PHILIPPINE METALS

BY THE

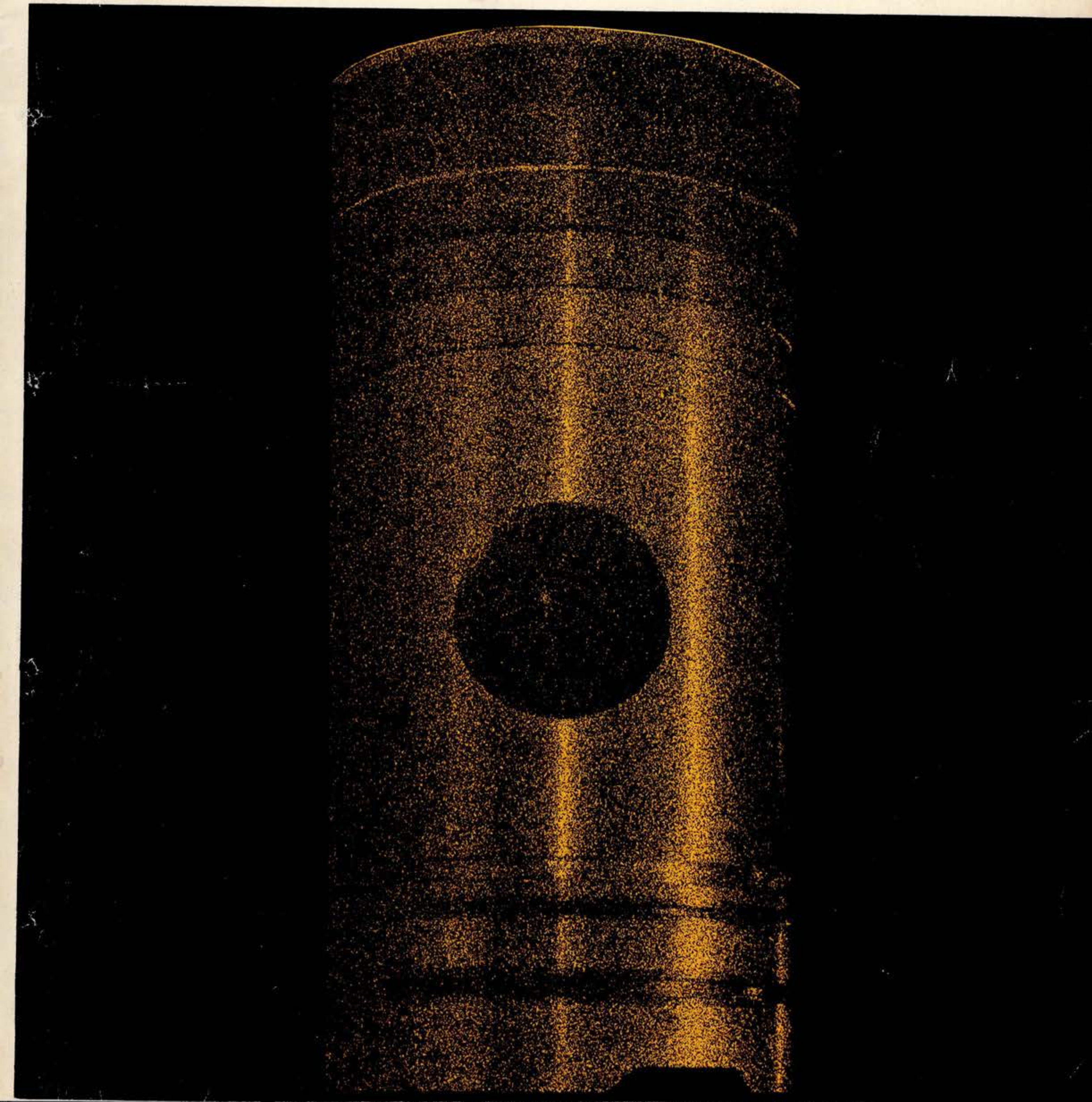
METALS INDUSTRY RESEARCH AND DEVELOPMENT CENTER

Volume - 1

1971

PHILIPPINE metals

A METALS INDUSTRY DEVELOPMENT CENTER QUARTERLY MAGAZINE, VOL. 1 NO. 2, APRIL-JUNE 1971



THE SOUTH EAST ASIA IRON & STEEL INSTITUTE

(SEAISI)

wishes to announce a technical

Mini-Mill Symposium

DATE : AUGUST 30-SEPTEMBER 3, 1971
PLACE: TAIPEI*

WHO WILL ATTEND? DELEGATES (SPEAKERS AND PARTICIPANTS) FROM SEAISI MEMBER NATIONS-SINGAPORE, THAILAND, INDONESIA, MALAYSIA, TAIWAN, THE PHILIPPINES, JAPAN AND AUSTRALIA.

PAPERS TO BE PRESENTED:

1. On electric furnace steelmaking —
   a. Critical operating aspects
   b. The use of oxygen
   c. Scrap — availability and preparation
   d. Refractory practice
   e. Electric consumption — quality, design, furnace practice
   f. Aspects of power supply and consumption
2. The small rolling mill —
   a. The use of repeaters
   b. Critical aspects of mill practice
   c. Heating for profits or problems
   d. The no-twist, straight line layout
3. General —
   a. Continuous vs. conventional casting
   b. Quality control — luxury or necessity
   c. Optimum layout of mini mill — electric furnace and rolling mill
   d. When is integrating right?
   e. Standardization — a part of development

Those who wish to attend the symposium (as speakers, participants, or observers from the Philippines), are urged to contact Dr. Arizabal, MIDC Director, Metals Industry Development Center, Delta Motors Building, Quezon Boulevard Extension, Quezon City (telephone 98-72-71).

* THIS IS TENTATIVE, WITH BANGKOK AS A POSSIBLE ALTERNATIVE.

Philippine Metals by the Metals Industry Research & Development Center

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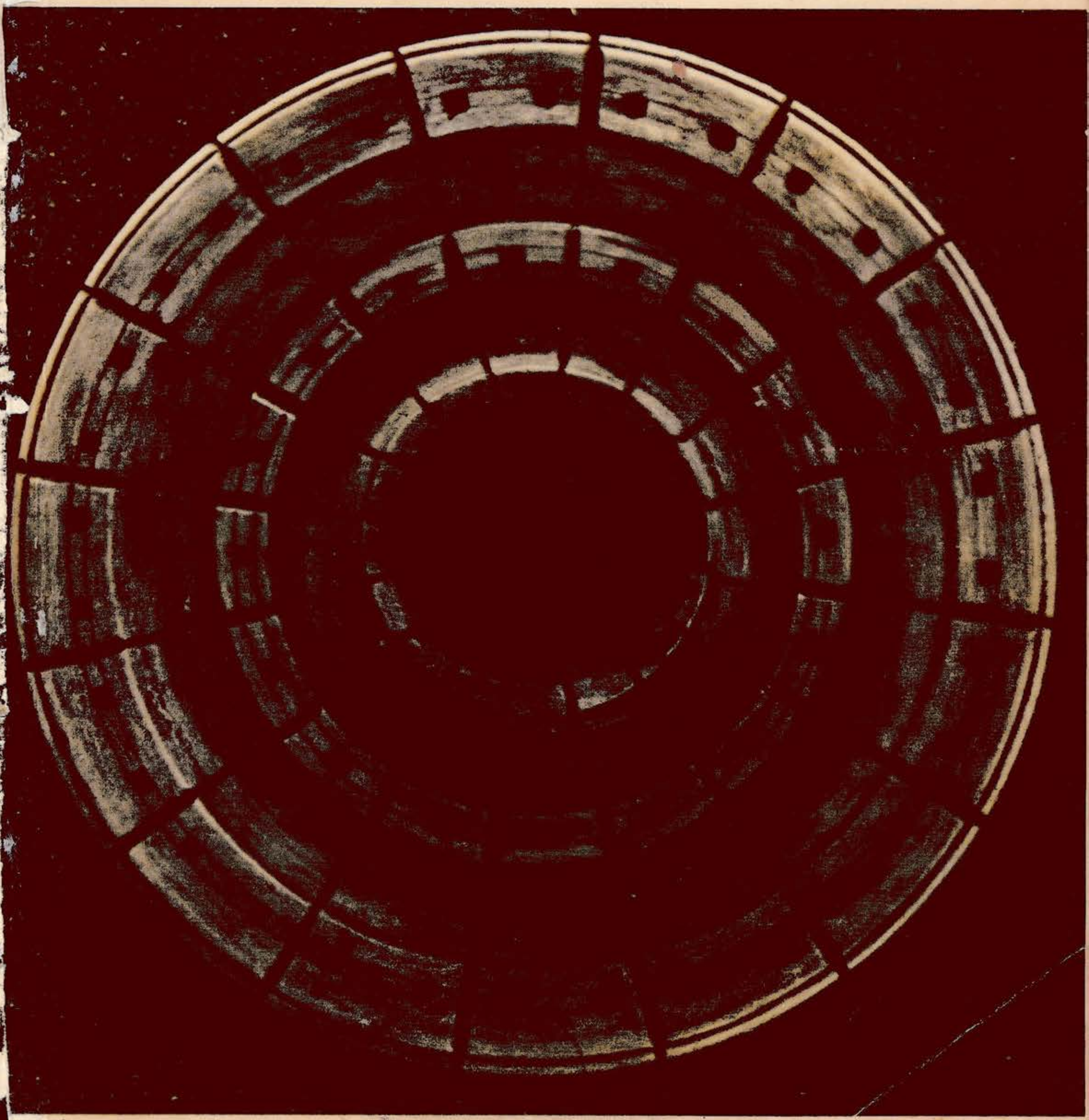
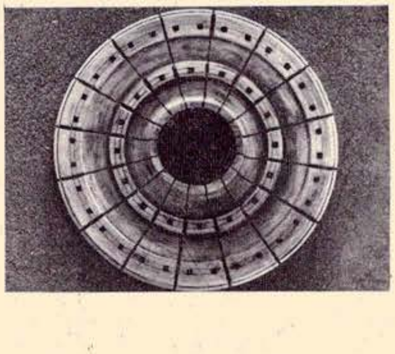
TAL INDUSTRY DEVELOPMENT CENTER QUARTERLY MAGAZINE VOL. 1 NO. 1 JAN. 1971





COVER Design of a rod mill end liner assembly — one of the most intricate and vital products cast by our local foundries for the mining industry. Specifications and original drawings supplied by EEI.

"Philippine Metals" *is the official technical and economic news media of the Metals Industry Development Center (MIDC) replacing the* Metals Newsletter *which was discontinued last year. The new quarterly bulletin, like its predecessor, will bring into focus the latest economic and technological developments in the metals industry here and abroad as well as the activities of the MIDC which includes research, metals testing, training, engineering and industrial management services. R.A. 4724 creating the MIDC expressly provides that information services be one of the principal functions of the Center. The publication of the* Philippine Metals *by the MIDC will be a partial fulfillment of this function.*

Antonio V. Arguelles

DIRECTOR
METALS INDUSTRY DEVELOPMENT CENTER

PHILIPPINE metals

A METALS INDUSTRY DEVELOPMENT CENTER QUARTERLY MAGAZINE VOL. 1 NO. 1 JAN. 1971

Philippine Metals is published quarterly by the Metals Industry Development Center (MIDC), Delta Motors Building, West Avenue corner Quezon Blvd. Ext., Quezon City and distributed without charge to qualified executives and technical men in the metals producing, processing and metalworking industries subscribing to MIDC. Those unable to qualify, or those wishing home delivered copies, may purchase subscriptions at these rates: Philippines, P20.00 a year; foreign countries, $10.00 a year; single copies, P5.00.

CONTRIBUTORS

Raul P. Sulit, Officer-in-Charge of the Technical Division of MIDC, recently finished a five-month fellowship in metal processing which was arranged and supervised by the Swedish Industrial Development Agency (SIDA) and sponsored by the United Nations Industrial Development Organization (UNIDO). In connection with this fellowship he visited various foundries, rolling mills, machine shops, assembly plants, research centers and universities in Sweden including Sandvik Steel Works, Bofors Steel Works, Kohlva Works, Coromant, Atlas Copco, Avos Verken, SKF, the Swedish Institute of Metals Research and the Royal Swedish Institute of Technology.

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John W. Bohlin, who is Team Leader of the United Nations Industrial Development Organization – Scandinavian Engineering Corporation (UNIDO-SEC) Mission for United Nations Development Project/Special Fund Project PHI-30 Manila, is Senior Industrial Consultant of Scandinavian Engineering Corporation; Harald Sten is Chief Engineer of the Swedish Association of Metal Industries; and Lars Villner is Managing Director of the Association of Swedish Foundries. This article was taken from their report to the UNIDO on the assessment of the capabilities of the metals industry and the general review of the present status of the Metals Industry Development Center (MIDC).

LEGEND
AMM – American Metal Market, BFSP – Blast Furnace and Steel Plant, F – Foundry, FTJ – Foundry Trade Journal, IAMI – Iron Age Metalworking International, IH – Industrial Heating, JA – Jernkontorets Annaler, JIM – Journal of the Institute of Metals, JISI – Journal of the Iron and Steel Institute, JMB – Japan Metal Bulletin, MB – Metal Bulletin, MC – Modern Casting, MEQ – Metals Engineering Quarterly, MP – Metal Progress, MT – Metallurgical Transactions, PE – Product Engineering, S – Svetsaren, STAL – Stal, TISIJ – Transactions of the Iron and Steel Institute of Japan.

Editorial

NEEDED: GOVERNMENT ASSISTANCE FOR THE ENGINEERING INDUSTRIES

The engineering industries are the biggest users of high grade metals and alloys which serve as basic materials for the manufacture of tools, equipment and durable consumer goods. This sector of industry also provides employment for more workers than any other sector in industrialized countries. In developing nations such as Taiwan, Hongkong, Singapore, Korea and others, the engineering industries have received proper government attention, recognizing their vast employment potential for skilled labor and technical manpower. In the Philippines, however, this sector of industry has been left very much to the initiative of the private sector. As a result, the industry has failed to play a major role in industrial development.

With the country's present balance of payments difficulties, there is an urgent need to earn and conserve foreign exchange. Of goods we import, equipment and capital goods top the list in terms of value. It is therefore in the local manufacture of these products that the Philippines can make dramatic strides to diminish importations. The export potential for these products cannot be found wanting because of the availability of skilled labor and engineering here.

We could save as much as 50% of the total value of foreign exchange spent for the construction of processing plants for cement, sugar, and chemicals if fabrication were done in the Philippines using existing skills and facilities. The reason given for failure of Philippine manufacturing has been the lack of long-term credit from local financial institutions. The few mining, chemical and processing firms that have on their own initiative used in great volumes locally-made equipment have achieved significant savings in capital cost.

Aside from foreign exchange and cost savings, the engineering industries, as mentioned, offer a great number of job opportunities. In a country with approximately two million unemployed and an even larger number of underemployed, the economic importance of technical labor intensive industries does not need further justification.

To produce durable consumer and capital goods, the engineering industry in the Philippines must be provided with incentives. It needs help. Financial and marketing assistance is important. However, the most vital requirement is technical assistance in the form of engineering consultative services, quality control and manufacturing standards and the training of skilled and technical manpower.

The MIDC considers the development of the engineering industries as an activity of highest priority and greatest challenge. Even with its modest resources, the MIDC could score outstanding gains for the national economy by aiding and promoting the advancement of the engineering industries. We have in the country today a large number of idle metal-working and forming equipment. We have an educational system that has produced a large number of scientists, engineers, and technicians and vocational school graduates who are still unemployed. What is principally needed to harness these untapped resources for the country's good is to provide training and technological direction. The MIDC can provide that training and that direction. The development of our engineering industries may still provide the formula for enhancing the nation's industrial growth without straining our international reserves.

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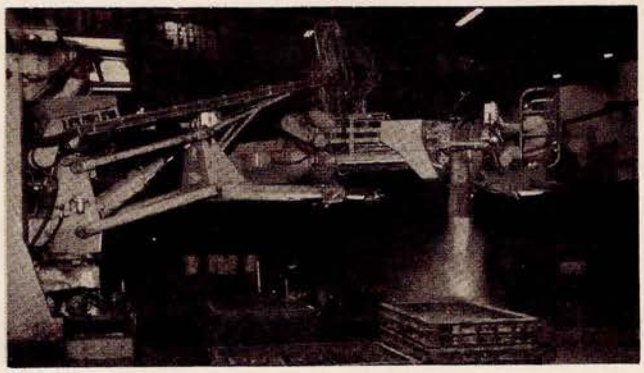

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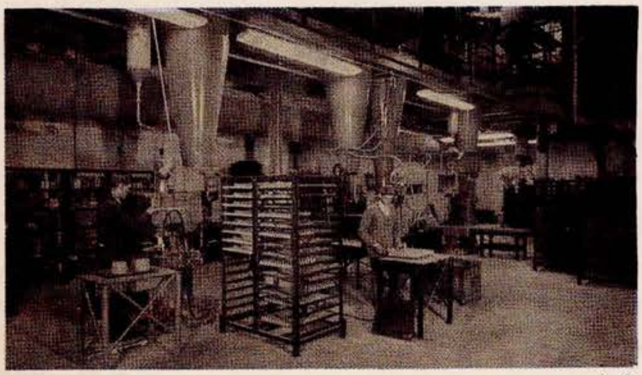

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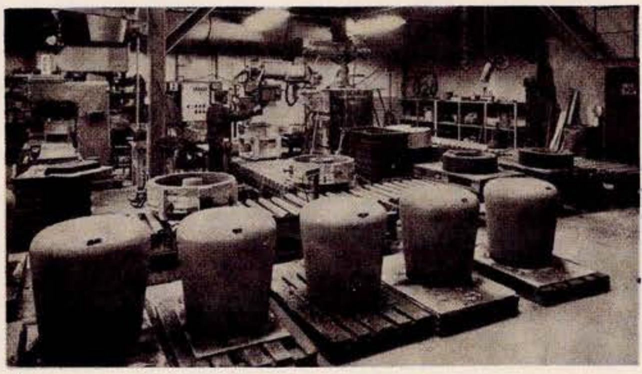

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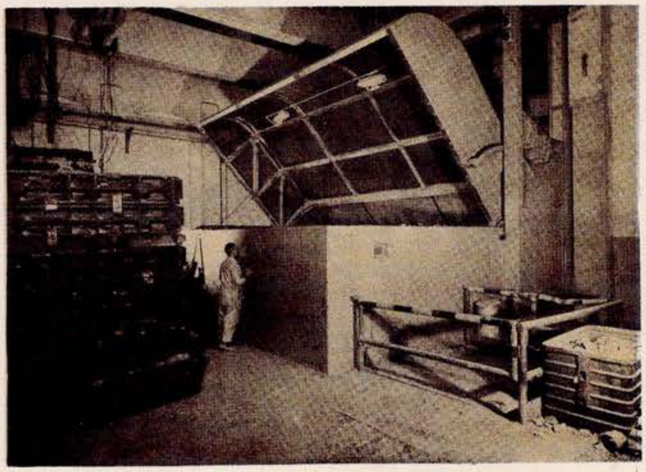

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by Raul Paras-Sulit

Foundry practices in Sweden

Introduction: SWEDEN

Sweden is the fourth largest country in Europe after Russia, France and Spain, covering 0.3% of the world's land area. It is approximately of the same size as California or twice that of the United Kingdom and is situated at the same latitude as Alaska. The average precipitation per year in Sweden is 22 inches. The temperature varies from 12° below zero in January to 18°C in July. It has an average of 1,700 hours of sunshine each year.

In 1968, Sweden's total population was 7,950,000 giving a density of 17 persons per sq. km. and per capita income of $3,241. Birth control is practiced to maintain the population at about 8.0 million.

Being a well developed country, Sweden has one of the highest standards of living. Of Sweden's total population of about 8 million, between 3.4 and 3.5 million are gainfully employed. Of these, 7-8% work in agriculture, about one-third in industry and crafts, and about 10% in construction or about 50% of the employed persons are in producing industries. A worker earns an average of $2.05 per hour and works an average of 37.1 hours per week in manufacturing plants. Approximately 50% of the income, however, goes to taxes.

Sweden is endowed with rich forests but, with the exception of iron, it cannot boast of any other metallic ore deposit.

Its manufacturing industry thrives primarily on foreign markets. Its investment abroad is even larger than that in Sweden itself. These conditions favor its status as a neutral country.

The largest sector of Sweden's industry, the engineering industry, accounts for 35% of the industrial production compared to 15% for forestry, 15% for foodstuffs, 8% for iron and steel, 5% for textiles and 22% for the rest of the industries.

The engineering industry manufactures highly diversified products ranging from airplanes, machineries, machine tools, ball bearings, computers, transformers to nails. Approximately one-third of the output of the Swedish engineering industry finds its market abroad, accounting for about 42% of total Swedish exports. The ores and metals' share in exports is about 16%; that of forest products, about 25%; and that of the other goods, about 17%.

Metal Casting Practices

I. PATTERNMAKING

Foundries in Sweden use both wood and metal patterns and their applications are similar to those in the Philippines. Swedish wood which are softer compared to those found in the Philippines is used as pattern material by almost all pattern shops.

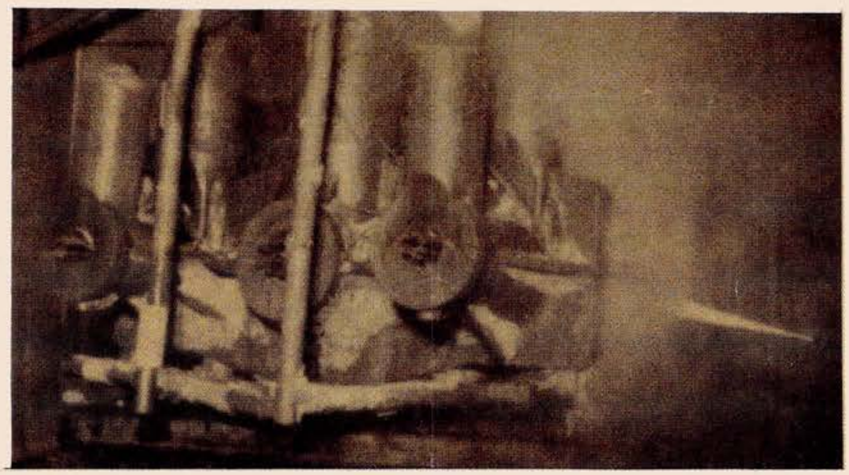
Unlike in the Philippines, the pattern shops are independent of the foundry operations and supervision. They are equipped for the mass production of both wood and metal patterns and all the equipment are located under the same roof. Because of high labor cost and scarcity of pattern-makers, the shops are highly mechanized. The author is not aware of any institution in Sweden, except for the Association of Swedish foundries, where patternmaking is taught.

Swedish management is very particular with the working conditions inside the pattern shops inspite of the fact that medical care in Sweden is almost free (it will cost an individual less than P15.00 for a general overhaul of his biological system). This is so because replacement of a worker on a temporary basis is very difficult if not impossible. The pattern shops are spacious, well-ventilated and illuminated as well as insulated. Almost all machines which produce dust are provided with automatic dust collecting units so that even with the large number of patterns produced daily, wood dust or chippings could hardly be seen accumulating on floors or benches. Fig. 1 shows a typical pattern shop in Sweden.

Almost all patterns are matchplated regardless of the number of castings that are to be made from them. Once the patterns are made, based on engineering drawings, they are endorsed to a development team which determines the gating and risering systems. This team checks and serves as liaison between the pattern and production shops as far as pattern efficiency is concerned. After the gating and risering system is provided for the patterns, trial castings are run on the virgin patterns. The development team has the option to conduct as many trial runs as it sees necessary to guarantee that the pattern will produce quality castings at a profit.

The pattern is then turned over to the planning section that attaches identification tags containing all pertinent data required to produce the castings. The molding or core-making section base their decisions on such information found on the tags. The pattern itself is so informative and comprehensive in the sense that the different component parts are colored to facilitate their identification.

After casting orders have been made, the pattern assembly i.e., with the core boxes, gating, match plate and risers, is properly labeled with the pattern serial number and stored



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in a shelf at the pattern storage shop.

Researches on pattern making in Sweden, focused on plastic-coated wood patterns and plastic patterns, have twofold objectives: first, to increase the wear resistance of the wood patterns against the abrasive action of the sand from slingers; and second, to develop master patterns for high-precision dimension as cast products.

Patternmaking in the Philippines lags as far as mechanization of the shop and researches are concerned. At present, no local patternmaking shop is engaged in any research activity. With respect to the art of patternmaking, however, the author believes that Filipinos are superior to the Swedes.

II. SAND PREPARATION

A. Sand and Sand Additives

Foundries in Sweden use the three common types of sands, namely: silica, olivene and chromite. Except for silica sand, which is artificially-produced locally by mining, crushing and grinding quartzite to size, the other types of sand are imported. Olivene is imported from Norway and chromite sand from Africa. In the Philippines sand naturally occur in great abundance, but in Sweden the climate is not favorable to either sand or clay formation.

The use of additives, sea coal, graphite or zirconite, is widely practiced in Sweden inspite of the fact that the demand is primarily supplied by importation. This practice reduces the labor cost of the operations concerning surface finish. It also improves the quality of the sand mixture thereby minimizing casting defects due to sand and facilitating the fettling operation.

Binders are also imported, bentonite from the United States and Germany, resins from England.

B. Sand Conditioning Plant

The sand plant, located in a building separate from the molding area, houses the storage silos, machines and equipment used in sand conditioning. Except for core sand, the utilization of which is small, all sand preparations are done at the sand plant.

Operations at the sand plant are highly mechanized. Workers are left with nothing else to do but to push buttons, remove graphs and/or open bags of materials. The mixtures are batch-processed and the operations are carried out by remote-control from a central room. The relative amounts of materials to be used and the time required for a certain operation are determined by a long series of research and development activities.

The prepared sand is transported to the molding shop by means of pneumatic conveyors. Conveying conduits are made of wear resistant pipes. The system is fast and cheap so that tons of sand mixtures are transported in seconds and at a cost of about P1.00/ton. The system is, however, only applicable when the volume of production is large, the conveying distance is long, and when open-to-atmosphere conveying is liable to change the composition of the sand mixtures. These conditions exist in Swedish foundries. Bucket and continuous belt conveyors are only practical for short distance conveying and when the surrounding atmosphere would not change much the moisture content of the sand mixture.

The sand mixtures are received in the molding area in hoppers which are fed automatically. When the contents of the hoppers reach the minimum level, the central control in the sand plant is automatically informed and the sand mixture for that particular hopper is then prepared and delivered before the hopper's content is exhausted.

The molding area is divided into sections primarily according to the type of sand used in the molds and not necessarily on the size of castings. This way, handling of the used sand is facilitated. Similarly, the shake-out is programmed according to the type of sand used in the mold.

Sand reclamation is done continuously, that is, sand is reclaimed as it is produced. The reconditioning process, like in sand mixing operations, is highly mechanized and automated. Machines are used to break the lumps, segregate foreign matters from the sand, size the recovered sand and cool the conditioned sand for the next cycle.

C. Sand quality Control and Inspection

Sand quality in Swedish foundries is controlled statistically. Automatic sampling of the sand for testing and analyses are done at critical stations not for the control of the sand for that particular batch but for statistical purposes. The composition of the sand in cycle and those stored are known from graphs. The sand samples are analyzed for moisture and clay contents and tested for hardness, permeability, strength, grain size and shatter properties.

The sand laboratories in Sweden are not as impressive as the metal and chemical laboratories. The equipment used, except for the shatter test and high-temperature strength properties of the sand, are similar to those which are used in sand laboratories in the Philippines. However, one will be amazed on how they use the data obtained from the analyses and tests. The composition and properties of the sand are evaluated against casting defects, surface finish, wearability of patterns and mold properties. The statistical data are also used as the basis for the continuous research on improving the quality of the sand.

The tests conducted on the sand are similar to those done in the Philippines except the drop-shatter test and high-temperature strength properties. The drop-shatter test seems to be European in nature since the author believes that even the Japanese and American foundries are not doing this test. The test consists of the following: A standard sand mixture specimen is dropped 190 cm. high into a steel plate surrounded by a screen. The amount of the sand retained in the screen, expressed in percentage weight of the sample, is a measure of the stability index of the sand mixture. This information gives the relative collapsibility of the sand and the ability of the molds that will be made from it to withstand stress during handling operation.

The equipment used for the measurement of the high-temperature strength of the sand consists of an oven provided with a temperature controller and recorder. The specimen is placed in the oven where it is subjected to thermal shock similar to that under which a mold is subjected to during pouring operation. The specimen is then inspected for cracks which gives an indication of the sand behavior at high temperatures.

D. Research and Development

The sand laboratories in Sweden are generally operated by 3 or 4 personnel working independently from the production group. These personnel are engaged in research and development activities rather than in the analysis and testing of production sand. Control of the sand mixture by statistical methods and mechanization has reached the point that every personnel concerned with production is confident of the consistency of the quality of sand mixture at anytime.

Sand research and development in Sweden varies from plant to plant. Some are engaged in the improvement of the high-temperature strength of the system and new sand mixtures, others are testing the quality of a new brand of bentonite or other binders and additives, while others are engaged in the substitution of zirconite wash with chromite or graphite wash. What is common to almost all sand laboratories is the continuous research on improving the grain distribution of the sand. This is understandable since Swedish foundries are very much concerned with this property of the sand. Continuous work is done on the system and other sands to arrive at a mixture which would give ideal distribution of the grains.

III. MOLDING

Molding machines employed in Swedish foundries range from the jolt-squeeze type to sand slingers. Pneumatic rammers, the most popular molding equipment in the Philippines, are only used in the finishing of molds made by slingers. Sand slinger in operation is shown in Fig. 2. Shell molding equipment vary in type and design from plant to plant. They are either gas-fired or electrically heated. Generally, shell core making machines are electrically heated while the choice of heating medium for shell molding machines depends on the design and relative cost of gas and electricity. Metallic flasks, standardized according to sizes, are used inspite of the abundance of wood in Sweden. In the Philippines, one riser is used for many molds and gates are hand-carved on the molds themselves. In Sweden, risers, gates and sprues are adapted to individual patterns.

The molding shop is the most mechanized shop in the Swedish foundry. Hand molding is rarely practised not only because of the scarcity of labor in Sweden but primarily of the inconsistency of the quality of molds made by this method. All operations which can be accomplished by pushing a button or pulling a lever is done so. The job of a molder is principally to operate machines and manual labor is only used in laying out gaggers in the flasks. All data and accessories necessary to control the operations are right in front of the molder. Conveying of molds, mold materials and accessories such as bottom plates, follow boards and used flasks are continuous and either semi- or fully-automatic.

Despite the high degree of mechanization of Swedish foundries; efforts are still exerted to attain more mechanization and automation especially in the molding operation. This is well-illustrated by the new plant of SKF furnished with a multi-million dollars worth of equipment. One molding equipment alone costs a million dollars. The operations are programmed and controlled electronically. The molders, core setters, pourers, shake-outers and fettlers are sitting in a room watching and monitoring the operations via a closed circuit television.

The sand is cooled, reclaimed, and conditioned continuously. Molds and cores are made automatically and assembled in the same manner. The mold assembly is heated or dried automatically and then transferred to the pouring station where pouring takes place continuously for twenty-four hours a day. The whole casting operations are carried out by not more than ten technicians.

IV. COREMAKING

In Sweden, almost all cores are made mechanically using either core blowers or mini-slingers. Only those small or complicated cores which cannot be made mechanically are done manually. Coremakers are mostly women and men make only the big cores.

Unlike the molding sand which is prepared in the sand plant, core sands are mixed within the core plant. The coremaking plant is also independent of the molding plant. Fig. 3 illustrates how a core shop is independent of molding plant. Operations are highly mechanized but not automated due to the variety of mixtures used. The core boxes, inspite of the large number of cores produced from them, are made of wood.

The choice of binder depends primarily on the type of machine used in coremaking. Most cores made by the blowers are CO_2 hardened while those made by slingers are either air-setting or oil-bonded cores. Example of these air or self-setting cores is shown on Fig. 4. Gassing of the cores with CO_2 is controlled according to their size and shape. Washing of cores with zirconite or other types of washer is done mechanically and in mass regardless of the size of the cores.

Inspection of the cores is done before they are turned over to the molding section. The cores, labelled with the pattern number and complete with fixtures to facilitate setting are delivered by roller conveyors. The rate of core production is so large that the coremakers do not set the cores that they make. Another team of workers has to do this work.

V. MELTING PRACTICE

The author was greatly surprised to see that in a country as developed as Sweden the trend is still the use of electric arc rather than induction furnaces. Electric arc furnaces outnumber the induction in all Swedish foundries despite the fact that ASEA, a Swedish firm, manufactures induction furnaces. How the Swedes shook their heads when informed that the situation is reverse in the Philippines. New and existing plants in the country tend to go for the induction rather than the arc. The Swedes commented that if this trend continues, the metals industry in the Philippines would soon come to a stop. It is indeed lamentable how few salesmen, who are only concerned with selling their products regardless of the applicability and versatility of these products, can bring detrimental consequences to the industry.

To the Swedes, steelmaking is an art and will remain so as long as the oxidation process continues to take place. Success in steelmaking lies on the degree of refining attained during the melting; and the quality of castings lies not on how close the composition or dimension are maintained, but on how much impurities have been removed. During the refining stage, the carbon boil always occur no matter what the composition of the steel is. These conditions are rarely attained in induction furnaces when charged with a burden of considerable impurities and induction furnaces can have only good performance if fed with good quality scrap. Scraps, however, no matter where one goes, do not become any better but on the contrary are getting worse and scarser with the passage of time. Induction furnaces are used in Sweden only in melting fresh scrap returns which are rarely mixed with other forms of scrap.

The Swedes have already made a name for their alloys yet their devotion to the quality of their melt is incomparable. They say that the secret of Swedish Steel lies not on the way of melting steel nor on the furnaces and the materials used, but on the dedication of the people who melt them.

There is no other way by which the author can describe Sweden's melting practices since the process is generally similar to that used in the Philippines. The Swedes are employing a few techniques of slagging and blowing which can be learned in due time. It is difficult to describe a person's devotion to a molten mass of metal but that is the Swedish melting practice, nothing more nor less.

VI. POURING PRACTICES

There seems to be a uniformity of ladle design in Sweden. Almost all foundries visited by the author use the bottom-pour type ladles. The ladles are provided with fixtures to facilitate removal of slags and patching materials. Jib boom cranes are seldom used as hoist for the pouring of melt. Overhead cranes are always used and almost always are operated by Swedish girls. Thus it is not very surprising for a visitor to be looking up at the crane rather than at the mold being poured. But if one would spend a few seconds looking at the mold being poured, he would notice the use of pouring basins in all the molds lined up for pouring. These pouring basins are made from cores using thermosetting binders. The author inquired why these pouring basins are widely used. The reply was they are more of a safety device rather than an element of the mold. According to Swedish foundrymen, statistics proved that most accidents occur during the pouring operation and at the place at which metal is being poured in the mold. So the use of a pouring basin is a standard operating procedure adopted for reasons of safety. A typical pouring station is shown in Fig. 5.

The temperature is seldom measured by means of optical pyrometers. Immersion thermocouples are widely used. After tapping, the melt is allowed to homogenize in temperature and after some time, the thermocouple is immersed into the ladle and the melt temperature is recorded automatically.

The ladles after patching, are preheated by means of oil burners. Heating is initially conducted slowly to remove moisture and give hot strength to the patching. When tapping time approaches, the preheating intensity is increased and the bottom is heated to red hotness in order to prevent the instantaneous solidification since it is the ladle bottom that first gets in contact with the melt.

The burner for preheating the ladles is designed in such a way that almost all the heat is utilized within the ladle itself. Two designs are possible; one, where the ladle is vertically preheated, and another, where the ladle is preheated horizontally. Large ladles are preheated vertically while small ones are preheated horizontally.

Hooking of preheated ladles are expertly carried out by the Swedish girls who operate the cranes. This phase is quite interesting considering that the operation of putting the hook into the hole of the ladle fixture could be difficult and tedious if carried out merely from crane controls. But not for the Swedish girls operating the cranes!

VII. SHAKE-OUT PRACTICES

The foundries visited by the author are relatively smoke- and dust-free, because state regulations in environmental pollution are strictly enforced. In contrast to the shake-out shops in the Philippines which are generally dusty, in Sweden, one can walk along the shake-out floor with newly shined shoes and come out of the shop without a single speck of dust on them. The molding floor is even most of the time dirtier than the shake-out floor.

The molds are shaken out by conventional shake-out machines. The difference from those locally employed are that the ones used in Sweden are provided with hood and dust collecting equipment and that instead of being above floor level they are located at floor level. There are two types of these hooded machines: one is the batch type and the other is the continuous type located in a tunnel lined with rubber. The former is used for heavy castings; the latter, for light castings.

The molds are lifted by cranes into the machines and the hood is then lowered and locked. The dust collecting equipment and shake-out machine are then operated simultaneously. The operator watches the operation in the machine through a glass window. Once the space inside the machine is free of dust, the shake-out machine is stopped and the hood is raised up. The flasks and castings are lifted out of the machines, and in separate conveyors, the former are returned to the molding shop while the latter are forwarded to the fettling area. Fig. 6 demonstrates cleanliness of shake-out area in a Swedish foundry.

Where the extra heavy castings wherein the sands and cores are not

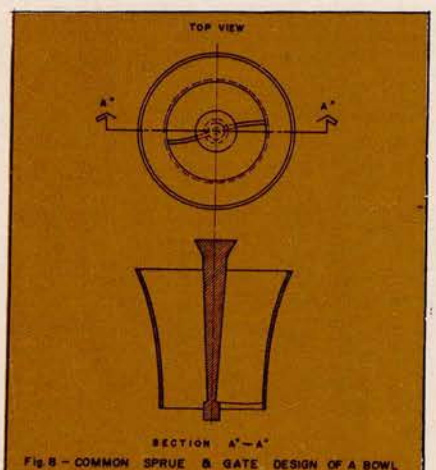


Fig. 8 – COMMON SPRUE & GATE DESIGN OF A BOWL LINER.

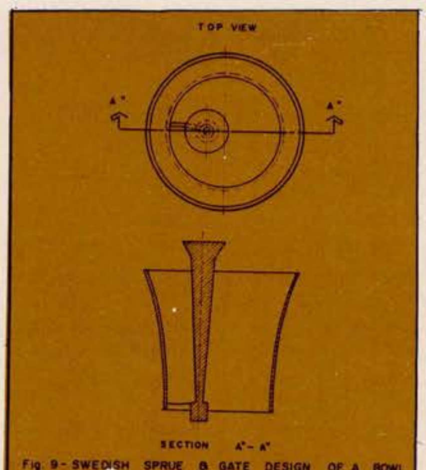


Fig. 9 – SWEDISH SPRUE & GATE DESIGN OF A BOWL LINER.

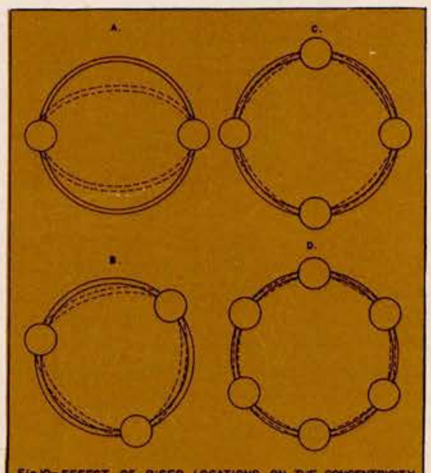


Fig. 10 – EFFECT OF RISER LOCATIONS ON THE CONCENTRICITY OF A CASTING.

efficiently removed by the shake-out machine or when "collapsibility" and "peel" do not work no matter how the sand mixture is conditioned (i.e. when the materials have fused with each other), shake-out by hydraulic method is used. It consists of placing the castings in an enclosed room, then subjected to pressurized jets of water from hydraulic guns. The jets are at 25 atmospheres, a pressure which can cut an individual standing behind a wall into two with a single pass. The sand and water are recovered and recirculated. Fig. 7 shows the operation of hydraulic blasting.

VIII. FETTLING PRACTICES

Several methods are employed in the removal of risers and ingots. Knocking-off the riser, torch-cutting and using cut-off wheels are the most common methods used.

Fettling by torch-cutting is one of the few arts left in Swedish foundries especially when handling large risers. Cutting of risers using oxy-acetylene torch cutters is done at a number of points employing several sizes of nozzles. The common practice is with the use of one nozzle. Cutting is initiated at one side of the riser progressing towards the center and to the other side until the whole riser is cut-off. This one-point approach is, however, time-consuming because of the considerable time spent in enlarging the cut-area as cutting progresses towards the center. At the same time heat is accumulated. Many alloys are very sensitive to excessive and localized heating and are likely to crack once a critical temperature is reached during the fettling operation.

In Swedish foundries, depending on the size of the riser, cutting is carried out from 3-, 4- or 5-point approaches. The process is as follows: a large nozzle is used and cutting is initiated at one point on the side of the riser until a depth of approximately 25% the diameter of the riser. The opposite side of the riser is then cut to a similar depth and so with the other sides thus avoiding cutting at two adjacent points consecutively. When the whole riser has been cut through a depth of 25% of the diameter, the nozzle is changed to a smaller one and the remaining diameter is cut through the center in the same manner as before. This method of cutting alternately at several points avoids accumulation of heat and facilitates cutting, at a faster rate, of the center of the riser which is the weakest portion of the riser. Moreover, the time needed for enlarging the cut is eliminated as cutting approaches the center of the riser.

The principle behind this method is metallurgical in nature. The outer portion of the riser has finer grains due to the fast solidification of the melt than the center portion. Thus the outer portion can be subjected to a higher thermal shock than the center portion with less probability of failure during the fettling operation.

IX. INSPECTION OF CASTINGS

Inspite of the degree of quality control observed in the various phases of the casting operation, very strict inspection is still done on the cast products. The Swedes believe that quality control is carried out not to eliminate defects but only to minimize them and that presently, it is quite impossible to totally eliminate defects. They also believe that intelligent customers are not after certificates of quality but rather after the soundness of the castings. They do not rely on random inspection particularly of mass-produced castings. Individual inspection of castings is done such that very often failure to deliver on time is not due to the rate of production but rather on the rate of inspection. This is the reason why Sweden is noted as a quality-conscious nation.

Inspection is done in the true sense of the word, i.e. not primarily to certify the quality of the castings but to look into the extent of the defects. Unlike most inspectors who look for defective castings, Swedish inspectors consider most castings to be defective and their main job is to segregate the good ones from the rest.

Inspection of the finished castings is done at the end of the production line and undertaken under the supervision of the production group. Results of this inspection is final and cannot be contested by any other group. Random sampling and inspection are also undertaken for statistical purposes.

Inspection instruments and equipment used are standard and similar to those used in the Philippines except for the stress meter. What is amazing is the degree of utilization of the instruments that one can rarely see them idle. The inspectors say that the cost of operating the instruments is negligible compared to the results obtained. Once again they believe that it takes not only machines, knowhow and time to produce quality castings but foremost are the attitude and dedication of the people who man the operations.

X. CASTING OF MANGANESE STEEL

Some operations in the production of manganese steel seem to violate casting principles and/or common foundry practices. However, these operations have been continually practised for decades with satisfactory results. Deviations from common practices of the gating, risering, fettling and heat treatment practices for the production of bowls and mantles and the finishing of shell liners, will be presented in this paper.

Similar to the practice in the Philippines, bowls and mantles are cast with the larger diameter at the top. The sprue is obviously vertical. The difference lies in the location of the sprue and number of ingates. Locally, the sprue is concentric to the center of the bowl or mantle and provided with two ingates symmetrically located with respect to it as shown in Fig. 8. In Sweden, the sprue is eccentrically located from the center and is provided with only one ingate as shown in Fig. 9.

The casting principle states that molds must be filled up as fast as possible without causing erosion or cracking of the mold face and with the melt at the lowest temperature possible without causing cold shot defects in the castings. Assuming the same size of sprue neck and ingate cross-section, the pouring rate in Swedish practice is slower due to the reduction of the number of ingates. The liability of producing cold shot defects because of slow pouring rate is, however, offset by the use of high pouring temperature. It was explained that the Swedish practice is more advantageous than the local practice inasmuch as the mold is not subjected to thermal shock usually brought about by fast pouring rate and that localization of the thermal gradient is avoided since enough time is given for the melt to homogenize in the mold. Moreover, the practice facilitates control of directional solidification such that the portions which solidify last are those where the risers are located.

The only local consideration for the use of risers is the provision of extra metal to take care of shrinkage brought about by changes in state and temperature. The casting depending upon the size can then be cast with two, three, four, etc. risers and the same effect, i.e. no shrinkage defect, can be obtained. In Sweden, the risers are used not only to prevent shrinkage defects but also to control the concentricity of castings. The concentricity of castings depends upon the number of risers. Two risers distort the castings rectangularly; three, triangularly; four, quadratically; five, pentagonally; etc. shown schematically in Fig. 10, a to d.

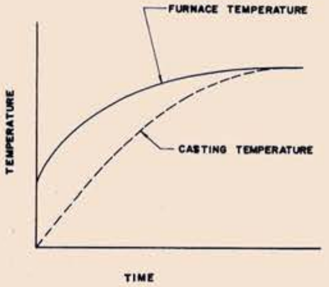
The choice of the number of risers depends upon the economics of machining and the cost of metal. If the cost of machining the excess metal to correct for the concentricity of the castings is less than the cost of the extra metal spent due to more risers, then less number of risers may be used, or vice-versa. In Sweden, when man and machine hours are very expensive, more risers are used in a casting than are necessary in preventing shrinkage defects as shown in Fig. 10, c and d.

The most fascinating phase of the Swedish system of manufacturing manganese steel is the fettling-heat treatment operations. The common practice is to fettle and then heat-treat the castings. In Sweden, the raw castings are shaken out cold, inspected for casting defects, put in a car, heat-treated with the riser and gates, then fettled. The system may seem wasteful due to the extra metal to be heat-treated which consumes fuel and decreases the capacity of the furnace. Considering however, the rejects due to cracking and salvaging expenses brought about by the reverse method, the system may eventually turn out both economical and practical. If castings are fettled either hot or cold prior to heat treatment, cracking susceptibility is great because manganese steel is relatively brittle in the as-cast condition. No matter how careful a fettler is, there is the liability for the casting to crack along the riser remnants. These cracks increase during heat treatment to a depth not removable by grinding. On the other hand, if the castings are heat-treated first before fettling, the steel becomes very tough so that if cracks should occur during fettling their depth is relatively shallower and within the range of the grinding or machining operation. The Swedish system also permits charging of the castings in the furnace at a higher temperature such that utilization of heat in the furnace is more efficient. In this way the capacity of the furnace is increased and fuel consumption is reduced because cooling time and loss of sensible heat of the furnace is minimized.

The heat treatment temperature is higher and soaking time is longer compared to the local practices. The advantages of the Swedish practice can be better understood by analyzing the objective and mechanism of heat treatment. Heat treatment is done to dissolve the carbides precipitated during casting and homogenize the whole casting with respect to manganese and carbon contents. These processes are both time and temperature-dependent. The use of higher heat treatment temperature is based on the common knowledge that the temperature indicated in the recorder is that of the furnace and not of the castings. The temperature of the castings lags from that of the furnace and it takes an appreciable time for thermal equilibrium between the furnace and the castings to take place. This is shown schematically in Fig. 11. The time lag varies from furnace to furnace depending upon the type of refractory, furnace design, burners used and the weight and shape of the castings. The time lag in a particular furnace can only be determined by the analysis of the data obtained from the operation of the furnace.

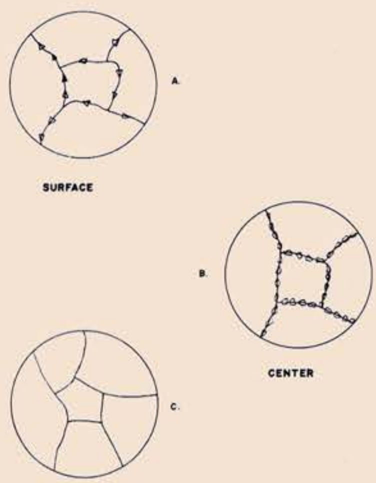
More important than the temperature and considered the key to

Fig. 11



VARIATION OF FURNACE & CASTING TEMPERATURES WITH TIME DURING HEAT TREATMENT.

Fig. 12



SCHEMATIC MICROSTRUCTURE OF AN F_e-M_n-C ALLOY successful heat treatment is the soaking time. Extensive research and development have established that once thermal equilibrium between the casting and the furnace is attained, a soaking time of one to two hours is required to homogenize the composition of the casting depending on its size.

During the solidification of a casting, the surface solidifies first and at a faster rate than the center. In view of this, neither homogeneity or consistent heterogeneity in composition is attained throughout the casting. From the ternary phase diagram of the Fe-Mn-C system, the first solid formed is rich in Mn but low in carbon and as the remaining liquid solidifies, the condition reverses. Moreover, the inner part of the casting which is solidifying at a very slow rate and with high carbon content tends to precipitate more carbides than the surface as shown schematically in Fig. 12 a and b. During heat treatment, manganese atoms diffuse from the surface toward the center while carbon atoms diffuse from the center toward the surface until homogenization of composition is attained as in Fig. 12 c. These phenomena take place during the soaking time.

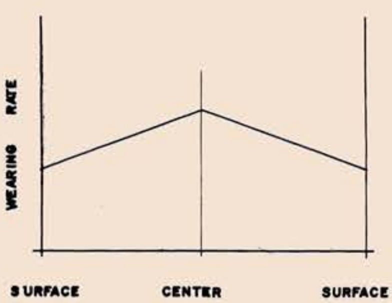
For manganese steel castings to be of good quality, the chemical composition must be consistently uniform from the surface to the center. If homogenization is not attained, the rate of wear increases with the distance from the surface to the center of the casting. The outer portion which solidifies first with more manganese content has good abrasion and impact resistance properties while the inner portion with relatively large amount of carbides precipitated cannot be hardened by cold working. Thus, when the outer portion is worn out, the rate of wear of the casting increases towards the center thereby shortening the total life of the liner. The results of abrasion and impact tests on non-homogenized and homogenized castings are given in Figures 13 and 14 respectively.

There have been so many cases of locally manufactured liners which had much shorter life than the imported ones of the same specifications. The author believes that this situation is due to the fact that the specifications of those locally manufactured liners are apparently "surface" specifications only. Locally, after heat treatment, castings are sampled only on the surface for control purposes. The author is not aware of any case in any local shop where a casting has been cut and subjected to metallographic analysis for either quality control, inspection or development purposes. To effect proper heat treatment of castings, the operating conditions of the furnace have to be obtained through research and development campaigns. This phase, however, is taken for granted by local manufacturers.

Shell liners are cast in Sweden with the wearing side on the cope and the shell side on the drag. The risers which are on the top are so located that they do not affect the bolt holes. The reason for this is the ease and economy in grinding the riser remnants. The liners are delivered to the consumers with the riser remnants not completely ground off. The consumers and manufacturers have agreed on these practices since the presence of the remnants is advantageous to the operations of the consumers. At the same time, the manufacturer realizes savings in grinding cost which offsets the cost of the extra metal in the remnants. The disadvantage of this finishing practice which the local consumers may point out is the appearance of the liners. However, it is high time that local consumers look into the quality and workability of a product rather than on their presentability.

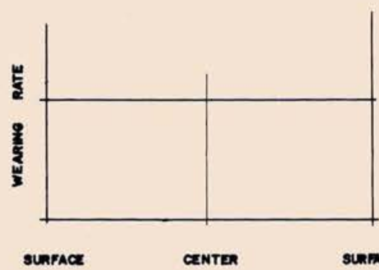
The author believes that local manufacturers of manganese steel should give due consideration to the foregoing practices since castings produced by these practices may turn out not only of better quality but be also more economical under local conditions.

Fig. 13



WEARING RATE OF NONHOMOGENIZED CASTINGS

Fig. 14



WEARING RATE OF HOMOGENIZED CASTINGS

IRON
MALLEABLE PRODUCTION

by **PABLO SILVA, JR.**

Malleable iron is a ferrous casting material belonging to the broad family of cast iron-carbon-silicon alloys, which has long served an important role in industrial, agricultural and transportation machinery industries. In any developed country the malleable iron industry holds a significant position in the economy and continues to grow with technological advances in the field.

The greater tonnage of this metal goes into the automotive truck and car manufacturing industries, where it has found its most eminently useful applications, to cite just a few — steering gear cases, axle housings, hubs, differential cases, camshafts, crankshafts, etc. It is also used for railroad car and trackage parts, employed in a wide variety of agricultural implements and tractor parts, and is standard material for the manufacture of pipe fittings and valve parts, and other plumbing, building and hardware supplies. Mention must also be made of industrial machinery components, such as conveyor and transmission chains, gears and sheaves, fastenings, rollers, hoists, to mention only a few.

The manufacture of malleable iron, an important component of the domestic metal industries' growth and development, has hardly begun to take root in the Philippines. While foundries have been in existence for the past several decades in this country, and the castings industry has continued to grow by expansion and proliferation, most of these operations have been confined primarily to the manufacture of cast gray iron and steel items, with a few specializing in a non-ferrous castings. There is only one firm, at this writing, presently engaged in the full-scale commercial production of malleable iron on a regular basis, producing primarily pipe fittings.

Presently, this local malleable iron production is roughly estimated at only 1% of total domestic ferrous casting production, the rest being gray irons and steels. On the other hand, the ferrous castings output in the United States in 1969 had the following composition: 6% malleable iron, 9% steel, and 85% gray (including nodular) iron. It is therefore evident that, if the needs of our industrializing and growing economy for cast metals are to be met in the next several years, malleable iron production must grow at a much faster rate than that of the castings industry as a whole.

Malleable iron as an engineering material possesses the castability, machinability, low cost, and other favorable characteristics of gray cast iron, while approximating the strength, toughness, ductility and versatility of heat treatment of steels.

It is worth noting that the same might be said for the newer metal known as nodular iron or S. G. iron which, while differing somewhat in chemical composition, is quite similar in microstructure. Nodular iron has to some extent penetrated the malleable iron market in other countries. However, in most applications traditionally held by malleable iron, the nodular iron process is not yet at its present "state of the art", quite competetive, cost-wise and the writer believes that this cost difference is even more pronounced under local conditions. Material costs for nodular iron are higher, because of the required higher levels of carbon and silicon alloys and the desulfurizing and nodularizing elements which need to be imported from foreign sources.

The raw materials required for the production of the basic grades of malleable iron are essentially the same as for common gray irons, namely: pig iron, scrap, and returns, and no special inoculating alloys are generally needed. However, the composition of these input materials must be more accurately known, and further must be free of certain impurities and harmful elements such as, for instance, chromium. The manufacturing process is more sensitive to variations in analysis than the more common cast iron. Unfortunately for local foundries, such a degree of raw material control is not always easy to attain because much of local scrap supplied by scrap dealers come in odd unclassified assortments of various types of steel and iron, plated parts, even non-ferrous inclusions. It becomes the foundry's burden itself to carefully identify and segregate the scrap delivered to its yard.

It is perhaps this aspect, plus the need for adequate melt-refining and heat treatment equipment, and the increased technical control demands of the process, that have caused attempts of some local foundries in this direction to yield unsatisfactory results, and held back others from establishing manufacturing facilities. Still, the basic process, if properly understood, is no more difficult to perform than most other metallurgical operations, and it is regrettable that many machine parts originally designed for malleable iron are often substituted by local shops with either gray iron castings, which sacrifice strength and shock resistance; or with steel castings, which is a resort to an "ignorance" factor of safety, when the parts could really be more soundly and less expensively made of malleable iron. The other and even more uneconomic practice of fabricated weldments required in quantity is also a case in point in favor of malleable iron.

The fundamental objective in producing malleable iron is to obtain a casting entirely free from precipitated carbon or graphite, referred to as white iron, and having a carbon content high enough for the desired fluidity and machinability, as well as low enough for the desired strength properties. This may be in the range of 2% up to 3%. Once this iron has been produced, it is then subjected to a heat treatment cycle the purpose of which is to hold it at a temperature well above the metal's transformation range. At this temperature graphite will precipitate out of solution, and as is typical of such a solid-state reaction, form into aggregated shapes or compact globules or nodules. The subsequent cooling sequence is also of critical importance, as this will control and determine the structure of the matrix, on which will primarily depend the strength, ductility, hardness, and machinability of the material.

Malleable iron is produced in various grades, depending on the requirements of the final product, but these can be classed into three general types: so-called white-heart malleable, where part or all of the free carbon is decarburized by oxidation during the heat treatment operation, thereby leaving a structure similar to steel in appearance as well as in properties; black-heart malleable, which gives a matrix structure that is completely ferritic and possesses maximum ductility, impact resistance and machinability; and pearlitic malleable which is intended for applications calling for high strengths, wear resistance, case-hardening, and the like, which properties are obtained by variations in composition and/or heat treatment.

In controlling the process of manufacture, important consideration must be given to the type of raw materials to be used, the composition and structure of the as-cast product, the dimensions of the casting, the heat treating cycle, and the types of melting and heat-treating equipment to be used. These are all inter-related factors which, while allowing for a certain degree of flexibility and versatility, necessitate that a determination or specification of one will depend on the nature of the others in order to arrive at a satisfactory combination of variables. By the same token, a change or modification of one factor — for instance, casting dimensions, brought about by change in product type or by force of circumstance, may require a change or changes in the other variables, e.g. composition and heat treatment. Hence, it is not possible to offer a standard set of process specifications that would be applicable on a general basis, as such could be misleading. Rather, it is necessary that the metallurgist on the line fall back on the specific metallurgical principles involved, a subject that is beyond the scope of this article.

Metal is usually melted in a reverberatory or electric furnace, either of which may be charged with solid metal or liquid metal from a cupola furnace. The latter procedure is known as "duplexing". Metal poured directly from a cupola, termed as cupola malleable iron, is used largely for the manufacture of items where fluidity and casting soundness are more important than high tensile strength or elongation.

The molten metal is poured off at about 2700°F into sand molds made from properly rigged patterns and coreboxes. Rough castings are shaken out and placed in annealing pots or boxes packed with sand or other supporting material, which are then charged into stationary or car-bottom batch type furnaces; or alternatively, pushed into a conveyor running through a continuous-type tunnel furnace. They are then heated to temperatures above 1400°F and subsequently cooled to below 700°F for a period of from 20 to 150 hours, depending on composition, size, type of furnace, properties desired, etc. Quenching, tempering, normalizing, and other heat treating operations may also be carried out as needed.

(Continued on page 49)

INSPECTION PROCEDURES IN METAL INDUSTRIES

by DAVID A. MUNNS

Inspection of castings consists of viewing them closely and critically for certain characteristics or attributes which come under the broad terms of quality. In that sense, inspection aptly has been defined as the business of proving that an agreed standard of quality has been achieved. The characteristics or attributes involved in describing casting quality vary from a few to a large number, depending on the casting application.

Thus, the only requirement of a cast iron sash weight maybe that it is as close to a specified weight and shape. On the other hand, a casting for Apollo 13 has to meet a wide range of requirements, including complete soundness, high mechanical properties and close dimensional tolerances. Other requirements maybe that the castings fall within a certain hardness range, possess a specified microstructure, and meet stringent compositional requirement.

We will concentrate on one branch of testing of materials which is the Non-Destructive Testing or N.D.T. which means the inspection of materials without destroying the properties of the material. We have a wide range of N.D.T. Testing, but the most common inspection applied to metal industries include: X-Ray and Gamma Radiography, Ultrasonic Testing, Dye Penetrant Test, and the Magnetic Particles Test.

RADIOGRAPHY

X-ray and gamma ray equipment will detect gas holes, gas porosity, shrinkage, inclusions, tears and cracks in castings. The operating energies of radiographic equipment range from 50 to 2000 kv in x-ray machines, 6 to 31 million electron volts (mev) in betatrons, and from .084 mev for thulium 129 to about 1.25 mev for cobalt 60.

Practices for radiographic inspection are described in Tentative Recommended Practice for Radiographic Testing, ASTM E 94-62T. The quality level of the radiographic image is specified at a certain level determined by a pentrameter but may be of lower or higher quality by agreement between purchaser and supplier.

A pentrameter is made of material similar radiographically to the object being inspected. Usually, it is 2% of the object's thickness. The pentrameter contains holes with diameters in the ratio of one, two, and four times its thickness. Details on quality of radiographs are discussed in Tentative Method for Controlling Quality of Radiographic Testing, ASTM E 14-59T.

REFERENCE NEGATIVES — Additional aid to identifying radiographic images is contained in reference radiographic negatives showing various types of discontinuities in steel, aluminum and magnesium castings. Those for steel castings are available from ASTM as Industrial Radiographic Standards for Steel Castings. They are E 71-64 for steel castings up to 2 in. thick, E 186-65T for steel castings from 2 to 4-1/2 in. thick, E 280-65T for steel castings from 4-1/2 to 12 in. thick, and E 192-62T for investment steel castings.

Radiographic negatives of aluminum and magnesium castings are available from ASTM as Tentative Reference Radiographs for Inspection of Aluminum and Magnesium Castings, ASTM E 155-60T. Thirteen radiographic negatives for aluminum and 12 for magnesium are available. Each shows eight grades of severity of discontinuities. The discontinuities are related to gas holes, gas porosity, shrinkage, and foreign material.

SONIC — ULTRASONIC

Sound waves can be used to inspect castings for physical properties, structures, thickness and internal flaws. The methods employed are divided into two types based on sound wave frequencies. Sonic testing involves frequencies up to 20,000 cps (audible range). Ultrasonic inspection involves frequencies above that range, usually 400 kcps to 100 mcps.

Sonic inspection measures the resonant frequency of a component electrically, and the resonant frequency for a given component design is determined primarily by the modulus of elasticity and density of the material. Thus, the method can be employed for determining, in for example gray iron, the tensile strength, damping capacity, modulus of elasticity, and graphite form and amount.

Either castings or test bar specimens can be measured, and sonic testing often is used on long runs of castings which must meet definite physical requirements.

THE SONIC METHOD — In sonic inspection, the casting or test specimen is supported on a rigid bench, and the transducers of the testing device are placed at both ends, leaving small air gaps between the part and the transducers. Transducers are electro magnetic components which convert electrical energy into mechanical energy and vice versa.

One of the transducers is connected to the output of a variable frequency oscillator. It converts the electrical energy from the latter into magnetic oscillations of the same frequency, causing the part under test to vibrate. The other transducer converts the vibration or magnetic oscillations into electrical energy which is indicated on a meter.

When the oscillator frequency equals the natural frequency of the part tested, the amplitude of the vibrations increases to a maximum. This is indicated on the meter and the frequency in cycles per second is indicated on a frequency counter.

Use of sonic inspection requires the development of calibration curves specific to the casting design. The curves are developed by selecting a number of satisfactory production castings and determining their resonant frequencies. Test specimens cut from the castings at points where required tensile strengths are specified are subjected to conventional tensile strength determinations. Those values are plotted against the resonant frequency readings to develop curves establishing minimum frequencies for satisfactory castings.

ULTRASONICS — Ultrasonic inspection can be employed for detecting flaws, measuring thickness, determining modulus of elasticity, and for studying metallurgical structure and processing variables.

The two types of ultrasonic inspection involve the use of either resonant waves or pulse reflections.

In the resonant wave procedure used for thickness measurements, electronically generated variable frequencies are transmitted to the test casting. This is accomplished through a piezoelectric transducer using light oil, grease, or glycerine as a couplant.

When one of the variable frequencies corresponds to the natural frequency of the part, resonance is created and indicated in one of several ways such as use of a cathode ray tube, a stroboscope, a meter, or headphone indications.

Stroboscopic presentation is a common method. It employs a small neon

(Continued on page 48)

OBSERVATIONS ON FOUNDRY

by – John W. Bohlin, Lars Villner and Harald Sten

The production of the Philippine foundry industry is not known in detail and it is strongly recommended that reliable statistics should be assembled.

An estimate shows that foundries in the country number about 150 of which the majority (more than 100) is in the Greater Manila Area. Gray iron foundry is most in number followed by the steel foundry which seems to be surprisingly high, about 30. Most foundries are diversified and cast in 2 or 3 different types of metals.

Estimates of total foundry production come to some 50,000 tons of gray iron, 15,000 tons of steel castings, 1,000 – 2,000 tons of aluminum and 4,000 tons of copper alloy castings.

Of the eight foundries visited the following observations may or may not be valid for the whole foundry industry.

General Observations

Foundries are generally very small in size with an average production of less than 500 tons a year. Few foundries produce 2,000 tons a year or more except for a pipe foundry which produces more than 5,000 tons. The size of the foundries is generally too small for mechanization, product control, etc.

A few foundries are well equipped with a comparatively high output per man-hour and cast good products, but the majority of foundries are far below the standard required in the next stage of industrial development.

Raw Material

Pig iron is being imported. A small smelting plant produced about 5,000 tons of pig iron during its brief trial period of operation but it has been closed down. Production of pig iron or sponge iron in the country would form a useful basis for the mechanical industry. Imports should be done in big lots and against certificate to ensure quality.

Excellent silica sand and chromite sand are found in the Philippines but they are not marketed properly. More sand deposits should be investigated. Bentonite is found in the Philippines but its quality is not consistent. The same is true in the case for binders of different types. The industry can benefit considerably from developing these indigenous resources in collaboration with the MIDC.

Sand Testing

Sand testing equipment has been installed at several foundries, but they seem to be of moderate value for these foundries. To fully benefit from the result of sand tests, the procedures for sand testing must be standardized, the mixing of sand must be performed in mixers of high standard and from raw materials with reliable and consistent quality and the interpretation of test results must be done with a thorough knowledge of sand technology.

Mechanical and Chemical Testing

Foundries visited have no tensile testing. Tensile testing is the foundation of metal classification and standardization all over the world and it is strongly recommended that tensile testing should be widely used in the Philippine industry.

Brinell and other hardness testing apparatus are installed in several foundry laboratories as well as metallographic microscopes. Generally, the quality of the apparatus and their utilization and maintenance were not up to the standards required in the foundries and machine industry.

Surprisingly, a high number of foundries has bought expensive apparatus for carbon and sulfur determination although these tests can be done by simple methods. Courses in normal wet analyses of C, Si, Mn, S and P in metals and the equipment needed seem to be urgent.

Analyses are of limited value unless the raw materials are of consistent quality and the melting process is well under control. Full attention must be given to these important fields.

Moulding – Mechanization

Several modern techniques for moulding and core making such as shell-moulding, CO_2,-cores, resin-bounded cores, chromite sand moulds, etc., were observed. Handmoulding is dominant in the majority of the foundries. This is quite natural because of the low labor cost. With the increasing demand on the quality of the castings and with the bigger series in mass production to be expected, it will soon be necessary for the foundries to use more moulding machines. The estimated total number of moulding machines of all the foundries is 100 (or less than 1 per foundry) and not all seem to be in use.

The handmoulds are generally observed as loosely rammed and the flasks are of low quality (wooden frames or weak steel flasks). To make

THE PHILIPPINE INDUSTRY

castings without material shrinkage, good dimensional accuracy, consistent quality and high metal yield, it is necessary to have hard moulds in flasks having good stability and good steering pins and bushings. Full mechanization with mechanical mould transport, overhead sand supply, etc.... may not be economically justified in most foundries for the next step of development, but with the growing size of machine molded castings, lifting devices and mechanical transport will be needed.

For larger castings, the use of effective pneumatic rammers is recommended. Self-setting resin-bonded sands which give hard moulds with a minimum of work are widely used in Europe and the MIDC could undertake development work in this field.

Melting

Most furnaces are quite small due to the small scale operation in most foundries. Melting in small furnaces for a long time is costly, however, and it will pay to have bigger furnaces in order to melt and cast within a shorter period only. This is true especially for the cupolas. Some of the cupolas are very old. Modern cupolas require less coke, which is of special importance in the Philippines where coke is wholly imported.

Electric furnaces are used to a pretty big extent, about 25 of them altogether. As a rule they are small, highly utilized but badly maintained in many cases. The melting area should be clean and well organized to obtain good metal quality. Immersion thermocouples seem not being used. They give the true metal temperature and are here recommended. In melting higher grades of cast iron, they can be utilized to give the carbon equivalent, which is the best way to check the metal quality.

Planning and Maintenance

A few foundries are well planned, but most foundries had sand heaps everywhere and no planned transportation. A foundry must be clean and nice. It should have an open and level areas for transports. Good planning pays itself in short time.

The maintenance of foundry shops and foundry machinery is neglected. Good preventive maintenance is a necessity especially in a mechanized foundry and should be given full attention by the foundry managers and their subordinates.

Marketing of Castings

In the competition of the marketing of castings, more importance is given on the price rather than on the quality. If the competition is based first on the quality and secondly on the price, there is a better chance to get the right price for a casting. It is therefore necessary to organize marketing departments in bigger foundries.

The MIDC can maintain close work with the foundries by giving information to customers regarding specifications on casting such as quality of the melt, surface properties, dimensional accaracy, and the soundness and freedom from defect of the castings.

Training

To attain a high industrial level in foundries, it is necessary to train people engaged directly in foundry industry. Courses on management, marketing and various technical developments should be offered to managers and assistant department heads in foundries. Similarly, foremen should be given appropriate training in the handling of machinery and instruments and new technical methods. They will then be in a better position to train their workers in order to obtain the ultimate goal of better castings at a lower price.

Health Protection

Health protection for workers is given little attention. Many workers grinding castings are without eye protection; others at the melting furnaces and pouring areas seldom, if any, have protection for eyes, legs and feet.

In many foundries, dust concentration is thick in some areas. Workers exposed in such dusty air can contract silicosis and there is no cure for this deadly disease. In the Philippines, there is little need for ventilation in foundries compared to other countries because of favorable climate. However, the growing sizes and mechanization of foundries will create dust hazards and it is strongly recommended that dust problem be tackled to avoid silicosis.

Authorities concerned should therefore set up general rules for the protection of workers. This is an important task for the MIDC in collaboration with the foundries.

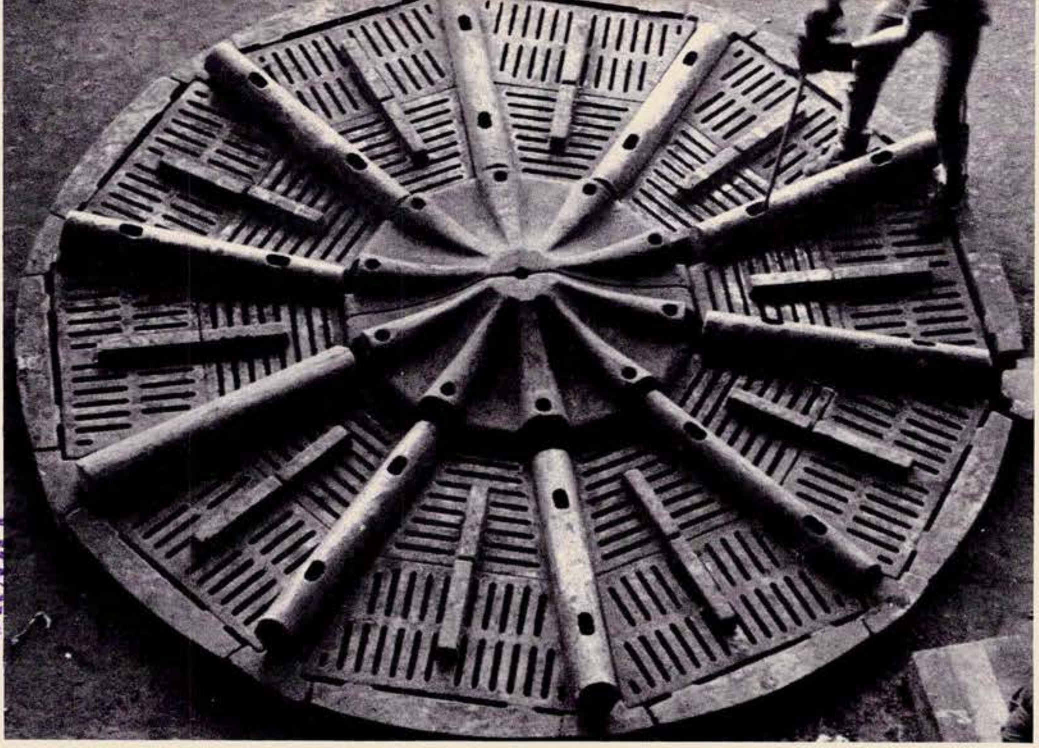
THE STEEL FOUNDRY DIVISION OF ENGINEERING EQUIPMENT INC.

Although the corporate history of Engineering Equipment Incorporated (EEI) dates back to April 17, 1931 when it was established as the Engineering Equipment and Supply Company (EESCO), its Steel Foundry Division was put up only in 1960. From this small jobbing foundry shop which manufactured small castings for mine equipment, the EEI Steel Foundry Division, during the first decade of its operation, has made remarkable growth and accomplishments to become a leading manufacturer of quality castings for the mining, cement, sugar, wood processing and other industries. With the present personnel of 350 men, the different shops of the Steel Foundry Division operate at three shifts per day, six days a week. Production of castings is 18 to 20 tons per day. The company aims to double its present production capacity in its expansion plan when it moves to its new 3.9 hectare site located near its present site at Mandaluyong.

Ninety six percent of the production are ferrous castings and four percent are non-ferrous. Ferrous castings consist of manganese steel, carbon, low-alloy, high-alloy steel castings and cast iron. The weights of the cast products range from a fraction of a kilogram to 3.5 tons. On the consumer end, 55% of the products are for the mining, 25% for the sugar and 20% for the cement and other industries.

The offices and shops of the Steel Foundry division occupy about one hectare of the EEI site at Mandaluyong. The pattern and molding shops are well-equipped and manned by highly skilled personnel. Sand mixing is mechanized while sand handling is manual. Chromite sand bonded with air setting binders or western bentonite, depending on the type of casting, are used for the molds. Core sands are bonded with CO_2, air-setting or thermosetting resins depending on the use. Recycled sand is used for mold backing. Molding is done in three molding machines and by hand by means of a pneumatic rammer in the case of big castings. Close control is maintained throughout the preparation of the sand, the cores and molds. Risers are lined with exothermic sleeves prepared also in the molding shop.

Melting is done in four electric induction furnaces having capacities of 300 lbs., 500 lbs., 4,000 lbs. and 6,000 lbs. with two power sources — a 120-KW Variable Induction Power unit for the two small furnaces and a 750-KW unit for the two big furnaces. The small furnaces are used in melting and refining of small



Assembly and inspection of the ball mill grate discharge liners.

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high-alloy and precision castings from alloy stocks and choice scrap. The big furnaces with a rated capacity of 1 ton per hour each are used for larger casting jobs. Baled scraps and returns are the principal charges. Seven to eight heats per day are common happenings in the melting shop.

The refined molten metal is poured into lip pour type ladles, having capacities ranging from 10 kg. to 250 kg. for the small castings and 500 kg. to 3 tons for the bigger castings. The composition and temperature are closely controlled during the refining and pouring of heats.

After a specified time in the molds, the mold and casting are brought to the shake out area to remove mold sand and cores. There are three shake-out machines for this purpose including the recently installed one which is equipped with a dust collecting system. In addition a shot blasting machine was recently installed for the cleaning of castings. Sands are reclaimed for use as mold backings.

Gates and risers are removed by cutting torches in the case of heavy castings and by a cutting wheel in the case of small castings prior to machining. The machine shop section has complete equipment, facilities and highly skilled personnel for machining and finishing of castings from small precision cast products to heavy ones like bowl and mantle liners for cone crushers with diameters up to five and one-half feet.

Annealing and heat treatment of castings, when required, are done in any of the four heat-treating furnaces depending on the size of the casting and process required. There are two electrically-heated and two oil-fired furnaces with capacities from 2 to 10 tons of castings. When desired, case hardening by pack carburizing can be done in these furnaces.

One thing highly emphasized in the EEI foundry is quality control and with good reason since the foundry has been casting products used by the major industries comparable in quality and standards as the imported ones. The quality control department oversees and checks that standard procedures are rigidly observed and proper materials and the correct process are used during all the phases of the casting process from the pattern to the finished product. This department has a strength of 30 personnel divided into four sections, namely: the Mechanical Inspection, Metallurgical, Chemical and Non-Destructive Testing Sections.

Each section has complete equipment and facilities for testing and analyses. The Mechanical Section checks the physical state and mechanical characteristics of in-process materials and products. The Metallurgical Laboratory conducts metallographic, metallurgical and sand tests. This section closely looks after the molding, melting and pouring stages of casting and sees to it that standard methods and procedures are rigidly followed. The Chemical Section Laboratory is well equipped for analytical work. It is one of the very few laboratories which has an atomic absorption spectrophotometer for analyzing the common elements present in ferrous, high-alloy and non-ferrous castings. The Non-Destructive Test-


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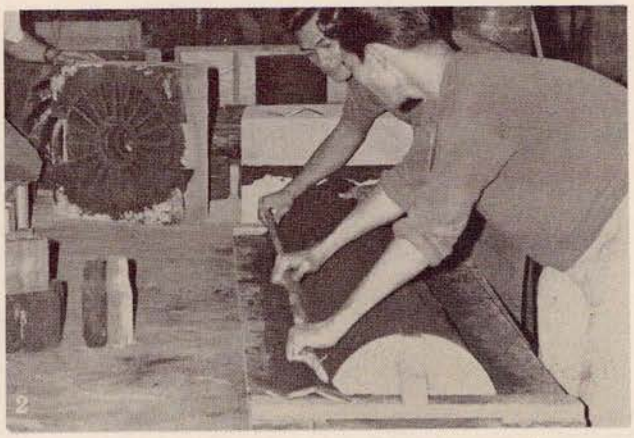
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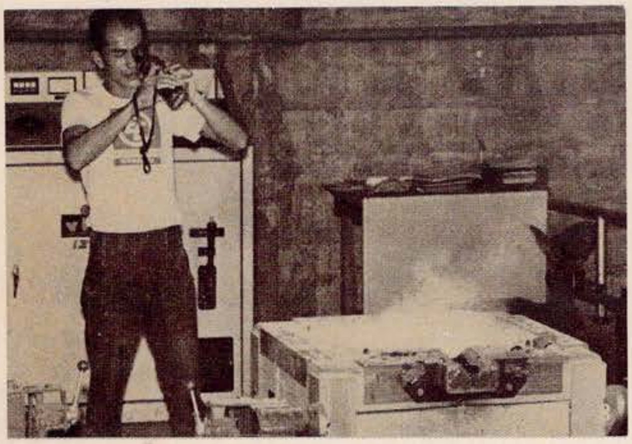
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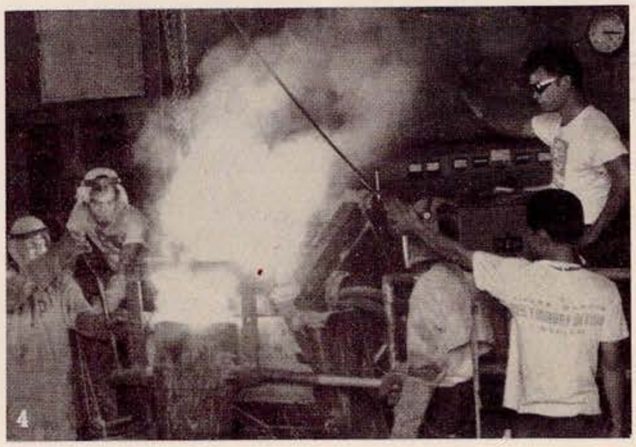
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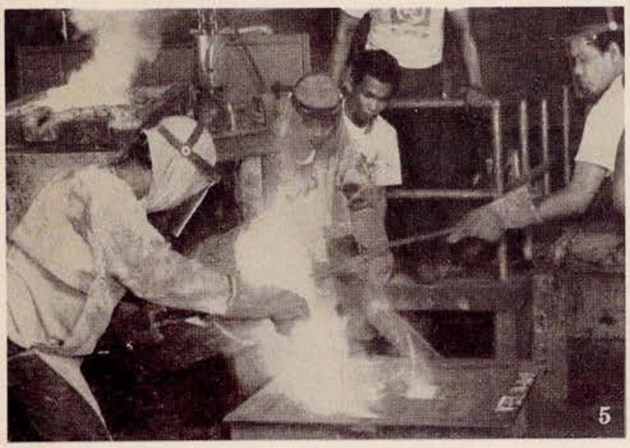
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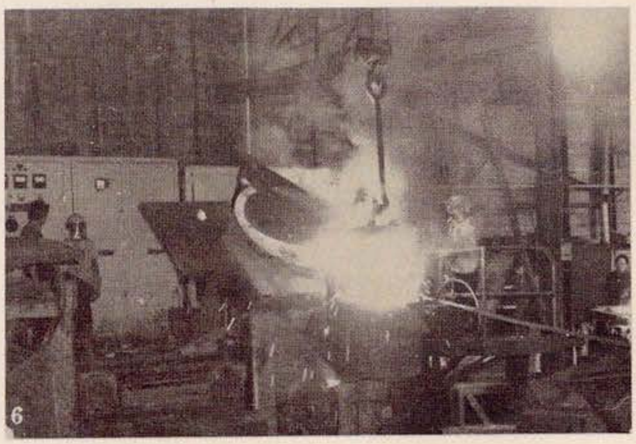
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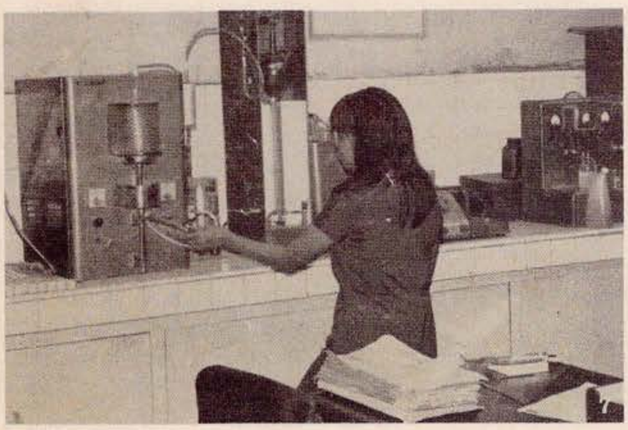
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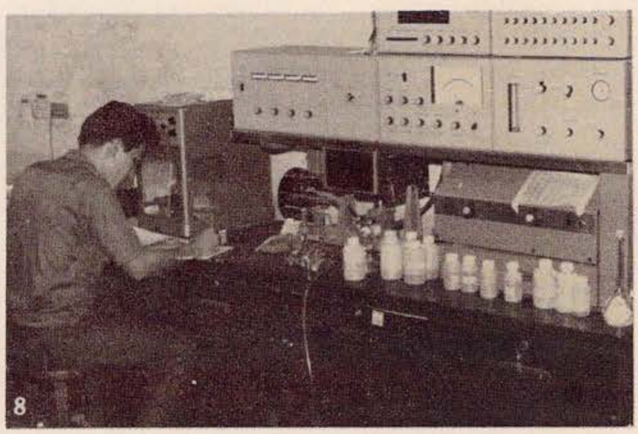
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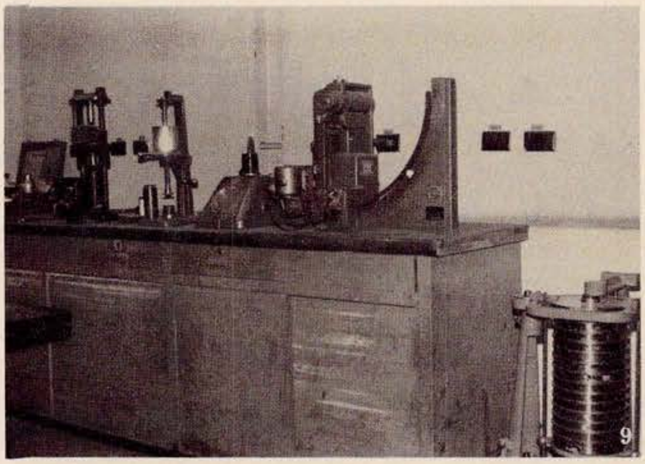
(1) Preparing the mold for a heavy steel casting manually with the aid of a pneumatic rammer. (2) Preparation of a sand core. (3) Optical pyrometer measurement of the temperature of an alloy steel heat being refined in a crucible of the VIP Induction Furnace. (4) Tapping a heat from the VIP Induction Furnace crucible to a pouring ladle. (5) Pouring of the refined alloy steel into the mold. (6) Tapping a heat of steel from the 2 ton capacity crucible of the 750 KW Induction Furnace. (7) Carbon content determination of a cast steel sample by means of the carbon determinator. (8) Atomic Absorption Spectrophotometer determination of the major and residual elements of a steel sample. (9) The sand testing laboratory. (10) The metallurgical laboratory. (11) Surface grinding of a cast manganese steel mantle liner for a cone crusher. (12) Machining of a cast steel sugar mill roll pinion. (13) Zyglo process Dye penetration inspection of a steel casting.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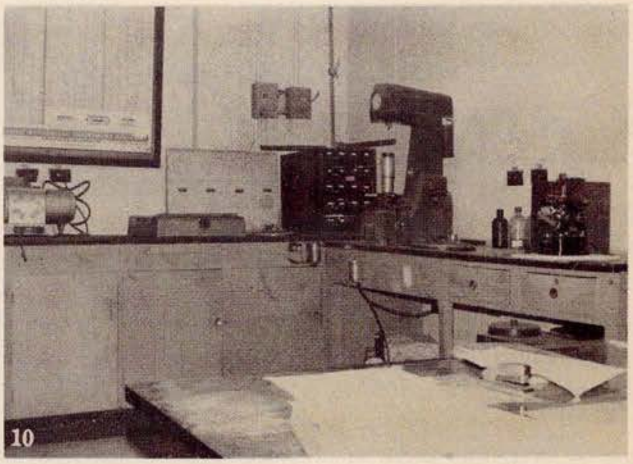
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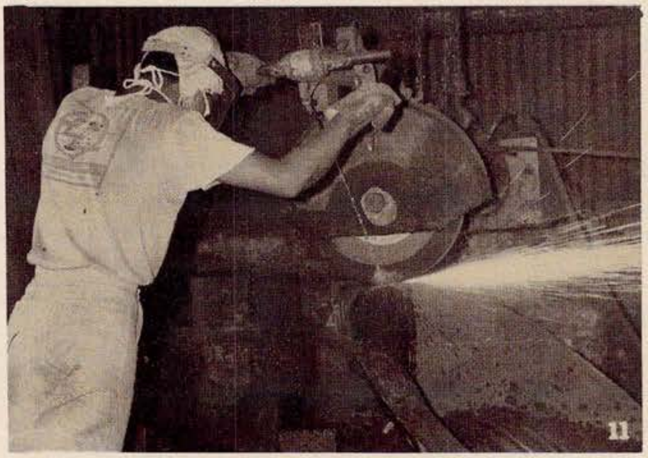
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ing section conducts ultrasonic, radiographic (by a Cobalt 60 gamma-ray machine) and dye penetrant (zyglo) tests. All tests done in the different sections of the quality control department are performed according to internationally accepted standard procedures.

At the helm of the management team of the Steel Foundry Division is Isidro D. Cariño, General Manager of the Division and Vice President of EEI; Vicente N. Muñoz, Operations Group Manager; Serafin M. Alleje, Jr., Sales Manager; Estanislao A. Caballes, Marketing Group Manager; Leandro C. Fajardo, Products and Systems Manager; and Ernie M. Santiago, Engineering Manager.


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ENGINEERING & TECHNOLOGICAL DEVELOPMENT

Increasing Importance of Patternmaking in the Foundry Industry *(FTJ – May 7, 1970)*

Patternmaking occupies a central position in modern foundry practice. Hence, material as well as methods used need to be scrutinized. For instance, it is necessary to establish to what extend the requirements for greater accuracy, greater consistency in manufacture and quality, shorter supply times and greater economy could be fulfilled under existing conditions.

The author shows how structural changes in the foundry industry triggered innovations in patternmaking, raw materials for patterns and new manufacturing methods for mould components. Principles of the functional division of work to achieve savings in the jobbing foundry, equivalent to the economies of mass production, are explained. Organizational adjustment of the production cycle and the incorporation of patternmaking into foundry planning, together with integration of design, pattern production and casting process is also advocated.

System Sand Control by Compression vs. Compactibility Test *(MC – July 1970)*

Over the years many different sand tests have been added to the sand laboratory's list of tests to control a sand system and to ensure freedom from scabs and expansion defects. Too often, even with all the different tests that are available and are often run, defective castings are made despite system sand tests show all results are within the established range. Presentation by Wenninger and Volkmar and also Hoffman have emphasized the research leading to the construction and application of a control graph. This work was based on fundamental water-clay relationships and introduced the green compression vs. compactibility and moisture measurements. It was felt that foundrymen would appreciate additional information on the aspects of implementing this original research to practical operating control of a sand system.

This presentation describes the steps that were taken by one foundry to implement the control of system sand. Included are steps taken to improve the mulling effectiveness of the existing equipment and the standardization of the laboratory testing equipment. A description of how 3 tests; green compression, compactibility and moisture; using the graphs presented, enable the foundryman to determine the working clay and available bond in the sand at all times. Methods used to simplify sand formulations and ways to involve all the foundry molding and laboratory personnel in the control of the sand are discussed. It is felt that as more people are trained on how to comprehend and apply the control graphs to the sand test results, some of the mysteries of sand control will disappear. As these controls are implemented on a regular basis many of the problems of sand control of the past will be minimized.

Determining Characteristics of Clay by Electrical Conductivity *(F – March, 1970)*

Clays lose their bonding properties when they are heated to high temperature and the water content is driven off. The temperature at which the water is driven off depends on the type of clay, particle size, degree of crystallinity and impurity content. Clays that lose their combined water are called inactive clays to distinguish them from active clays that retain combined water and bonding capability.

Active clays exhibit an ion-exchange capacity which depends on the amount and type of exchange ions present in the clay. This property of clay makes it suitable for electrical conductivity test. The procedure consists of preparing clay water slurry with 0.5 gram clay in 50 cc of distilled water. The conductivity cell is immersed in the solution and the conductivity read on the Wheatstone bridge indicator. A combination chart is prepared for different clays.

Test shows that it has the same results as any conventional test of clays such as the methylene blue test. Clays that have poor ion-exchange capacity show less conductivity.

Sand-Faced Dies

(FTJ – February 12, 1970)

The method makes use of molding boxes produced from foamed-polystyrene patterns. These boxes are made to conform very closely to the configuration of the pattern and the narrow space between is filled with a free-flowing resin-bonded sand with self-setting properties. After the pattern is removed and the core set, the mold is ready for pouring.

One of its disadvantages is that it is only applicable where mass production is needed.

Die Cast Aluminum Engine Powers Mini-Car *(PE – April 27, 1970)*

The 330-lb. lightweight engine which is 50 lb. lighter than a comparable cast-iron engine also heralds two other firsts: the 4-cylinder engine is the first engine to be made from the high-silicon hypereutectic Reynolds 340 alloy and it is the first to be die cast by the Acurad process.

The hypereutectic alloy with 17% silicon allows engine designers to employ aluminum cylinders instead of the expensive iron sleeves. To achieve an iron-to-aluminum bearing combination, General Motors' engineers worked out a coating system that applies a thin layer (0.001 in.) of iron on aluminum pistons. Both electroplated and spray-coated processes were considered in early research stages, along with epoxy-iron combination coatings.

Producing Forged Parts from Cast Pre-Forms

(FTJ – February 5, 1970)

A two stage process which is claimed to have very important potentialities may well have far-reaching effects. The process involves the production of a cast form which, after a pre-determined interval for solidification and partial cooling, is subjected to a forging operation.

Water cooled mold is set for casting such that the product of this casting is fairly close to that of the finished product. As soon as the casting has cooled sufficiently to be "self supporting", it is transferred to an intermediate position for further cooling.

After trimming of runners and flash, the casting is ready for forging.

Now and then – The Direct Casting of Iron

(MC – August 1970)

Developments in the art and science of ironmaking and casting have occurred slowly. However, the year 1969 was also significantly important in this technological field as several plants became involved in commercial operations to produce hot metal directly from ore by processes other than the blast furnace. Three facilities of interest are the SL/RN plant in Korea; the Highveld rotary kiln process plant near Witbank, Transvaal, South Africa and the D-LM process plant at Mobile Alabama. Of these three, only the Alabama plant is designed to process controlled grades of foundry iron suitable for direct casting. This could be of vital importance to foundries of the future. This paper traces the direct casting of iron from antiquity to the present.

New Concept in Automatic Pouring Increasing Production and Cutting Cost

(MC – August 1970)

Liquimetrics, of Berkely, California, produces an automatic, inert, gas, pressure pouring furnace that should capture the attention of every die-caster, permanent mold shop and sand metal-caster using automatic molding equipment. It combines high speed with precision accuracy.

Liquimetrics' new furnace does automatic pouring at rates never reached before. Shots of molten metal are very consistent. This unit can pour molds on a conveyor or turntable, or can pour permanent molds and die-casting machines. Its capabilities for protecting a molten bath from the atmosphere make it ideal for aluminum or magnesium diecasting. As set up for magnesium diecasting, inert gas protects the metal all the way to the die. At the transfer point, a flame surrounds and protects the metal as it enters the die.

Comparing Processes for Making Ductile Iron *(F – July 1970)*

The article discusses the purification of melts for the purpose of producing nodular graphite. It also dwells on nodulizing alloys such as magnesium and calcium and the processes of introducing these alloys to the melt. Slags produced together with the evaluation of processes and alloys used are at the end of the article.

Factors Influencing the Castability of Austenitic Spheroidal-Graphite Cast Irons

(FTJ – March 26, 1970)

Founding properties of spheroidal-graphite cast irons are briefly discussed, with particular reference to the austenitic grades, containing about 20% nickel. Test-pieces representatives of both light-and medium-section castings, developed by the British Cast Iron Research Association, were used to investigate the formation of shrinkage defects in the austenitic irons. In light-section castings it was found out that such defects are generally associated with the formation of chromium containing eutectic carbides. If unsoundness problem arise when producing light-section castings, the effects of maintaining the chromium content at a maximum of about 1.5% and using a eutectic composition obtained with a higher-than normal silicon content (2.75% Silicon), should be determined because both these measures will minimize carbide formation. Mold-cavity dilation appeared to be the major cause of unsoundness in medium-section castings; in this case, it is recommended that a hypo-eutectic iron be used (Carbon Equivalent = 3.6 – 4.0) and that the pouring temperature superheat should be about 80°C. Irrespective of the ruling sections involved, it is always advantageous to use hard-rammed molds.

Spheroidization of Binary Fe-C Alloys over a Range of Temperatures *(MT – January 1970)*

The spheroidization of cementite in binary, Iron-Carbon (Fe-C) alloys, 0.24, 0.42 and 0.79 wt. percent C, was investigated over a range of temperatures, 594°, 649° and 704° C, and time up to about 10^6 sec. Quantitative metallography techniques were used to obtain the following microstructural data on the cementite particles: shape, size distribution, mean size, number of particles per unit volume, and growth (and shrinkage) rates of various sizes in the size distribution. The variations of these microstructural parameters were analyzed in terms of existing models for the spheroidization process. The Lifshiftz-Wagner analysis is shown to have limited applicability to the spheroidization of cementite in binary steels, since the required steady-state size distribution is not attained in less than about 10^6 sec. An analysis similar to that of Lifshitz and Wagner, but requiring no specification of the shape of the size distribution, is shown to apply and indicate that the observed spheroidization was diffusion-controlled. The effective diffusion coefficient was between the values for the diffusion of carbon and iron in ferrite and approximated the coupled diffusion coefficients developed by Oriani and Li, Blukely and Feingold.

Control of Graphite Structure in Heavy Ductile Iron Castings

(MC – July 1970)

The deterioration of the spheroidal graphite structure in the thermal center of heavy ductile iron castings has been reported by several investigators. The resultant nonspheroidal graphite is referred to as chunk or vermicular graphite and it vaguely resembles flakes of ASTM D type. Some trace elements such as lead are known to restore spheroidal graphite structure both when added deliberately and when derived from an inferior melt charge. Such a procedure is dangerous, however, because flake graphite instead of chunk may be generated. A working hypothesis adopted for the present investigation assumed that graphite chunks are the individual building components of graphite spheroids; i.e., chunk graphite is the result of the disintegration of spheroidal graphite. Although this hypothesis was neither proven nor disproven, it drew attention to the role of austenite shells which protect the growing spheroids against the attack of liquid. One method of strengthening the austenite shells is increasing their absolute thickness. This, in turn, suggested a beneficial influence from decreasing nodule count. Two influences were examined which are known to affect nodule count: Silicon (Si) content and inoculation. As expected, lower Si content and less effective inoculation both reduced the quantity of, or eliminated chunk graphite. It is concluded that decreasing nodule count in a reference test casting is beneficial in restoring spheroidal graphite structure in heavy ductile iron castings. Decreasing Si content was found to be the most practical and useful method of accomplishing this. An industrial observation suggested that small additions of tin are also capable of restoring spheroidal graphite structure. Experiments have shown this to be the case within limited concentration ranges.

As Cast Structures, Defects and Graphitization Kinetics in Ductile Cast Iron Pipes

(MC – June 1970)

Defects found in cast iron pipes may be classified into three (3) categories: metallurgical, processing and mechanical, on the basis of the main causative factors. Metallurgical defects due to variation in graphitization potential of the melt are investigated. Checks or wrinkles are found if this potential is either inadequate or excessive. Close examination of the macro-features of checks showed that these hot tears occurred as a sequence of small fractures on thin sheets of metal starting on the outer surface with each successive tear pulled apart through smaller distances. Also whirls and bleedouts are shown and from these a probable mechanism for the formation of checks is described and contrasted with the formation of wrinkles which are depressions occurring on the outer surface of pipe due to excessive graphitization during solidification. Because of rapid solidification under dynamic conditions, the as-cast microstructure of the pipes are different from those seen in static castings of the same size. A cross section of the pipe wall revealed 3 zones. The structures of each zone in normal, checked and wrinkled pipes are described and compared. In particular, the amount of carbides and number of nodules decreased with distance from the outer diameter, but the ordinates and shapes of these curves are different in the above pipes. Graphitization kinetics are measured through nodule counts and percent carbides reflected these differences in microstructure with position in any one pipe, and also at analogous position in normal, checked or wrinkled pipes. On the basis of the above data, an optimum structure derived as a balance between the need to avoid defects and also for the shortest graphitization times is described, and various test which can be used to determine whether the melt can give the above structure is also discussed.

Fatigue Notch Sensitivity of Nodular Iron

(TISIJ – February 1970)

The Neuber material constant has been determined for nodular iron. It is found from data in literature that this constant is about nine times that of steel of the same strength in a rotating beam specimen with grooves. This implies that the relation between notch-sensitivity of nodular iron $q^{(N)}$ is in accordance with the equation

$$q^{(N)} / q^{(s)} = (1 + \sqrt{A/R} / (1+3\sqrt{A/R})$$

where A is the "Neuber constant" for steel and R the notch radius. Consequently, the notch sensitivity is less for iron than for steel, since the above relation is less than one. This would be a natural result when considering the internal stress concentrations in nodular iron arising from the graphite nodules. In view of this fact, the fatigue limit will not decrease as much as for steel when a mechanical notch is applied to the specimen. Further on it appears from this study that the net fatigue, i.e. the notched fatigue limit of nodular iron, often is at least comparable to that of steels of the same strength. This is also confirmed by fatigue test on gears made of both cast and forged carbon steels. The cause of this is discussed. The main reason as propounded by the author is probably the capacity of nodular iron to "damp" the peak of stress concentration due to the applied notch.

Aids in Riser Removal

(F – August 1970)

The development of a new method of removing risers from ductile iron casting is discussed in this article. In the new method, a layer of graphite cloth is stretched across the edge of a riser connection to form a thin parting or notch when the iron solidifies. This notch makes it possible to knock off the riser.

The strength and impact resistance of the metal would make it difficult to knock off the riser otherwise, and the high carbon and silicon contents make acetylene and carbon arc-cutting impractical. The removal of risers by abrasive cutting often is expensive and time consuming. With these properties of the metals, it seems that the new method has a bright future.

Annealing Cycle for Malleable Iron Castings Reduced from Days to Hours with New Continuous Furnace

(IH – May 1970)

The new equipment reduced the heat treating cycle time for malleable iron castings from 6 1/2 days to 24 hours. In addition, quality is improved and controlled atmosphere has eliminated scaling for improved machinability of the castings. Fuel costs are less because of shorter cycle.

The furnace has a gas-fired radiant tube combustion system designed to operate at a maximum continuous temperature of 1800° F. It is divided into five zones of temperature control with a total BTU input rating of 7 million BTU per hour. Each zone is separately controlled. Having five separate zones of temperature control on the furnace permitted the heating cycle to be independently adjusted. This flexibility also serves as a safeguard against over heating or under heating the castings which can be controlled during the holding portion of the cycle.

Low Temperature Surface Treatment Process Improves Wear Properties

(MF – March 1970)

The process not only increases wear qualities but is also designed to reduce friction.

The "Caubet" process involves an electrochemical salt bath operating at 360 to 390°F, permitting application to case-hardened, induction-hardened, or through-hardened steel parts without loss of hardness.

The process involves surface diffusion of sulfur forming iron sulfide zone approximately 0.0002 to 0.0003 in. deep which can be attained in less than 30 minutes.

The process produces a surface with strong anti-welding characteristics and excellent absorption of lubricating oil films. Dimensional tolerances are said to be insignificant.

Convenience, Economy Characterize Versatile Quenchant

(MP – April 1970)

The product called Aqua-Quench 250 is a versatile water soluble quenchant. Concentrations can be adjusted to compensate for variation in steel's composition from batch to batch. It also eliminates the smoke and fire hazard that always accompany oil quenchants. Furthermore, it provides different quenching speeds ranging from that of water to nearly those of oils. This versatility makes the quenchant applicable to high production shops which work with several grades of steel.

Effects of Various Deoxidation Treatments and Tool Conditions on the Machinability of Slightly Hypoeutectoid Carbon Steels

(JA – May 1970)

The effect of deoxidation treatments on machinability of steel was studied. Cutting tests carried out on the various steels showed that (1) machinability, defined by tool wear, was heavily dependent on the deoxidation treatment of steel. The terminal cutting speed, below which no crater wear appeared in the tool, varied from 0 to 180 m/min. and the terminal cutting speed below which no blank wear appeared varied from 0 to 200 m/min. (2) cooling of the tool lowered the terminal cutting speed and increased the tool wear rate at cutting speed above this.

Theoretical Considerations in the Grinding of Metals

(JIM – 1969 Vol. 97)

An elementary theory of metal displacement in grinding is developed on the basis of an analogy with bulge formation in strip drawing. It is predicted that metal can be removed in the form of continuous swarf or can be displaced without removal from the surface being ground. A major factor is the geometry of the individual abrasive grit. Some quantitative predictions, and especially the transition from one mode of deformation to the other, have been verified by experiments with large-scale model grits sliding on Plasticine. Quantitative explanations of the influence of friction and of strain-hardening are offered.

Welding of Austenitic Stainless Steel

(S – May 1969)

As an estimate, about 90% of all welded stainless steel is austenitic. After giving a survey of the most common austenitic steels, the welding question has been dealt with from various points of view.

Previously, one of the most important problems was the risk of intercrystalline corrosion. Today, extra low carbon steel qualities are used in increasing quantities which reduces this risk.

Since the physical properties of the steel are very different from those of the structural steels, it is necessary to give various considerations to the production problems at the design stage, so that deformation and warping do not become too great. The latter also influences the choice of welding method. An important rule is to reduce the heat input as much as possible during welding.

Metal Separator Highly Successful *(AMM – January 19, 1970)*

The Coreco Metal Separator has found acceptance in plants which range from little scrap yards to automobile shredder operations, aluminum and die cast foundries. The ability of this machine to automatically sweat the desired metal has made it highly economical in these days of high labor costs.

The separator is a continuous feed-pour machine. The material is fed in one end and then travels through the machine. The molten metal is discharged into pigs or sows.

Selective melting is achieved through the pin-point automatic temperature control. In this way, the zinc base die cast is recovered first from bi-metallic units such as carburator and fuel pumps, and at a later time, the furnace temperature is raised and aluminum is recovered.

Steel Firm Gets U.S. Patent for Scrap Preheating Process

ARMCO Steel Corp. has been awarded a patent for the invention of a multiple-use preheating process for scrap which is already in use in electric furnace steelmaking at Armco's Kansas City works. According to L.F. Weitzenkorn, Senior Vice President for research and technology, the process "has measurably increased the production of our electric furnaces at Kansas City, and is currently being considered for use at other Armco facilities."

The patented process automatically regulates the flow of fuel and air to the scrap charging vessel, which provides even heating and controlled oxidation of the scrap. It also brings the scrap to the desired temperature in less than 30 minutes by use of top burners in the charging vessel.

Optimum Range of Carbon Content at Meltdown

(Stal – February 1970)

Under the operational conditions obtained in 75t open-hearth furnaces at the Hammer and Sickle Works, the optimum extent to which the carbon content at meltdown should exceed the average of the specified ΔC is 0.35–0.65%. The correlation between ΔC and the duration of the boil, rate of carbon drop V_c and desulphurization V_x, etc. was examined. If ΔC is too small, technological operations (heating up of the metal) are inhibited, and if ΔC is too great furnace productivity is reduced without any improvement in metal quality.

The Use and Functions of Oxygen in Electric Arc Furnaces

(BFSP – June 1970)

The use of oxygen lance for controlling the carbon content of electric furnace steel shortens heat time and provides some major metallurgical benefits such as lowering the nitrogen and hydrogen content of the melt. The carbon-oxygen reaction releases energy in contrast to iron oxide-carbon reaction which consumes energy, hence power and electrode consumption are improved.

The other advantages of gaseous oxygen over iron ore are:

1. faster decarburization,
2. less oxidation of charged metallics,
3. improved refractory life,
4. improved steel quality,
5. much faster control of bath temperature and composition.

Today, there are four known methods of blowing oxygen to the arc furnace metal bath which are the following:

1. Uncoated steel pipe – for small foundry furnaces with very short blowing periods. Pipes must be cleaned for safety
2. Refractory protected steel pipe – for furnaces, small or large, where time of blow is somewhat extended and where savings in pipe cost are important.
3. Water-cooled jets through door or side wall opening. While the initial equipment cost is high its life span is extended.
4. Water-cooled vertical lance through the roof, similar to those in the B.O.F. There are now a number of these installations on large furnaces.

Developments in the field of reduction of iron ore in the solid state have approached the stage where there is great interest in these products as a lower cost substitute for blast furnace hot metal and scrap. This is not only because of lower capital costs. Higher metallic yields are obtained than in the case of BOF because of the lower amount of excess carbon that has to be removed. This yield factor can be of major economic importance.

Two Processes Advance Metals Refining Technology

(IAMI – January, 1970)

Two processes which remove the refining from the melting phase hold the interest of metal producers. One is known as "combine refining process" and the other is known as ASEA-SKF process. Both processes offer power cost savings, high yield and higher quality of the end product.

The combine refining process carries out well the removal of inclusions, gaseous impurities, volatile metallics and carbon removal by carbon-dioxide.

In the ASEA-SKF process, the heart of the process is the induction stirring performed within the ladle furnace for refining purposes only. Primary benefits are generous reduction in the levels of oxygen, hydrogen and nonmetallic inclusions.

Vacuum Oxygen Decarburization

Republic Steel Corporation and its newly acquired subsidiary, Finkl's and Sons, recently unveiled a new process for the production of extra low carbon stainless steel and other alloys. This new process, the result of 10 years of research, is called V.O.D. for Vacuum Oxygen Decarburization.

In the Republic-Finkl process, the electric furnace is used primarily for melting. The steel scrap is melted and the molten steel is transferred in a special ladle to the vacuum finishing unit. Gaseous oxygen is then introduced to reduce carbon and other impurities to extremely low levels, producing corrosion resistant, workable and weldable grades of 18 – 8 ELC grades of stainless steel. Aside from this, the process can also be used to produce a new family of stainless steel alloys that cannot be produced by current conventional processes.

Republic has installed a 90 ton unit in its operation in Canton, Ohio to step up its production of V.O.D. stainless steel.

Hoover-Ugine, a subsidiary, jointly owned by Hoover Ball and Bearing Co. and Ugine Kuhlmann of France has developed a new process which converts sheet metal scrap into wire products by using hot extrusion principles without remelting. This is known as the Ugine Sejournit process.

Continuous Electroslag Remelting Unit

A continuous extraction electroslag remelting unit for the conversion of solid electrodes into ingots, has begun commercial production at Aztec Metals, Inc., Pittsburgh, Pa. The electroslag remelting (ESR) furnace can remain in production indefinitely because solid electrodes are fed alternately from two stations into a single mold and an electroslag remelted ingot is continuously withdrawn from the bottom of the mold.

Currently, the unit can produce ingots up to 6-in. diameter or equivalent cross sections in other shapes. Annual ingot capability is estimated at 2,000,000 lbs. The furnace can produce high alloy, stainless, tool and super-alloy steels in forms suitable for direct forging, extrusion and rerolling to bar and wire sizes. Principal markets include aerospace/aircraft, automotive, chemical processing and electronics.

The ESR process refines metal electrodes that are partially immersed in a protective slag bath of special composition. Electrical resistance heating melts the tip of the electrodes as it is lowered into the bath. Drops of electrode metal are refined as they pass through the slag, forming a molten metal pool that freezes and takes the shape of the mold. Electroslag remelting is gaining wide acceptance in the U.S. and overseas as a major processing technique for improving the properties, over all quality and fabricability of high-alloy materials.

The Role of Nickel, Copper and Columbium in Strengthening a Low-Carbon Ferritic Steel

(MT – February 1970)

The contributions of the alloying elements nickel, copper and columbium are evaluated in a low-carbon precipitation hardenable ferritic steel. The influences of nickel, copper and columbium as individual and dual elemental additions on microstructure and mechanical properties are described. These elements each contribute to the as-rolled strength by grain refinement and solid solution strengthening. Copper provides an additional strength increment of about 15,000 psi as a precipitation hardener upon 1050° F aging.

Reducing Pinhole Porosity in High-Alloy Steel Castings by Additions of Selenium

(MEQ – February 1970)

A problem that has faced the high-alloy founding industry is the occurrence of pinhole porosity in greensand molded castings. The hypothetical reason for reducing the pinholes by addition of selenium is that it lowers the surface tension of the metal and this inhibits nucleaction of the steam bubbles required to start the porosity.

Kinetics of Austenite Grain Growth in Steel

(JISI – May 1970)

Austenite grain growth was studied in cast and forged steels containing various amounts of grain-refining elements. The investigated temperature range was 950°-1250°C and the time range 10^1 to 10^7 seconds. Additions of niobium, vanadium and titanium, could inhibit grain growth while zirconium, cesium, aluminum and uranium had no apparent influence on the amounts studied, probably due to oxide formation. Growth inhibition was observed at two grain-size levels, 15-25 mm and ≈ 100 mm. respectively. The former was attributed to nitrides or carbides, the latter to slag inclusions. The time required for unpinning was correctly predicted on the basis of Lifschitz and Slyzov's equation for precipitate coalescence. Three types of growth, characterized by the exponent in the growth equation $D^n = kt$, were observed; $n = 6$ was found for normal grain growth and $n \approx 1$ for abnormal grain growth after unpinning. A very slow grain growth, $n \approx 20$, occurred during inhibition.

On Primary Blow-Hole of Rimmed Steel

(TISIJ – April 1970)

Primary blow-hole is one of the most important factors dominating the quality of rimmed steel. In this paper, further development on the analysis of the formation mechanism of primary blow-hole and the solid skin was on the basis of a former paper.

It was found that the diameter and the number of primary blow-holes per unit solidified area were dependent on the rimming intensity.

The surface tension of liquid steel, as well as CO gas evolution, was considered to be one of the factors influencing the thickness of the solid skin.

The effects of these factors, the influence of oxygen, carbon and sulfur contents on the thickness of solid skin were discussed. The relation between the weight of ingots and the thickness of solid skin was also studied and estimated from the composition of molten steel and teeming conditions.

Nisshin Develops Non-Nickel Stainless Steel

(JME – August 27, 1970)

Nisshin Steel Works has developed a new kind of stainless steel without the use of nickel, called "NHS 104". This contains chrome, manganese and copper and has better qualities than the conventional 18-8 stainless steel. Mass production in converters is possible in order to reduce production costs much lower than the 18-8 stainless steel.

Electrical Conductor Alloys Developed

Pittsburgh – The Aluminun Co. of America has announced availability of two new alloys for electrical conductor. The alloys, CM71 and CK76, resulted from a joint development effort by Alcoa and its Alcoa Conductor Products Co. division. The new conductor provides excellent flexibility, reliable performance in mechanical connections and high strength. P.T. Coffin, Jr., Alcoa's manager of electrical equipment sales, said they expect the two new alloys to substantially displace other metals in products that distribute, control and consume power, just as EC and 6201 aluminum alloys have replaced copper in transmission lines. Among these products are building wire including nonmetallic sheet bed conductor; welding cable; automotive and appliance wire; telephone exchange cable; hookup wire; cord sets; and winding for motors and transformer.

Microsegregation in Steel

(JISI – May 1970)

Chemical and metallographic aspects of steel manifesting microsegregation in the as-cast and annealed conditions are presented in this paper. In the first part of the paper, certain chemical aspects of solidification are considered, i.e., suppression of blowholes, computation of microsegregation on the microstructures of steels in the as-cast and annealed conditions. It is found that blowholes resulting from carbon monoxide evolution in solute-enriched interdendritic liquid can be surpassed by judicious adjustment, oxygen, carbon, silicon and manganese contents of steel, as predicted from theoretical considerations. The metallographic investigations reveal that manganese-sulphide inclusions form in solute-enriched liquid in the interdendritic spaces during the last stages of freezing. The sulphide inclusions, thus delineating the rims of dendrite arms, also act as nuclei or the precipitation of the ferrite phase during decomposition of austenite. Furthermore, the network of sulphide inclusions is found to influence the grain size during re-austenitizing. In the last section of the paper, the relation of cast structure to the banding in wrought steel is shown to originate from the interdendritic microsegregation occurring during solidification.

Welder Controllers

Square D Co.'s "Norpak" load distribution welder controllers help eliminate some of the special problems resistance welding loads present with regard to electrical power systems.

Heavy currents for short lengths of time can cause drastic reduction in line voltage, resulting in poor weld quanlity and in light flicker. The controller unit reduces the demand by distributing the load over a longer period of time.

The controllers are offered in flexible designs to meet a broad range of specific application requirements. Any number of ignition contactors can be cascaded, each with its own weld time and heat control.

Austrian Firm Patents Steam Generating System

Waagner-Biro A.G., Vienna, Austria, has been granted a patent (U.S. No. 3,400,518) for a steam generating system which eliminates the use of steam drums in the waste gas cooling apparatus of basic oxygen plants.

In this system, heat is extracted from the gases by passing them through a tubular water duct which channels the heated fluid into an accumulator. A conduit leads directly from the accumulator back to the duct, omitting the steam drum. The initial cost of this waste gas cooling system is lower because it requires less equipment.

The new method also eliminates cold start-ups by maintaining the temperature of the fluid in the duct at a substantially constant level.

High-Speed Grinding Advances

(IAMI – February 1970)

Grinding finished parts from the solid stock is the main goal of high-speed grinding. Increased cutting speed reduces grinding time and improves accuracy.

A surface grinder with wheel speeds up to 120 m/s is a late development. Metal removal rate can be stepped up to 20 times by this machine. The major problem is adequate cooling of the grinding area. High coolant pressure is necessary to penetrate the cushion of air surrounding the rotating wheel.

Why Tools and Dies Fail

(MP – April 1970)

Tool and die breakdowns can rarely be studied with a conventional fracture-mechanics approach or stress-time analysis. Also, the lack of a complete and accurate log of manufacturing and service history thwarts attempts to analyze failures.

A tool's performance depends on six fundamental factors: mechanical design, grade of tool steel, machining procedure, heat treatment, grinding and handling (before and during service). The factors resemble links in a chain; a deficiency in any one can lead to a failure. Each factor requires consideration to insure satisfactory performance.

Rockwell Hardness Testing: The Effect of Tilting the Specimen

(JISI – November 1969)

The effect on the Rockwell C hardness test, of tilting of the specimen has been examined. It has been shown with significant probability that the angle between the axis of the indenter and the normal to the test surface should be less than 1° if the error in hardness number is not to exceed 5%.

Welding Cast Iron to Steel Comes of Age *(F – December 1969)*

Welding cast iron alloys to steel alloys has been difficult due to the formation of a metastable white cast iron in the parent cast iron and a transition zone between the iron and steel. In addition, specific cast iron structures are destroyed by fusion welding techniques due to the formation of a liquid phase and its subsequent, rapid, metastable solidification and cooling.

Hydrodynamic welding (HDW) is a new joining process using sequential heating and pressuring. This report describes metallurgical features of three typical HDW joints: gray iron to steel, malleable iron to steel and nodular iron to steel. In all three, optimum metallurgical joints were produced, and minimum or no major miscrostructural damage took place in the parent cast iron alloys or in the transition zones.

METAL STATISTICS & ECONOMICS

Table 1
Continental Steel Export
Monthly Price Averages for 1970
(In U.S. $ Per Metric Ton)

	January to March (Average)	April	May	June	July	August
Billets	–	–	–	–	110	–
Reinforcing Rounds (a)	130	129	127	122+	113+	101+
Merchant Bars	130	129	128	124+	119+	112+
Joists, Channels (Brit.)	–	–	–	152	–	–
Channels (US)	–	125	126	–	–	137
Joists, Channels (Cont.)	161	160	159	156	152	–
W.F. (Univ. beams)	140	152	160	156	150	150
Wire Rods	160	155	151	147+	138+	119+
Hot Rolled Strip	132	137	–	–	127	–
Tube Strip	131	130	130	129	128	126
Plates: 4.76 mm. and up (c)	156	151	150	–	133	130+
Plates: 34.75 mm	153	150	146	–	133	130+
Universal Plates	153	–	–	–	137+	132
Chequer Plates	159	155	150	146+	138+	132+
HR Sheets: 16 g. and up	159	159	159	147	140	136
HR Coil (dry)	–	–	–	–	156	–
CR Sheets: 17-20 g.	166	165	164	159+	158+	148+
Galv. Coils: 17-20 g. (b)	171*(d)	171*(d)	171*(d)	171*(d)	171*(d)	171*(d)
Bright Wire	–	–	145	144	144	139
Galv. Wire: 5-16 1/2 g.	–	175	160	160	158	152
Black Annealed Wire	156	160	160	157	154	149
Barbed Wire	–	–	–	–	–	175
Wire Nails	–	–	–	–	–	

Source: Metal Bulletin

+2 1/2% exporters' commission incl. *less $5; Corrugated extra $2; flat sheets $3.

(a) Usual deformed bar premiums; structural $2, intermediate $3

(b) 4-ton coil

(c) $136-$138 for over 8 mm.

(d) $5 now minimum rebate

MB'S appraisal Continental (ECSC) mills' basis (net unless stated) FOB export prices, ordinary Thomas commercial quality. Markets, sizes, quantitites, delivery, etc. can affect prices shown.

Table 2
JAPAN EXPORT QUOTATION
Iron and Steel Products
(In U.S. $ Per M.T., F.O.B. Japan)

	April Ave.	May Ave.	June Ave.	July Ave.	Aug. Ave.
Plain Round Bars 3/8"	135	140	140	140	140
JIS G – 3101 1/2"	130	135	135	135	135
5/8" - 1"	130	135	135	135	135
Wire Rods					
JIS G – 3501 5.5 m/m	130	130	130	130	130
Equal Angles 3 x 25 x 25 m/m	137	135	135	135	135
JIS G – 3101 6 x 75 x 75 m/m	137	135	135	135	135
Channels					
JIS G – 3101 6 x 65 x 125 m/m	150	150	150	150	150
Joists					
JIS G – 3101 7 x 100 x 200 m/m	145	145	145	145	145
Plates					
JIS G – 3101 1/8" x 4' x 8'	–	–	–	–	–
1/4" x 4' x 8'	–	–	–	–	–
1/2" – 3/4' x 5' x 10'	130	130	130	130	130
Hot Rolled Sheets					
USG 16 (1.6 m/m) x 3' x 6'	135	135	135	135	135
JIS G – 3131, SPH Unpickled, uncoiled					
Cold Rolled Sheets, Qty (Pickled, Oiled)					
JIS G – 3310, SPC – 1 U.S.G.					
18 x 3' x 6'	155	155	155	155	155
Standard Pipes (Black P.E.)					
ASTM A–120 2"	140	140	140	140	140
Plain &/or Corr. Galvanized Iron Sheets					
JIS G – 3302 U.S.G. 26 x 3' x 6'	169	170	170	170	170
Galvanized Iron Wire					
B.W.G. No. 8	166	167	167	167	167
inplates					
Electrolytic (107 lbs.)	213	220	220	220	220
Hot Dipped (107 lbs.)	237	245	245	245	245
Common Nail (Bright) (per 100 lbs.)					
20D-50D	6.70	6.70	6.70	6.70	6.70
Hot Rolled Steel Hoop					
JIS G – 3308 0.4-1.2 m/m x 1/2"-1"	180	180	180	180	180

Source: Japan Metal Bulletin

Table 3
Japan Export Quotation
Non-Ferrous Metal Products
(In U.S. $ Per M.T., F.O.B. Japan)

	April Ave.	May Ave.	June Ave.	July Ave.	Aug. Ave.
Copper Wires 1 m/m	1588	1590	1650	1900	1900
Copper Rods 25 m/m	1730	1750	1750	1761	1772
Copper Tubes 40 x 4 m/m, 50 x 5 m/m	2030	2055	2055	2068	2080
Copper Strip 150 x 2.0 m/m	1977	1977	1977	1988	1998
Brass Rods 25 m/m	1205	1278	1278	1284	1290
Brass Sheets SWG 16 14 x 48"	1335	1389	1389	1397	1404
Brass Wire SWG No. 6 – No. 13	1396	1400	1400	1408	1416
Brass Tubes No. 23 – No. 24	1722	1722	1722	1731	1739
Brass Strip 150 x 2.0 m/m	1406	1417	1417	1425	1433
Brass Flat Wires 0.035" x 0.16"	1466	1444	1444	1452	1460
Bare Electric Wire of Copper 6 m/m	–	–	–	–	–
Aluminum Plain Sheet 2S SWG No. 19	667	667	667	667	667
Aluminum Corr. Sheets USG No. 32	681	681	681	739	750
Aluminum Circles 2S SWG 19 x 7" – 25" dia.	707	722	722	722	722
Aluminum Wire 52S 6 m/m	701	708	708	708	708
Aluminum Rods 25 m/m	955	955	955	955	955

Source: Japan Metal Bulletin

Table 4
FOREIGN DOMESTIC PRICES
For the month of July

	U.S.	U.K.	JAPAN	BELGIUM	FRANCE	W. GERMANY	ITALY	CANADA
Non Ferrous Metals, cents/kg								
Copper, electrolytic	132.55	136.60	140.80	121.42	135.80	137.98	150.00	118.00
Lead, common	33.77	30.16	35.50		31.30	31.42	34.40	35.20
Zinc	34.10	29.70	33.00		31.80	32.24	34.90	33.66
Tin	361.90	348.13	382.20	315.80	363.40	362.84	409.50	–
Mercury, $/flask	425.00	–	–		–	–	–	–
Aluminum, ingot	63.80	63.80	61.10		67.90	62.84	61.40	63.80
Nickel, cathode	281.60	288.00	527.70		265.70	–	341.20	286.00
Steel Products, $/MT								
Billets, rerolling	116.60	106.32	–				119.00	97.97
Billets, forging	138.05	122.64	–				123.80	
Wire rods	168.30	127.32	125.25					148.50
Skelps	–		–	168.00	156.75			
Shapes, standard	151.80	130.56	115.78					139.70
Shapes, wide flange	151.80		141.67					139.70
Sheet piling	–	132.20	–		136.90	146.20		
Plates	150.70	137.28	112.88	164.00	147.90	154.40	134.90	128.70
Reinforcing rounds	129.80		131.90				134.90	124.30
Merchant bars	–		–	140.00	118.20	123.00		
Bars, cold finished	212.30		–					
Sheets, hot rolled	166.10	121.44	116.00		141.40		150.80	122.10
Sheets, cold rolled	196.90	150.48	155.00	164.00	152.40	165.30		155.10
Strips, hot rolled	160.60	134.52	–					
Strips, cold rolled	212.30	177.12	–					
GI Sheets	187.00	183.60	170.00		189.20		198.41	154.00
Black plates	121.00	23.43*	116.67	50.00xx	42.90xx	50.54xx	47.50xx	
Tinplates, electrolytic	8.85***	25.22*	227.50					
Tinplates, hot-dipped	–	31.56*	250.00					
Pig Iron, basic	68.50		–	61.00				
Pig Iron, foundry	69.00		–	64.40	71.53	85.50	73.00	
Steel scrap	41.37		47.50		–	–		

Source: Japan Metal Bulletin
CECA Publication
American Metal Market

* per S.A.T.
xx per $100 m^2$
*** per base box

Table 5
Comparison of Home Steel Prices
Source: British Steel Corp.
(Long tons delivered; tinplate ex. works per s.a.t.)

	Exchange Rate to £		Billets (RR Tested 4") 100 tons £	Plates (basis quality 6' x 3' x 3/8") 50 tons £	Plates (Structural 20' x 5' x 1/2") 25 tons £	Plates (ship Lloyds D 20' x 6' x 1") 10 tons £	Plates (boiler (20' x 6' 3" x 3/8") 10 tons £
UK	–		39.90	56.85	53.35	60.50	59.40
USA	$	2.40	–	76.35	72.60	–	80.10
W. Germany+*	DM	8.784	46.40	70.15	69.00	82.30	82.30
Belgium+	BFrs	120	51.10	66.55	77.55	82.00	79.90
France	Frs	13.330	44.60	63.35	70.20	84.30	80.50
Luxembourg+	BFrs	120	39.15	70.05	70.95	–	–
Italy+	Lire	1,500	42.80	67.45	67.10	74.20	74.20
Netherlands+	Fl.	8.688	–	61.50	63.80	75.75	76.45

	Exchange Rate to £		Reinforcing rounds (20 mm dia.) 50 tons £	RR (flats basis 3" x 3/4") 25 tons £	RR (angles basis 2" x 2" x 1/4") 50 tons £	Wire rods (soft basic 6.5 mm) 25 tons £	HR (strip basis 12" x 0.118") 50 tons £
UK	–		53.05	53.15	53.85	53.05	57.75
USA	$	2.40	–	78.45	80.30	80.90	75.40
W. Germany+*	DM	8.784	55.50	59.55	59.00	56.85	57.65
Belgium+	BFrs	120	62.30	64.00	63.40	61.05	63.65
France+	Frs	13.330	51.80	59.35	58.75	54.65	57.90
Luxembourg+	BFrs	120	60.75	63.55	62.75	55.25	58.10
Italy+	Lire	1,500	55.25	56.60	57.30	55.90	58.30
Netherlands+	Fl.	8.688	54.60	—	—	62.65	62.30

Based on published home prices on August 1, 1970. +Turnover taxes, etc. not included; e.g. W. Germany 11%, Belgium 7%, France 23%, Luxembourg 8%, Italy 4%, Netherlands 12%. *W. Germany: Temporary rebate for structural plates and CR coil-GP taken into consideration. RR = re-rolled; GP = general purpose; EDD = extra deep drawing.

Comparison of Home Steel Prices
Source: British Steel Corp.
(Long tons delivered; tinplate ex. works per s.a.t.)

	Heavy angles (5" x 5" x 1/2") 25 tons £	Channels structural (6" x 3") 10 tons £	Broad flange beams & structural (24" x 9") 25 tons £	RR rounds (1" dia.) 25 tons £
UK	52.75	51.15	50.90	51.30
USA	74.95	78.20	72.60	77.50
W. Germany+*	58.40	–	–	56.70
Belgium+	64.85	75.50	–	64.90
France+	58.65	62.15	69.15	57.15
Luxembourg+	62.70	71.20	–	61.45
Italy+	58.65	62.85	70.30	55.90
Netherlands	–	–	–	61.15

	HR coil basis (3" x 0.099") 50 tons £	CR coil basis (3' x 0.0785") 100 tons £	CR coil EDD 4" x 0.039") 50 tons £	HD tinplate (28" x 20" x 0.0118") 25 tons £	Electro tinplate (8 oz. 29" x 23" x 0.0099") 50 tons £
UK	53.90	61.25	67.55	14.754	11.913
USA	66.55	88.50	89.90	19.731	14.150
W. Germany+*	57.10	69.25	79.10	17.700	13.532
Belgium+	58.60	76.10	79.05	17.608	14.321
France	59.50	72.50	75.35	16.069	12.051
Luxembourg+	–	73.60	76.55	–	–
Italy+	56.60	71.50	79.65	15.743	13.583
Netherlands+	49.70	66.50	80.25	15.914	12.369

Table 6
JAPAN MONTHLY AVERAGE DOMESTIC QUOTATION
(In US $ Per M.T. Unless Otherwise Indicated)
For 1970

	April Ave.	May Ave.	June Ave.	July Ave.	August Ave.
Iron and Steel Products					
Round Bars (Reinforcing)					
9 m/m	151.98	141.89	118.63	127.65	148.76
19 m/m	146.22	137.93	116.55	131.19	138.26
Flat Bars 6 x 50 m/m	153.76	145.60	131.59	136.11	136.11
Equal Angles 3 x 25 m/m	159.91	149.76	138.30	147.47	166.66
6 x 50 m/m	134.72	125.69	110.64	115.78	122.22
9 x 75 m/m	134.72	125.69	110.64	115.78	122.06
Channels 5 x 50 x 100 m/m	165.47	153.00	139.11	141.67	147.22
9 x 90 x 250 m/m	153.96	145.25	135.53	138.13	143.88
Joists 7 x 100 x 200 m/m	174.60	160.64	154.39	158.33	161.11
H Shapes 9/14 x 250 x 250 m/m	130.55	127.20	127.89	135.73	138.88
Black Sheets (HR) (3' x 6') Plate Rolled					
1.6 m/m	126.58	124.07	119.44	116.67	117.28
Cold Rolled Sheets (3' x 6')					
1.0m/m	142.26	141.20	138.88	137.50	137.18
Plates 3.2 m/m x 4' x 8'	123.21	120.60	116.55	112.88	121.66
6 m/m x 4' x 8'	123.80	120.60	116.55	112.88	121.66
Tinplates (Electroplating)					
0.257 m/m	277.50	277.50	227.50	227.50	277.50
Wire Rods 5.5 m/m	148.80	139.35	131.48	125.25	125.00
Plain Galvanized Iron Sheets (Per Sheet)					
U.S.G. 0.4 m/m 3' x 6'	0.93	0.93	0.89	0.96	0.93
0.27 m/m 3' x 6'	0.65	0.65	0.62	0.62	0.62
Corrugated G.I. Sheets (Per Sheet)					
0.25 m/m 2.5' x 6'	0.55	0.54	0.55	0.62	0.65
Stainless Steel Sheets (SHS 27)					
18-8 0.3 m/m	1,305.55	1,305.55	1,305.55	1,305.55	1,305.55
Iron Wire B.W.G. no. 8	158.13	148.03	137.61	139.90	141.66
Barbed Wire B.W.G. no. 14	235.31	227.77	222.91	225.00	225.00
Common Wirenail 4"	163.88	162.96	154.86	154.80	155.55
Wire Nettings (per 910 m/m x 30 m)					
Galvanized B.W.G. 10 x 15 mesh	5.27	5.27	5.30	5.56	5.55
Green Enameld B.W.G.					
33 x 14 mesh	12.50	12.50	12.50	12.50	12.50
Steel Scrap (Special Grade)	61.90	57.05	48.28	47.50	47.86
Pig Iron Scrap	76.38	76.38	76.38	76.38	76.38
Non-Ferrous Metals					
Electrolytic Copper	1,661.00	1,625.00	1,486.00	1,408.00	1,325.00
Electrolytic Zinc	325.00	327.00	330.00	330.00	330.00
Electrolytic Lead	366.00	363.00	355.00	355.00	350.00
Primary Tin	3,913.00	3,908.00	3,827.00	3,882.00	3,778.00
Antimony	7,180.00	6,850.00	6,155.00	6,161.00	5,278.00
Nickel	6,111.00	5,391.00	5,277.00	5,277.00	5,153.00
Copper:					
Sheets 2 m/m x 365 x 1200	2,033.00	2,047.00	1,997.00	1,933.00	1,825.00
Tubes 40 x 4 m/m	2,094.00	2,097.00	2,063.00	2,002.00	1,947.00
Rods 25 m/m	2,050.00	2,055.00	2,008.00	1,938.00	1,861.00
Wire 0.9 m/m	2,000.00	2,005.00	1,952.00	1,911.00	1,828.00
Brass:					
Sheets 2 m/m	1,469.00	1,477.00	1,427.00	1,372.00	1,275.00
Tubes 40 x 4 m/m	1,719.00	1,722.00	1,700.00	1,661.00	1,597.00
Rods 25 m/m	1,316.00	1,291.00	1,222.00	1,191.00	1,147.00
Wire 6 m/m	1,494.00	1,491.00	1,436.00	1,447.00	1,314.00
Aluminum Sheets 1 m/m x 400					
x 1200	819.00	819.00	819.00	819.00	819.00
Mercury	13,888.00	13,888.00	12,336.00	13,661.00	13,055.00
Primary Aluminum	625.00	625.00	608.00	611.00	611.00
Secondary Aluminum	536.00	536.00	527.00	530.00	531.00

Source: Japan Metal Bulletin

Table 7
DOMESTIC RETAIL PRICES OF SELECTED STEEL PRODUCTS
Source: Bureau of Commerce
January to August, 1970

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST
Galvanized Iron Roofing Sheet, per sheet:								
Local – Gauge No. 26 – Apo & River Brand								
32" x 6' Corrugated	7.80	7.80	9.00	9.42	8.65	8.40	8.40	8.00
7' Corrugated	9.10	9.10	10.50	11.00	10.10	9.80	9.80	9.25
8' Corrugated	10.40	10.40	12.00	12.55	11.50	11.20	11.20	10.50
9' Corrugated	11.70	11.70	13.50	14.15	12.94	12.60	12.60	11.75
10' Corrugated	13.00	13.00	15.00	15.70	14.38	14.00	14.60	13.00
36" x 8' Plain	10.40	10.40	12.00	12.56	11.50	11.20	11.20	10.50
Gauge No. 31 – Apo & River Brand								
32" x 6' Corrugated	6.00	6.00	7.60	7.85	6.85	6.60	6.60	6.50
7' Corrugated	7.00	7.00	8.90	9.00	7.70	7.70	7.70	7.50
8' Corrugated	8.00	8.00	10.15	10.50	9.10	8.80	8.80	8.50
9' Corrugated	9.00	9.00	11.40	11.80	10.25	9.90	9.90	9.50
10' Corrugated	10.00	10.00	12.70	13.10	11.40	11.00	11.00	10.50
36" x 8' Plain	8.00	8.00	10.15	10.50	9.10	8.80	8.80	8.50
Gauge No. 26 – Union Brand								
6' Corrugated	7.80	7.90	9.00	–	–	–	–	–
7' Corrugated	9.10	9.10	10.50	–	–	–	–	–
8' Corrugated	10.40	10.40	12.00	–	–	–	–	–
9' Corrugated	11.70	11.70	13.50	–	–	–	–	–
10' Corrugated	13.00	13.00	15.00	–	–	–	–	–
Aluminum Sheet, per sheet								
Gauge No. –								
.016 x 33" x 8'	12.00	12.00	13.00	15.30	16.50	16.50	16.50	16.50
.019 x 36" x 8'	14.00	14.00	16.55	18.22	21.15	22.00	22.00	22.00
.024 x 36" x 8'	18.00	18.00	19.75	22.00	23.45	27.00	27.00	27.00
.027 x 36" x 8'	21.00	21.00	22.60	24.80	31.25	30.50	30.50	30.50
.032 x 36" x 8'	24.50	24.50	28.80	34.60	38.25	38.50	38.50	38.50
Square Bars								
3/8" x 3/8" x 20'	3.00	3.00	3.70	4.00	4.40	4.50	4.50	4.50
1/2" x 1/2" x 20'	6.30	6.30	7.20	7.70	7.45	8.40	8.40	8.40
5/8" x 5/8" x 20'	9.55	9.55	11.50	12.50	14.15	13.70	13.70	13.70
1" x 1" x 20'	32.25	32.25	34.10	35.00	40.25	42.00	42.00	41.00
Round Bars								
1/4" x 20' (5 mm)	1.20	1.20	1.85	2.20	2.20	2.20	2.20	2.00
3/8" x 20' (9 mm)	1.95	1.95	2.80	3.20	3.05	3.00	3.00	2.50
1/2" x 20' (11 mm)	3.45	3.45	4.60	5.20	4.68	4.50	4.50	4.50
5/8" x 20' (14 mm)	6.00	6.00	7.05	7.60	8.65	9.00	9.00	9.00
Flat Bars								
1/8" x 3/8" x 20'	1.65	1.65	2.15	2.40	–	–	–	2.60
3/16" x 1/2" x 20'	3.00	3.00	3.65	4.00	4.60	4.80	4.80	4.00
1/4" x 1/2" x 20'	4.80	4.80	5.85	6.40	5.35	5.00	5.00	5.50
1/2" x 1" x 20'	14.25	14.25	17.40	19.00	18.63	18.50	18.50	18.50
1/2" x 1 1/2" x 20'	18.75	18.75	22.90	25.00	25.30	25.40	25.40	25.40
Angle Bars								
1/8" x 3/4" x 20'	6.00	6.00	7.35	8.00	6.50	6.00	6.00	6.00
1/8" x 1" x 20'	6.80	6.80	8.40	9.20	9.05	9.00	9.00	9.00
3/16" x 1" x 20'	10.50	10.50	12.83	14.00	13.40	13.20	13.20	13.20
1/4" x 1" x 20'	15.00	15.00	18.35	20.00	18.20	17.60	17.60	17.60
Galvanized Iron Pipe								
1/2" x 20'	10.60	10.60	11.05	11.30	12.20	12.50	12.50	11.50
3/4" x 20'	15.00	15.00	15.40	15.00	17.40	18.00	18.00	16.00
1" x 20'	20.00	20.00	20.90	21.35	23.34	24.00	24.00	22.00
1 1/2" x 20'	34.50	34.50	35.35	35.80	38.95	40.00	40.00	37.20
2" x 20'	43.00	43.00	44.80	45.70	47.90	48.60	48.60	47.30

Black Iron Pipe, a piece								
1/4" x 20'	9.00	9.00	9.35	9.50	–	–	–	–
1/2" x 20'	9.50	9.50	10.15	10.50	10.90	11.00	11.00	9.80
1" x 20'	18.00	18.00	18.70	19.00	19.75	20.00	20.00	18.70
1 1/2" x 20'	31.40	31.40	32.15	32.50	34.40	35.00	35.00	31.60
2" x 20'	38.70	38.70	39.40	39.70	44.45	46.00	46.00	40.20
Barbed Wire, per roll, local								
70 lbs.	52.00	52.00	52.00	67.00	67.00	67.00	67.50	67.50
60 lbs.	42.50	43.00	46.00	62.50	62.50	62.50	62.50	62.50
35 lbs.	37.50	37.50	37.56	34.00	34.00	34.00	34.00	34.00
Machine Bolts, with nuts, per kilo								
All sizes	2.40	2.40	2.40	2.50	2.40	2.50	2.50	2.50
Common Wire Nails, per kilo								
1" – 1 1/2"	1.80	1.80	2.20	2.40	2.10	2.00	2.00	2.00
2" – 2 1/2"	1.65	1.65	2.00	2.20	1.90	1.80	1.80	1.80
3" – up	1.55	1.55	1.85	2.20	1.78	1.70	1.70	1.70

(Continued from page 56)

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54. Mechanical Engineering
55. Metal Finishing
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58. Philosophical Magazine
59. The Wang Laboratories Programmer
60. The International Journal of Metals Producing
61. The Review of Scientific Instruments

PERIODICALS

1. Japan Metal Bullein
2. Business Day
3. American Metal Market
4. Manila Daily Bulletin
5. Manila Chronicle

MAPS

1. Mineral Distribution Map of the Philippines Ceramic & Refractory Minerals.
2. Mineral Distribution Map of the Philippines Chemical and Fertilizer Minerals.
3. Mineral Distribution Map of the Philippines Industrial Minerals.
4. Mineral Distribution Map of the Philippines Base Metals.
5. Mineral Distribution Map of the Philippines Iron & Ferro-Alloy Metals.
6. Mineral Distribution Map of the Philippines Precious and Rare Metals.

TABLE 1

TOTAL WORLD NICKEL CONSUMPTION, PRODUCTION (Millions of Pounds)

1959	450	475
1960	500	550
1961	525	600
1962	475	570
1963	550	525
1964	680	585
1965	775	690
1966	845	625
1967	815	700
1968	850	795
1969	840	780
1970	899	1,015
1971	962 *	1,140 *
1972	1,029	1,250
1973	1,101	1,380
1974	1,178	1,700
1975	1,260	2,100
1976	1,346	2,200

* DATA FOR 1971-1976 ARE PROJECTIONS

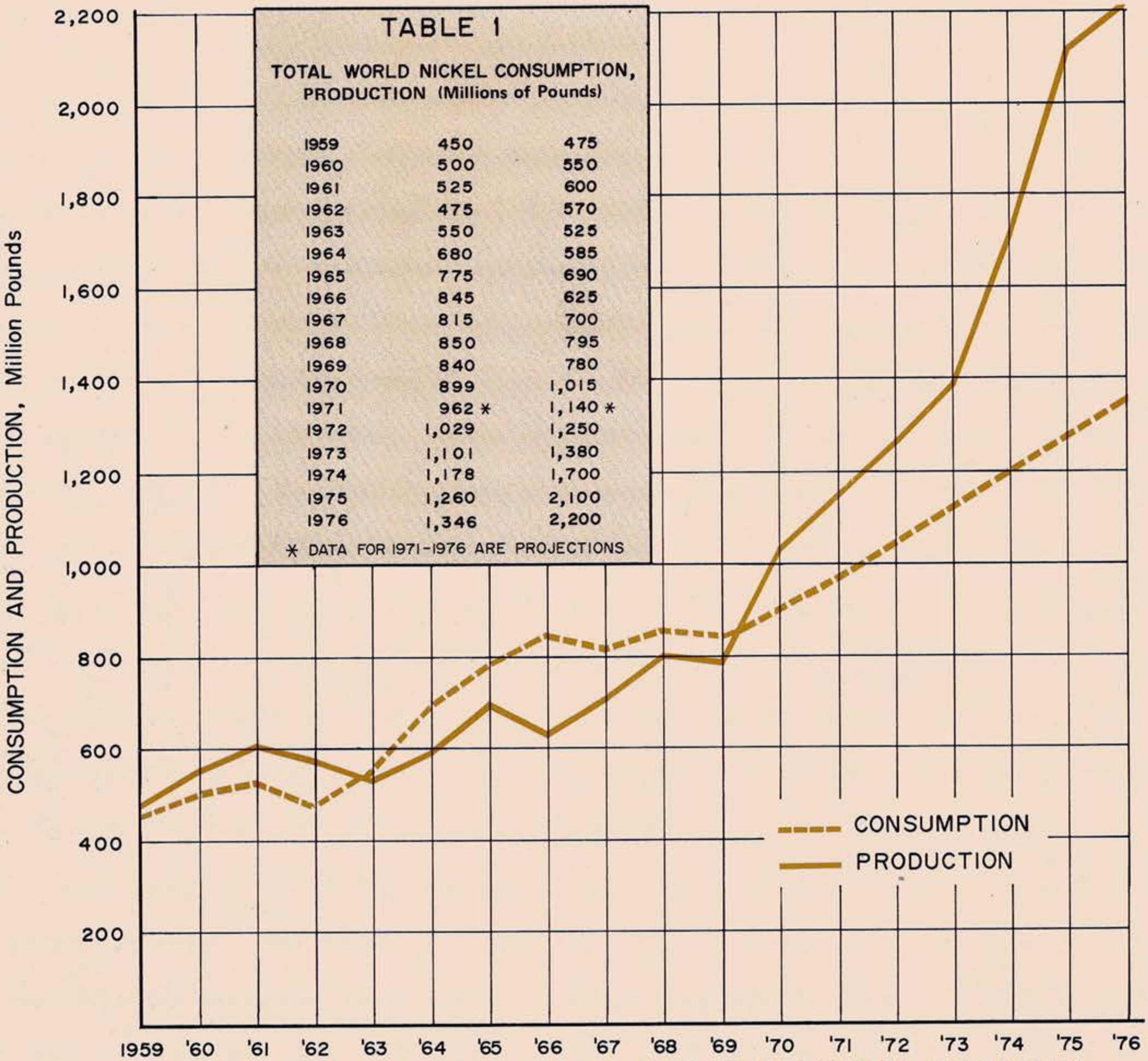

FIG.1 TOTAL WORLD CONSUMPTION & PRODUCTION OF NICKEL

THE WORLD MARKET SITUATION OF NICKEL

Table 2
ACTUAL (1969) AND PROJECTED
PRODUCTION (1975) OF
NICKEL BY COUNTRY
(thousand pounds)

Country	Production	
	Actual 1969	Projected 1975
Australia	22,050	103,000
Botswana		29,200
Brazil	2,200	6,800
Canada	459,900	791,300
Columbia		40,000
Dominican Republic		63,400
Finland	7,400	7,400
Germany	7,700	7,700
Greece	9,000	10,000
Guatemala		60,000
Indonesia		120,000
Japan	122,900	145,000
Morocco	1,000	1,000
New Caledonia	85,000	550,000
Philippines		75,000
Rhodesia	13,500	24,300
South Africa	9,700	13,700
United States	28,250	30,000
Venezuela		22,000
Total Free World Production	**768,600**	**2,099,800**
Cuba	81,000	90,000
Russia	240,000	250,000
Yugoslavia		7,000
Total Communist Production	**321,000**	**347,000**
Total World Production	1,089,600	2,446,800

Introduction

Nickel has become a vital raw material because it is so well suited to the extreme demands of today's high technology industries and, more basically, because its end uses are so broad and so diversified.

Nuclear energy systems are major nickel consumers. In nuclear power, about 1,300 pounds of nickel are required per megawatt of capacity. Likewise, the petroleum industry uses about 80 million pounds of nickel a year. Nickel stainless steel, because of its cleanability and resistance to corrosion, is increasingly gaining use in containers for transporting acids, chemicals, milk and other food products.

The metal's most rapidly growing use is as key ingredient in the production of alloys from which advanced machines are made, from jet engines to aerospace hardware. In Nickel-Cadmium long-life batteries, in fuel cells, gas turbines, nuclear-power plants, water desalination and in cryogenic applications where liquids are stored and carried at extremely low temperatures, nickel is virtually irreplaceable.

These are few of nickel's applications in the growth markets of the seventies and beyond. Its basic properties give it key advantages in serving increasingly demanding and sophisticated needs.

Market

Markets for nickel can be described in two ways: first, according to types of materials in which nickel is consumed and second, by the types of industrial products utilizing nickel-containing materials.

It is possible that nickel may not share fully in the growth of some traditional markets. The changes in the price relationships of nickel materials against competitive materials can have both short and long term effects in consumer and automotive markets. Changes on taste can affect appearance markets no matter what the price situation may be.

In the next few years, there will be significant changes in the pattern of end use markets with strong and continued growth in the applications. Other markets that are more easily upset by price dislocations or styling changes may experience a lower rate of growth.

A. Supply and Demand

Table I and figure 1 shows the total world consumption and production of nickel with projections for 1970 to 1976.

An upsurge in nickel use in the early sixties caught the producers by surprise in 1966. But a vast program of investment in new mines could end the shortage by the mid-seventies, when capacity will exceed demand projected at a long-term annual growth rate of 7% (which is about the historical average).

B. World Reserves

The world nickel ore reserves exceed 75 million tons of metal based on a 0.4 to 4% nickel content. The minerals are located mainly in New Caledonia, Canada, Cuba, Philippines, Indonesia, Central America, Australia and South Africa. Deposits in the U.S. are small. At present, two-thirds of the free world's supply of nickel originates from Canada. International Nickel Company of Canada (INCO) has been most fortunate to be operating sulphide ore bodies in Canada particularly in the Sudbury and Thompson areas which have sustained substantial market growth for many years.

Although these reserves have been increasing each year, there is growing dependence on steadily decreasing grades of ore each year in order to permit the full use of these reserves. This has placed a steady burden upon costs. In addition to increased direct production costs, there is the added cost due to large capital expenditures needed to handle the increased tonnage of ore just to produce the same amount of nickel.

To date, 80% of the world nickel production has come from sulphide ores and 20% from lateritic or oxide ores. Of the known world nickel ore reserves, the ratio is the other way around, 80% lateritic and 20% sulphide.

Price

The price of nickel was held at 35 cents per pound from about 1929 to 1939. Then it started to move up: 94 cents in 1967 and then to $1.28 following a 35% wage boost over the period of 3 years in Canada. Nickel prices have been quite steady at periods compared with the fluctuating chrome prices. Theoretically, the nickel price would list $1.50 in a few years, unless industrial production falls.

Problems

The unforeseen rapid growth in nickel demand in 1963 (see Table 2), the disruption in potential Cuban output and strikes in 1966 and 1969 were the major causes for the present nickel shortage. Another factor has been the underestimation of the difficulties in both sustaining existing production levels and also increasing them against the steadily declining ore grades. These difficulties were due to a number of factors including shortage of labor, forcing the nickel producers to ration their output even while operating their mines at full capacity.

Plans

To solve these problems, major producers embarked on an unprecedented investment program to increase capacity. International Nickel Co. of Canada, Ltd., Falconbridge Nickel Mines, Ltd. and Societe Le Nickel plan to spend a total of over $2 billion on new mining and refining facilities over the next five years. And they will no longer have the market all to themselves. Aggressive outsiders, including American Metal Climax, Kaiser Aluminum and Chemical and Freeport Sulphur, Western Mining, Marinduque Mining and Industrial Corporation, Chevron, Kaiser and Nickel, Peñarroya Amax, U.S. Steel and a number of Japanese producers have all announced new investments in nickel.

The major producers who will have important roles in these expansion programs are:

A. Laterites

1. Société Le Nickel

It is evident that the major new source of nickel will be the laterite ore bodies in New Caledonia. In this connection, Société Le Nickel has already launched the largest of all projects in the industry. One phase will be production of an additional 66 million pounds by 1971. If the nickel ore responds to the Sherritt-Gordon process (a test is under way), 110 million more pounds of capacity may be added on or about 1975. There is another 88 million-pound project at Poum in the northern part of the island, which is scheduled for start-up in 1972 (if the French Government approves). All told, Le Nickel could be producing 350 million pounds by 1975.

Le Nickel is also allied with a venture formed by American Metal Climax. Société Minière et Métallurgique de Peñarroya S.A. (a French Mining Company that is controlled by Le Nickel) has joined with Amax to form Penamax G.I.E., which will manage a project that will produce 100 million pounds in New Caledonia by 1976.

2. INCO

INCO has also managed to get a foothold in New Caledonia by participating in COFIMPAC, a partnership venture with a consortium of other French interests. INCO owned land in New Caledonia at the turn of the century, but abandoned it to Le Nickel when it found large sulphide deposits in Canada. INCO has pledged to find 61% of the $400 million financing for a 100-million pound project in the southern part of the island and will get half the nickel output. If a feasibility study due last July turns out favorably, the installation will start with completion set for 1974.

INCO has already spent $15 million on the open-pit mine on the northwest shore of the vast lake Izabal. INCO also has a 25,000 square mile concession in Sulawesi, Indonesia where encouraging exploration results suggest a possible 50 million pound operation.

3. AMAX

Around 30 million pounds of nickel a year could come from a mine now planned in Botswana in Southern Africa, in which AMAX has over one quarter interest.

4. Marinduque Mining & Industrial Corporation, a Philippine company, has decided to put up a $190 million project on Nonoc Island by 1972. Parcel II of the Surigao Mineral Reservation which was awarded to Marinduque Mining and Industrial Corporation on July 3, 1968 is now on the second phase of the nickel project designed to earn for the Philippines about $100 million annually. The total ore reserves in Parcel II is about 62 million tons analyzing 1.34% nickel, 0.10% cobalt, and about 37% iron.

Marinduque expects to produce 75 million pounds of nickel yearly from the Nonoc nickel mine and refinery by 1973 at the latest. However, problems over the clearing surface rights in Nonoc Island may delay the progress of the project.

5. Others

Falconbridge recently announced that financing had been arranged for a $190-million project in the Dominican Republic, which is expected to produce 63 million pounds by 1973.

Philippine Surigao Mineral Reservation: As per the study submitted last August 19, 1970 by the Special Committee created by the Surigao Mineral Reservation Board to assess the possibility of offering Parcel I of the Surigao Mineral Reservation for exploitation, exploration work conducted has blocked out 524 million DMT of serpentine ore averaging 47.7% iron and 0.9% nickel; and 194 million DMT of serpentine ore averaging 12.4% iron and 1.15% nickel. The said quantity and grade can support large scale operations for several years. It was recommended that the government offer Parcel I for exploitation to an independent contractor or contractors. So far, no formal invitation for bidding has yet began.

B. Sulphide Ores

Before the current moves to exploit laterites, some important expansions were already under way in sulphide ore mining. INCO has spent some $600 million out of $1.1 billion budgeted to open eight new mines in Canada that will add 150 million pounds to the company's capacity by 1972. By 1971, Falconbridge also expects to lift capacity in Canada to 110 million pounds annually. The ore grade in Canada is declining steadily, however, so that more and more ores must be mined to produce the same amount of nickel.

Sulphide mining may have a bright future in Australia. Although prospecting is still at an early stage in this area, the 1966 find by Western Mining Corp. Ltd. is already in production at Kambalda, Western Australia, at a rate of 24 million pounds annually of nickel concentrate. This will be upped to 65 million pounds by the end of this year. Other findings made recently by Freeport Sulphur and Anaconda (each in separate partnerships with Australian companies) resulted to a full-pledged mining boom in Kalgoorlie.

There are reports that Soviet Russia have major investment plans in nickel production. In Cuba, recent reports suggest that if the government can obtain the necessary financial assistance from Russia or from any country in Europe, their annual capacity will be expanded to 260 million pounds or more (under the Castro regime the present output is 81 million pounds).

If all these plans are carried out, the maximum potential capacity in the free world would rise from 0.8 billion in 1969 to 1.1 billion at the end of 1971, 1.2 in 1972, 2.1 in 1975 and 2.2 in 1976. Projecting this, maximum possible capacity against a consumption growth rate characteristic of the period from 1950 to 1968 indicates that availability may slightly exceed consumption in the period of 1972 to 1976. In the intervening period of 1970 and 1971, unless there is a business recession of some consequence, it appears that nickel will remain in tight supply. Future world growth for nickel use has been placed at about 7 to 9% annual average, depending on availability, prices and world economy.

The 1975 estimate includes every new mine that has been officially announced, with its output projected at maximum capacity. The increases in Russian and Cuban productions may be understated, for recent reports suggest much bigger plans are afoot. The total world production is greater than the most optimistic projects of demand. However, mines rarely operate at full capacity, and the troubles attendant on opening up new sources in underdeveloped regions may delay many projects.

(Continued on page 49)

The Floating Rate & The Foundry Industry

To assess the immediate effects resulting from the adoption of the floating exchange rate in February 1970, the MIDC undertook a survey of the Foundry industry, leading to interviews with six major foundries in the country.

The foundry industry's average production or sales breakdown follows: 70% on iron and steel; 25% on copper-base alloy castings; and 10 % on aluminum-base alloy castings. One firm however has a 95% production of iron and steel castings, its market being concentrated on land transportation. The market share for foundry products by industry classification is as follows: mining — 25%, sugar — 18% and cement — 13%. The remainder is consumed by the following: transportation (for automotive parts), logging and wood processing industries, home appliances, agriculture, textile, office equipment and other allied industries.

After the floating rate, producers generally experienced an increase in demand for foundry products from 100% to as much as 300%. However, some experienced a decrease in demand from 25% to 50%, the rest remaining more or less on the same level as before. This decrease may be attributed to the cheaper repair of the cast products rather than buying replacements which are more expensive. Accordingly, prices of foundry products increased, ranging from 17% to 50%.

The increase in demand in the mining sector came mostly from Lepanto Consolidated, Atlas Consolidated, Inco Mining, Philex Mining Corp., Black Mountain, Marcopper, Marinduque and Benguet Exploration.

Some firms interviewed are expanding their operations by doubling their capacities for 1971 while others are freezing any expansion plan due to the currency instability as well as changing governmental policies.

The floating exchange rate not only resulted in an increase in demand by compulsion, but it also created problems to the industry mainly in the supply of raw materials. Seventy per cent (70%) of the local alloying element requirements are imported. The only locally available ferro-alloy is ferro-silicon, but it is not being produced in quantities sufficient to meet the increased local demand. Pig iron and coke are not readily available, more so with the alloying elements. The only firm manufacturing ferro-alloys expects to supply the local requirements of ferro-manganese, ferro-silicon and silico-manganese starting early 1971.

In general, the prices of raw materials for castings increased from 50% to 100% and sometimes even more as in the case of Malaysian tin which increased from ₱15 to ₱36 per kilo. There is only one local supplier of foundry coke and local foundries complain that the quality of this coke is not consistent.

NEWS BRIEFS

LOCAL

PES, NEC, OEC Merger – The Commission on Reorganization recently proposed for the merger of Presidential Economic Staff (PES), National Economic Council (NEC), and the Office of Economic Coordinator (OEC) by creating the Economic Planning Implementation Commission (EPIC). The proposal is an alternative to the congressional plan to create the National Economic Development Authority (NEDA). These two proposed economic planning bodies are similar in the sense that they will embrace the commercial, investment and planning functions of the government except that EPIC will leave the Board of Investment (BOI) as an independent entity.

Copper Industry Council Created – The copper industry received a big boost recently when President Marcos created a presidential advisory council to plan the development of the industry.

In creating this body, the President has two aims: to forge a closer relationship between the expansion of mining and the processing of ores into blister and refined copper products; and to assess the possibility of the Philippines engaging in direct copper trade in the light of world production and the consumption of copper products.

The council is composed of the chairman of the BOI, secretary of finance, and the director of mines on the part of the government; and the chief executives of the copper producing companies or their authorized representative on the part of the private sector.

Pellets, Pyrites Subject to Export Tax – The Monetary Board ruled that exports of iron ore, pellets and pyrites are subject to export tax. The ruling was made in response to the query made by Pellet Corporation of the Philippines and Atlas Consolidated Mining and Development Corporation. The MIDC, whose definition of pellets was also sought by PCP, defined pellets as "products of agglomeration in which moist, finely divided iron concentrates produced usually by magnetic separation is mixed with a binder, formed into balls (green pellets) and fired or indurated under oxidizing conditions primarily to improve the strength of the balls. The firing also transforms the magnetite to hematite, a higher stage of oxidation of iron." The Bureau of Mines, likewise, said that "pellets are finely ground iron ore concentrate agglomerated with a binder into pellets and heat treated to give sufficient structural stength to resist stresses in the blast furnace." All these definitions together with those definitions by buyers abroad were considered by the Central Bank and classified pellets as iron ore concentrate.

In the case of pyrite, the Central Bank based its classification on a definition handed down by the Bureau of Mines – that pyrites are produced by a process of concentration which would separate the gangue materials from the pyrite and it is by form an ore concentrate.

Chrome Ore Export to Yugoslavia Approved – President Marcos has paved the way for trade relations with the communist countries by approving the proposal to export Philippine ore to Yugoslavia.

The proposal came from the Benguet Consolidated Industries asking government permission to export refractory grade chrome to Yugoslavia which was favorably recommended by the National Economic Council.

The approval of the chrome shipment is held significant because Yugoslavia is among the list of communist countries with which is trade banned under present government policy except on a chamber to chamber basis.

With the relaxation of the government hard-line policy towards the communist countries, it is opined by some quarters that it would not be far when the Philippines will open export trade with these countries.

MMIC $120 Million Loan Ok'd – The Central Bank approved a $120 million foreign loan that the Marinduque Mining and Industrial Corporation intends to get from foreign firms: $60 M from Kobe Steel Ltd. in Japan and another $60 million from the U.S. Export-Import Bank and a syndicate of private U.S. banks.

These loans will be in addition to the $30 million proposal earlier approved bringing the ceiling of MMIC's foreign borrowing to $150 million.

Central Bank Governor Gregorio Licaros disclosed that this is the first foreign borrowing approved following the approval of the Foreign Loan Borrowing Act.

The government is giving special attention to the nickel project because of the expected huge foreign earnings that it could generate, expected to be $97.6 million at current prices, and additional government taxes and royalties.

Marinduque Mining is a publicly-owned corporation duly listed in the Manila and Makati stock exchanges managed by Jesus Cabarrus, a well-known industrialist.

The MMIC Board is composed of the NEC chairman; the secretaries of agriculture, finance and justice; the governor of the Central Bank; and the director of the Bureau of Mines.

Maria Cristina to Produce Ferro-alloys – Maria Cristina Chemical Industries has decided to produce ferrosilicon, ferromanganese and silico-manganese to meet the country's demand. These alloys are widely used as additives to steel and cast iron products.

A worldwide ferrosilicon shortage last year forced many foundries and steel producers to shut down operation and cut production. The country's supply of ferro-alloys comes from Taiwan, Japan, Australia and Europe.

WEI To Produce Malleable Iron – The proposal by the Winning Enterprises, Inc. to produce malleable iron fittings has been approved by the Board of Investments recently. The malleable iron plant will be producing 50 to 100 tons of fittings per month using an induction furnace. This will be the second malleable iron plant, the first being Liberty Manufacturing.

New Heat Treatment Complex Inaugurated – Chemplex Philippines which started as a chemical trading firm in 1968 now puts a new vista to heat treatment here. Situated in a three-hectare plant in Cainta, Rizal, Chemplex has been giving services to the metals industry of the country since mid-September.

With five furnaces (4 electric and one oil-fired), they are ready to give thorough service to the industry. They do carburizing, hardening of high speed steels to 1300°C, hardening of tool steel to 900°C, tempering, marquenching, martempering, tuff-grinding, cyaniding and nitriding.

EEI Installed 15-Ton Heat Treatment Furnace – As part of its long range expansion plans, Engineering Equipment, Incorporated has installed a new 15-ton heat treatment furnace. The furnace will be capable of treating 2,250 tons of castings per year with an increase of 25% capacity over the existing 10-ton furnace. The new furnace can also absorb the recent increase in the foundry's melting capacity.

In acquiring this new furnace, EEI has contributed its share in reducing the country's dollar outflow. It will construct and fabricate all furnace parts which may be done locally.

Heat treated products from the new furnace are expected to be higher in quality because it has features such as an automatic temperature control system, overfiring-underfiring burners' system and high quality structural and refractories.

First RP-Made Loom Introduced by Precision Iron – Precision Iron formally introduced the first locally produced loom to the textile industry recently in collaboration with Mantrade Industries Incorporated. The men directly behind its development are Candido Miguel, a group of managers from Precision and Marcelino Balabbo, a textile engineer.

At the start, there were doubts as to how textile manufacturers would receive the loom, but a sneak preview turned out to be quite impressive. An immediate economic benefit from the Precision loom will be the end of foreign domination in the sale of textile weaving equipment.

Mining Equipment May Be Produced Locally – A mining equipment which a Swedish firm supplies, can be possibly produced locally. This was learned from Robert W. Kneeshaw, managing director of Atlas Copco (Phils.), Inc. He said that the manufacturing plan is "immediate" and follow the government's intention of producing locally major items it imports.

The plan has two phases: the first is the assembly phase which involves local assembly of mining machineries; the second is the manufacturing process wherein those parts that could be locally produced would be put together with parts that are yet to be imported.

Atlas Copco, having a good service department, is starting the first phase of manufacturing these equipment. Their servicemen had undergone training in repair, servicing and maintenance under Swedish experts.

Igri-Kirloskar Industries Inc. Produce Diesel Engines – The Igri-Kirloskar Industries Inc. proposal to produce locally-made diesel engines was approved by the BOI last year. The engines to be produced are Models AV1, AV2, JV1 and JV2. These will have ratings of 6.5 hp, 8 hp, 13 hp and 16 hp, respectively.

Igri-Kirloskar Industries Inc. were supposed to have produced 1800 units for the first year, 1970, and gradually increase its production to 8000 units by 1979.

This is the third diesel engine manufacturing venture approved by the Board of Investments. The first two were Kubota-Marsteel tandem and Warner Barnes for Peter Engines.

India to Expand Business in Asia – K.D.N. Singh, Head of the Indian delegation of the first Investment Promotion Meeting sponsored by UNIDO/ECAFE held in Manila recently, disclosed the expansion of India's business to other Asian countries. However, this does not mean that India wants to spread out its economic tentacles all over Asia.

Singh said that his country only believes that regional economic cooperation is the answer to development. India has already set up 22 joint ventures abroad producing cotton and woolen textiles, light engineering goods, solvent extractions, steel furnitures, asbestos cement products, hardboard, PVC leather cloth, automobile spares and components, sewing machines, razor blades, soaps, etc. Besides these, Singh added, 56 units are being set up in the fields of rubber products, paper and pulp, textiles, airconditioners, pharmaceuticals, enamelware, sugar mill, commercial vehicles, malt house and brewery, aluminum sheet, rolling mill, electric motors and transformers, diesel engines, pumps, radiators, electric fans, etc.

Two UNIDO Experts Conferred with MIDC – Two distinguished visitors were here recently to look into the status of the secondary copper industry.

Mr. K.R. Pompfret of Metra Consulting Group Ltd. of London made a courtesy call on Dr. Antonio Arizabal, MIDC Director, and at the same time inquired on the status of the metals industry particularly on the copper industry's capacities and facilities.

Mr. K. R. Pompfret was subcontracted by the United Nations Industrial Development Organization to make a study on the copper production and market of copper products in Southeast Asia.

Another visitor, Mr. Sidney Kayes, came to Manila as a representative of the Council of the Copper and Brass Information Center. Mr. Kayes is a member of the Building Science Forum of Australia, the Solar Energy Society, Australian Institute of Metals and Australasian Corrosion Association.

Dr. Arizabal, SEAISI's PNC Chairman Bares Institute's Progress – Dr. Antonio V. Arizabal was unanimously chosen Chairman of the Philippine National Committee for the Southeast Asia Iron and Steel Institute (SEAISI) by representatives from the various sectors of the local iron and steel industry. As such he *ex-officio* became a member of the 15-man Board of Directors of SEAISI, an organization of Southeast Asian countries with the primary aim of promoting and undertaking collection, dissemination and maintenance of data and exchange of information and experience among organizations of member countries undertaking research ventures within Asia.

SEAISI has six founding member countries – the Republic of China, Malaysia, Thailand, Singapore, Indonesia and the Philippines – with Japan and Australia as the two supporting countries. Explaining the workings of the organization, Dr. Arizabal, SEAISI's Chairman for the Philippine National Committee said:

"SEAISI proposes to further the development of the iron and steel industry in Southeast Asia through closer cooperation among these countries as well as the neighboring countries with particular emphasis on the scientific and technological aspects.

The SEAISI functions through the establishment of individual nation committees in each member country, hence our Philippine National Committee. Now the Philippine National Committee is administered by a 15-man Board of Directors chosen from the offices of the founding member countries and supporting countries."

After attending the board meeting in Singapore, last October 21-23 last year (preparatory to the formal inauguration of the Institute), Dr. Arizabal disclosed, upon his return, that Singapore, China, Malaysia, Thailand and the Philippines each pledged US$4,000 as their contribution to the Institute for 1971 while Japan and Australia pledged US$50,000 each. Indonesia agreed, in principle, to contribute without specifying the precise amount.

Dr. Arizabal commented that "several iron and steel firms, foundries and other entities in the Philippines engaged in metals production and processing displayed spontaneous interest and cooperation. The interest shown only indicates that our people, more than ever, are very much aware of the importance of vigorous development in metal product through research."

The Metals Industry Development Center has been designated as secretariat for the Philippine National Committee, SEAISI's representative arm in the Philippines.

Foreign Experts Assist MIDC – Six foreign experts, three Swedish and three French, were here recently to assist the Metals Industry Development Center.

The Swedish experts – John W. Bohlin, Harald Sten and Lars Villner – were sent by the United Nations Industrial Development Organization to assess the technological needs of the metals industry in connection with the activities and acquisition of equipment by the MIDC from the United Nations Industrial Development Organization-Special Fund. They reviewed the overall equipment for the foundry shop, machine shop, tool and die shop and instruments for the chemical, physical and metrology laboratories.

The French automotive manufacturing experts – Alain Ray, Maurice Reyne and Claud Sicard – assisted the MIDC staff in undertaking studies on the progressive car manufacturing program, specifically on the following:

1. Assessment of the capabilities and potentials of local foundries, metal working plants and other allied industries for producing automotive parts and components;
2. Identification of the parts and components which may be economically manufactured locally and the preparation of a program for their manufacture;
3. Programming the acquisition and identifying the equipment and machineries necessary for the manufacture of components which cannot be produced with the existing facilities;
4. Identifying the components that may be commonly used by the different brands of cars used in the Philippines; and
5. Detection of potential problems and possible bottlenecks that may hamper the implementation of such a program, determine their causal factors, and make recommendations on the necessary measures to be taken.

MIDC Seminars – The Metals Industry Development Center held two seminars last October.

The first was a seventeen session training seminar on Foundry Technology and Practice which was held at the MIDC Conference Room in Quezon City and featured foundry experts as speakers. Fifteen technical men were awarded with certificates of completion by Prof. Estanislao P. Angeles, Sr., Vice-Chairman of the MIDC Board of Trustees during the awarding ceremony held on December 22,1970 at the D & E Restaurant, Quezon City.

The successful participants are Messrs. Virgilio G. Morando of AG & P; Ruben C. Bartolome, Virgilio T. Garcia, Silvino L. Jacinto and Victor M. Lagman of EEI; Daniel D. Magniza and Teodoro M. Segura of Honiron; Ruben Z. Gomez of IISMI; Herminiano I. Gutierrez of Marsteel Corporation; Reynaldo D. Acuña and Nicomedes A. Bodo of Philparts Mfg. Co.; Florencio B. Antonio and Maximillan M. Marasigan of Precision Iron Mfg. Co.; Joseph Kentzie of Union Steel Mfg. Co.; and Anthony B. Fletcher of Warner Barnes & Co. Ltd.

The second was an information seminar on "The Art and Science of Ferro-Alloy Making" with Mr. Robert Scheid, President of Union Carbide Phil. Inc., and Mr. Cesar Santos, Senior Staff Engineer and Asst. to Executive Vice-President of Maria Cristina Chemical Industries Inc., as lecturers. This was held at the Economic Development Foundation (EDF) Seminar Room, 3rd Floor, JMT Building, Ayala Avenue, Makati, Rizal.

Earlier, MIDC awarded 28 technical men from different sectors of the industry with certificates of completion for finishing the first MIDC seminar, a course on Metal Component Failures, their Causes and Remedies. The awarding ceremony was held at the Sulu Hotel, Quezon City with General Florencio Medina, Chairman of the NSDB and MIDC, awarding.

The successful participants are Messrs. Gregorio Buendia of MMIC; Edgardo Coronel of EEI; Osmundo Escrin of ELISCO; Clemente Follosco, Jr. of Reynolds Philippines; Bienvenido C. Garcia of Pasudeco; Oscar O. Jacob of Reynolds Philippines; Manuel Luis D. Juan of ELISCO; Pablo Ledesma of Fortune Cement; Harry D. Pastores of Honiron; Vicente G. Ramos of I.I.I.; Abraham Ragon of Pasudeco; Nestor Sanoy of EEI; Alfredo Santos of Pasudeco; Eduardo Taclibon of Hooven; Artemio Torres, Jr. of EEI and Catalino Villarama of Union Steel.

MIDC Operations Plan Signed – The plan of operations of the Metals Industry Development Center for the Philippines was signed on December 23, 1970 at the National Economic Council.

Those who signed in the operations plan are: Chairman Gerardo P. Sicat for the National Economic Council, Chairman Florencio M. Medina for the National Science Development Board and William M. Harding for the United Nations Development Programme who also represented the U.N. Industrial Development Organization.

The project, as planned, will serve the needs of the metals industry in the fields of technical advisory services, quality control and management and technical training. In addition, the project will also guide the Government in formulating its policies for the expansion of this sector of the national economy.

The Government will operate the center in cooperation with the UNDP, UNIDO and International Labor Organization (ILO) as the joint participating and executing agencies. The center will be funded by P3,800,000 contribution from the Government and $913,000 from the UNDP for three years.

FOREIGN

UNCTAD Reports Iron Ore Increase – The United Nation Conference on Trade and Development (UNCTAD) reported that world production of iron ore increased 4 percent in 1969 an equivalent of 360 million tons in terms of iron content. In developed nations such as Canada and Sweden, the production of iron ore was greatly reduced because of labor strikes; but in developing countries including the Philippines, a 7 percent increase in iron production was registered.

In the same year, world production of copper rose by 10 percent among the developing countries thereby creating a great demand. Similarly, the prices rose by 18 percent over the 1968 prices.

The production and the prices of lead and zinc also improved in 1969, a 10 percent increase over 1968. The prices of lead and zinc increased by 9 percent and 7 percent, respectively.

The decline in world production of tin in 1969 was noted. This eliminated the surplus gained in two previous years. As a result, world price of tin also increased. The shortage of tin benefited many of the Southeast Asian developing countries.

Mineral Expansion Boom in Australia – Australia is undergoing an expansion in mining. Plans to double production in the 1970's would create a need for qualified and skilled staffers in the fields of exploration, production and marketing. A series of massive discoveries of nickel, bauxite, oil and gas, iron, copper, lead-zinc, rutile and coking coal leads to an unprecedented demands for geologists, engineers, metallurgists, fabrication and sales specialists.

More than 100 new mining companies have been formed in the last 18 months. These include Kaiser Aluminum Chemical, Anaconda, Kennecott, International Nickel, Esso, Consolidated Gold Fields and American Metal Climax, Union Miniere, Penchiney and Swiss Aluminum.

The mining share market boom which followed the big discoveries has eased in line with world markets. However, the physical mining boom in exploration, mining, minerals treatment, fabrication and sales is continuing.

Japanese Firm to Finance Chile Iron Mine – Tokyo – Canadian Foreign Minerals last week sent representatives to Japan to negotiate with Japanese steel firms on their financial participation in developing the Sero Neglo Nolte iron mine in Chile. A Japanese blast furnace steeler signed a contract last November with Canadian Foreign Minerals for imports of pellets and powder ores totalling 81 M tons. The Japanese will deliver an annual schedule of 3 M tons for 20 years beginning in 1973.

The "Sero Neglo" will be capitalized at $80 M. To develop the mine, about $200 M in funds is needed. The Japanese are being asked to bear 35 percent of the total investment. The steelers believe that the quantity of those products will be increased in the future, and Port Caldero in Chile could be expanded to permit the passage of 250,000 ton ore carriers to load the cargoes. *(JMB – September 12, 1970)*

Peruvian Government to Control Output and Price of Copper – Peruvian Minister of Mining, Brigadier General Jorge Fernandez Maldonado, recently stated that the Peruvian government will control production and price of copper in the country. The government is setting up a National Mining Corporation for the purpose. Starting August next year, this entity will control the development, mining and pricing of minerals. To this end, General Maldonado conferred with government leaders and the private sector in Japan with the aim of setting up joint ventures with the Japanese towards the development of Peru's mineral resources. Among the projects would be the setting up of a copper refinery with a capacity of 100,000 tons to be erected in March 1971. The project could be completed in the next two years.

Predict Increase of Gold Price – Paul Jeanty, Director of Bullion Brokers and Merchant Bankers, predicted that within five years, the price of gold could rise to $75.00 an ounce; and during the next ten years, $100 an ounce. Jeanty said that this increase lies on several factors. One is that gold in Europe has traditionally been hoarded as a currency hedge and for political reasons. With the growth of taxation and controls since the war, fiscal evasion has probably become the primary motive of gold hoarders in France and in many other countries. For this reason, Jeanty is inclined to believe that little gold will be discharged even at much higher prices.

Japanese-Australian Firms Slate Papuan Copper Venture – *Tokyo* – (Reuter) Nittetsu Mining Co. has announced a plan for a joint Japan-Australia venture, Laloki Copper Mining Pty. Ltd., to exploit copper in Papua. A spokesman said that the venture would be established by and between Lionel Gross of Melbourne and Nittetsu and Kanematsu-Gosko Ltd. This mine, with an estimated 360,000 tons of copper deposits, covers an area of 20 square miles in Laloki, about 19 miles east of Port Moresby.

Applications will be filed with the governments in Melbourne and Tokyo. Operations are expected to start early in 1972 with an output of 1,000 to 1,500 tons of concentrates monthly. All concentrates will be shipped to Japan.

Copper Firms to Get Enough Supply of Materials – *Japan* – The 8 copper producers of this country are expected to obtain enough supply of materials for their electrolytic copper productions in 1973. Presently, they have a total of 329,440 tons of ore on long term contracts with foreign firms. This will increase to 433,440 tons in 1971, 545,040 tons in 1972 and 753,090 tons in 1973. They will import 93,000 tons of blister copper on long term contracts and 25,000 more tons on the spot copper contracts. These copper producers are eager to develop oversea mines through the financial and technical assistance of foreign mine companies to secure stabilized sources of copper ore in the future. *(JMB – July 21, 1970).*

Prices of Copper, Copper Scraps Lowered by 10,000 Yen – Copper producers have announced a price cut of 10,000 yen per ton of their electrolytic copper and copper scraps. Their new prices per ton are 525,000 and 470,000 yen respectively. These price cuts are due to the bearish tone of their copper at present and also to the lesser demand during the months of July and August. *(JMB – July 14, 1970).*

Siberian Copper Mines Not To Meet Immediate Demand – Mr. Aiso, President of Mitsubishi Metal Mining Co., revealed that the copper, zinc and nickel mines in Siberia are not yet developed to be able to meet the immediate demands for these ores in Japan. A surveying team headed by Mr. Doko, President of Toshiba, toured Siberia and stated that it will take many more years before the mines could be developed. Mr. Aiso concluded that Japan will have to turn to other sources. *(JMB – July 11, 1970,*

Japan Export Talks On Copper Getting Brisk – Negotiations are being held for the export of electrolytic copper to Europe and Southeast Asia. Export contracts amount to 15,000 tons; 12,000 tons of which shall be shipped to Europe and 3,000 tons to Southeast Asia. Shipments are slated for August. Prices of electrolytic copper fluctuates those for Europe are set at LME prices minus 9-15 based on the average price in the month following the shipment of that item, and those for Southeast Asia, at LME prices plus 4. Both are per ton price f.o.b. Japan. *(JMB – July 16, 1970).*

Japanese Import of Copper Ores Reaches 151,393 Tons – According to the Ministry of International Trade & Industry (MITI) Customs Bureau, import arrivals of copper ore in June totalled 151,393 tons; January to June 730,405 tons. The major supply sources are the Philippines with 55,127 tons, Canada 74,380 tons, Haiti 1,005 tons, Peru 12,650 tons. Bolivia 1,720 tons, Chile 1,296 tons, and Australia 4,183 tons. Imports of copper scraps totalled 324 tons, copper alloy 4,133 tons, refined copper 9,449 tons and tin ingot 2,737 tons. *(JMB – July 25, 1970).*

Export Negotiation With Brazil – Tokyo – On and after 1971, Brazil's National Council on Iron and Steel will import all its steel requirements through Mitsubishi Shoji, a Japanese trading firm. Mitsubishi is now preparing for exports estimated to reach a total of 440,000 tons. The items required are 300,000 tons of slabs, bloom and hot rolled coil; 20,000 tons of galvanized sheet; 20,000 tons of tinplates; 50,000 tons of cold rolled sheets and 50,000 tons of shapes. The Brazilian agency is sending its representatives to Japan to conduct talks with the Japanese steel firm.

Nagoya's Blast Furnace Sets World Record – Nagoya – NIPPON Steel Corporation laid its claim on the world record on pig iron production rate per day on November 1 last year. Its no. 3 blast furnace which has an inner volume of 2,924 cubic meters at its Nagoya works produced 9,177 tons of hot metal. This was the same furnace that set a record of 8,534 tons on September 3 with the following operational data:

Coke rate	414 kg/ton
Heavy oil injection .	49 kg/ton
Top pressure	2.2 kg/sq. cm.
Oxygen/hour ...	14,000 cu. meters

(MB – January 5, 1971; JMB – September 8, 1970)

The Outlook for Automation In The Iron And Steel Industry – Automation is not an end in itself but a means for attaining a result which is almost always based upon economics. Some people think that steelworks and industry in general will soon be operating with a staff of only a few men monitoring production processes on television screens. But steelmakers realize that many obstacles will have to be overcome before this vision of the future becomes a reality.

Indeed, people too often confuse the mechanization of the limit functions, the science of servo mechanisms, with the process of automation. The three principal areas to which automation has been applied in this industry are ironmaking, steelmaking and rolling mills. It is to these that this report is confined. *(IAMI – January, 1970)*

Billet Marking Machine – A new type of remotely operated marking machine for billets as small as 4 1/2 inches square has been developed by M. E. Cunningham Co.. Previous standard 9-wheel marking machines of this type could stamp the ends of billets no smaller than 7 3/8 inches wide. The model 1001 is composed of nine remotely-controlled marking wheels, a head and box frame which fit into existing bumpers, a control header and a remotely-positioned control console and relay cabinet.

Designed for stamping aluminum billets with installation in an existing bumper at the end of a runout table, the machine can also be used for stamping steel billets, as well as other non-ferrous metals. The mark itself is made when the billet moving on the runout table makes impact with the marking head. As contact is made, a lever is actuated automatically to move the billet back from the marking wheels so it can be moved along a transfer table.

Marking wheels are changed as desired by push buttons at the control panel, the buttons actuating stainless steel push-pull cables which move the individual wheels. Wheels are interlocked in position through a slide mechanism, an escapement device allowing them to move only one step at a time. The actual head containing the marking wheels and cable slide mechanisms is positioned in a steel box frame which fits into the face of the bumper. Design allows for 5 degree-head swivel to either side to compensate for off-square billets or those which are delivered crooked.

The special spring-type centering device returns the head to square position after impact.

U.S.A. to Get Large Gas-Pipe – *Tokyo* – Nippon Kokan has concluded a contract with Chrispin Co., for export of 10,000 tons of 36-inch gas pipes. This voluminous product valued at $2 M will be delivered in the first half period of next year. The Chrispin Co. is specialized in the construction of pipelines. The large amount of 36-inch pipes will be used in construction of gas pipe lines projected in the city of Texas, USA. *(JMB – September 24, 1970)*

Sees Growth For Ferroalloys – The Ferroalloys Division of Union Carbide Corporation has expressed confidence in the future growth of ferroalloys. Mr. Kroft, President of the Division, disclosed the necessity of higher prices to get the profits that will keep the ferroalloy industry healthy. He observed that in the past, the industry had a basic flaw in operating policy; keeping the furnaces at a steady rate of full capacity production. This was pursued regardless of demand. Mr. Kroft also noted that there is now a strong demand for chromium products. This was attributed to a catch-up situation that resulted from forced cuts in the production of alloy steel. *(AMM – May 15, 1970)*

Tekkosha To Double Manganese Output – *Tokyo* – Tekkosha is speeding up construction works of metallic manganese plants at its Hyuga works to meet the demands from both domestic and foreign consumption. Expected to be finished early next year, the manganese plant will produce 500 tons more of its present 500 tons production or a total output of 1,000 tons a month. After supplying the demands at home, Tekkosha will offer the product to customers in Europe and USA who are eagerly asking for that metal.

Production Of Metallic Chrome Up To 150 Tons – Tekkosha, the sole producer of metallic chrome in Japan is increasing its monthly production of the metal from 120 to 150 tons starting August of this year. Expansion works are underway to be able to cope with the demands in the market. Aluminum, copper and nickel or cobalt alloy producers are placing big orders. Because of this, Tekkosha plans to increase its metallic chrome monthly production by 30 tons. It also expects to increase its production capacity to as high as 200 tons by May of next year. *(JMB – July 4, 1970)*

Nippon Mining Company Plans To Produce Metallic Cobalt – Nippon Mining Company is pushing up a scheme to produce metallic cobalt starting 1974. It is currently conferring with Free Port Sulphur Company of Australia for a 15-year supply of 4,000 tons of nickel-cobalt sulphide beginning 1974. Nippon Mining Company also plans to import cobalt containing ores which will be produced from MUSOSI and Kinsenda Mines of Katanga, Congo, Africa. From these ores, Nippon Mining expects to produce 500 tons of cobalt annually. With these two sources, NMC expects a total annual production of 1,500 tons of metallic cobalt.

Nickel Supply Maybe In Balance With Demand Next Year - Albert D. Gagnebin, President of the International Nickel Company, said that the supply and demand of nickel will probably balance next year. Gagnebin indicated the possibility of a trend towards larger inventory positions in the consuming areas in the future. This will be due to the fact that much of the nickel are being produced at distances which are farther away than Canada from the U.S. *(AMM – July 15, 1970)*

Powder Metallurgy – Boom Expected in Five Years – Powder metallurgy in ferrous and non-ferrous categories and its related techniques are expected to make exciting progress in the next five years. Powder metallurgy's cost savings and engineering advantages are having more impact than before. Powder metallurgy offers elimination of secondary machining, precision, high strength, unique engineering properties and sharply reduces scrap losses and reduced labor requirements. The most attention in this market is being given to forged P/M gears where extreme impact loading is called. *(AMM – July 13, 1970)*

New Uses of Powder Metals – The year 1971 will usher in the "decade of powder metallurgy". Albert P. Gagnebin, President of International Nickel Company, told some 2,000 delegates (with participants from Russia and satellite countries) to the International Powder Metallurgy Conference at the Waldorf-Astoria, New York, U.S.A.. He pointed out that this new breakthrough taking place in the rapidly advancing field of metal processing will possibly produce colored alloys, pre-coated steel and steel sheets and tubing from powders.

Gagnebin emphasized the need for companies to exchange ideas and to work together in laboratories and pilot plants in order to create a giant, new and profitable industry with increased powder metallurgy activities. Potentials of powder metallurgy growth can be stimulated by timely product research coupled with statute market research and development. These would make feasible the conversion of powder to high-purity alloys in wrought products form.

Mr. Gagnebin observed that his company has proven the technical feasibility of pre-coating cold-rolled steel strip with a thin layer of nickel. Powder suspended in an aqueous slurry, has been successfully applied directly to the surface of the steel strip. The coated steel can then be processed and fabricated with the same equipment and in the same manner used for uncoated steel. This invention called "Slurry Coating", is still in the development stage, but Gagnebin expressed high hopes for its commercial success. Said Gagnebin, "Nickel powder alone is not involved in roll compaction or isostatic pressing. The concept is equally appropriate for other powders as well. Others in this country and in other parts of the world, are now employing such techniques to make alloys that are finding wide acceptance in the electronics industry."

Cite Metallurgy Advances – *New York* – Stanley Abkowitz, President of Dynamet Corporation, Burlington, Massachussets, expressed the view that recent advances in titanium powder metallurgy are expected to result in a wider application of small titanium alloy parts with P/M processing technique. The new titanium techniques extend through the broad areas of pressed and sintered parts forging and extrusion preforms and composites. Application will include aerospace, chemical processing and massive hardware, Abkowitz said. Titanium powder may be produced by the following methods: hydride-dehydride, mechanical attrition, rotating electrode and chemical reduction.

Motor Cars – Big Users of Powder Metals – At the International Powder Metallurgy Conference held at Waldorf-Astoria, New York, U.S.A., Kempton H. Roll, executive director of the Metal Powder Industries Federation, in a speech expressed the view that by 1980, production of an estimated 10 million motor cars per year could consume about 500,000 tons of powder metals, of which 60 percent would go with powder forgings. This year, Roll said, some cars contain about 13 pounds of powder metallurgy parts. In the future, cars will contain 50 pounds of such metal.

He also said that powder metallurgy is probably experiencing some impact from the slow down in the economy. However, the end result would show up, first as a softening in shipment, then at an increasing growth rate accompanied by a shortening in the time lag between laboratory innovation and commercial application.

In his speech, Roll emphasized these points: the growing industrial awareness of powder metallurgy; improvement in quality and precision plus economy; improvement in standards in the potential to supply what the customers seek; growing success with new techniques – spark sintering, electron beam welding, tool steels preforms, titanium dispersion strengthening, higher alloy system; increasing capacity; trends towards lower prices; and roll compacting and mill shapes.

Demand For Electric Wire Increasing – According to the Japan Electric Wire and Cable Makers' Association, orders for their electric wires totalled 49,000 tons in June. This is 3,200 tons higher than in May. Shipments of electric wires totalled 52,800 tons with 1,621 tons decline on May. All these figures are in terms of copper. *(JMB – July 28, 1970)*

Asian Countries Deficient In Farm Equipment – A fact-finding team of the Asian Industrial Development Council found that Asian countries are deficient in the production of selected types of farm equipment. This disclosure was made after the team visited twelve countries this year under the ECAFE (Economic Commission for Asia and Far East). The countries visited were: Ceylon, Taiwan, India, Indonesia, Iran, Republic of Korea, Malaysia, Nepal, East and West Pakistan, the Philippines, Singapore and Thailand.

The team found that as of 1968, India, Iran and Thailand have plants manufacturing tractors, while Ceylon, Pakistan, Thailand and the Philippines have assembly plants for this machinery. Ceylon, Taiwan, India, Iran, Republic of Korea and Malaysia produced power tillers. The manufacture and assembly of the tractors and power tillers are undertaken with the cooperation of leading manufacturers.

Low-speed diesel engines, high-speed engines, small gasoline engines, centrifugal pumps, deep-well pumps and hand pumps are also manufactured in some of these countries. After investigation, the Asian Industrial Development Council recommended that priority be given to projects aimed at increasing the production of engines, low-cost power tillers and their attachments, harvesting machinery and rice mills in that order.

Japanese, Germans may be First in Car innovation – *Washington – (UPI)* – Virginia H. Knuer, President Nixon's Consumer Adviser, has predicted the Japanese will be first to turn out a car that would not pollute the air; and the Germans will be the first with an automobile bumper that really works. This will happen, she said, because American industry has turned its nose up at recent breakthrough inventions in those areas. She said that a Florida engineer, Wallace Minto, invented a non-polluting freon-powered engine and sold it to Datsun Company of Japan after domestic carmakers said they were not interested. Another inventor, Stephen Nesbitt of Blandensburge, Maryland devised an exhaust reduction system which U.S. firms do not want but which the Japanese are actively looking into. A California firm, Menasco, has developed hydraulic arms that when placed between the bumper and the car, can take head-on collisions of up to 28 miles an hour (45 kph.)

Inspection Procedures

(Continued from page 15)

lamp that flashes, observed through a window over which a special slide rule is mounted. The slide rule is rotated until the marks on its harmonic scale match the stroboscopic light pattern.

An index on the rule indicates the thickness of the part being examined. Details of ultrasonic resonance inspection are given in Tentative Recommended Practice for Ultrasonic Testing by the Resonance Method, ASTM E 113-55T.

PULSE REFLECTIONS – Ultrasonic pulse reflection methods, used largely for flaw detection, employ high frequency waves which are transmitted through one side of a part and reflected back from the other side to the receiver. Discontinuities in the part are indicated by blips on a cathode ray tube.

Testing may be by direct contact of the transducer with the part through an oily couplant, or the part may be immersed in water, with the transducer arranged so that it can be moved across the part manually or automatically. The water is the couplant between the test piece and the transducer.

Information on procedures for pulsed wave inspection are presented in Recommended Practice for Ultrasonic Testing by the Reflection Method Using Pulsed Longitudinal Waves Induced by Direct Contact, ASTM E 114-63.

PENETRANT

Discontinuities open to the surface on both nonferrous and ferrous castings are indicated effectively by liquid penetrant inspection processes. The procedure is to free the part from rust, scale, dirt, grease, or oil, making sure that the removal does not peen over the discontinuities.

The casting is coated with the penetrant by dipping in a bath or flowing the penetrant over it. After a holding period of 5 to 30 minutes to permit the penetrant to enter any defects present by capillary attraction, the penetrant is removed from the surface and the part dried. A developer to minimize the background and to act as a blotter is applied, and the penetrant seeping or bleeding through it indicates the location of discontinuities.

Liquid penetrants may contain a dye that fluoresces (yellow, red, blue) brilliantly under black or near-ultraviolet light, or a dye that exhibits an easily seen color (red) in visible light. All steps involved in cleaning, penetrant application, rinsing, developing, drying, and inspection must be conducted with care to insure the best results.

Parts must be dry after cleaning so that no water or solvent remains in or over the discontinuities to hinder entrance of the penetrant. After inspection, the penetrant should be removed under black light to insure complete removal from the surface. With visible dye penetrant, the rinsing is continued until no visible evidence of the red dye remains.

Developers for both types of penetrants may be wet or dry. The wet type is applied after rinsing off the penetrant and before drying; dry developers are applied to dry castings. Suitable developing time should not be less than the time allowed for penetration of the liquid.

Fluorescent liquid penetrants can be used for locating leaks in hollow castings by closing all but one opening and injecting the penetrant under pressure. Appearance of the penetrant on the exterior surface under black light examination indicates the leakage area.

Procedures on the details of liquid penetrant inspection are described in Standard Methods for Liquid Penetrant Inspection ASTM E 165-63.

EDDY CURRENT

Electromagnetic induction inspection involves placing the part to be tested in the varying magnetic field of a coil carrying alternating current. The magnetic field induces an eddy current of the same frequency in the part being inspected, and that current is affected by discontinuities in the part.

Different types of coils may be used. One is a small probe coil which is placed by hand on the part to be tested so that the axis of the coil is perpendicular to the surface. The other type is a circumferential coil through which the part is passed.

Eddy current testing can be employed for detecting cracks, voids, inclusions and other flaws in metal parts. It also can be used for determining conductivity, hardness, and structural variations. Other applications include sorting parts, gaging the diameters of solid and hollow cylindrical objects, and determining the thickness of casting walls.

In testing copper and aluminum alloys for electrical conductivity, the small probe coil is placed on a part to be tested and the current applied. The eddy currents induced in the part affect the impedance of the probe coil in proportion to conductivity, and that value is indicated on a meter in direct percentage of the International Annealed Copper Standard.

Hardness testing of gray iron is accomplished by the use of two circumferential coils. A standard part which possesses the desired quality is placed in one coil to present a particular wave form on a cathode ray tube. The part to be tested is placed in the other coil. Any variation in hardness is indicated by a difference in the wave form indicated. The part being tested must have the same orientation in the test coil as the standard part in its coil. A conveyor belt may be used to carry castings through the test coil for volume production inspection.

The test coils should not be placed near other electrical equipment or near quantities of castings because these affect the magnetic properties of the coils and test results may be unreliable.

World Market Situation

(Continued from page 39)

Outlook

Nickel is likely to be in easier supply late in 1970. Production costs will rise but stainless steel consumers may resist excess price over the moderate price boosts. Substitution in lower nickel alloys is possible and, in some cases, the refractory metals could replace nickel, but at much higher costs.

Nickel will always have high status in industry and defense, and aerospace and undersea work. Jet engines and gas turbines need nickel superalloys. These alloys are superb for marine hardware. The U.S. is over-dependent on supplies from the outside source. Mineral exploration has been intensified on a global scale. Alloy development and refining technology will attract more attention. The metal may see greater uses in cladding.

Laterite ores, associated with warm climate, will grow in importance although they are more costly to process.

Thus, it may be concluded that the nickel industry has a bright future being a metal that has a real value in today's technological world.

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American Metal Market Nickel Section February 24, 1970

Fortune Magazine March, 1970

Malleable Iron

(Continued from page 13)

The casting are now cleaned, ground, passed through straightening, coining, or reforming presses if required to correct distortions caused by heat treatment, and thence proceed to whatever other finishing, coating or machining operations called for.

The products of this process will give tensile properties of about 40,000 to 100,000 psi or more, elongations of 3% to 30%, and hardnesses of Brinell 140 to 500, all depending on the aforecited process factors. It is noteworthy, in regard to finishing operations, that malleable iron's machinability is gnerally superior to any other metal of equivalent strength, a characteristic that recommends it to mass-machined applications.

FOUNDRIES & PRODUCTS INDEX

COMPANY	PRODUCT LINE
1. ABS Metal Craft	1. Aluminum base
2. AC Foundry	1. Aluminum base 2. Copper base
3. A-1 Foundry Shop	1. Aluminum base 2. Copper base
4. Aguinaldo Development Corporation	1. Aluminum base 2. Copper base 3. Cast Iron 4. Steel
5. Al-Craft Manufacturing	1. Aluminum base 2. Copper base 3. Cast Iron
6. Alliance Foundry Shop and Engineering, Inc.	1. Aluminum base 2. Copper base
7. Allied Industries Corporation	1. Cast Iron 2. Steel
8. Arco Metal Products	1. Diecasting (Aluminum and Zinc)
9. Arty Foundry and Machine Shop Co. Shop Co.	1. Cast Iron
10. Asia Foundry	1. Cast Iron
11. Associated Foundry and Machinery Co.	1. Cast Iron
12. Atlantic Foundry and Machinery	1. Cast Iron
13. Atlantic Gulf & Pacific Co. of Manila, Inc.	1. Aluminum base 2. Copper base 3. Cast Iron 4. Steel
14. Atlas Consolidated Mining and Development Corp.	1. Copper base 2. Cast Iron 3. Steel
15. Avenue Manufacturing Co., Inc.	1. Cast Iron
16. BGS Engineering	1. Aluminum base
17. Balagot Industries Works	1. Diecasting
18. Enrique Baysa	1. Copper base
19. Benguet Consolidated, Inc.	1. Cast Iron
20. J. Bernabe & Co., Inc.	1. Aluminum base 2. Cast Iron
21. Caloocan Foundry Shop	1. Cast Iron
22. Carabao, Inc.	1. Copper base
23. Cashmere Foundry Shop	1. Aluminum base 2. Copper base
24. Century Foundry	1. Cast Iron
25. Chuan Son Foundry Shop	1. Copper base
26. City Foundry & Engineering Services Co.	1. Cast Iron
27. Consolidated Mills, Inc.	1. Cast Iron
28. Cuison Engineering & Machinery Company	1. Cast Iron 2. Steel
29. Davao Engine Rebuilder	1. Aluminum
30. Davao Speed Machine Shop	1. Cast Iron
31. De Luxe Foundry Shop	1. Aluminum base 2. Copper base
32. Dong Tek Foundry Shop	1. Cast Iron
33. Duracast Metal Products	1. Diecasting
34. Dynamic Casting	1. Aluminum base 2. Copper base
35. El Varadero de Manila	1. Aluminum base 2. Copper base 3. Cast Iron 4. Steel
36. Engineering Equipment, Inc.	1. Aluminum base 2. Copper base 3. Cast Iron 4. Steel
37. F. G. Foundry	1. Cast Iron
38. Falcon Metal Corporation	1. Copper base
39. Feati Industries	1. Aluminum base 2. Copper base
40. Filipino Pipe and Foundry Shop	1. Cast Iron
41. Foundry Shop 81	1. Aluminum base 2. Copper base 3. Cast Iron 4. Steel
42. Gerflora Metal Craft	1. Aluminum base
43. Gold Star Foundry Shop	1. Aluminum base 2. Copper base 3. Cast Iron
44. Gold Star Steel	1. Steel
45. Golden Hill Shop	1. Cast Iron
46. Honiron Philippines	1. Copper base 2. Cast Iron
47. Hoover Equipment Industries	1. Diecasting
48. Hycarox Enterprises	1. Copper base
49. Ideal Foundry Shop	1. Copper base
50. Inductocast Cebu	1. Copper base 2. Cast Iron 3. Steel
51. International Foundry and Machine Shop	1. Aluminum base 2. Copper base 3. Cast Iron
52. Island Foundry and Machine Shop	1. Cast Iron
53. Jalandoni Foundry &	

	Machine Shop	1. Aluminum base
54.	Jok Tek & Company	1. Cast Iron
55.	Kim Heap Sing Foundry Shop	1. Cast Iron
56.	Kim Hoc Hing Foundry	1. Copper base
57.	Kim Yek Engineering and Foundry Co.	1. Aluminum base 2. Copper base 3. Cast Iron
58.	Kimbee Machinery and Foundry Company	1. Cast Iron
59.	Lepanto Consolidated Mining Co.	1. Steel
60.	Liberty Manufacturing	1. Copper base 2. Malleable Iron
61.	Luzon Foundry Shop	1. Copper base 2. Cast Iron
62.	Luzon Slipway and Drydock Corp.	1. Copper base
63.	M.A. Foundry	1. Aluminum base 2. Copper base 3. Steel
64.	Makati Foundry	1. Cast Iron
65.	Malabon Foundry Shop	1. Aluminum base 2. Copper base
66.	Marsteel Corp.	1. Aluminum base 2. Copper base 3. Steel
67.	Master Steel Products, Inc.	1. Cast Iron 2. Steel
68.	Mechanical Center of Manila, Inc.	1. Copper base 2. Cast Iron
69.	Metal Lux Ltd.	1. Aluminum base
70.	NIST	1. Aluminum base 2. Copper base 3. Cast Iron
71.	National Shipyards & Steel Corporation (NASSCO)	1. Aluminum base 2. Copper base 3. Cast Iron 4. Steel
72.	New Asia Foundry & Manufacturing Co., Inc.	1. Copper base 2. Cast Iron
73.	New Far Eastern Foundry Shop	1. Aluminum base
74.	New Quality Products Mfg. Corp.	1. Cast Iron
75.	New United Foundry Mfg.	1. Cast Iron
76.	Ngo Lock Foundry	1. Copper base 2. Cast Iron
77.	Occidental Foundry Corp.	1. Cast Iron
78.	Original Foundry & Machine Shop	1. Copper base
79.	P.M. Parts	1. Steel
80.	Parkway Engineering and Gearworks	1. Copper base 2. Cast Iron
81.	Perfect Mfg. Enterprises	1. Aluminum base 2. Copper base
82.	Philparts Mfg. Co., Inc.	1. Aluminum base 2. Copper base 3. Cast Iron
83.	Philippine Foundry	1. Cast Iron
84.	Phil. Iron Mfg. Co., Inc.	1. Cast Iron
85.	Phil. Metal Foundries	1. Copper base 2. Cast Iron
86.	Phil. Navy	1. Aluminum base 2. Copper base 3. Cast Iron
87.	Phil. Sewing Machine Mfg. Corp.	1. Copper base 2. Cast Iron
88.	Philippine United Foundry and Machinery Corp.	1. Aluminum base 2. Copper base 3. Cast Iron
89.	Ponce Foundry and Machine Shop	1. Copper base
90.	Precision Iron Mfg. Corp.	1. Aluminum base 2. Copper base 3. Cast Iron
91.	Prime Industries, Inc.	1. Aluminum base 2. Copper base 3. Cast Iron
92.	Progress Foundry Industries	1. Cast Iron
93.	Quality Aluminum	1. Aluminum base
94.	Quality Metal Manufacturing Inc.	1. Aluminum base 2. Copper base 3. Cast Iron
95.	R & K Trading	1. Aluminum base 2. Copper base
96.	Rizal Foundry Shop	1. Aluminum base 2. Cast Iron
97.	Royal Foundry Shop	1. Copper base
98.	Sibern Enterprises, Inc.	1. Copper base 2. Cast Iron
99.	Singer Industries Phil., Inc.	1. Cast Iron
100.	Soriano Foundry	1. Copper base
101.	Square Steel Co., Inc.	1. Cast Iron 2. Steel
102.	Standard Electric Mfg. Corp.	1. Diecasting
103.	Strachan & Macmurray Ltd.	1. Cast Iron
104.	Super Hercules Mfg. Co.	1. Cast Iron
105.	Superior Gas & Equipment Co.	1. Copper base
106.	Texparts, Inc.	1. Cast Iron 2. Steel
107.	Times Manufacturing Corp.	1. Diecasting
108.	Tong Sing Foundry Shop	1. Aluminum base 2. Copper base
109.	U.S. Foundry and Eng'g. Co.	1. Copper base 2. Cast Iron
110.	Union Industries	1. Diecasting
111.	Union Philippine Foundry Shop and Co.	1. Copper base 2. Cast Iron
112.	Union Steel Mfg. Co., Inc.	1. Steel
113.	United Foundry Shop	1. Cast Iron
114.	Universal Foundry and Machine Shop	1. Cast Iron
115.	Unno Steel Products Co.	1. Copper base
116.	Victorias Milling Co., Inc.	1. Copper base 2. Cast Iron
117.	Ysmael Steel Mfg. Co., Inc.	1. Cast Iron 2. Copper base 3. Aluminum base

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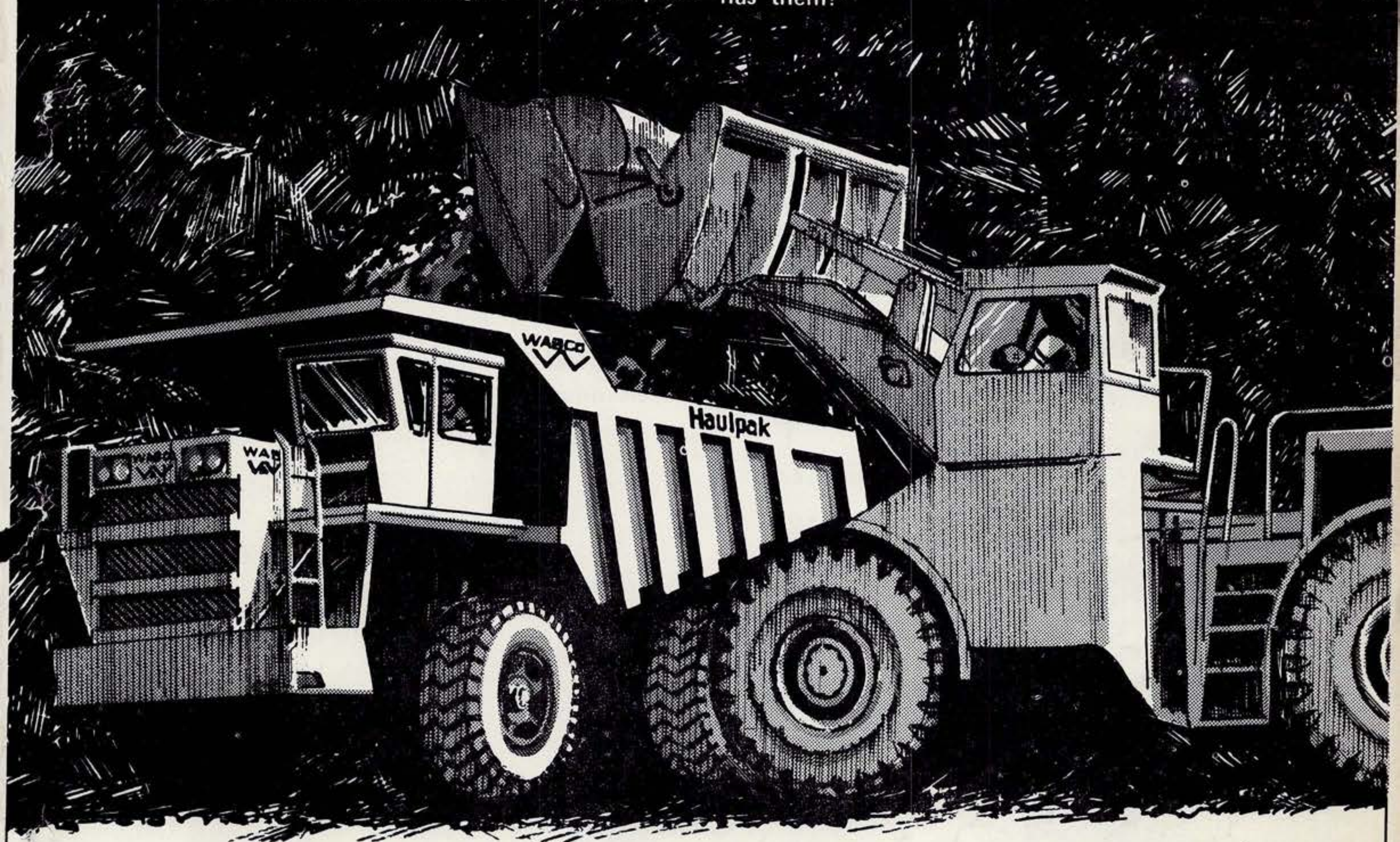

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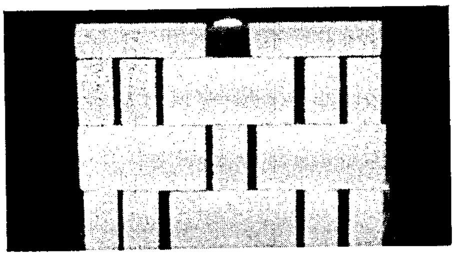
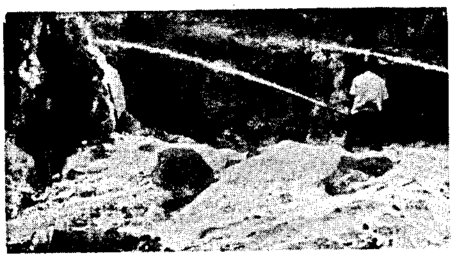
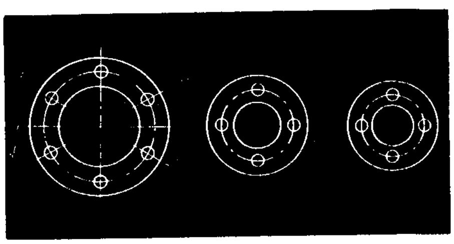
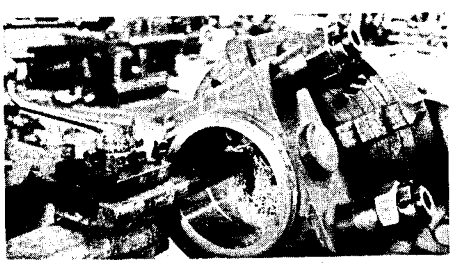
A METALS INDUSTRY DEVELOPMENT CENTER QUARTERLY MAGAZINE, VOL. 1 NO. 2, APRIL-JUNE, 1971









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Antonio Gimenez is a Metallurgical Engineer. After graduating from the University of the Philippines in 1968, he joined Benguet Consolidated, Inc., then Warner Barnes & Company's FOSECO Foundry Technical Services before joining MIDC. He is presently the leader of one of the Center's research projects.

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Dr. Manfred Knayer, doctor of engineering sciences from the University of Stuttgart, Germany is presently an industrial management expert of the UNIDO. He has served as consultant to various productivity centers in Central America, North Africa, India and recently in Ceylon.

Cover Design of an aluminum piston manufactured by PHIL-PARTS MANUFACTURING CO., INC., cast in permanent mold.

LEGEND:

TISIJ — Transactions of the Iron and Steel Institute of Japan, PE — Product Engineering, IH — Industrial Heating; MP — Metal Progress, JISI — Journal of the Iron and Steel Institute, E/MJ — Engineering and Mining Journal, ME — Materials Engineering, F — Foundry, MEQ — Metals Engineering Quarterly, BFSP — Blast Furnace and Steel Plant, ISE — Iron and Steel Engineer, JIM — Journal of the Institute of Metals, FTJ — Foundry Trade Journal, MD — Machine Design, AFSCMRJ — American Foundrymen's Society Cast Metals Research Journal, AFST — American Foundrymen's Society Transactions, CIMB — Canadian Institute of Mining and Metallurgy Bulletin, CE — Chemical Engineering, WJ — Welding Journal, LMA — Light Metal Age, MC — Modern Casting, JAIM — Journal of the Australian Institute of Metals, MB — Metal Bulletin, IAMWI — Iron Age Metal Working International, JMB — Japan Metal Bulletin, AMM — American Metal Market, IMMT — Instituiton of Mining and Metallurgy Transactions

editorial

FILIPINO METAL WORKING CRAFTSMEN-

The Missing Resource in the Development of Local Capital Goods Industry

As long as we keep on importing most of our capital goods, the availability of foreign exchange will remain a critical factor in limiting the nation's rate of industrial growth. Trade balance projections for the Philippines indicate that it will be practically impossible to sustain a high rate of economic growth over a number of years, i.e. 10% of gross national product, since not enough foreign exchange could be generated to import all the capital goods required for economic development. The rapid build up of our capital goods industry should be given the highest priority by government industrial planners.

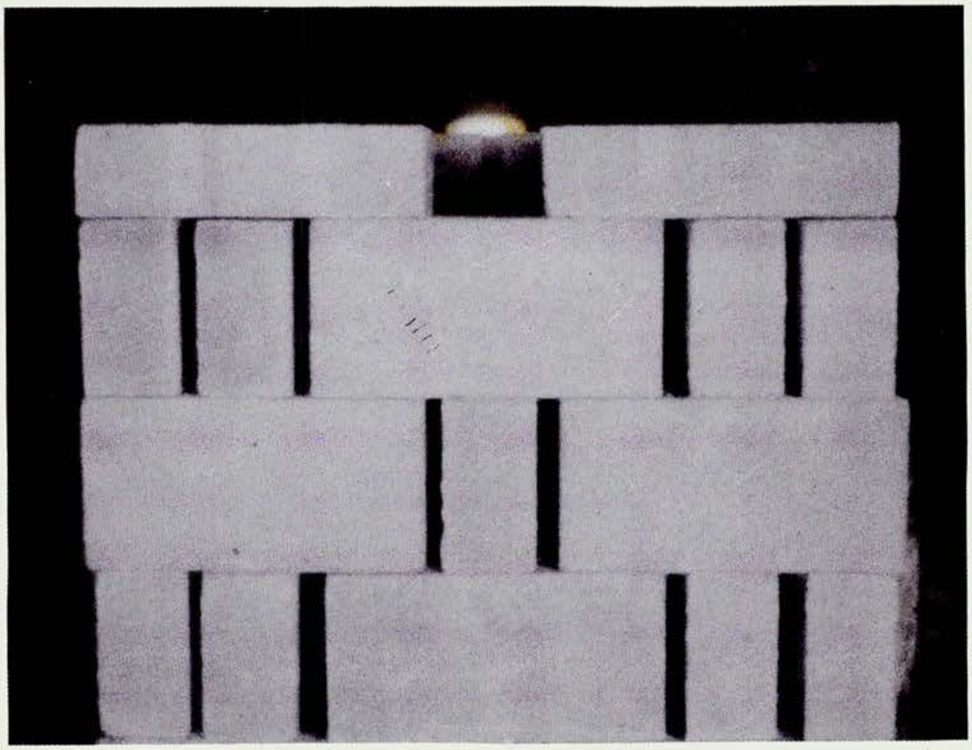
The most vital inputs to the capital goods industry are 1) skilled manpower 2) technology and 3) financing. Although all three items are normally in short supply in a developing country, the last two can still be acquired from external sources under reasonable terms. To import large numbers of skilled workers will defeat the economic purpose of setting up a capital goods inlustry. The low cost of manpower is the only countervailing factor that can offset such disadvantages to a developing economy such as economies of scale, high cost of money and high technology fees.

This leads us to the question of availability of trained manpower in the Philippines. The strategy for capital goods manufacture for a country like the Philippines would call for a much greater use of multipurpose machine tools rather than the high output single purpose machine tools which are more applicable to the extensive markets of the richer nations. Multipurpose machine tools require greater skill in their usage than single purpose machine tools which are more or less automatic in operation. Whereas the craftsman is gradually being phased out in most equipment manufacturing establishments in industrialized countries, there is great need for such highly skilled workmen in the emerging capital goods industries of the developing countries.

A systematic training program for craftsmen is practically nonexistent in the Philippines. The graduates of our trade and vocational schools cannot be rated as craftsmen without supplementary specialized and on-the-job training. Our present system relies on industry to develop their own craftsmen through inplant training. Most industrial plants, particularly the few that are engaged in capital goods manufacturing, do not have the resources and facilities to conduct this type of training. The infant capital goods industry has to rely therefore in most cases on semiskilled workmen to carry out tasks that can be properly and efficiently carried out only by craftsmen.

It is obvious that there is a dire need to set up a number of craftsmen training centers to upgrade the products of our trade and vocational schools so as to equip them with the skills needed to launch a successful capital goods manufacturing program. Metalworking craftsmen constitute the majority of skilled workmen needed by the capital goods industry. The training of metal workers at the craftsman's level requires a sizeable investment in training equipment and facilities — approximately ten times that which is needed to train mechanical engineers. The Metals Industry Development Center (MIDC) will start operating its training facilities in 1972 for foundrymen, tool and die makers, machinists, etc. The start will be a modest one and the ability of MIDC to expand such a program will depend on the support given by government and industry.

STATUS OF THE REFRACTORY INDUSTRY IN THE



Firebricks as they enter kiln for firing. Courtesy of Diamond Ceramics.

PHILIPPINES

TERESITA H. HIZON

An ECAFE conference held a few years back revealed that the Philippines is the richest country in Asia in mineral deposits and potentials. The ECAFE survey not only confirmed the fact that Philippine mountains are abundant with mineral wealth, it also showed that the widest variety of mineral deposits can be found in the country. These minerals include chromite, silica, dolomite and magnesite — which are the raw materials needed for the manufacture of refractories. The Philippines is noted to be the world's fourth largest chromite producer.

TABLE I

CLASSIFICATION OF REFRACTORIES ACCORDING TO COMPOSITION

Fireclay Brick	Minimum P.C.E.
Superduty	33
High-duty	31—1/2
Intermediate duty	29
Low duty	15
Semi-silica-minimum SiO_2	= 72%
High-Alumina Brick	
50% alumina	34—1/2
60% alumina	36
70% alumina	37
80% alumina	38—1/2
90% alumina	40
99% alumina	41—2/3
Silica Brick	
Superduty	
Conventional	

Basic Brick

*Magnesite brick — fired
  $<$90% MgO
  $>$90% MgO (periclase brick)

*Chrome brick — fired

*Magnesite-chrome brick**

  high fired
  chemically bonded

*Metal encased brick
  chrome-magnesite
*Forsterite brick — fired

*Spinel-bonded magnesite —
  chrome brick — fired

* The ceramic bond consists of magnesium and calcium silicates.

** The terms "magnesite-chrome" and "chrome-magnesite" refer to blends of magnesite and chrome ore. The constituent predominating is named first.

(1) Large grinder is used to reduce clay to proper grain size.

And yet with all this natural wealth Philippine importation of refractories amounted to $3,107,431 in 1969. With the floating rate the price of imported refractories has increased by 25% and is still going up.

..The manufacture of refractories is essentially a simple process which includes the following physical operations and chemical conversions: grinding and screening, mixing, pressing or molding and repressing, and drying and burning or vitrification. The technology involved in the manufacture of refractories is within the capabilities of Filipino manufacturers.

There is no doubt that there exists a big market for refractories, essential in practically all the manufacturing industries, particularly in iron and steel production, cement and glass as well as in the generation of steam power. In the iron and steel industry alone, the refractory consumption amounted to 11,853 metric tons in 1969. The ratio by weight of metal processed to refractory consumption is estimated to be 27.83: 1. These figures show the vital role of refractories in the advancement of the metals industry of a country. In line with the function of accelerating the growth of the metals and allied industries of the Philippines, the Metals Industry Development Center has undertaken a study of the status of the refractory industry, the findings of which follow.

INDUSTRIAL REFRACTORIES

Refractories are non-metallic materials of construction exposed to high temperature. There is no well defined dividing line of temperature which distinguishes refractories from nonrefractories, although in A.S.T.M. classifications of various types of fireclay brick, the lowest temperature for which any type must meet requirements related to thermal stability is 1515° centrigrade (2760° Fahrenheit). Stability at high temperature — both physical and chemical — is the primary requirement for refractory materials. They may be called upon, while hot, to withstand pressures from the weights of furnace parts or contents, thermal shock resulting from rapid heating or cooling, other stresses induced by temperature change, mechanical wear resulting from movement of furnace contents and chemical attack by heated solids, liquids, gasses or fumes.

I. CLASSIFICATIONS

Refractories may be classified in a number of ways, no one of which is completely satisfactory. On the basis of composition or properties, refractories are grouped according to the following main types: fireclay, high-alumina, silica, basic and insulating refractories, in each of which there are different classes. Refractories are classified as high-alumina when the alumina content is greater than 45 per cent. In addition to these, there are various special refractories, including silicon carbide, graphite, carbon, zircon, zirconia, fused-cast products and several others. Table I shows the different classes of refractories under these main types.

From the chemical standpoint, refractories are of three classes; namely, acid, basic and neutral. Theoretically, acid refractories should not be used in contact with basic slags and basic refractories should be exposed to no other conditions. In actual practice, however, these rules are continually violated. The neutral refractories are comprised of a group of materials which are neither strongly basic nor strongly acid. The existence of a strictly neutral refractory may be doubted since the refractory and the material entering into reaction are rarely confined to simple two component acid base systems.

Examples of this system of classication are:

Acid: silica, fireclay, zircon and zirconia

Basic: magnesite and dolomite (chrome is sometimes considered a basic refractory.)

Neutral: high-alumina, chrome, carbon, silicon carbide and mullite.

Classifications by use, such as blast-furnace refractories or open-hearth refactories are generally too broad and are constantly subject to revision.

II. PHYSICAL FORMS

Refractories are manufactured in several physical forms which include brick, finely ground cementing materials, plastics, castables, granular materials in bulk, patches and ramming mixtures.

Brick

The principal refractory product is a brick or other preformed shape. The standard sizes are bricks of certain definite dimensions and relatively simple design which are used in sufficient amounts to permit quantity production. The bricks most extensively used are the standard 9 x 4-1/2 x 2-1/2 -inch and 9 x 4-1/2 x 3-inch straights and the corresponding series of standard sizes, including arch, wedge, key brick and certain others. Illustrations of standard (9 x 4 1/2 x 2 1/2) sizes are shown in Figure 1. All shapes of non-standard dimensions are regarded as rectangular title or special shapes. They include a wide variety of brick regularly used for special services, such as a by-product coke-oven shapes, baffle tile for boilers, checker brick for blast furnace stove regenerators and many others; together with shapes of special design manufactured on particular orders from design submitted by users.

Cementing Materials

Refractory materials are also available in the form of mortar or cements for laying up, coating or patching brickwork. They are supplied either dry (water added when used), or wet in a ready mixed form for immediate application. They may be air-setting at ordinary temperatures or heat-setting during furnace operations.

Plastics

Plastic refractories, made from nearly all the common materials, are essentially moist, unformed brick mixtures supplied for forming special shapes and solid monolithic (jointless) furnace sections at the point of installations. They are rammed into place with comparatively low pressure and fired by the heat of the furnace in which they are installed.[1]

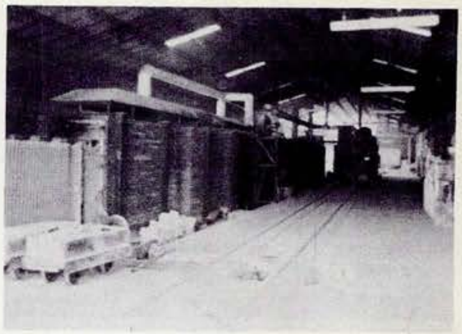
Ramming Mixtures

Ramming mixes are special types of plastic refractory which require high pressure on the job. It contains a higher proportion of aggregates and less bonding agent and moisture. Ramming mixes are nonplastic.

Castables

These are refractory concretes, and all of the common refractory materials are used as aggregates. Castables are furnished in a form suitable for either pouring or tamping into forms, as well as for gun emplacement by blowing.[1]

(2) Handmade process of forming bricks to desired shape. Photos courtesy of Firestone Ceramics.



(4) Refractory bricks, loaded on small cars, are fired in long tunnel-shaped kiln where combined water and carbonaceous materials are removed and oxidation takes place. Courtesy of Diamond Ceramics.

Bulk Products
Refractories such as grain magnesite, dolomite, chrome ore, ganister, sand and fireclay are supplied in various grain sizes to be used in making bottoms, banks and fills of furnaces, as well as for other miscellaneous uses.[1]

III. APPLICATION OF REFRACTORIES

Refractories are as numerous and as varied as the industries using them. The utilization of refractories from a technical viewpoint depends on the proper balancing of two factors — the properties and the behavior of the refractories on one hand, and the destructive conditions likely to be encountered in service on the other. Even in furnaces of the same type and design, and processing approximately the same kind of material, it is not always possible to state in advance that a certain type of refractory will prove satisfactory. This is because variables can be involved which cause differences in service and necessitate the use of different kinds of refractories.

It is obviously impractical to present all types of industrial furnaces and the refractory requirements for each part of the furnace. The following discussion is limited to the standardized application of different types of refractories.

Refractories in the Iron and Steel Industry
Blast Furnace. "For many years, blast furnaces were lined throughout with high-duty fireclay brick and, despite much recent experimentation with a number of special types of refractories, the high-duty brick still predominates"[2] The usual practice today is to employ "zoned" linings, in which various types of superduty, high-alumina or carbon black are used.
Cupola. "Cupola operation imposes some of the most severe conditions to which refractories can be subjected, and even under the best controlled conditions, it is necessary to repair the lining after melting operations are completed. Failure of the refractory lining is generally the result of abrasion, heat, mechanical strain and chemical activity."[1]

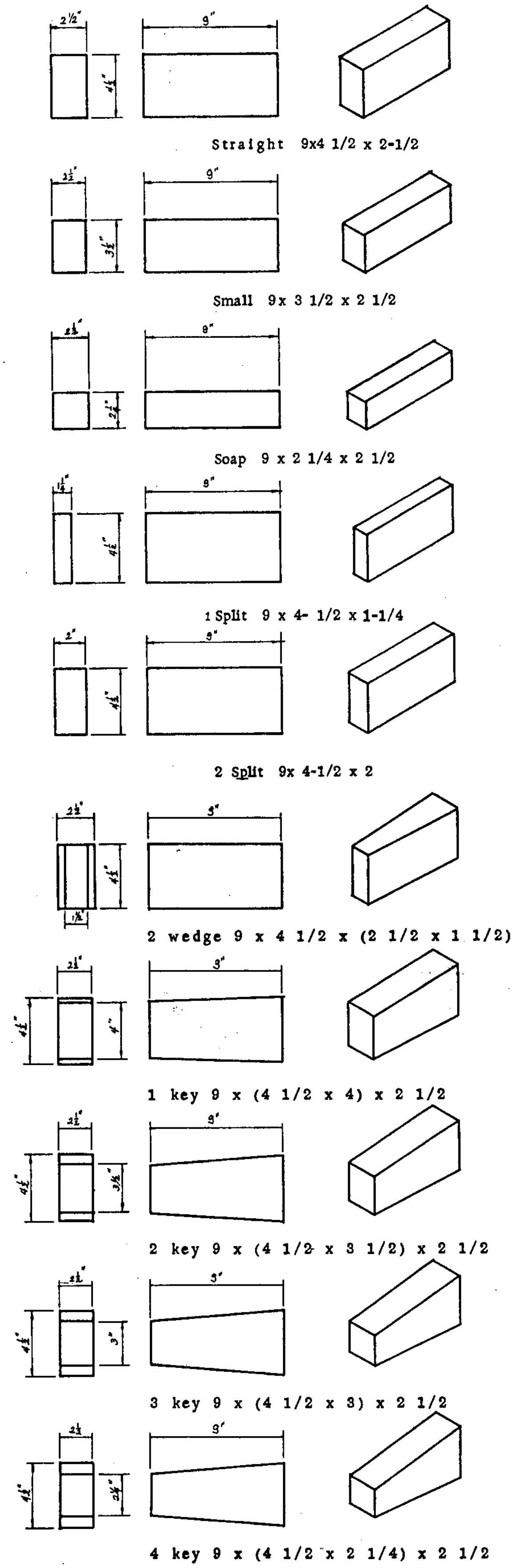
(3) Tunnel kiln where drying and burning operations are carried out. Courtesy of Firestone Ceramics.

Fireclay bricks are so generally used for cupola practice that they may be regarded as standard for this service. Their adoption has come about as a result of their combination of desirable physical and chemical properties, and their relatively low cost. Also used in cupolas are monolithic linings which are mixtures of fireclay and grog in suitable proportions, properly tempered with water and rammed against the shell or fireclay backing. "Other refractories, used to a small extent, are the more costly superduty fireclay, silica and high-alumina brick. Slabs of siliceous rock are used extensively, but chiefly for lining the melting zone. These materials are used for conventional cupola, operated with an acid slag. For basic operation, cupolas are lined with magnesite monolithic basic refractories for at least four feet above the tuyeres."[1] Fig 2 shows a typical arrangement of cupolar lining refractories.

Acid Open-Hearth Furnace. Most of the open-hearth furnaces are lined with basic refractories, but there are a number which are operated with acid slags and which, consequently, must be lined with acid refractories. "The refractories used in the construction of acid-open-hearth furnaces are fireclay brick, silica brick, acid ramming mixtures, furnace bottom sand, crushed ganister, fireclay and in some furnaces, basic brick."[1]
Basic Open Hearth Furnace. In few types of industrial furnaces are the refractory requirements so varied and so specialized as in the different parts of the basic open-hearth furnace. "Basic refractories used in this type of furnace are basic brick, steel reinforced basic brick, magnesia ramming mixtures, plastic chrome refractories, basic gun refractories, dead burned magnesite, dead burned dolomite and raw dolomite. The acid refractories used are fireclay brick, silica brick, fireclay and insulating firebrick."[1]
Heat Treating Furnace. Heat treating furnaces generally operate in the temperature range of 800° to 1750°F, and are seldom designed for temperatures above 2100°F. Refractories used in heat-treating furnaces are either in brick shapes and castables or ramming mixtures. "The brick shapes are used to construct conventional linings or supporting parts of layers or courses of bricks bonded together with a suitable mortar. The ramming mixtures are usually used to construct monolithic linings in cases where such linings can be applicable. Air-setting mixtures are preferred. A large application for castable or ramming refractories occurs in maintenance of furnace linings since this is an expedient method for repairing damaged refractory structure."[1]
Soaking Pits. Several types of refractories for pit walls have been and are being used, with the siliceous types — sandstone, silica brick and semi-silica bricks — predominating. Fireclay brick generally have proven less satisfactory for this application, although superduty fireclay plastics have gained some acceptance in recent years. Basic bricks predominates in the lower side-walls, but in many cases 70% alumina brick or 75 to 90% alumina plastics have provided at least comparable service. The use of the latter material is increasing. The application of gunning refractories for pit maintenance is widespread. These may be siliceous or fireclay refractory material for the upper walls and high-alumina or basic material for the lower walls.
Pouring Pit Refractories. These refractories — sleeves, nozzles, stopper heads and ladle brick — must be strong and resistant to spalling and to corrosion and erosion by slags and molten metals.

Ladles: "In foundry practice, the ladles used are of many types and sizes. The lining materials commonly used are high-alumina brick, high-fired superduty fireclay brick, high duty fireclay brick, high-alumina plastic refractories, fireclay plastic refractories and mixtures of ground quartzite with plastic clay."[3] Two types of ladles are shown in Fig. 3.

Sleeves, nozzles and stopper heads: Sleeves and nozzles are single use refractories. They are generally made of the lower grades of refractory clay. Stopper heads which must remain hard and corrosion resistant are made of refractory clay-graphite mixtures.
Acid Electric Arc Furnace. "Acid refractories as silica, fireclay and mullite are commonly used in lining electric arc furnaces. The most important components of these refractories are silica and various mixtures and combinations of silica with alumina. Acid refractories used are as bricks, in granular form or as plastics which are usually referred to as fireclays."[1]



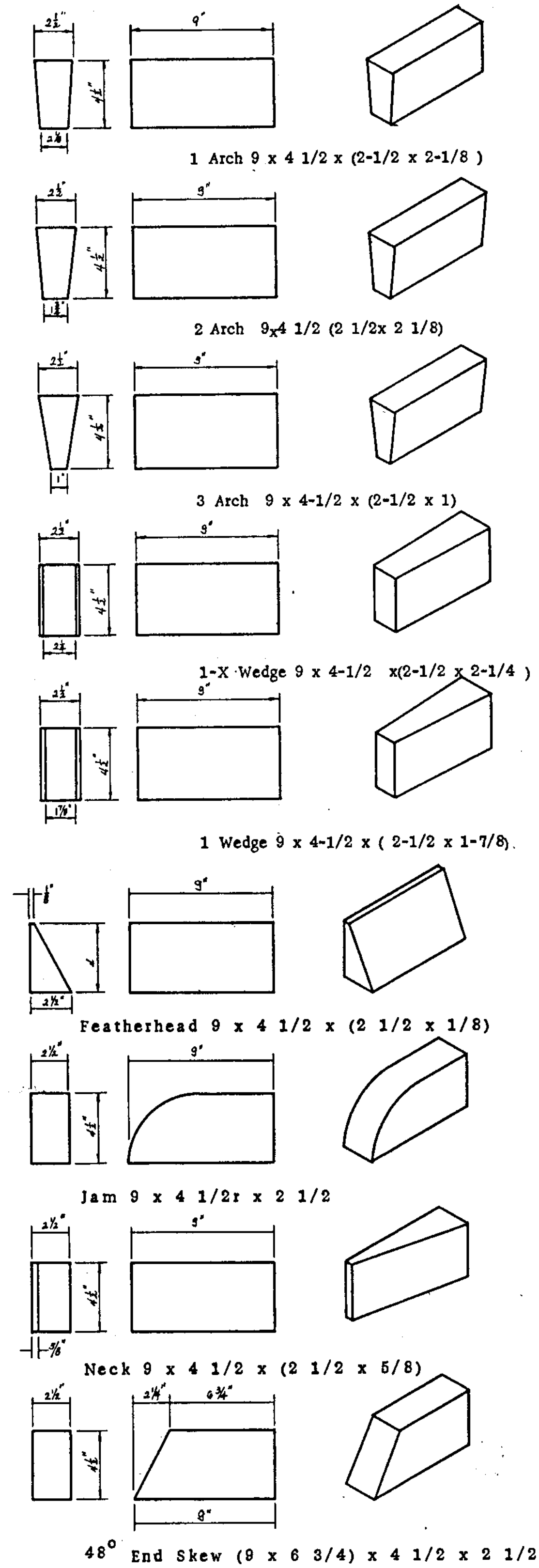


FIGURE I
STANDARD 9-INCH (9 × 4-1/2 × 2-1/2) SIZES OF BRICKS

Basic Electric Arc Furnace. Basic refractories for this use are obtained in granular form and as brick. "The most important constituent of the granular refractories are dead-burned magnesite and dolomite, whereas basic bricks are made of magnesia and various combinations of refractory chrome ore and magnesia."[1]

Induction Furnace. The refractory lining of this type of furnace may be either acid or basic. In the smaller units, the furnace lining usually consists of a fired crucible or siliceous clay for acid practice and high purity magnesia for basic practice. In the larger furnaces the lining material consists of coarsely ground quartzite ganister mixed with a small percentage of fireclay for acid practice, and a high purity magnesite ramming mix for basic practice. Fig. 4 shows typical induction furnaces.

Refractories in the Cement Industry

In the drive for better portland cement, manufacturers have resorted to progressively higher operating temperatures and, step by step, materials of higher refractoriness have been made available. Refractories in the cement industry are used mainly as linings of rotary kilns.

No single refractory can economically resist all the conditions throughout a rotary kiln. For resistance to abrasion at the moderate temperature which prevail in the feed end of many kilns, superduty, high-duty and medium-duty fireclay bricks are used. Chemical and thermal conditions too severe for fireclay refractories require linings of high-alumina or basic refractories. Semi-silicon carbide bricks are also suitable for the most severe conditions.

Refractories for the Glass Industry

Furnace design, composition of the glass batch, and operating conditions vary so widely from plant to plant that no entirely definite rules can apply for the selection of refractories.

Furnace Crowns or Caps: "For the construction of the caps, silica brick are almost universally the standard. For some parts of the smaller tanks making special glasses, high-alumina brick caps are sometimes used."[3]

Walls and Ports: "At moderate operating temperatures, fireclay brick and more extensively silica brick continue to be used with satisfactory service. Bricks of 90% alumina and fused cast refractory consisting essentially of beta alumina and basic brick are also used for walls and ports."[3]

Lower Sidewalls and Bottom Blocks: "Fused cast zirconia-alumina-silica refractory best fulfills the most severe requirements for use in contact with molten glass. It serves advantageously in the sidewalls of the melter, bridge wall, throat and doghouse areas. Fused cast refractory containing both alpha and beta alumina, is used mainly in contact with the glass in refiner ends and feed channels. Zircon bricks and bonding mortar are applied to this portion."[3]

Regenerators: "In order to meet the greatly intensified conditions of higher temperatures and higher rates of production, accompanied by increased carry-over of alkali fluxes into the regenerators of soda-lime-silica glass furnaces, basic brick have largely replaced superduty fireclay and high alumina checkers at the hottest ports in varying depths and in some cases from the top down to the rider arches. In many installations, basic brick is used for the entire checker setting."[3]

Refractories in the Nonferrous Metal Industry

The smelting, refining and electrolytic reduction processes in nonferrous metallurgy involve widely different furnaces and refractories.

Aluminum. Practically all of the aluminum metal processed commercially is extracted from bauxite ore, which consists of aluminum oxide chemically bonded with water.

Rotary Kilns: Mined bauxite is usually dried or calcined in rotary kilns prior to shipment. These kilns are equipped with Dutch ovens for firing. High-duty fireclay brick are used as lining materials.

Pot Furnaces: "Reduction of alumina to the metal is accomplished by electrolysis in cells referred to as pots, which usually are lined with carbon blocks or carbon paste. In some cases, fireclay brick or refractory installation is used between the steel shell and the carbon block linings."[3]

Carbon Baking Furnace: The carbon anodes for the pots may be of self-baking or pre-baked types. High-duty and superduty fireclay brick are used with excellent results for this application.

Ladles: "The ladles used to transport

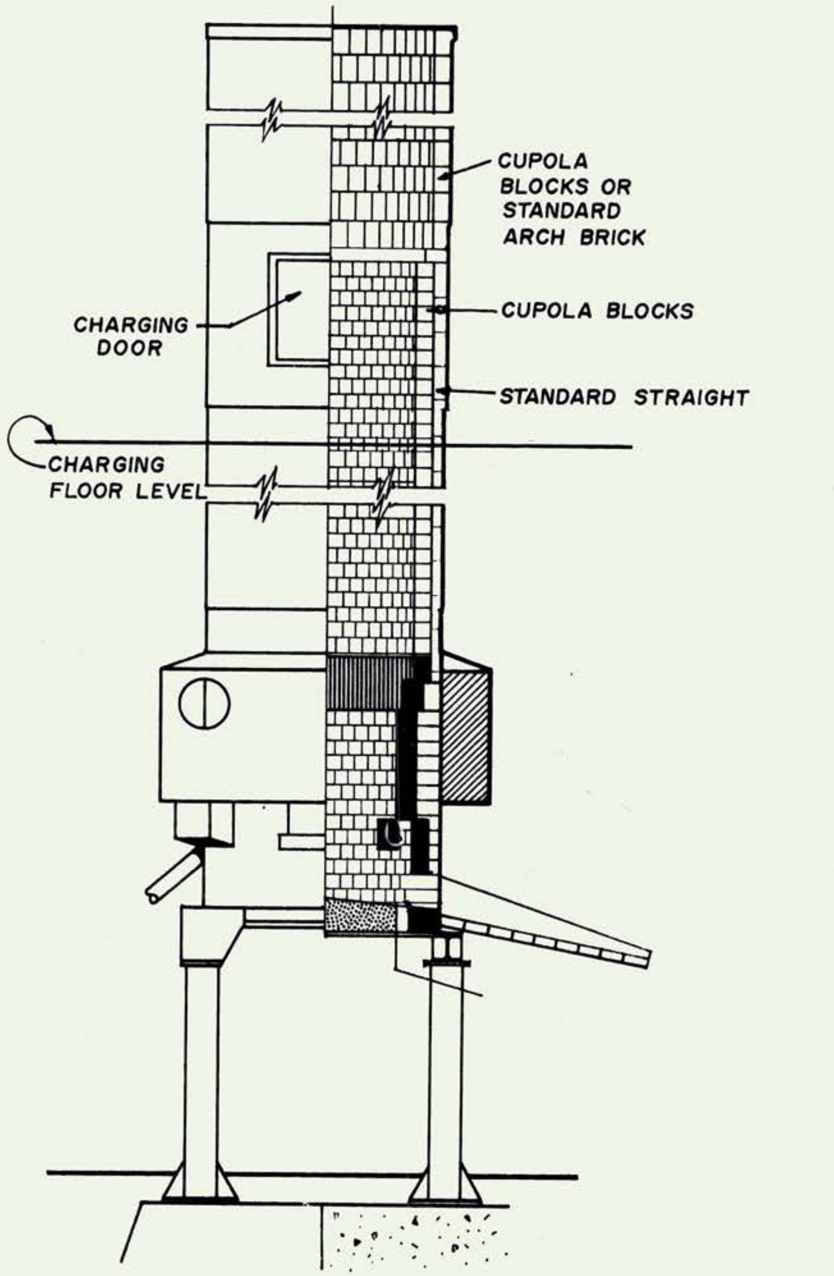


Fig. 2. Typical arrangement of cupola lining refractories.
Source: Refractories Manual, p. 50.

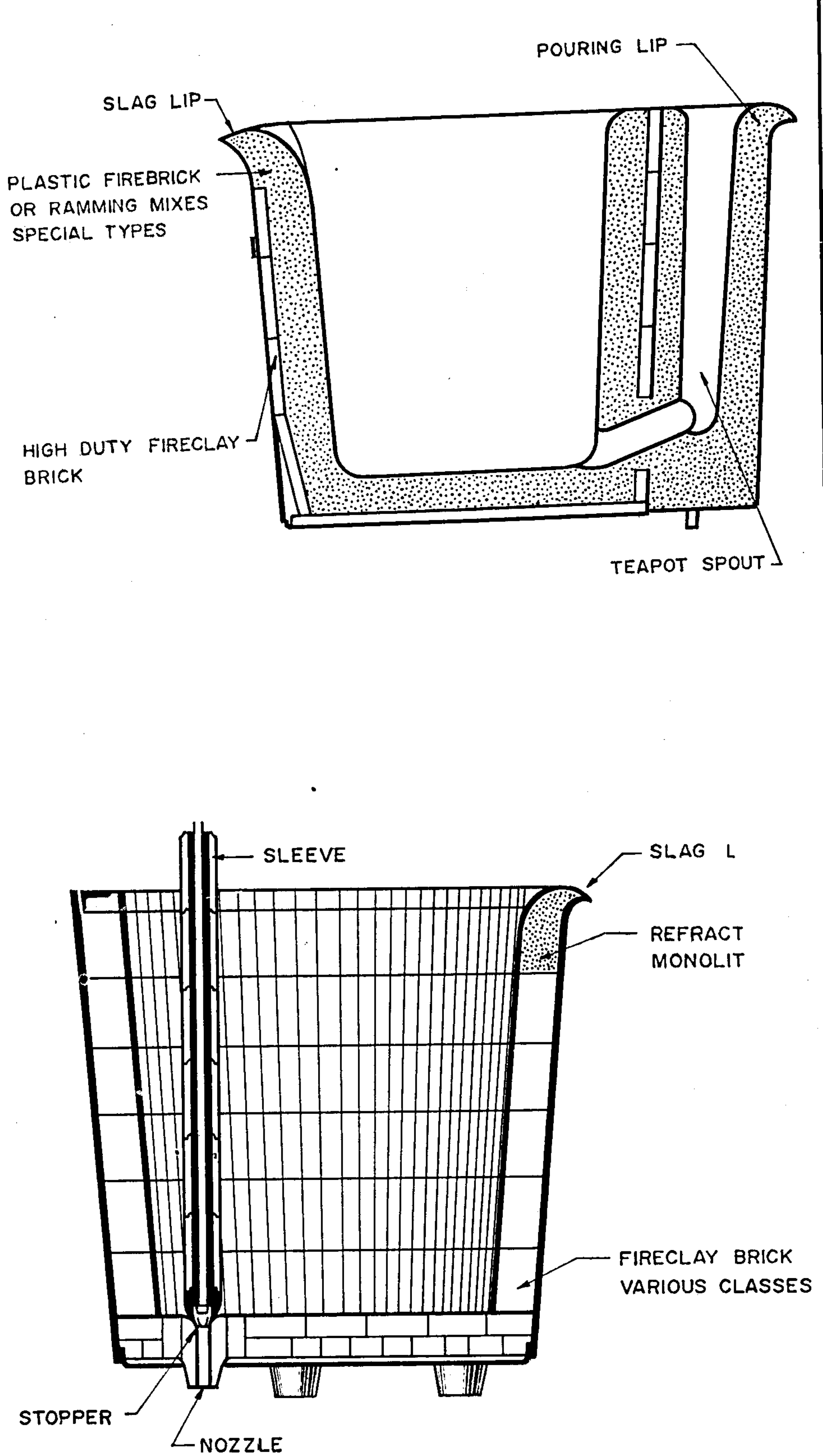


Fig. 3. Refractory arrangements for bottom-pour ladle (left) and teapot ladle (right).
Source: Modern Refractory Practice, p. 362.

molten aluminum from the electrolytic cells to furnaces for further refining or casting are usually lined with dense high-duty fireclay brick. Various types of castables are also used."[3]

Aluminum Melting Furnaces: Refractories for lining aluminum melting and holding furnaces depend upon design of furnace, melting rate, kind of metal or scrap charged and alloys to be produced as well as other operating conditions. High-duty and superduty fireclay bricks, superduty fireclay refractories and alumina brick are used for this application. Plastic refractories, castables and ramming mixes are also used for installations where monolithic linings are preferred.

Copper. Refractories in the copper industry are used mostly in smelting furnaces and converters.

Reverberatory Smelting Furnace: "At one time, silica brick were used almost to the exclusion of all other refractories for the complete construction of copper reverberatory furnaces. Higher production rates have imposed increasingly severe conditions on the refractories and now silica bricks are frequently inadequate. This has led to the increased use of basic brick for the entire furnace structure."[3]

Converters: Frequently, grain magnesite, hard-burned basic brick and chrome-magnesite bricks are used for lining the converters.

Electric Arc Furnace: Hard-burned basic brick and spinel bonded basic refractory are being used for economical construction of furnace lining.

Nickel. The furnace and refractories employed in the usual metallurgy of nickel correspond closely to those used in copper smelting and refining.

Lead. The smelting and refining of lead involve a complex series of operations and require refractories which could meet the service conditions.

Superduty and high-duty fireclay bricks are the most often used for linings of sintering machine ignition stoves, lead blast furnaces, drossing kettles and lead oxide furnaces operating above the melting points of the oxides.

Zinc. Furnaces most widely used in the reduction of zinc ore to metallic zinc are the horizontal retort furnace, the continuous vertical retort furnace and the electrothermic furnace of vertical shaft construction. High-duty and superduty fireclay bricks, silicon carbide, semi-silica and alumina bricks are widely used for this application.

Refractories in the Ceramic Industry

Ceramic ware is fired in kilns under widely varying conditions, involving differences in kiln design, type of fuel, kiln atmosphere and temperature and rate of firing.

Periodic Kilns. For kilns used in firing hollow tile, face brick, other building brick and some types of refractory brick, superduty, high-duty and medium-duty fireclay bricks are used with excellent results. In salt glazing kilns, insulating bricks are sometimes used with considerable savings in fuel consumption.

Tunnel Kilns. Continuous tunnel kilns types of ceramic ware. Included among are widely used for firing nearly all the various high-alumina brick and superduty, high-duty and medium-duty fireclay brick are the silica bricks and silicon carbide.

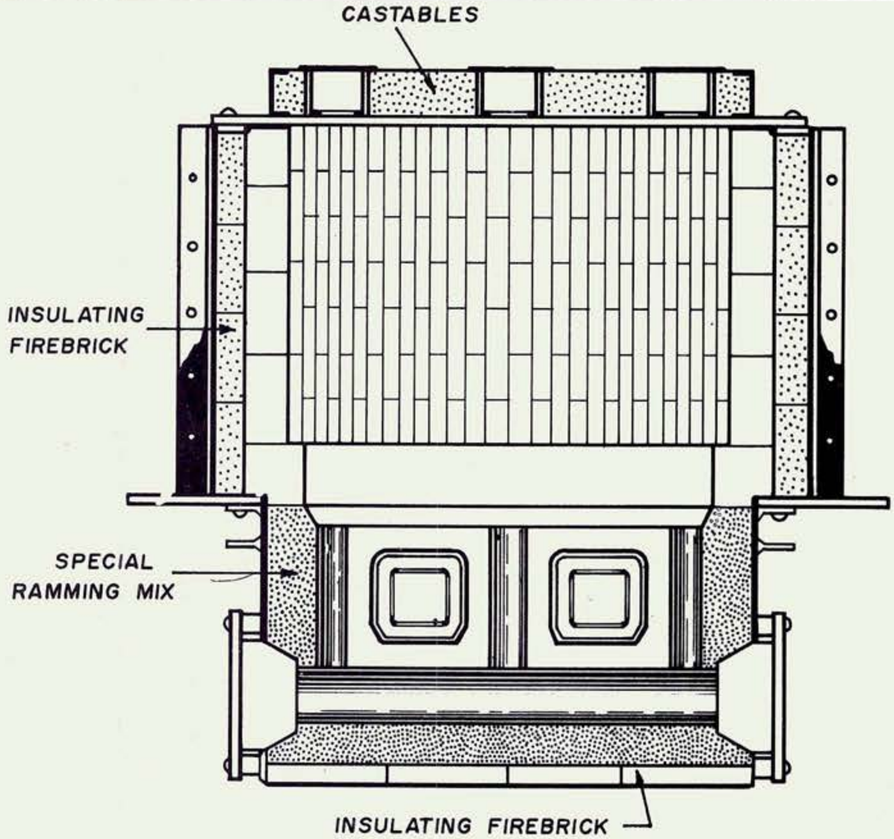
Refractories in Thermal Power Plants
Two types of industrial boiler furnaces are used in power generating plants where the steam is used to generate electric power: (1) those with water walls, and (2) those with refractory walls. Most of the large boilers belong in the first group.

Power-Plant Boilers with Water Walls. "In the settings of water-wall boilers, refractories are used for backing the water tubes, for baffles and seals and for the walls beyond the furnace proper. When the tubes are closely spaced or tangent, the side of the tubes away from the fire is generally covered with a layer of castable refractory. Where there is an appreciable space between the tubes, the exterior portions of the wall are built of close-fitting refractory tile, with a backing of insulating brick, lightweight castable or block insulation. The tile are made of high-duty or superduty fireclay materials, or of high-alumina material depending on the severity of the operating conditions. The walls beyond the furnace proper are often of suspended construction. They are built of fireclay brick, of insulating firebrick or of monolithic refractory material. The floors beneath the tubes generally consist of fireclay tile and block insulation."[3]

Power-Plant Boiler with Refractory Walls. "Few of the more recent power-plant boilers have complete refractory settings. However, older boilers are still in service, in which the combustion chambers and other parts of the settings. are enclosed in solid or air-cooled walls built of high-duty fireclay brick, nine inches or 13-1/2 inches thick, with an outside backing several inches thick of less refractory fireclay brick, insulating firebrick or block insulation. For some boilers, especially the smaller units, the settings are made either partially or entirely of monolithic construction. Either air-setting plastic refractories or prefired refractories may be used for the balance of the setting. For linings which are exposed to direct action of both flame and fuel ash, high-duty fireclay refractories is most suitable. In boiler settings with limited combustion space and operated at high ratings, even superduty fireclay brick may give relatively short life. High-alumina bricks are used for this purpose. Materials used for patching small sections of a lining include plastic refractories, ramming mixes and castables."[3]

Refractories in the Pulp and Paper Industry
Large quantities of steam are used in all pulp mills for such requirements as power generators, digesters and evaporators. Some of this steam is produced in the usual steam power boilers and in the bark-burning boilers.

Chemical pulp used in the manufac-



CORE-TYPE LOW-FREQUENCY FURNACE

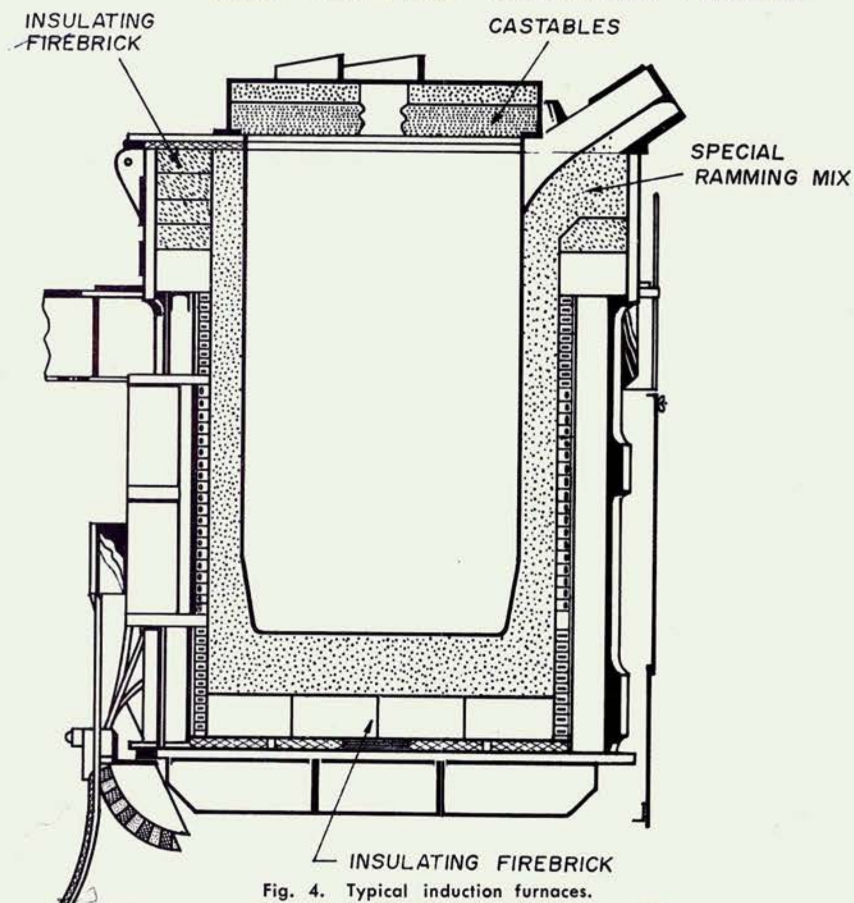


Fig. 4. Typical induction furnaces.
Source: Modern Refractory Practice, p. 385

CORELESS LOW-FREQUENCY FURNACE

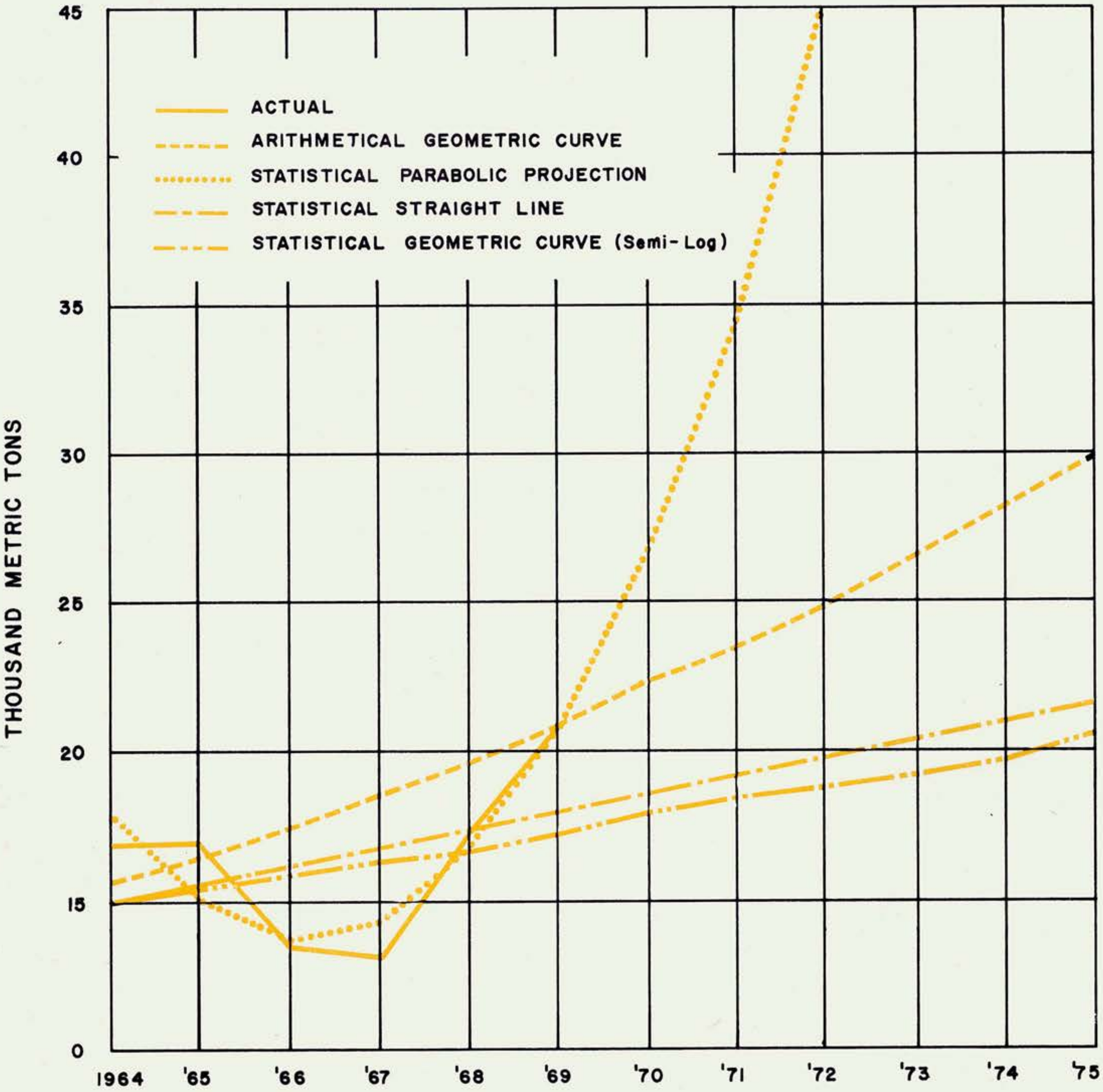


FIGURE 5

TREND FITTING OF STATISTICAL METHODS

ture of practically all types of paper is produced principally by the sulfite, sulfate and soda process.

Sulfite Process. In the sulfite process, refractories are required for lining furnace which burn sulfur or pyrites to produce SO_2 gas used to make acid for the liquor. Refractories for the burner are superduty fireclay and high-alumina brick. Dense, highly impervious, acid towers, accumulators, storage tanks and blow pits, and for the lining and packing of acid reclaiming towers.

Sulfate and Soda Process. Sulfate and soda pulp are produced by alkaline processes and the equipment used in modern mills for both is very similar. In the bottom and lower sidewalls of recovery boilers, chrome bricks are preferred. Chrome castables and plastic refractories are giving excellent service in monolithic bottoms and packing around sidewall water tubes. However, the chrome refractories should not be exposed simultaneously to the action of both steam and the sodium compounds.

Refractories in Gas Manufacture

Manufactured gases most widely comprise water gas, coal gas, producer gas, oil gas and coke-oven gas from the chemical-recovery ovens.

Water gas. The refractory linings of water gas generators are subjected to the corrosive and abrasive action of ash and slag and to severe mechanical treatment. Fireclay and high-alumina bricks are used for this requirement.

Coal Gas. For coal gas manufacture, silica refractories are most often used.

Producer Gas. High-duty and superduty fireclay bricks serve most satisfactorily for protection of shell in the manufacture of producer gas.

Oil Gas. High-duty and superduty fireclay brick give excellent service in linings of regenerators and checker chambers used in making oil gas.

ANALYSIS OF THE MARKET

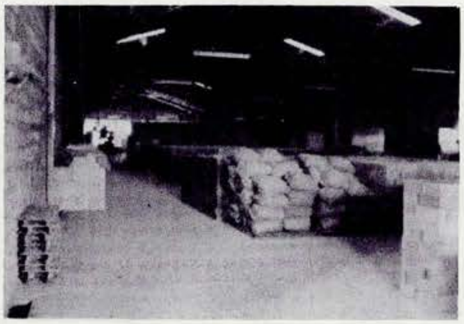
I. DEMAND

The major consumers of refractories in the Philippines are the iron and steel mills, the cement plants and the foundries. Hence, the bulk of our refractory importation goes to the melting and rolling mills and to the cement plants. There are at present six melting and rolling mills (excluding the 22 rolling mills without melting units): Philippine Blooming Mills, Marcelo Steel Corporation, Central Steel, Iligan Integrated Steel Mill, Marsteel Corp. and Union Steel Mfg. Co. Refractory needs of these plants are mostly of the basic and high-alumina type. In the foundries, refractories commonly used are the acid bricks. Most of the foundries are using locally manufactured runner and ladle bricks. On the other hand, the cement industry does not utilize any of the locally produced bricks. To date, no local manufacturer has come up with refractories which could meet the requirements of the cement industry. There are thirteen operating cement plants and they use mostly magnesite, high-alumina and chrome-magnesite bricks.

The sugar centrals and the glass industry also consume a sizable amount of refractories. The 32 sugar centrals are using superduty fireclay and high alumina bricks for their boilers. Of the seventeen reported glass companies, only the five big ones were considered in this study. Refractories used in the glass industry are varied. Special types are most often used. These are fused-cast zirconia-alumina-silica, forsterite, fused cast refractory containing both alpha and beta alumina.

The thermal power plants which use only imported refractories for their boilers were also included in this study. Most of the refractories used are fireclay bricks and castables.

Minor consumers of refractories are the pulp and paper mills, petroleum refineries, nonferrous metal industry, fertilizer plants and textile industry. Refractory application in these plants are limited to boilers and heat treating ovens.



Finished products (firebrick and refractory mortar) ready for delivery. Courtesy of Diamond Ceramics.

Table II shows the refractory consumption from 1965 to 1969 broken down to major industry users. Consumption was determined by the use of stratified sampling. This method was employed because of difficulty in obtaining consumption figures from the 257 firms using refractories. The bakeries which are also using refractories were not considered in the study since most of them utilize second hand bricks. Based on these consumption figures the demand for the next five years was projected using the following methods: arithmetical geometric curve, statistical straight line, statistical geometric curve and statistical parabolic. The projected demand resulting from the different methods used are shown in Table III and Figure 5. It may be noted from Figure 5 that the method best suited for this particular application is the arithmetical geometric curve.

II. SUPPLY

Local Production

Historical background. The refractory industry in the Philippines dates back to 1954 with the establishment of International Ceramics. In 1962, production of ceramics was partly stopped by the company. Under a new ownership, the company is now known as Security Industries Corp. and is solely engaged in the manufacture of refractories. Their product list includes low duty and superduty fireclay bricks, insulating bricks, bonding mortar and refractory cement. It is at present in the process of recapitalization.

The second plant, Ceramica Enterprise, was set up in 1958 in Sampaloc Avenue, Quezon City. In September 1963, the company name was changed to C.E. Firebrick under a new ownership. However, the company was forced to stop its manufacture of refractories in 1964.

Another plant, Pioneer Ceramics, was set up in 1959 but stopped refractory production in 1962 and since then have concentrated production on floor tiles and other ceramic products.

In November 1962, another plant started operations. This plant, Firestone Ceramics, is located near the NDC compound in Sta. Mesa. It produces fireclay and silica bricks, mortars, insulating materials and castables. The acquisition of new equipment this year is expected to double the plant's annual capacity.

The most recent company to join the refractory industry is Diamond Ceramics. The plant is in Barrio Pamplona, Las Piñas. It started operations in May 1969 and is not yet operating in full capacity. The plant turns out low duty fireclay bricks, insulating materials, mortar and castables.

Two companies have plans of setting up refractory plants within the next two years. One is a specialties plant which will be engaged in the manufacture of mortar, plastic products, ramming mixes and castables. The plant will be using only imported raw materials. The second proposed plant has included in its product list high-alumina, silica and chrome-magnesite bricks. Local raw materials will be used except for bauxite which will be imported. Both plants have plans of teaming up with foreign refractory firms.

Firms in the Industry. There are at present three firms engaged in the commercial production of refractories. Two of these firms are using 100% local raw materials while the third is importing part of its raw material from India and Africa. Only two types of refractories are presently being manufactured by these three firms, namely: fireclay bricks of the alumino-silicate group and silica bricks.

Four other firms are manufacturing refractories for their own use. These are Philippine Blooming Mills, Marcelo Steel, Fil-Hispano Ceramics and Mariwasa Corporation. Marcelo Steel started manufacturing runner bricks in 1956. At present they also make ladle bricks of P.C.E. 29-30. Philippine Blooming Mills which started manufacturing runner bricks in 1964, is now turning out checker bricks as well. They also have plans of going into ladle bricks production to fill their requirements.

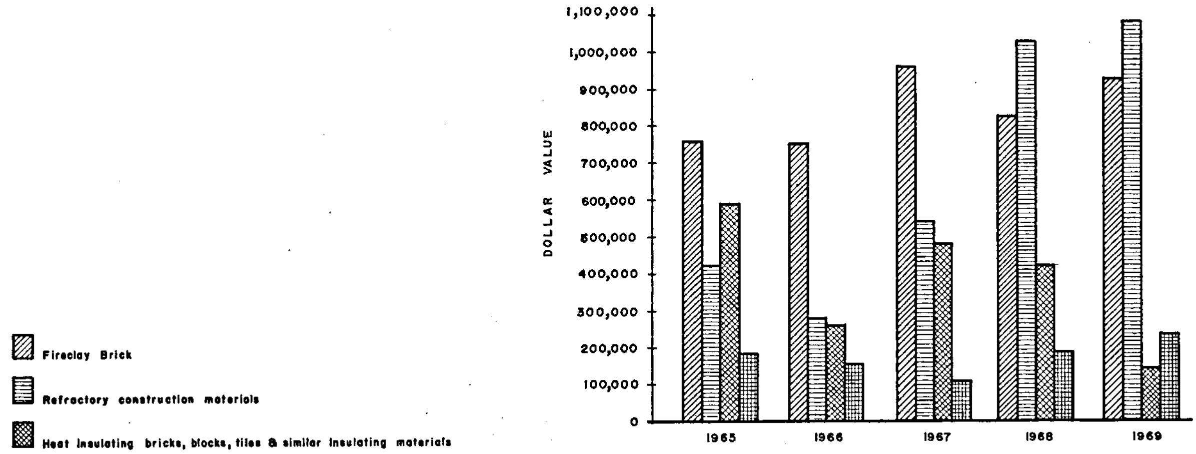


FIGURE 6

IMPORTATION OF REFRACTORIES

SOURCE: CENTRAL BANK

Fil-Hispano Ceramics has long been manufacturing saggers and plates which can withstand temperatures of 2192 to 2282°F. The latest to join the field was Mariwasa Corporation, a glazed tile manufacturer. In 1969, the firm started making its own saggers and plates that can withstand temperatures of 2280°F. Still another firm, Master Steel, has plans of producing their own runner bricks. At present they make reclaimed bricks from their used firebricks.

Importation

At present the market for local refractories is limited to the foundries and a small percentage of the sugar industry. The bulk of our refractory requirement is still filled through importation. Fig. 6 shows the steady increases in refractory importation from $1,945,039 in 1965 to $3,107,431 in 1969.

The major sources of our refractory imports are the United States and Japan. This year, 1970, more companies are using British refractories which are reported to be cheaper than the Japanese brands.

The refractory raw material resources of the Philippines and refractory technology will be featured in the next issue.

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ANTONIO GIMENEZ

FOUNDRY SAND PROPERTIES: The Need for Its Control

In the sand casting of metals there are three basic control points, the control of metal composition, of melting conditions and of molding sand properties. This paper will deal only with the last control point, the control of sand properties in the Philippines.

By definition, sand are grains of mineral matter with sizes ranging from 0.01 to 0.05 mm. in diameter. Its composition can be varied. The most common, however, is silica sand. This is due to the chemical nature of the silicon and its special affinity for oxygen. Because of its common occurrence, silica is the most inexpensive (₱50.00/ton) and is therefore the most commonly used basic material for foundries.

Silica sand can either be naturally bonded or in synthetic mixes. Naturally bonded sand must contain at least 75 percent SiO_2 while synthetic mixes use high purity silica sand containing 98 per cent SiO_2. Silica is very cheap, has very high refractoriness but low thermal qualities. When heavy steel castings are to be made, materials possessing superior thermal stability are therefore used. These can be zircon, chromite or olivene.

Zircon ($ZrO_2 \cdot SiO_2$) is a main constituent in igneous rocks although this is also found in certain metamorphic rocks. Zircon deposits with varying amounts of $ZrO_2 \cdot SiO_2$ from 20 per cent to 40 percent are abundant in Australia, India and the United States. These are in association with rutile, monazite and ilmenite. Zircon sand used in foundries is a by-product of monazite concentration. These are separated either by oil flotation or by electrostatic method.

Zircon's innate properties have made it popular in some steel foundries. Zircon is not melted by molten steel and has a high chilling power. Unlike silica, it has a low coefficient of thermal expansion. It is made of 67.2 per cent ZrO_3 and 32.8 per cent SiO_2 athough in actual practice, 1.5 per cent Al_2O_3 and traces of impurities like Fe_2O_3 and TiO_2 may be present. Zircon with a specific gravity of 4.75 dissociates above the temperature 1,550°F but this does not have any detrimental effect on the castings. Zircon sands are locally used by five big steel foundries — AG & P, Philparts, Union Steel, MA Foundry and NASSCO.

Chromite sand because of its ready availability is very popular locally. Chromite sand is derived from chrome ore, crushed and graded, or from fines from wemco classifiers. This has found application as facing material in molds and core sand. Like zircon, it is not easily wetted by molten steel and has a lower thermal expansion than silica — 0.007 in/in. as opposed to silica's 0.024 in/in. It is however, inferior to zircon which has a thermal expansion of 0.003 in/in. Typical chemical analysis of chromite sand is 45 per cent Cr_2O_3, 25 per cent Fe_2O_3, 10 per cent MgO, 14 per cent Al_2O_3 two per cent SiO_2 and small amounts of CaO, MnO, and TiO_2. It has a specific gravity of about 4.50.

At present olivene is not being used locally. Two years back, however, AG & P used olivene in their foundry operations. Olivene is a genetic term for various combinations of fayalite ($2FeO \cdot SiO_2$) and fosterite ($2MgO \cdot SiO_2$). Most suitable for foundry use is olivene which is high in fosterite content. Majority of the world's olivene supply comes from Norway and the U.S.

PROPERTIES AND EVALUATION OF SAND MIXTURES

Foundry sand is used for making molds and cores. Thus it is most important that it meets the main requirements demanded of it. For mold and core making the sand must be:

1. amenable to shaping processes such as ramming around patterns and core boxes;
2. the rammed mold and core must be able to retain their shapes and rigidity until the casted metal has formed a strong solid skin;
3. it must resist fusion with the metal.

The sand mixture must be consistent in fulfilling these requirements so as to produce consistently good castings. American practice, which is also common local practice, is to test and control its mechanical properties while European practice stresses the importance of chemical properties. Europeans have recently assimilated American methods.

Chemical treatment of molding sands are divided into two parts:

1. the treatment of bonds (bentonites) by producers to alter viscosity and mechanical properties, and
2. the control of acidity and alkalinity of molding sands.

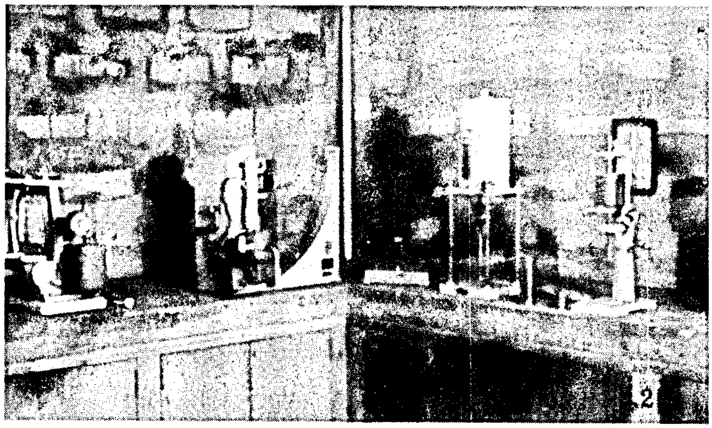
These two factors control the dispersion of clay particles. The mechanical properties of molding sand are divided into:

1. base properties
2. green properties
3. air set properties
4. dry properties
5. hot properties
6. retained properties
7. heat transfer properties

Base Properties—Base properties are mechanical properties inherent in the sand such as grain size, shape, distribution, permeability, its chemical composition and stability.

As mentioned earlier, composition of foundry sand may be zircon, olivene, chromite and others with the most commonly used material being silica (SiO_2).

Composition directly influences the sand's refractoriness and chemical inertness when in contact with metal. Chemical analyses of sand are, however, very seldom done. Silica-based sand (like lake and bank sands) have small amounts of iron, magnesium, sodium, potassium, aluminum and other compounds. These generally have no adverse effects on the mold unless lime is present in which case the refractoriness of silica is lowered. If the lime is granular, it may liberate carbon dioxide in small quantities and cause pin holes on the casting surface. Zircon, chromite and olivene have no known adverse effects on sand properties.



(1) Silica sand mining by hydraulicking. (2) Sand Laboratory Equipment: Rotary clay washer, Universal sand strength machine, Balance, Perimeter Specimen Rammer and Moisture Teller. (3) Rotap Seive Shaker & Sand Mixer. (4) Casting defect due to sand rough furnish, fused sand, drop & rattail.

In order to be reliable, the sand must have enough strength to resist fracture during handling, mulling and molding. This property is called stability. Silica, zircon and chromite display good behaviour during these operations while coke and olivene have tendencies to be less durable.

When the sand is subjected to heat, it induces dimensional changes in the sand grains, often causing mold fractures. This is one major defect of silica sand, although its expansion can be controlled to prevent failure. Zircon, chromite, coke and chamotte sands are rarely affected thermally because they have lesser co-efficients of expansion.

Grain size, shape and distribution are very important base properties of foundry sand. Grain size is measured by AFS standard screen analysis. Fineness of sand grain on the other hands, is expressed in percentage by weight of a sample that is contained in each US standard sieve.

The grain fineness number of sand is the mesh number of the screen that would just allow a grain that represents the average of the sample to pass. Computation of grain fineness number is shown in Figure 1. It is approximately proportional to the surface area per unit weight of sand, exclusive of clay. Grain shape is also influential in this surface area to weight relationship.

Grain size and distribution have a direct influence on porosity, strength, permeability and refractoriness. A wide distribution of sizes would give less porosity while a narrow distribution of coarse or medium fine sand would give optimum porosity and permeability. It was found that as the sand gets coarser, its bonding, hence cohesive properties decrease at the same time that silica content which adds resistance to fusion increases. It was also found that to develop a narrow or a very broad range of grain size will require large percentages of binders than will a moderate screen-spread sand.

The shape of the sand grains directly influences pore space. These could be angular, rounded, sub-angular and compound-shaped as shown in Figure. 2. The rounded grains effect closer packing and less pore space while irregularly shaped grains have a more open packing. This in effect influences permeability and plasticity of the sand since the rounded grains give maximum flowability and higher permeability.

Permeability of sand reaches its maximum when the grains are large, uniform in size and spherical in shape. Base permeability of sand may be calculated by the following formula:

$$\text{Base Permeability} = \frac{SD\ (714)^2}{3 + M}$$

Where S — 1.0 for rounded grains and 0.8 for angular grains
D — 0.66 for 3 screen sand and 0.50 for 4 screen sand
M — AFS fineness number

From the formula, it is obvious that uniformly sized and rounded grains give higher permeability as compared to a sand mixture with a broad range of sizes.

Green Properties: The green properties of molding sand are green compressive strength, green shear strength, green tensile strength, green permeability, green mold surface hardness, green deformation, green flowability, green density and stickiness.

Green strength (compressive, shear and tensile) is the maximum stress (compressive, shear or tensile) which a tempered sand mixture is capable of sustaining when prepared, rammed and tested according to standard procedures. The green strength of sand is largely controlled by the quantity or quality of clay present in the sand mixture. Such relationship is shown in Figure 3. Figure 3 also shows maximum strength obtained at six per cent Western Bentonite, 30 percent Southern Bentonite, 20 per cent Fireclay and 35 per cent silica flour.

The clay factor also determines the amount of water needed to temper the sand to its most favorable working conditions. The relationship of green compressive strength of Western Bentonite to water in mixture is shown in Figure 4. Highest green strength is attained when moisture content is slightly under the best temper, on the dry side. Excess moisture decreases green strength. The sand's green strength helps to evaluate the green bond strength and tells the foundry man if the sand is strong enough to be used for molding.

Green permeability -- a measure of the freedom with which a molded mass of sand in a moist or tempered condition permits gases to pass through. The finer the sand, the lower the permeability.

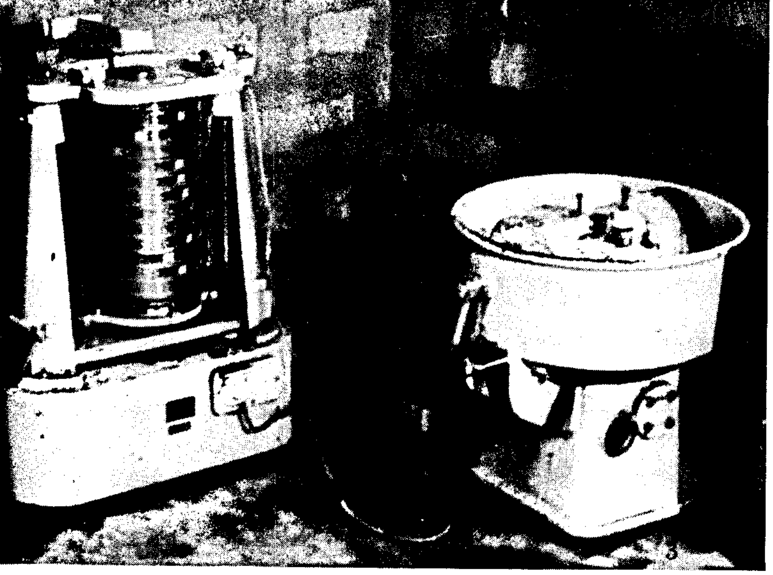
Casting finish and permeability are also related since higher permeability would require coarser sand, thus a coarser casting finish.

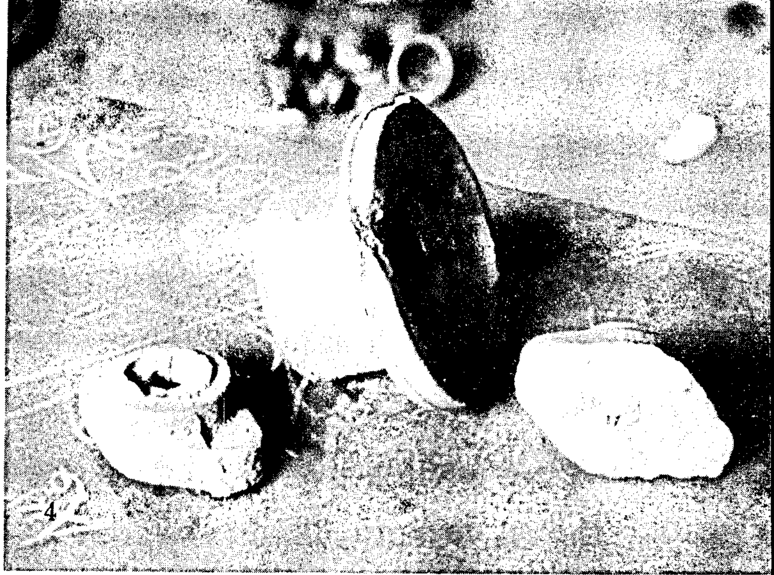
Green mold hardness affects the ability of the sand mold surface to withstand the ferrostatic pressure of the metal. It also has an effect on sand mold permeability and strength and influences scabbing, buckling and rattailing tendencies. In addition, it influences casting contour which in turn affects casting weight. Mold hardness is also a method of checking uniformity of ramming or squeezing.

Green deformation is a measure of the sand's ability to deform before rupture, expressed in inches per inch. It indicates the plastic value of a mixture used in developing green strength. A sand mixture with low deformation is usually brittle. Thus it is more desirable to have a sand mixture with high deformation even if it is more difficult to ram because it can stand more abuse before breaking. On the other hand, an extremely high green deformation will result in a soft, open mold which does not follow the contour pattern perfectly.

Green flowability refers to the movement of sand grains in a tempered mixture when they are subjected to molding forces. It is an indication of how readily the sand grains will flow into the mold cavities while under pressure. Flowability is usually higher at low and high moisture contents than at temper moisture as shown in Figure 5. As the strength of the sand increases the flowability decreases. Flowability likewise decreases with the increase of fines and poor grain distribution.

Green density of a sand has a marked influence on other physcial properties. Denser sand increases green strength and





decreases permeability. Mold hardness is also increased. The density of sand can be controlled by:

1. grain distribution of the base sand;
2. the type and amount of bond used with it; and
3. the type of additives used.

It should be noted that high density promotes tendencies towards scabbing, buckling and rattailing.

Air Set Properties: Air set properties indicate the strength of the sand under atmospheric conditions after molding. It is defined by the air set strength of the mold. To measure the air set property of a molding sand, we measure the sand's compressive strength with a conventional sand strength testing machine. An AFS rammed specimen is set in a 1/4 in. thick glass plate and allowed to dry for an hour, then up-ended and allowed to dry for another hour. The specimen is then placed in a strength testing machine to determine its compressive strength.

A 20 psi air set strength of molding sand, cereal binders highly soluble in water like dextrine are added. Another way is to add ample moisture.

Dry Properties: Dry properties of sand consist of strength and permeability. Dry permeability is the permeability of a molded mass of sand containing AFS clay or binders which have been completely dried at 220° to 230°F (105° to 110°C) and cooled in a desiccator at room temperature. To test for dry permeability, one uses the usual permeability meter with a holder which seals the specimen in a mercury well.

Dry strength is the maximum strength of sand after drying at 220° to 230°F and cooling at room temperature before breaking. Dry strength is required so that the mold can withstand heavy core loads and foot traffic. At the initial stage of pouring, it is only the dry strength of the sand that resists the erosive force of the molten metal. At this stage, the force exerted is at its greatest.

The best range for dry strength should be determined on the job. However, the following figures can serve as a rough guide: For light metals (light iron, non-ferrous and malleable work), a dry compressive strength of 30 to 80 psi; for heavier bronze and iron, 50 to 125 psi range; for steel and iron, a dry compressive strength of 150 to 300 psi. The relationship of moisture to dry strength is seen in Figure 6 which shows increasing dry strength with moisture content as opposed to green strength and permeability whose peaks are reached at three and five per cent, respectively, then go down with increasing moisture.

Since dry strength is very important, it should be considered as one of the basic control points together with green strength, permeability and moisture. There is no correlation between green and dry strength whatsoever and one cannot be controlled by controlling the other.

Hot Properties: Upon pouring, the "entree" of the molten metal into the mold places the sand into the hot property field. Most important among the hot properties are expansion, hot strength, hot deformation and hot sand toughness. These properties have to be controlled in order to have a good casting.

Expansion of sand can be determined by two methods — by dilation and by shock expansion. The expansion of materials by dilation is determined with gradual heating. Shock expansion is preferred by most foundries since this is representative of what happens during pouring.

Shock expansion testing consists of heating the furnace to 1,800°F. Specimens of rammed hardness as used in the foundry are inserted between the posts at 15 second time intervals. A load is applied by means of a manual oil pump which may be equipped with a dilatometer. The magnitude of expansion is relative to the composition of sand. The expansion value is useful in controlling sand for iron and steel castings to eliminate mold wall fracture scrap such as scabs, buckles or rattails.

Hot strength is dependent upon the type of bond, grain size, moisture, additives, degree of ramming, atmosphere and degree of spalling. It is usually controlled by proper selection of binders, fines and additives.

Maximum hot strength is obtained by a mixture of fireclay, western bentonite and silica flour. Medium hot strength can be derived by using a mixture of western and southern bentonite and an addition of cellulose material. Low hot strength is derived from a mixture of southern bentonite and cellulose materials.

The grain fineness effect on hot strength is to reduce it as the grain size increases. The general rule is that the smaller the grain size the higher the hot strength for temperatures between 500 and 2,000°F inclusive.

Ramming also directly influences hot strength. The hardness to which the mold is rammed is directly proportional to the strength. Hot strength at all temperatures increases as squeeze pressure (psi) is increased.

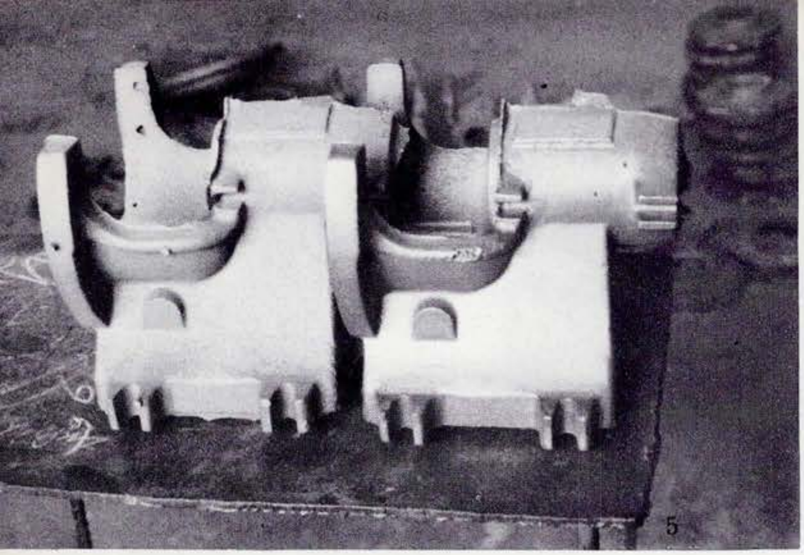
For control and testing hot strength of molding sand is tested in a 1-1/8 × 2 in. specimen (double end ramming) with standard or foundry hardness. The specimen is soaked in the furnace for 12 hours and loaded at standard rate. With a ceramic vehicle, loading is from 30 to 750 psi in 15 seconds. Soaking temperatures are at 500°, 1000°, 1500°, 2000° and 2500°F.

Hot deformation can be expressed as the shortening per linear inch. Sand with high hot deformation value is described as high plasticity or the ability to accommodate a great degree of expansion without mold fracture.

Factors that affect hot deformation are moisture content and the additive used. Additions of seacoal, pitch, cellulose and cereal increase the hot deformation rate. High moisture content will give low deformation while sand tempered on the dry side will have a higher deformation.

Hot sand toughness is used to express the amount of punishment a mold wall can withstand in reference to toughness. Hot sand toughness factor is expressed as a product of ultimate hot strength and ultimate hot deformation times 1000. As a guide, hot toughness at 2000°F from low to high order can be derived from the following mixture: four per cent southern bentonite, four per cent western bentonite and 12 per cent fireclay. 1.75 per cent western bentonite, 1.75 per cent southern bentonite and 3.5 per cent fireclay.

Retained Properties: As the word implies, retained properties of sand are those physical properties of sand after shake-



(5) Casting defect—blow holes. (6) Quezon Silica rocks. (7) The author shown seated on top of the Silica rock deposit — Tagkawayan, Quezon. (8) Palawan Silica sand deposits.

out. Of these, the most important and the only property we are concerned with is retained strength. It is defined as the sand strength remaining after the molding sand has been subjected to shock heating. The compressive strength test is used to determine this particular property.

In any foundry, high and low retained strength of sand are both desired and have their own places. The decision is in the choice of products and in the amount of temper water required. The control of retained strength lies in several factors. These are grain fineness, density, composition, heat flow time, types of bond, facing additives, moisture content, pouring temperature, standing time and venting.

In general more fines increase retained strength as does excess water.

Bonding materials and some additives usually increase retained strength. Western bentonite and fireclay have more retained sensitivity than southern bentonite mixtures. Corn flour, wheat or rye cereals generally add to retained properties. Seacoal also increases retained strength as do organics such as molasses, water, gluetrin water and others.

If low retained strength is so desired, the best way to avoid high retained strength is to use cellulose additives such as wood flour. If water is not increased with wood flour additions, retained strength drops drastically. With the exception of cereals, any other cellulose addition reduces retained strength. It is therefore advisable to study this effect to obtain the desired effects.

Heat Transfer Property: Finally, the cast property desired in a molding sand is its heat transfer property. This is the rate at which the heat travels further into the mold as the casting solidifies.

The factors that influence this property most are the size of casting and the standing period, sand permeability and moisture. Permeable sand transmits heat faster than impervious sand, while dry sand becomes slightly hotter and transmits heat more readily than green sand.

The large castings carry more heat and require longer standing time because the sand has to absorb and dissipate more heat. The larger castings bring the sand to baking range quickly and longer standing period raises it to collapsibility range. Small castings, on the other hand, do not have enough heat to bring the sand beyond baking. Aside from this, the sand will not reach collapsible range no matter how long the standing period is allowed.

These and all the other properties previously mentioned have to be controlled to give good sand casting. Only after all these properties are controlled can one say that complete sand control has been achieved.

NEED FOR CONTROL

Control of sand properties in the Philippines is not highly appreciated. Out of the 150 foundries only about 25 have some kind of sand testing equipment. And these are confined mainly to steel foundries. (60 per cent of the 25 to steel foundries. 32 per cent to cast iron foundries, four per cent to non-ferrous foundries and four per cent to malleable iron foundries). Most of the equipment are universal and strength machines, permeability testers, moisture tellers and rotaps for sieve analysis.

Local sand control practice are limited to green strength, air setting strength, dry strength, moisture content, permeability, and sieve analysis. There is very little or perhaps no control of hot properties, heat transfer properties, retained properties, sintering point, flowability of sand and deformation.

This lack of control would explain the high percentage of casting defects that can be attributed to improper sand mixtures. Defects such as metal penetration; broken or cracked castings; crushes or push-ups; gas defects; fusion; carbon flotation; misruns and coldshots; rough surface; hot tears; erosion scabs; warp castings; swells forms: strains and sags, and cuts and washes, are common among local foundries.

Metal penetration is caused by improper grain size distribution and low flowability. Broken or cracked castings can be due to poor sand collapsibility, low sintering point coupled with high hot strength and low green deformation. Slow heat transfer causes misruns, poor collapsibility causes hot tears, erosion scabs are due to low hot deformation and high moisture content, gas defects such as pinholes, blows and others are caused by low permeability and high moisture content. High moisture content also causes misruns and coldshots and together with low formability this causes rough surface. Low fusion point can result to fusion, inclusions of slags and dirt, hot tears and rough surface. Drops are caused by low flowabilility and low dry strength. This together with low green strength causes crushes and push ups; cuts and washes. Low green strength together with high hot strength and low green deformation also tends to give warped castings. All these defects can be critical depending on how extensive they are.

To minimize these defects, it is essential to institute sand control. Aside from this, the other factors such as melting and metal compositions has to be controlled also.

Sand control should start from the source of sand or the supplier and maintained throughout molding and pouring. Reclamation of the used sand (silica) and naturally bonded sand are seldom processed. Grading and processing of local sand is rarely done. It is quarried and sold directly to users as is. Silica sand are oftentimes washed but grain size and size distribution are left to the user. Composition and impurities are seldom if ever controlled. There is a need for a local sand processing plant if ever we hope to equal the quality of imported castings.

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Production of small lots of many different parts can be streamlirted by grouping parts according to common characteristics

GROUP TECHNOLOGY* a new approach to MANUFACTURING

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Widely developed in Europe but almost known in North America, is a method of manufacturing known as Group Technology. It is based on the fact that small lots of different parts can be produced much more economically if they are grouped and scheduled for production according to common characteristics. It usually goes hand-in-hand with a careful review of classification and coding of drawings, parts, and production methods throughout the plant or corporation. When successfully applied, the technique allows large batches to be manufactured in close sequence following the same patterns of operations and using the same tools, fixtures, and machines.

Since the advent of group technology, several procedures of establishing families of parts have been developed and introduced, depending on the character of the products made in a shop, and on the extent to which this new technology is to be installed.

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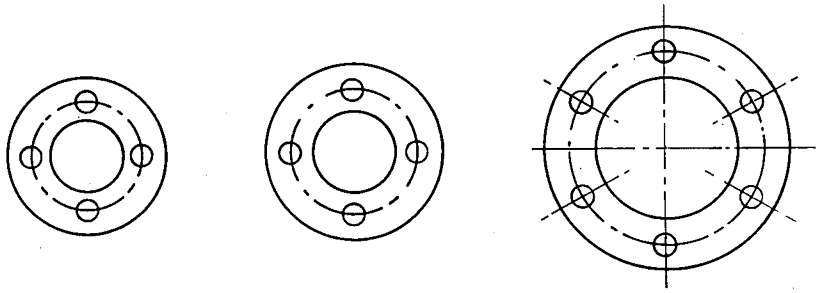


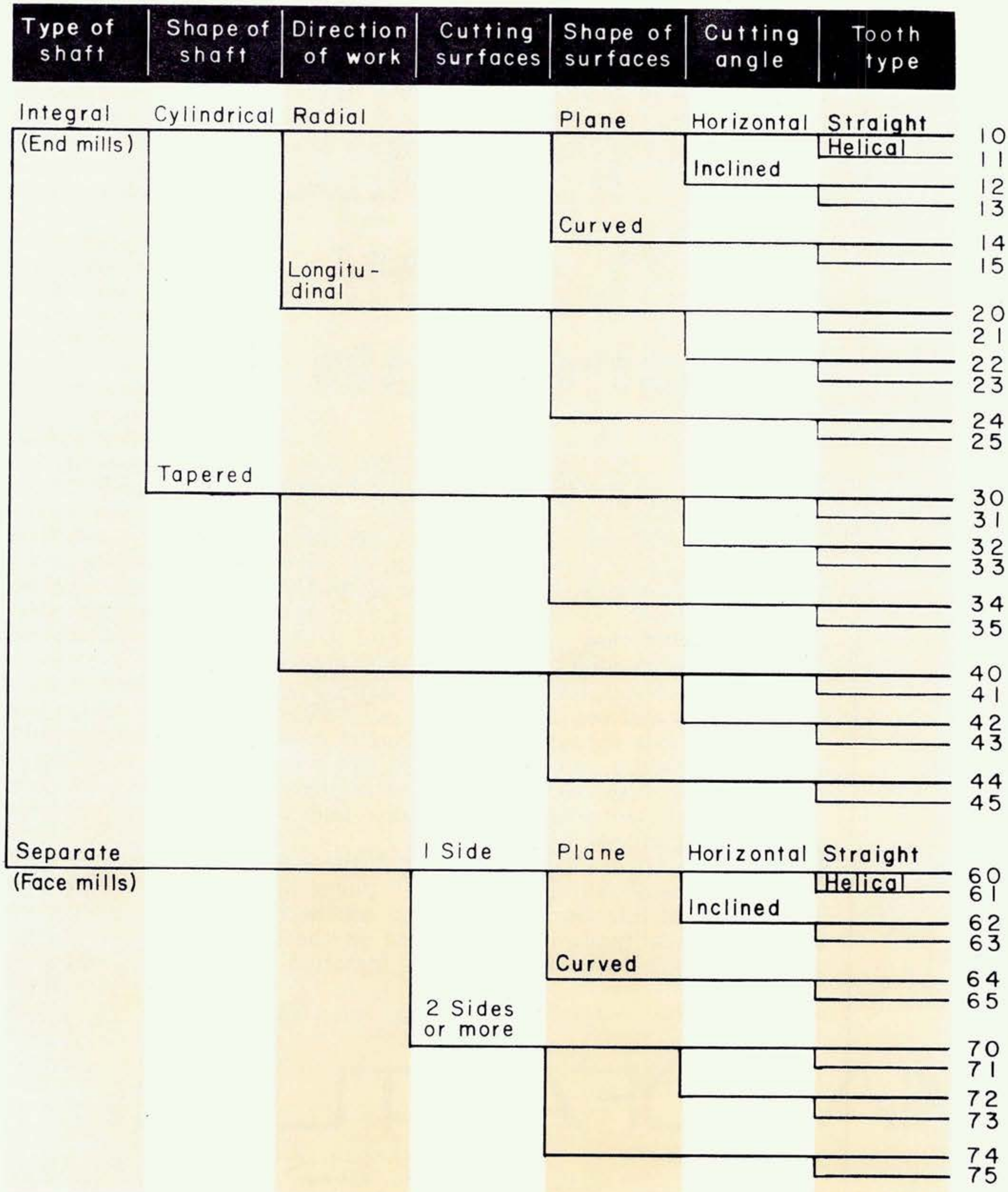


Figure 2. In some cases a classification system can be based on the principles of logic and set-theory as shown here for milling cutters.

Some companies have experimented with this innovation on a minor scale before completely reorganizing their numbering, manufacturing, production planning, and control system. They simply grouped together parts by function, such as bushings, base plates, flanges, gear wheels, bearings, and end shields of electrical motors. One manufacturer of milling cutters in India started by studying just two operations that had to be carried out on all form cutters-hobbying the slot, and grinding the inner cylindric hole after hardening. A camera manufacturer redesigned the lens rings from this view-point, a company making internal combustion engines improved three of their machining operations for their various connection rods, a producer of fans standardized the turning operations of their rotor shafts, and a manufacturer of semiautomatic lathes developed a universal fixture for drilling certain holes in to all their cams.

It is important to note that some parts with the same name do not have the same function and shape. Inversely, parts of the same function may have been given different names. A slightly extended search for additional family members that are not so closely related may be useful at this stage.

The principle of grouping parts into sets for economic manufacturing can be extended to parts of different functions. This task can be carried out by the production engineering department and requires a certain organizational effort. Parts of similar shape are collected during a search through the stores and shops of a plant. As an alternative, an analysis of the drawings may be made. With such a wide sweep, the number of families will grow as well as the number of members in a family. The family size may vary between 10 and 60, but large groups of more than 200 individual parts have found their way together occasionally, Figure 1.

The first steps in this technique were taken by Mitrofanow, Reference 1, in an effort to use the turret lathe more rationally. Further development attained high perfection and showed the technique to be applicable to a number of machining operations.

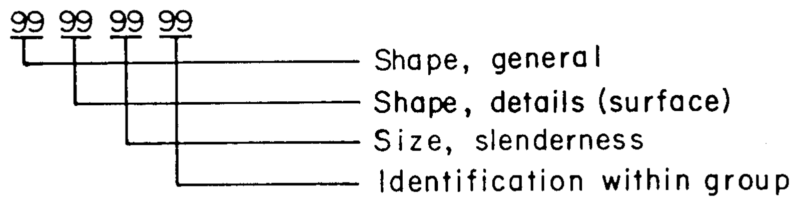


Figure 3. A group technology code number identifies shape, size, and the relation of the part to the family or group.

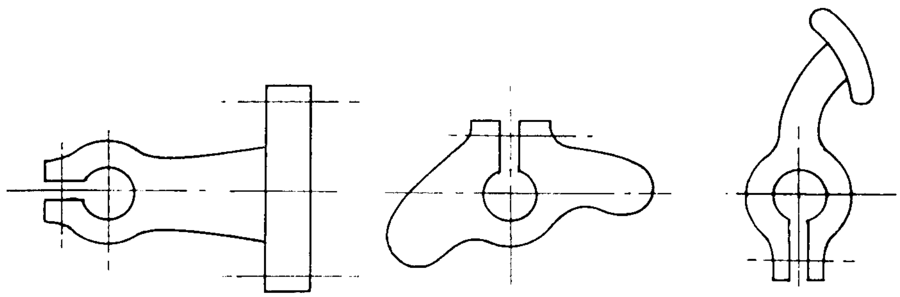


Figure 4. Sometimes parts can be grouped according to certain operations they need. These levers all require the same slitting operation. Grouped according to shape, they would never have found their way together.

SYSTEMATIC APPROACH TO CLASSIFICATION

A systematic approach to create order among the parts in a shop was conceived by the late E. G. Brisch. It starts in the drawing, standardization, and product engineering department, from where it influences practically all manufacturing functions. As a first step, a code is designed for the classification and enumeration of parts according to their shape and size so that parts of similar shape will automatically find their way together. This kind of industrial classification will soon become an important activity in industrial engineering.

In Germany, considerable effort was made to design a classification system that could be used throughout mechanical workshops. Some companies specializing in certain products or components preferred to design their own system adapted to the particularities of their products, such as tools, electrical components, and valves.

In certain cases, a natural system of classification may be found as in the case of milling cutters, Figure 2. In other cases, a more or less arbitrary system will be developed. The number of digits used may be between 6 and 10, although codes of up to 15 digits have been introduced to provide detailed description of a great variety of parts. Figure 3 shows an example of a code and the meanings of different digits.

A few cases have been reported where parts are grouped according to special operations, such as slitting, tapping, and grinding. Parts classified according to shape would never have found their way into such groups, Figure 4. In this case, the production engineer opened the road to universal tools and fixtures designed for families linked together by a special characteristic. Attempts have been reported to group parts simply according to the order of operations. The aim is to accelerate the production flow through a department that is laid out specifically for such production. This helps to reduce in-process inventory.

INTRODUCING GROUP TECHNOLOGY

Introduction of group technology may affect wide areas of an enter-

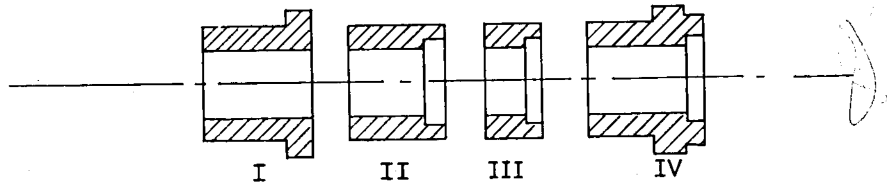


Figure 5. Part number IV contains all the characteristics of Parts I through III. Tooling and estimating for IV will take care of all the other parts.

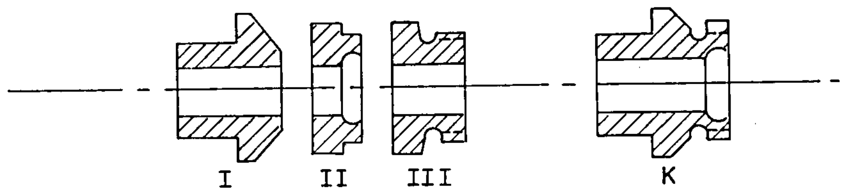


Figure 6. In none of the parts I through III can all the peculiarities of the group be found, so a fictitious part K is designed for production planning.

Table I. Typical savings that companies have actually realized through the application of group technology.

Size of group of family	10 to 300 parts
Savings in time and costs:	
—For tooling and estimating	10 to 40 percent
—Time per piece	30 to 50 percent
—Setup time	up to 60 percent
Other savings:	
—Number of fixtures	20 instead of 100
—Reduction of waste	up to 40 percent
—In-process inventory	up to 50 percent
—In-process time when changing over to family-wise layout	up to 80 percent
—Number of drawings not required	5 to 10 percent

prise, depending on the extent to which it is applied. Considerable preparatory effort is required, including the training of staff to get acceptance of the expected changeover.

Machine shops that manufacture specialized equipment, such as cranes, chemical and textile processing equipment, and custom machine tools should recognize group technology as a major breakthrough which is very helpful if introduced properly.

A central coordination and codification office is established to design a code system after studying a very large sample of drawings. All the drawings and parts — often numbering up to 50,000 — will receive a second number. Some companies use microfilm with that kind of work. As a by-product, standardization of certain parts and even of details such as chamfers, radii, key seats, and slits may be accelerated. Drawings of nearly identical parts are eliminated in favor of one standard part. These investigations may be accompanied by a statistical survey analyzing the dimensions, proportions, and surface qualities of the parts manufactured, and of their volume to find out which items should receive preferred consideration.

On entering the second phase, all the designers and draftsmen are invited to send a rough sketch of each part they intend to design to the coding office. The office returns it with a code number for that part and, possibly, a few drawings of similar parts of which one might do the same service after a small alteration or additional operation. As a result, five to ten per cent of the proposed drawings need not be drawn at all. In large enterprises this may figure up to a savings of 5000 drawings and new parts each year.

Once a number of families have found their way together, either by a classification system or simply by inspection, the production engineering department can look forward to a number of promising tasks, Figure 5. Since the parts in a family are of similar shape, it may become possible to use forge or injection-molded parts rather than cutting them out of bar stock. This would result in considerable savings in material and machining time. Savings of up to 40 per cent in material have been reported.

Process sheets and lists of operations (route charts) of the family members are compared and usually a great and undesirable variety is discovered. A new kind of work simplification or standardization of operations can be introduced here. The best method of manufacturing the whole family is developed, either by combining the best elements of the previous methods or by completely redesigning a new sequence of efficient operations.

In certain cases a so-called complex part is designed. This part has no mechanical or physical function but it combines the geometric characteristics of the family, Figure 6. Tooling and estimating is done carefully by selecting the best operation, process, tools, and machine for this fictitious part. The list of operations for the individual members of the family can be derived easily from such a master plan.

Tools and fixtures are designed for the whole family. Dozens of obsolete jigs are scrapped and replaced by high performance and possibly power-operated fixtures. Some of them may be permanently fixed to an older machine tool, converting it to a special single-purpose machine tool for the entire group. One boiler manufacturer first standardized the method of describing the dimensions and shapes of their boiler tubes and out of that developed a fully automatic tube-bending machine.

With more and more numerically controlled machine tools being used and by combining their facilities with those of group technology, programming and tape punching is no longer done for the individual part only, but for the

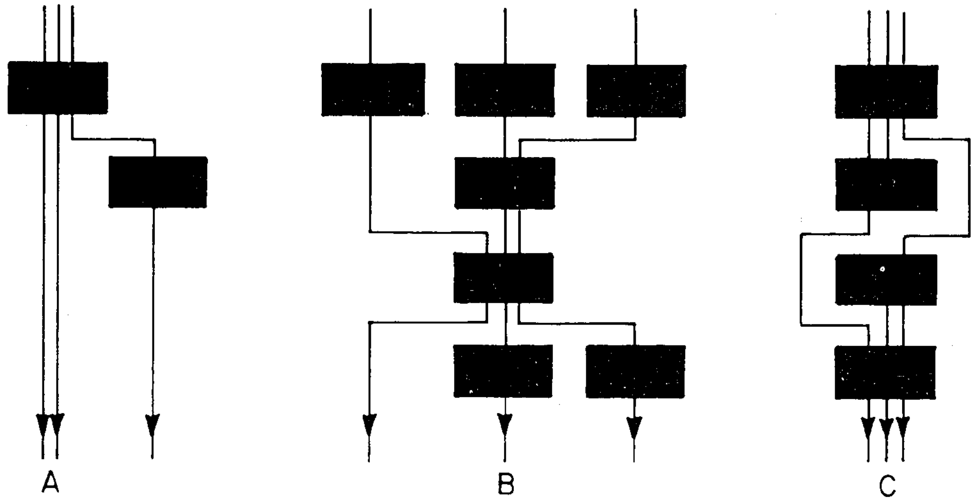


Figure 7. In its simplest form, group technology combines, standardizes, and perfects, single operations common to a family of parts. These operations are carried out on a single machine (A). Some parts pass on to subsequent operations. In other cases (B), parts coming from various machines pass through one common high-performance operation, but again follow different routes afterwards. In more advanced cases a special family-oriented machine layout is used and all parts in a group follow the same basic path—some of them possibly skipping one or two operations. This is where group technology has the maximum benefit.

whole family resulting in considerable savings in programming time.

New procedures in production planning and control are needed if the advantages of group technology are to be realized fully. Instead of working out monthly programs for the individual parts and lots, they become additive and are canvassed into one big order which is released and processed together with great savings in setup and changeover time. At the same time, the size of the lots can be reduced because of the lower setup costs. Inventory of finished parts can be similarly reduced.

When group technology is first introduced, one operation common to a great number of parts may be studied and perfected. At certain machines, lots accumulate and are processed according to priority rules. As more data become available on the volume and quantities of parts and family members, it becomes possible to set up progressive manufacturing lines for families. In this instance the real advantages of group technology will be found.

Among the various benefits from group technology are reduction of manufacturing costs, in-process inventory, in-process time, and materials handling. In addition, quality often increases considerably. It is the first piece of a batch that is difficult to turn out, and it is not unusual for this part to hold up the whole production program. With many similar parts being made this danger decreases. The operators learn faster and retain details better — another factor helping to increase productivity and keep down scrap and waste. Versatile measuring devices and jigs for inspection may follow in the wake of these innovations and are an extension of group technology into quality control.

Certain problems of communication cannot be avoided. The customary numbering systems are usually designed to indicate which product or group of products a part belongs to, or what kind of function it has to carry out. When changing over to a numbering system designed exclusively for group technology, this valuable information gets lost and extensive cross-referencing becomes necessary. Some companies use both systems simultaneously despite the increase in information handling.

Some engineers fear that the pattern of work demanded by group technology will prevent them from fully performing their creative work. It is certainly true that a high-performance part or component should be designed in view of its function without any restriction or interference by other considerations. Cooperation should help to overcome difficulties here. When high-performance equipment is needed, the codification office, rather than the designer, must make concessions. On the other hand, for general purpose parts, sold under high competition, more weight should be given to standardization and economic manufacturing methods.

Not all available scientific methods have been applied to group technology yet. Classification and coding are still arbitrary in many cases. Boolean algebra and all the theories of sets, graphs, and information are waiting to be used for the optimization of such systems, including the minimization of errors in communication.

Companies that have introduced group technology and related techniques report many surprising results as shown in Table I. These figures show clearly that group technology is not just a fad, but that it has its place and future in industry.

REFERENCE

(1) Mitrofanow, S.P., Scientific Fundaments of Group Technology, USSR, 1959.

Firm Feature

PHILPARTS

After 10 years of preparation, PHILPARTS MANUFACTURING COMPANY, INCORPORATED was established in 1960, the first company to attempt to manufacture engine bearings and pistons which until that time were imported.

A thorough study of the domestic market situation showed that although there was a good demand for replacement engine bearings and pistons, particularly for industrial engines, tractors and marine engines, there were many types of engines in existence requiring small volume of parts per type.

PIONEER IN ENGINE BEARINGS &

At foreground are imported aluminum alloy ingots for bushing and bearing applications. At the back are bronze alloy ingots refined by PHILPARTS from bronze scrap.

This prompted management to use conventional machine shop equipment devised to meet the requirements of small lot production runs. Due to limited capital the engine bearings plant started operations in September, 1961 while the piston plant followed in March, 1963. Today, both pistons and engine bearings are marketed and registered under the Microlite brand.

The plant is located at Marulas, Valenzuela, Bulacan, occupying an area of 4,120 square meters. At present it has a daily output of 200 pairs of plain bearings having 3 1/2 to 4 inch diameters, 40 to 50 pistons of 4 to 4 1/2 inch diameters, and a monthly output of 70 pieces of cylinder sleeves having bore diameters from 5 3/4 to 6 inches. It has 5 major departments, namely: bearings, pistons, foundry, miscellaneous parts and service departments.

MICROLITE parts are marketed under an exclusive arrangement with Micro-Products Philippines (also a 100% Filipino enterprise). Nationwide distribution is through dealers in all principal industrial cities of the country.

RAW MATERIALS

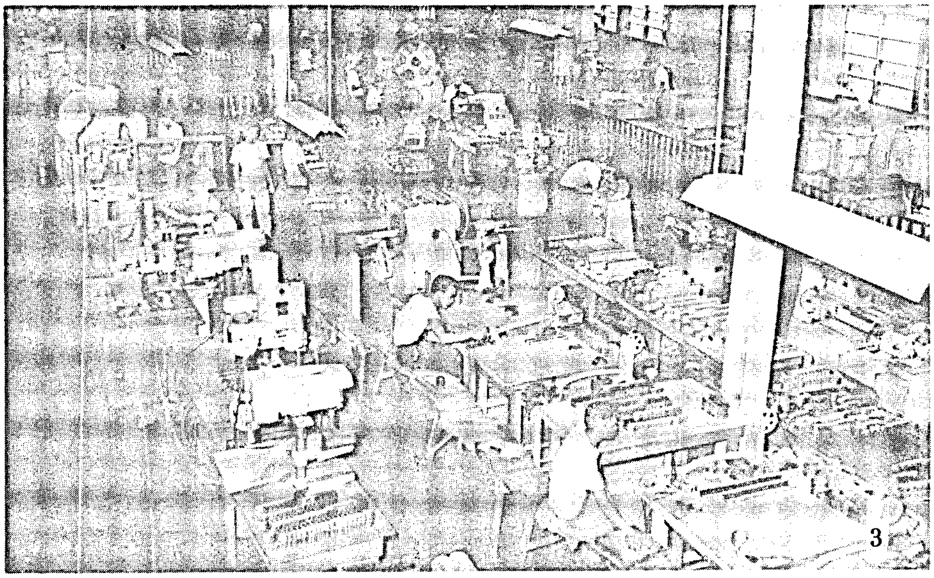
Although the required alloys can be prepared locally the basic materials are not availabe. Thus, the alloys and the other metal parts used for the manufacture of engine bearings, pistons and cylinder sleeves, are all imported. Aluminum alloys are imported from the United Kingdom and Australia, low carbon steel tubing from Japan and babbitt metals from England and the United Kingdom.

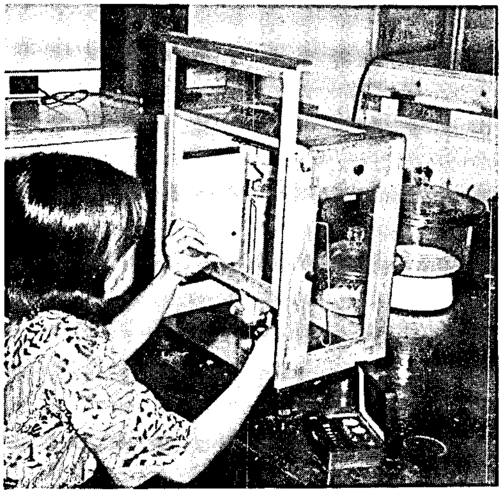
PRODUCTS

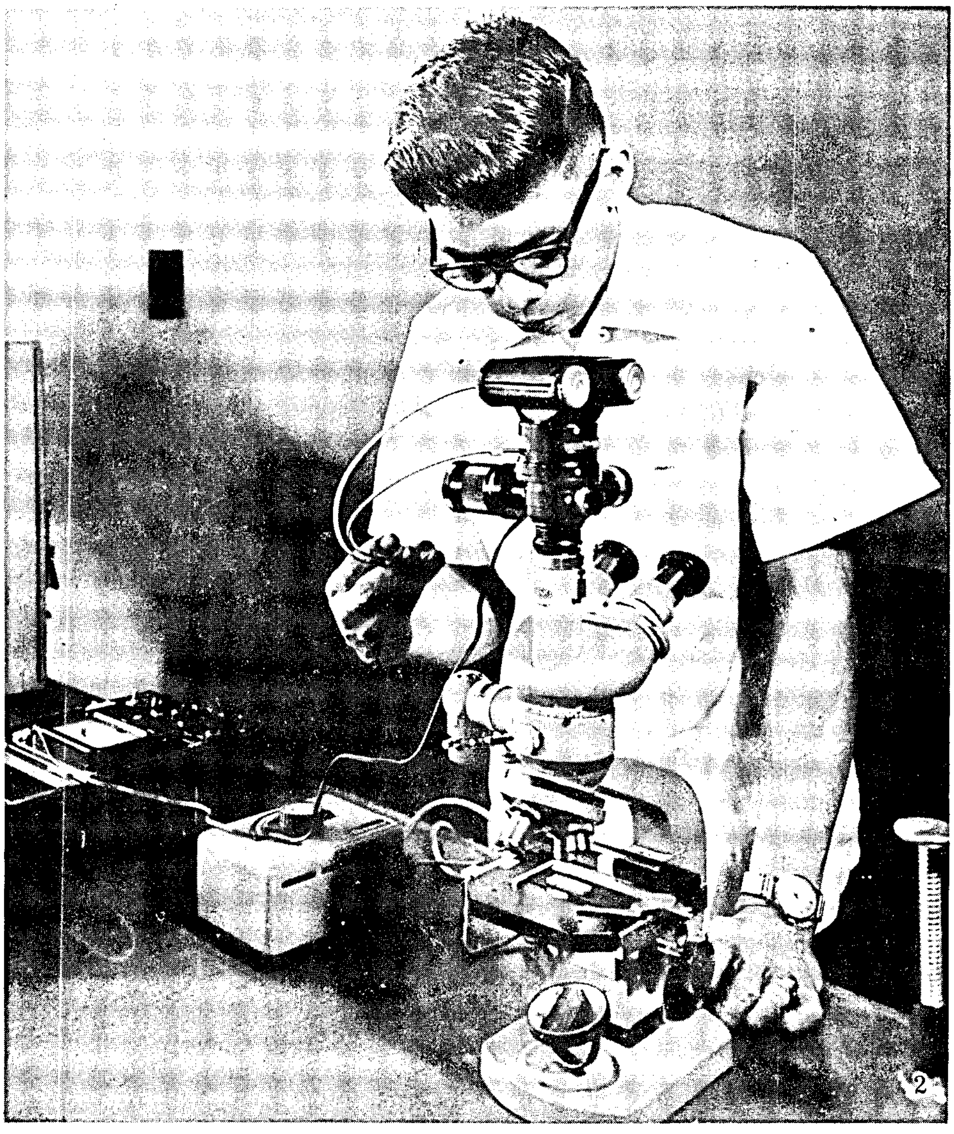
Philparts manufactures several types of engine bearings, namely: (1) bronze-backed and steel-backed babbit bearings, (2) regular steel-backed copper lead bearings,

PISTON MANUFACTURING

MICROLITE Pistons for automotive and industrial engines duplicate the performance of original parts.







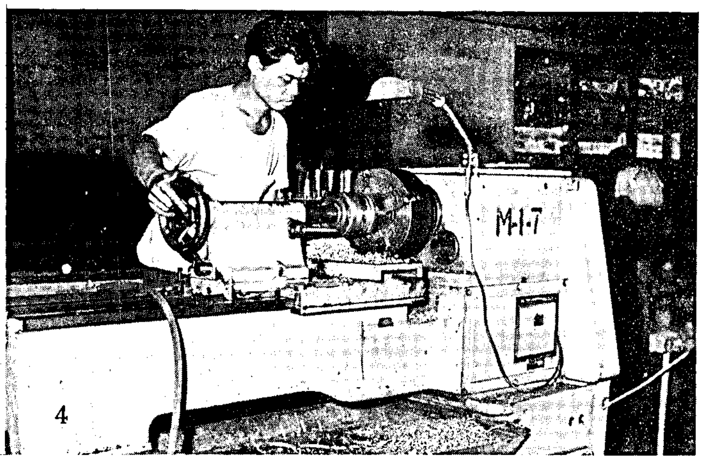
(3) M3 heavy duty (steel-backed copper-lead with lead-tin alloy electro-plated overlay) bearings and (4) solid cast aluminum alloy bearings. It also produces cast iron and aluminum pistons and cylinder sleeves made of gray cast iron.

BEARINGS

Most bearings are bi-metallic (except the solid cast aluminum alloy bearings) wherein there is a back metal, usually made of low carbon steel to provide the necessary rigidity and strength and a lining that provides good bearing qualities. In Philparts where all items are for replacement applications, the specifications for bearings of engine manufacturers are duplicated.

COPPER-LEAD ALLOY BEARINGS

Copper-lead alloy bearings are composed of 5 layers: the back metal, the copper-lead lining, the nickel plate, the lead-tin plates and the pure tin electro-plate. The bond between the back metal and the lining must be free from defects. This is made possible through control of the bonding and casting processes. The back metal after being cleaned is heated to 1100°C by means of a high frequency induction furnace whose temperature is controlled with the aid of an optical pyrometer. The copper-lead alloy melt is poured into the heated back metal which is rotating at an appropriate speed. This is followed by rapid water cooling to prevent copper and lead segregation. Machining and finishing operations such as cutting to proper lengths, rough centerless grinding, facing and chamfering of both ends, finish grinding of outside diameters, splitting into halves, locating lug pressing and milling or broaching of parting faces follow. Dimension of tolerances during machining is plus or minus 0.00025 inch on the bearing thickness, plus or minus 0.0005 inch on the circumferential length and parallelism of parting faces plus or minus 0.001 inch on the bearing width. Then the machined bearings undergo nickel-barrier dam plating, electro-plating with lead-tin alloy, and flash plating with pure tin for protection from corrosion. For M3 heavy duty bearings, the procedure is exactly the same, only the copper-lead layer is composed of 75-77% copper and given an overlay of 0.001 inch thick electro-plated lead-tin alloy to provide a satisfactory wearing surface during the break-in period.



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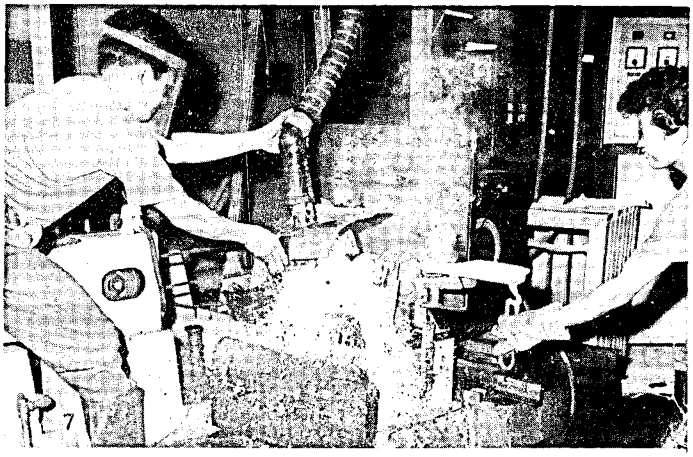

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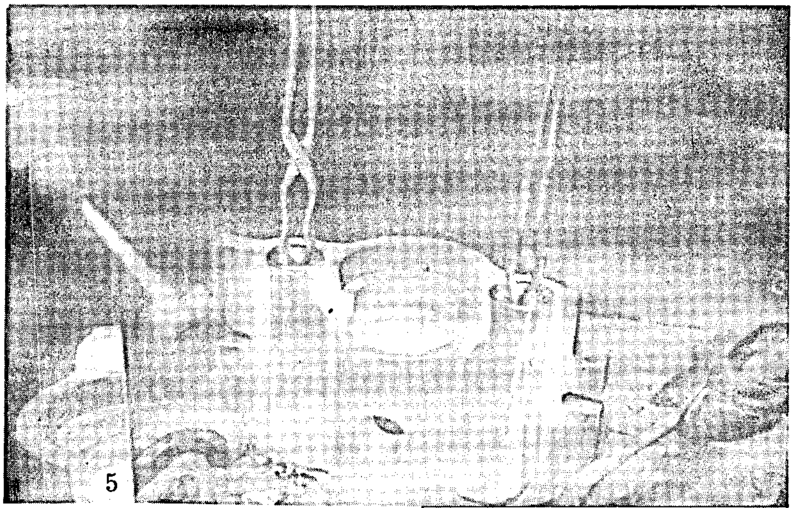

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(1) Chemical composition of raw materials are checked in the metallurgical laboratory. (2) Metallurgical checks on materials include metallography. (3) Machine Shop. (4) Centrifugal casting of steel back copper lead bearings. Controlled water cooling prevents segregation of copper and lead during solidification. (5) Aluminum pistons are cast in permanent molds for higher productivity and finer grain structure. (6) Proprietary graphite-base solution is used in coating green sand molds. (7) Rough machining of cast bearing materials.

ALUMINUM BEARINGS

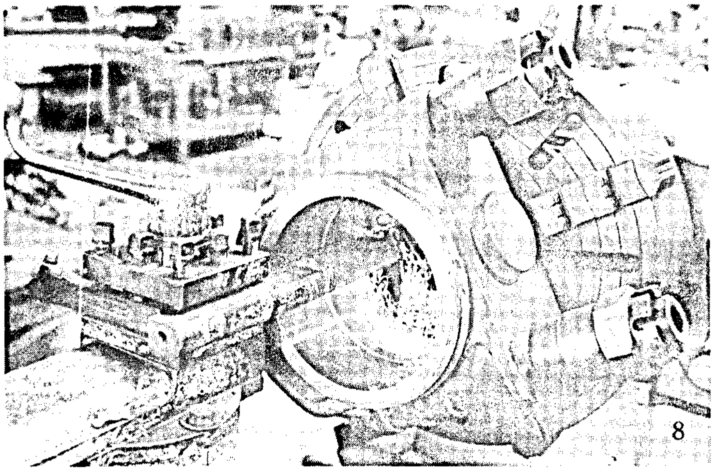
Aluminum bushing materials are cast in permanent molds and homogenized. It undergoes the same machining processes as the copper-lead bearing up to finish boring. Instead of electro-plating, the bearings are plated by immersion in sodium stannate solution after which it is flash plated with pure tin.

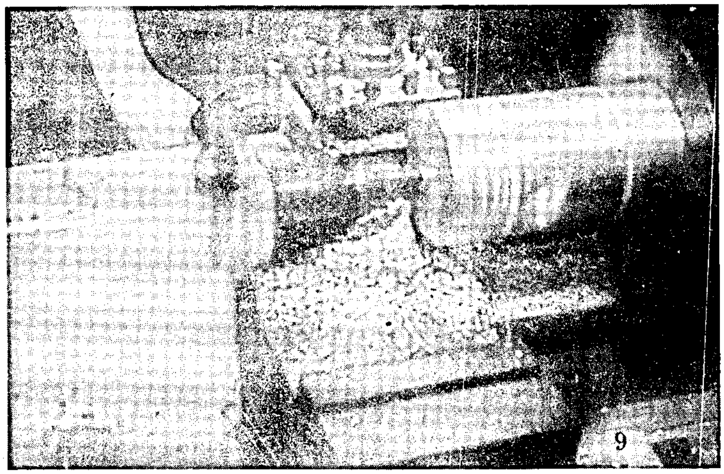
BABBIT-LINED BEARINGS

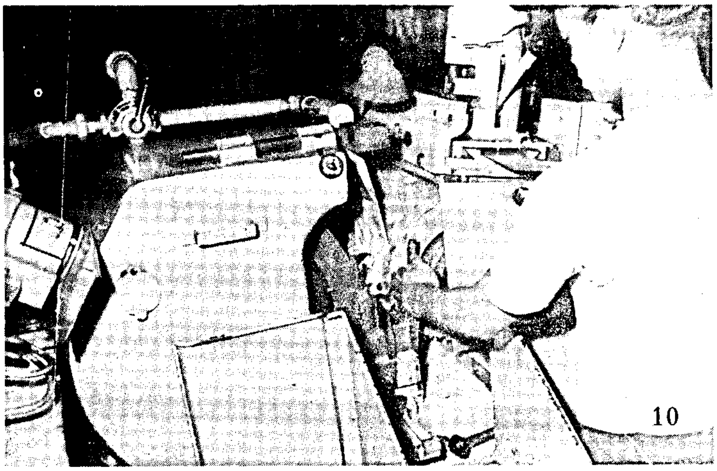
The back metal which may be bronze, steel or cast iron; after cleaning, pre-heating and tinning; is bonded by centrifugal casting with the babbitt lining at casting temperatures much lower than that used with the copper-lead bearings. After machining, the steel back babbitt bearings are flash plated with pure tin.

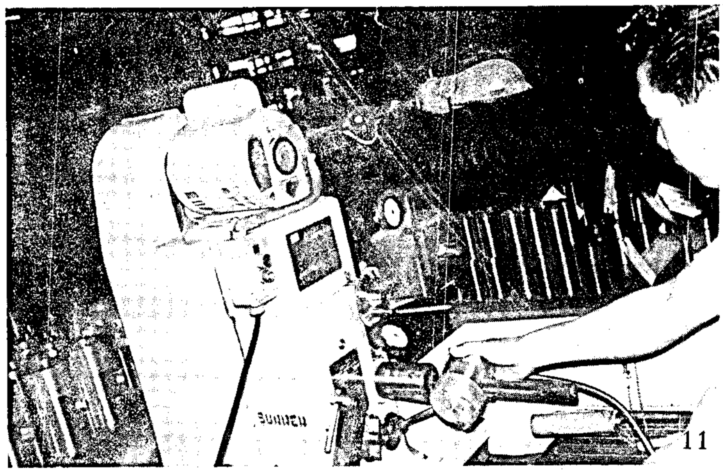
PISTONS

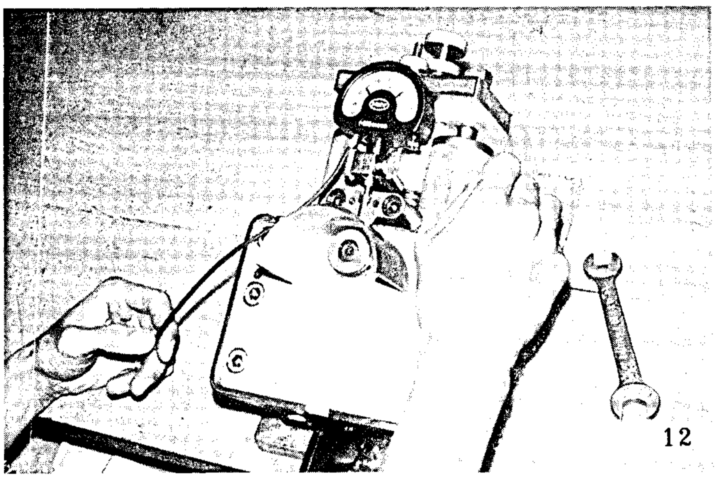
Although PHILPARTS manufactures both cast iron and aluminum pistons, production is mainly of the latter since the majority of engines are equipped with aluminum alloy pistons. To obtain the desired physical and metallurgical properties, suitably fluxed and degassed metals are cast in permanent molds which are made by the company's tool and die shop. After rough machining of the outside diameter as a quality check, the piston undergoes 6 to 8 hours of solution heat treatment at 520°C, after which it is water quenched to ensure the uniform distribution of the alloying elements. Precipitation treatment from 6 to 8 hours at 220°C to fix the position of the alloying elements follows. For heat treatment, an electric furnace with

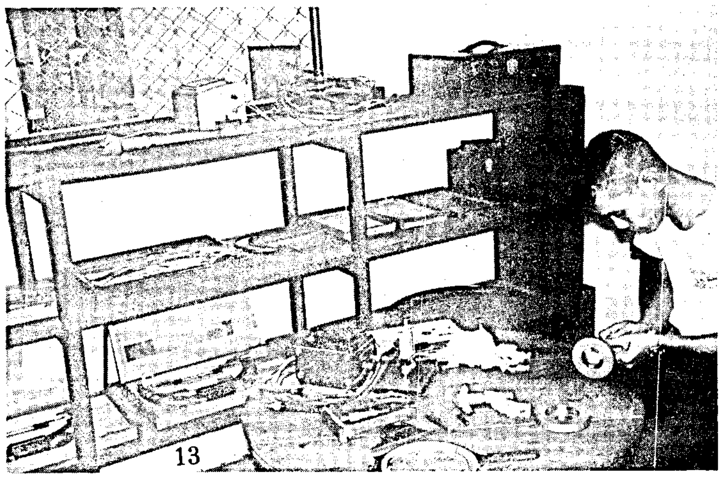


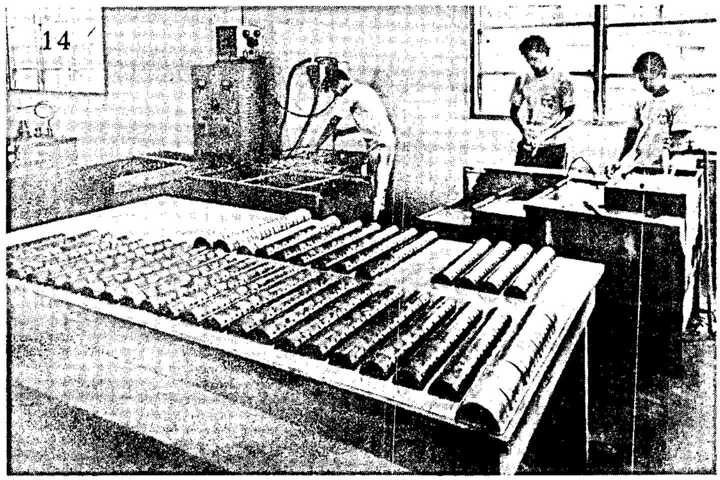












(8) Bore machining of connecting rod bearing for ocean going vessel.

(9) Ring groove machining of piston.

(10) Centerless grinding of semifinished bearings.

(11) Piston pin holes are honed to final dimension and specified surface finish.

(12) Bearing wall thickness is measured by dial gage to a precision of plus or minus 0.00025".

(13) Measuring instruments are regularly calibrated to insure accuracy.

(14) The electroplating line for finished bearings.

automatic temperature controls accurate to plus or minus 5°C is used. Machining, drilling, grooving, dressing and milling operations are done, after which the finished piston is honed and the weight is checked. In the machining of the cast piston materials, the tolerance used is plus or minus 0.00025 inch on the diameter, plus or minus 0.0005 inch on the compression height and plus or minus 0.001 inch on the overall length.

GRAY CAST IRON CYLINDER SLEEVES

The production of gray cast iron cylinder sleeves was started in 1967 to answer the demand for replacement parts of certain types of engines which are not readily available locally. The demand, however, is small and variable so that a very simple set-up was adopted with a 3/4-ton capacity cupola designed and built by the plant personnel. Cylinder sleeves are statically cast to produce a graphite orientation which provide better surface action between the walls of the sleeve and the piston rings, resulting in reduced cylinder wear and prolonged service life. Stress relieving of the cylinder sleeves is followed by rough boring, rough turning of the outside diameter, finish boring of the outside diameter finish boring of the inside diameter, finish machining of the outside diameter and finally honing.

QUALITY CONTROL

Service requirements imposed on the bearings, pistons and cylinder sleeves of an internal combustion engine call for quality control on all aspects of production — from materials to finish machining to reduce to a minimum the possibility of defective parts reaching an end-user.

Raw materials are analyzed in the plant's metallurgical laboratory upon receipt from the suppliers as a routinary check of the materials conformance with the supplier's own certificate of analysis. During casting, samples of melts are periodically taken to detect any possible variation in chemical composition. Process scraps are batch-melted and each batch analyzed for possible re-use if their chemical composition is still within specifications. However, even if the process scraps show satisfactory analysis they are used only in combination with new alloys in not more than 50% proportion.

Quality control during machining involves process inspections and final inspections. Process inspections provide the necessary check on pre-finished dimensions and early detection and rejection of defective workpieces.

All parts undergo thorough inspection at the end of the line prior to packaging. This is necessary because of the close dimensional tolerances of the parts manufactured. All gages and measuring instruments are calibrated at least once a day against standards of known precision.

MANAGEMENT, STAFF AND PERSONNEL

PHILPARTS has a total manpower of 124 men working on an eight-hour shift, composed mostly of machinists and mechanical engineers.

The organization is headed by Emiliano R. Bautista, President; Alejandro R. Bautista, Vice-President; Armando R. Bonifacio, Comptroller; Leonardo B. Santiago, General Manager; Conrado B. Santiago, Marketing Manager; Timoteo G. de Fiesta, Plans and Operations Officer; Bernardo E. Layos, Engineering Superintendent and Enrique S. Bulatao, Production Superintendent.

ENGINEERING & TECHNOLOGICAL DEVELOPMENTS

technical abstracts

A Lost-Wax Mold Every 60 Seconds

The wax-investment assembly was given a conventional dipcoat of water-based colloidal-silica-bonded slurry followed by zircon sand applied by a "raining" device. These investments were allowed to dry in the normal manner. The assembly was then dipped in the slurry which formed the basis of the second back-up coat. This slurry was said to have the consistency of conventional coats but to be based on a much cheaper chemical system. After draining, the tree of pattern is again rained with a coarser refractory in this case molochite although it could equally well be zircon or silica sand. This stage completed, the assembly is dipped in a bath of hardener, drained and then plunged into a similar vat of neutralizer. Immediately afterwards the wax tree is immersed in a slurry and then transferred to the raining device for the second coat of stucco. Hardening and neutralizing follow at once before the cycle is repeated. After the application of six coats of stucco the assembly is ready for immediate shock de-waxing and subsequent pouring. *F.T.J*, Jan. 22, 1970

The Increasing Demand for Monolithic Refractories

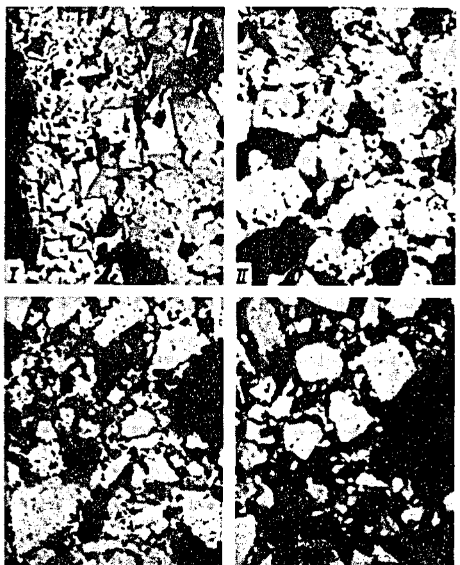
Historically, the growth of the refractories industry has been greatly influenced by the growth and changes within the iron and steel industry. This influence has helped create an increasing use of refractory monoliths, especially of the high-alumina type.

Refractory monoliths are supplied in plastic, ramming and castable consistencies to fit the particular need. Monoliths are usually easier and quicker to install than brick. They are good insulators, their thermal spall resistance is high, they are volume-stable at elevated temperatures and they are easy to patch. The monolithic designs reduce the need for stocking special brick shapes. Short delivery time is almost always possible. New and faster materials handling methods also help make refractory monoliths attractive for furnace linings.

These advantages and properties have not only made possible the more traditional applications, such as reheat furnace linings, and soaking pit covers and walls, but have opened up valuable new areas of application. The advantages of the areas of innovations discussed here may be summed up as follows:

1. The use of gunned castables in the blast furnace increases furnace life and reduces refractory costs through better utilization of refractories.
2. The use of plastic refractory linings for open hearth slag pocket aids in furnace efficiency by minimizing choke-up of furnace draft, facilitates slag removal and increases time between slag-outs.
3. In continuous casting, the use of plastic refractory tundish linings increases tundish life and aids in skull removal.
4. In furnace construction, the use of prefab monolithic components reduces furnace installation time.

I.S.E., May 1970



Pellet structural types based on outer zone structure.

Conditions for Hardening and Desulfurization of Fluxed Pellets During Firing

A study has been made of the mechanism and kinetics of the oxidation and desulphurization processes. This study includes that of structure formation, in fluxed pellets (basicity CaO/SiO_2 = 0.7-1.6) from high-sulphur (0.3-0.5%S) finely-ground concentrates made by the Sokolovka - Sarbai mining - beneficiation combine, and their optimum firing schedule. The main requirement for pellet hardening during firing is that they should be as highly oxidized as possible before the start of the high temperature firing, and that the optimum cooling rate (about 100% per min) from the firing temperature to 200-400°C should be provided. The highest oxidation rate is attained at 1000°C. The final S content in the pellets is determined by their retention time at 1150-1300°C. The retardation and cessation of desulphurization at 500-1000°C is connected with absorption of sulphur from the gas phase by the lime. On the basis of the recommendations made, one of the firing machines has been reconstructed and its performance has improved. *Stal* in English, June, 1970

A Technique for Producing Cold-Rolled Strip with Consistent Thickness

The effects of the different factors in the rolling of thin strip (knife blade type, 0.10 mm thick) on longitudinal variations in its thickness had been investigated theoreticaly; the variations in thickness are made up of two components: "inherited" (present in the initial 1.6 mm thick rolled stock), and caused by the inevitable roll wobble. The effects of roll diameter, tensioning coefficient of friction, rigidity of the mill stand, etc. are analyzed. It is proved that finished strip with variations in thickness less than the roll wobble can be produced. To achieve this, at the start of rolling a mill with small roll diameters should be used, while this mill should be as rigid as possible. The reduction conditions should include the largest possible number of passes and intermediate annealing operations; at the end (as the thickness of the strip is reduced and the variations in thickness reduced to the wobble level) a roll with the largest possible roll diameter should be used and the rigidity of this mill should not be so great. A lubricant with an increased coefficient of friction should be used. *Stal,* Feb., 1970

Process Factors Affecting Finish of Aluminum Alloy Extrusions

Investigations demonstrated that chemical composition and temper were the most important factors affecting the appearance of etched and anodized 6063 alloy extrusions. Other important factors included the effects of ingot homogenization and ingot reheat practices. Material in the T6 temper with 0.20 per cent or more iron consistently developed the most uniform diffuse surfaces and minimized the appearance of die lines.

Iron was the element most critical in affecting etching characteristics. Variations in other elements caused relatively minor variations in finish.

Ingot homogenization and reheating practices did not affect T6 temper material but did influence the etching characteristics of extrusions in the T1 and T52 tempers. More diffuse surfaces in these tempers were promoted by using either no homogenization or a low temperature homogenization treatment combined with a low reheat temperature. *M.P.,* June 1970

Production of Nickel Oxide From Ammoniacal Process Streams

At its iron ore recovery plant at Copper Cliff, INCO produces about 17 million pounds a year of a pure, acid soluble, dense nickel oxide from nickeliferrous pyrrhotite. The process used is also applicable to a broad range of ammoniacal nickel-bearing streams. The product has been widely accepted by the chemical, ceramic and electronic industries. *CIMB,* March 1970

Concepts of Gearless Ball Mill Drivers

The trend to drive to more than 10,000 horsepower on large capacity ball and autogenous mills for increased operating efficiency has been limited by factors in the conventional drive system. A solution to this problem, using modern developments in static converter technology, is the concept of driving the mill directly without gearing using a low speed, low-frequency synchronous motor with a cycloconverter power supply.

This paper presents various practical arrangements of mill and low-speed motors giving the specific advantages of each system. The means of controlling inrush currents on starting and of spotting by the use of variable-frequency control are outlined in general form.

Several gearless ball mill drivers are scheduled to be used in European cement plant and further orders have been placed. CIMB, January 1970

The Role of Oxygen in Xanthate Flotation of Galena, Pyrite and Chalcopyrite

A study was made to determine the effect of increasing concentration of dissolved oxygen on the floatability of galena, pyrite and chalcopyrite. Adsorption, flotation and contact angle tests were done in deoxygenated, air-saturated and in oxygen-saturated solutions. The results showed that adsorption of collector increased as a result of more oxygen concentration. Adsorption followed the exponential law $T = KC\frac{1}{n}$. Discontinuities in the curves were observed after the adsorption of several monolayers of collector. Although adsorption increased with oxygen increasing concentration, the floatability of pyrite minerals did not increase, because oxidation had adverse effects on the floatability of these minerals. The floatability of galena was maximum in oxygen-saturated solutions, pyrite was depressed and chalcopyrite also slightly depressed. Contact-angle tests proved that a bubble could not be attached to large flat surfaces in deoxygenated solutions, because sufficient surface free energy was not available for adhesion after the deformation of the bubble. In the presence of air, all the minerals yielded the same maximum angle of 72 degrees, characteristic of isopropyl xanthate. *CIMB,* June, 1970

Influence of Lime Quality on Oxygen Steelmaking

Literature on the effect of lime quality on oxygen steelmaking shows that high-reactivity lime, as measured by slaking test, does not always lead to faster solution rates in steelmaking. Two outstanding examples in the literature are the work at August Thyssen Hutte and Broken Hill, where virtually opposite conclusions were drawn. Trials carried out at Ebbw Vale gave improved desulfurization and dephosphorization with high-reactivity lime as well as other benefits which generally confirmed the results obtained at August Thyssen Hutte. The reasons for anomalous results in practice can be given, by consideration of surface area rather than reactivity of lime and by examination of the effect of blowing practice on slag formation. *JISI,* April 1970

Influence of Pre-stressing on Subsequent Behaviour of Foundry Alloys

Many foundry alloys, such as cast irons, aluminum, magnesium and copper alloys and certain alloy steels, present a non-linear stress/strain relation, the representative diagram of which is curved from the origin or near it. In addition, the first stress, even if slight, leaves a residual strain and modifies the structure of these alloys in such a way that their mechanical properties and especially their elastic limit, modulus of elasticity and damping capacity differ from those of alloys free from previous stress or pre-stressing. For this reason, these magnitudes have an arbitrary character which is not very favorable to the sound use of these alloys in engineering. It is difficult in practice to define a reference state free from pre-stressing, since solidification and machining already leave residual stresses which are not always removed with absolute certainty by heat treatment. Moreover, the mechanical properties determined on a test-piece under first stress are different from those of the alloy in service, subject to varying and intermittent stresses. This difficulty does not arise in the case of alloys such as carbon-steel, where the distortions remain proportional to effort until the figure reaches high values. The behavior of these materials is in fact not affected by pre-stressing below the limit of proportionality which corresponds precisely to normal conditions of use. In the case of alloys where the strain is not proportional to the stress, it is therefore important to ascertain whether there is a characteristic adapted to their special behaviour, which is specific to their nature and which indicates their tendency to be more or less modified by preliminary stresses or pre-stressing. One of the aims of this paper is to show that this characteristic exists, that it is not conventional, but specific to the nature of the alloy and its own distortion mechanisms. On the light of the experimental condition which has enabled these characteristics to be brought to light, it may be called the "limit of accommodation". FTJ, January 8, 1970

Metco Metallizing Gun Ends Warpage In Motor Repair

The porblem of warpage in rebinding worn parts of electric motors was solved by Electric Motor Repair of Hickory, N.C. The problem was solved when the company switched from high-heat methods or welding to low-heat metallizing with a Metco Type N metallizing gun.

Besides solving the problem other advantages of the Metco Type N metallizing gun are: cost of rebuilding is only half of the welding, the process is also speedy in that it can repair the spindle of a high-speed winder in only 27 minutes. Time and money savings over the previous methods also ran about 50 per cent less in repairing the journal of a motor shaft. In this case the previous method was electric welding.

Information on the type N gun and its applications is available from the manufacturers, Metco, Inc. Dept. 419, 1101 Prospect Ave., Westbury, N.Y. 11590. *AMM,* June 17, 1970

Metallized Agglomerates: A Raw Material for Steelmaking

The possible effect on overall steelmaking costs which could accompany the use of metallized materials (prereduced ore, pellets, briquettes, etc.) on a large scale are considered, giving particular attention to the Japanese steel industry. An attempt is made to estimate the value if such products (90 to 95 per cent Fe) as an enrichment material for blast furnaces and as a direct raw materials for steel making. It is inferred that the direct use of metallized agglomerates in conventional steelmaking offers considerable scope for an overall reduction in cost. It is also predicted that the twofold effects of the nuclear power and the availability of competitively priced agglomerates in quantity will lead to an acceleration in the growth rate of electric arc steelmaking, and that this particular processing route will provide serious competition for conventionally-based plants in the late 1970. In turn this should lead to substantial benefits to both raw material producer and steelmaker. A parallel is drawn between this concept and the processing of bauxite to alumina in Australia for eventual shipment to overseas smelting plants. It is felt that the future availability of agglomerates could lead to a radically new outlook on steel plant investment.—*JISI* Nov. 1969

Studies of Bonding Properties of Different Foundry Sands

Surface properties of foundry sand, bentonite and additives were studied with the scanning electron microscope. Measurements were made of grain surface area, water adsorption and bonding strength of the sand mixture, based on tensile strength and resonance frequency. Strength of a sand mix is determined by the weakest link in the sand-bentonite-water system. Below 0.3 per cent, moisture and sand surface determines strength. A 0.3 to 1.5 per cent moisture is determined by the bentonite bond. Above 1.5 per cent it is the capillary properties of bentonite which dictate strength.—*AFSCMRJ*, September 1970

Maraging Steels for Die Casting

For die casting aluminum, AISI H13 is standard. Years of experience have shown that a range of R_c42 to 48 provides the optimum combination of strength and toughness. Normally, dies fail by heat racking or erosion of the die, or both. Resistance to these effects would be improved by increasing the hardness, but raising the hardness of H13 out of the prescribed range leads to premature cracking.

Although excellent results have been obtained with maraging steel, these alloys need to be further improved and refined to assure consistently satisfactory results. Just as much experimentation was involved in establishing R_c42 to 48 as the ideal range for H13 for aluminum die-casting dies, we must establish proper hardness ranges for maraging steel. Obviously, some comparatively small, simple dies work well at R_c54. However, larger, more complex dies might work better in the R_c48-50 range. —*MP*, April 1970

Where Aluminum Extrusion Tooling Stands

Alloys for such parts require resistance to shock, heat, stress and wear. Because these properties tend to be somewhat divergent — gains in one property are lost elsewhere — compromises are inevitable. The 5 per cent Cr hot-work die steels will probably continue to get most of the perishable tooling assignments because they combine good toughness and strength with adequate wear and heat resistance.

Variations of these grades have improved machinability, wear resistance, or heat resistance.—*MP*, April 1970

Factors in the Selection of Structural Alloys

The paper discusses the future use of constructional alloys in the building industry and attempts to describe the factors underlying the selection of various alloys. Particular emphasis is placed on the role which economics play in the selection process.

The decision-making is usually in the hands of either an engineer or an architect and an attempt is made to delineate their separate roles. This leads to a subdivision of properties into those selected on the basis of cost-effectiveness and those in which economics is of secondary importance. Most situations in materials selection are seen to possess an optimum point at which the total system is most effective. It is emphasized that this optimum point does not consist of all the system components being used in their individual optimum condition.

Fig. 1 & 2: Figures showing the texture of a sand type, Baskarp sand.

Fig. 3: Molding sand mix of Barkarp and Bentonite

Fig. 4a & 4b: Bentonite distribution on sand surface

Considerable emphasis is placed on the system-performance approach to building as it is in this sphere that future developments would seem to lie. Valuable lessons learned from studying current efforts in system building are noted and guidelines indicated.—JAIM, May 1970

Control of Structure and Properties of Irons Cast in Permanent Molds

The authors added magnesium, nitrogen and trace elements (including Bi, Te, Pb, B, Sb, and Zn) to iron cast into metal molds in an effort to promote compact graphite forms (improved mechanical properties) and a ferritic matrix (improved machinability). Casting poured during magnesium fading had a modified graphite structure and improved mechanical properties. Nitrogen treatment of the melt failed to promote compacted graphite in these melts. But addition of Te and Be caused compact graphite formation. They also promoted chill. Boron, Sb, and Pb additions did not affect graphite shape.—*AFSCMRJ*, September, 1970

Controlling Soundness of Sand Castings

The solution of the general problem of controlling the occurence of cavities often is more difficult under production condition than the control of micro or macrostructure of cast metals. Major factors that can be applied for cavity control are 1) alloy composition 2) casting and mold design and 3) the application of external pressure during solidification.—*F*, December, 1969

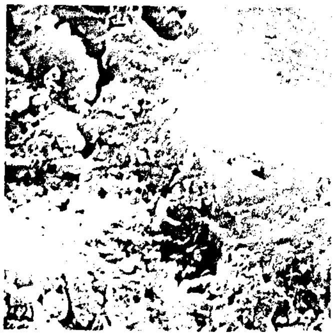
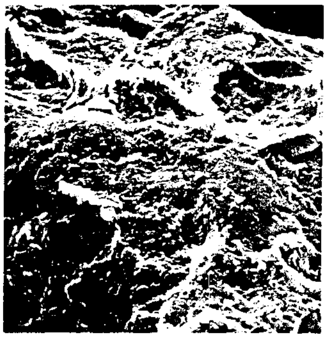
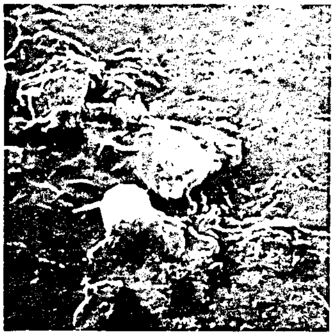
Alloys Rapidly Melted in Induction Furnace by Special Stirring Action

A 12,000 lb. 180 cycles vacuum induction melting furnace has a unique stirring action. This stirring action enables alloy addition to be taken into the melt in just nine minutes, a job which previously requires two and a half to three hours.

This 1600 furnace stirred in a controlled pattern away from the refractory wall minimizes reactive metal element contact with refractory wall.—*IH*, February, 1970

Investigation of Mechanism of Dross Formation in Ductile Iron

When magnesium and post inoculants are added to the ladle in ductile iron production, an appreciable quantity of dross forms—and this continues even after skimming. It consists mostly of MgO, SiO_2, Mg_2SiO_4, MgS, amorphous glassy silicates and metallic phases with Fe, Mg_2Si and Si. The amount of dross increases with holding time, Si content of inoculant and oxidation, rate of formation is most rapid at 2500 to 2600°F. Upon molding, constitution of the dross changes from mostly MgO and SiO_2 to their reaction product, forsterite.—*AFSCMRJ*, September, 1970

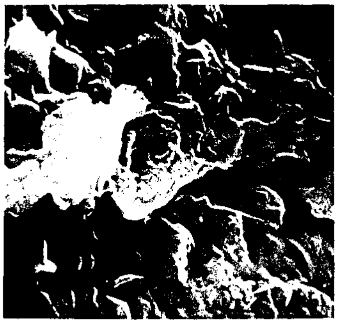
Magnesium Loss During Chlorination of Aluminum Melts

Aluminum alloys melts can be degassed using N_2, Cl_2, or mixtures of these gases, as well as various chlorinated hydrocarbons. It is known that when melts containing Mg are chlorinated loss of this elements occur, but little information on this subject could be found in the literature. Experiments were conducted to determine the loss of Mg by chlorination at various temperatures using pure Cl_2, a mixture of 90% N_2 and 10% Cl_2, and solid chlorinated hydrocarbon in the form of tablets. It is shown that in the case of pure Cl_2 or the 90% N_2-10% Cl_2 mixture the loss of Mg depends on the amount of Cl_2 used and the temperature of the melt. In the case of chlorinated hydrocarbons, the loss is proportional to the number of tablets used but does not vary with temperature. The efficiency of the reaction $Mg + Cl_2 = MgCl_2$ is quite low (approximately 20%) at temperatures below approximately 690°C rising steeply to approximately 90% above approximately 710°C for pure Cl_2 and N_2—Cl_2 mixture, but it is nearly constant (approximately 50%) for degassing tablets regardless of temperature. The results may be useful in control of the Mg content of alloys, particularly when it is low (approximately 1%) and where it is necessary to work within a narrow composition range.—*AFST*, Vol. 77, 1969

The Embrittlement of Babbit-Bronze Bonds

The failure of the metallurgical bond between a babbitt layer and its supporting bronze shell in a babbitted-bronze journal bearing frequently occurs in some service applications. This paper reports on a study of the problem including the reportedly beneficial effects of additions of zinc to bronze in suppressing embrittlement.

The results indicate that two separate types of embrittlement phenomena can occur in babbitt-bronze bonds. The first (layer-growth embrittlement) developing during heating in the range 180-225°C is related to the growth of a $Cu_2\ Sn_6$ compound layer. The zinc content is not a factor for this type.



The second type of bond embrittlement (heat-aging embrittlement) occurs in the temperature range 134-177°C. This is the result of an attack upon a Cu_3 Sn intermetallic layer, probably by oxygen diffusing to the bond region from the specimen surface. In this case, zinc has been influential in inhibiting embrittlement by reducing the rate of diffusion of oxygen through the bronze.—*AFST*, Vol. 77 1969

The Application of Neutron Activation Analysis of the Determination of Copper in Minerals

An account is given of the application of neutron activation analysis to the rapid, non-destructive determination of copper in minerals, using a 14-MeV neutron source. Elements that interfere in the determination of copper by this method are given, together with the errors in the estimation of copper that result from the presence of varying amounts of these elements. The possible use of a compact "sealed tube" 14-MeV neutron generator for the field assay of copper in minerals is discussed.—*CIMB*, April, 1970

Solvent Extraction of Electrowinning, Great on Paper

Solvent extraction and electrowinning of copper from acid solution is potentially capable of serving operating costs per pound of recovered copper some 27 to 51% below the theoretical level of more conventional leach-precipitation methods. The benefits of this newly emerging technology does not end with operating costs. For instance solvent extraction and electrowinning regenerate leach solution and yields a more valuable electrolytic grade than copper. —*E/MJ*, December, 1969

Duval Corp. Unveils Pollution-Free Process for Copper Ore Reduction —

In the new process (called Duval Process), the copper concentrates are leached with a metal chloride solution, metallic copper is separated and the backing solution is regenerated. The continuous process, which is carried out in a substantially closed system, accomplishes pollution-free extraction of copper and recovery of elemental sulphur iron oxide and other valuable metals. The roasting and burning steps associated with conventional pyrometallurgical smelter operations are eliminated. Also electrolytic grade copper is produced avoiding the necessity for a subsequent refining operation.—*AMM*, August 3, 1970

More Copper to Flow From Zambia

A new process developed by metallurgists of Zambia's Copper Mines, will mean additional 3,000 metric tons per year of finished copper. The copper will be extracted from low grade oxide concentrates and tailings which until now have been costly to treat.

The liquidation-exchange process will cost an estimated $45 million. The process is a method of concentrating a dilute copper solution containing about two gm. per liter of copper to produce a solution of high enough copper content to enable cathodes to be produced by electrowinning in a tankhouse.

The weak solution is agitated with an organic reagent called "Fix 64N" which is dissolved in kerosene. The copper transfer to the organic liquid which is then separated from the barren solution.

The copper-bearing organic reagent is then agitated with 150 gm. per liter sulphuric acid solution. The copper then transfers to the acid solution from which it is won by electrolysis in the form of cathodes. The organic reagent, now stripped of copper, is returned to the head of the circuit where it is revised. —*AMM*, July 13, 1970

Mold and Core Aggregate Effects on Defects in White Iron Castings

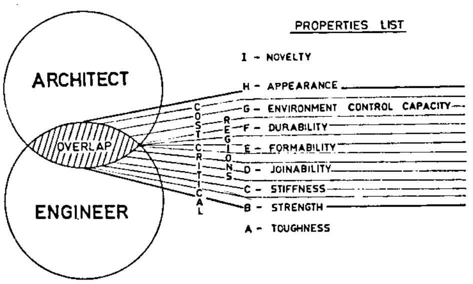
The effects of mold and core aggregates on defects in white iron castings were studied. The first phase of the research was concerned with the design of test castings to produce the defects in such a way as to be sensitive to changes in the composition and properties of mold and core aggregates. The effects of changes in mold aggregates such as per cent and type of clay, additives, fineness of sand, and rammed density were then examined. The effects of percentage of binder, hardness, cereal and other variations in core materials were also studied. Defects such as check tears, shrinkage, and pinholes were noted in relation to the aggregates.—*AFST*, Vol. 77 1969

The Role of Gases in the Structure of Cast Iron

There is an extensive literature describing opinions, observations and experiments concerned with the effects of the gaseous elements hydrogen, oxygen and nitrogen, and of vacuum melting on the structure and properties of cast irons. This paper reviews and discusses the most clearly established behaviour of hydrogen and nitrogen, together with other elements, in influencing the graphite structure, nucleation and carbide stability in gray irons and malleable irons, and comments on the recorded behaviour of oxygen and its compounds, and on the way in which vacuum melting affects microstructure. Subjects covered include the role of hydrogen in promoting inverse chill and abnormal graphite forms, the carbide stabilizing effects of hydrogen and nitrogen, the strengthening effects of nitrogen in gray iron and the influence of minor elements on graphite nucleation in relation to hydrogen, oxygen, nitrogen and vacuum melting. Unsoundness caused by gases is only referred to when it has a bearing on any of these features.—*AFST*, Vol. 77 1969

A Study of the Conditions Promoting Ductile Iron Dendritic Growth

Conditions promoting dendritic growth in ductile iron were studied using both commercial and laboratory ductile irons. Though their compositions and solidification mechanisms are considerably different, dendritic growth (or spiking) in ductile iron was found to closely parallel that in white cast iron.



Specifier-properties overlap.

Subjecting the base iron to oxidizing conditions within the melting or holding furnaces promotes spiking in ductile iron. These conditions include the use of heavily oxidized scrap, excessive air-coke ratios, water vapor in the atmosphere, high superheating temperatures, and so on. Dendritic growth was also observed to have a direct effect on the feeding ability of ductile iron. Borderline risered castings showed interdendritic shrinkage porosity in castings exhibiting spikes while it is absent in spike free castings. This behaviour is also related to riser piping differences. It was not determined whether spiking could be eliminated by obtaining a high nodule count; however, the effectiveness of a 0.01% Bi addition toward preventing coarse dendrite formation in an iron that was proven to be spiking was noted.—*AFST*, Vol. 77, 1969

Analysis of the State of Thermal Stress in Molds During Centrifugal Castings

The article gives an approximate solution of the state of thermal stress for thick and long tubes, verified by experiments to increase mold life for centrifugal casting. Sample calculation based on this solution are presented. Results are useful for both production centrifugal molds and for laboratory experiments. The following analysis of the state of thermal stress allowed modelling of the process of centrifugal casting. In test cases we found that the state of thermal stress was indentical to that found in molds used for production. The graph showed change of state of thermal stress in the mold wall in terms of time and radius.—*AFSCMRJ*, June, 1970

Kinetics of Decarburization of Liquid Iron in an Oxidizing Atmosphere

From the close check of results reported by many investigators, the most reasonable conclusion is obtained as follows:

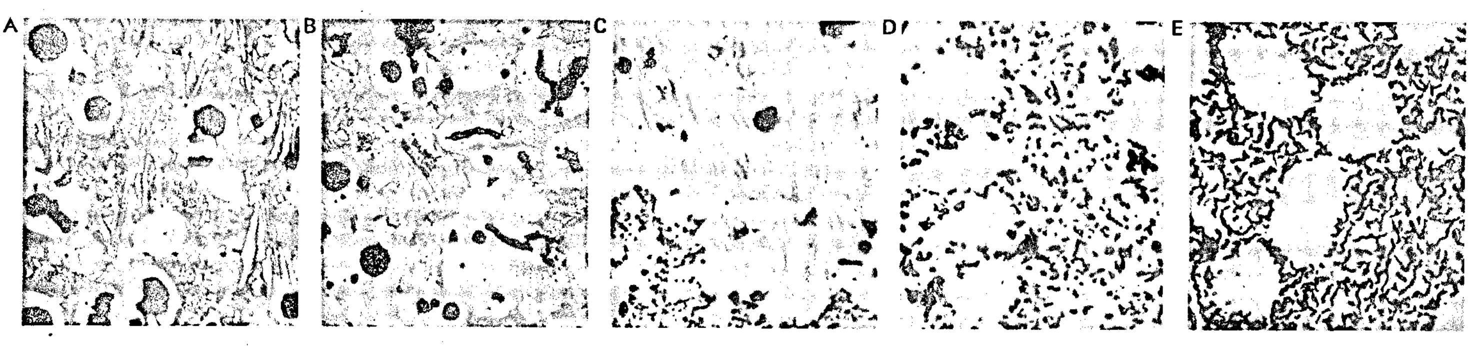
1) If liquid iron and carbon alloys are stirred, the decarburization rates in the carbon concentration greater than the critical value are wholly or predominantly controlled by the gaseous diffusion. It is very difficult to conclude that the surface reaction is the rate-determining step.

2) When the supplying rate of gaseous oxidant becomes greater than the rate of transfer of carbon to the gas-metal interface, oxygen is accumulated and the oxide appears on the metal surface. After the oxide formation, the rates are predominantly controlled by the transfer of carbon in the liquid metal.—*TISIJ*, Vol. 10, November 1, 1970

Effectiveness of the Pelletization of a Mix of Kursk Magnetic-Anomaly (KMA) Ores in Drums on Sintering Machines 252 and 312 m^2 in Sintering Area

An analysis has been made of the way the mix moves in drum pelletizers of three sizes 3.2 $\times$ 5.71 (A), 4.4 $\times$ 5.75 (B) and 3.2 $\times$ 12.5 m (cc). The drums are installed before two sintering machines at the Novo Lisetsk works. It was shown that there is an optimum drum rotation rate *n* as regards the attainment of the best mix permeability on the machines (6-8 rev/min at a throughput rate, i.e. a load on the transport route, of 6.6-7.5 t/min). An increase in *n* improves granulation conditions in the drum itself, but increases the extent to which the granules formed break down on the drum and along the mix-supply route. Curves are presented showing the change in the contents of the fractions in the course of pelletization in the drum and along the route, and also the change in the relation between the pelletizing (coarse, e.g. — 5 and 5-3 mm) and pelletized (fine, e.g. 0.15-0 and 2-1 mm) fractions along the drum. The activity of the fractions can be assessed from these curves. January, 1970

Microstructures of permanent mold cast gray iron poured at various times after Mg treatment.



Rational Organization and Economic Advantages of the Complete Processing of Blast-Furnace Slags

At the Azovtals works the slag-processing department forms part of the blast-furnace plant and also controls of slag-ladle park, which has a number of advantages over the organization at other works. The make-up of the main equipment is described and the volume of slag materials (granulated slag, crushed air-cooled slag, foamed slag and slag-wool materials) made in 1967 and 1968 is shown. Possibilities for considerably increasing profits from the sale of slag articles are pointed out. Utilization of liquid blast furnace slags was 89.5 per cent in 1967. A quary has been built at the works for reclaiming slag from banks and this should yield additional profits. January, 1970

First Basic Advance in Making Wire Emerging From Lab

Extruding wire mechanically was a technology first developed to make jewelry for the Pharaohs. Today it is still the basic wire-making techniques used. However, it soon will be replaced by an entirely new production method that turns out wire much faster and far cheaper.

The new process is called "continuous hydrostatic extrusion." The technique uses fluid under high pressure to squeeze ordinary metal rod into extremely fine wire in one step, instead of having to draw the rod through dozens of different dies on two machines. There is no metal-to-metal contact at any point in the process.—*PE*, May 25, 1970

Hot Forging of Metal Powder Preforms

One of the most promising new metal working processes is the hot forging of metal powders. There are two major reasons for the great interest in the process. The first is its simplicity. Preformed shapes pressed from metal powders are the starting material. These are heated, struck with one blow, and the result is a part that is virtually finished. No material is wasted and only single station dies are required. The second reason is that, since the process uses metal powder ingredients, a wide variety of materials can be custom-blended as required by the applicator. The powder are fine particles from which a fine-grained homogenous product results.

Although the basic process and principles seem simple, much development work has and is continuing to be done to make it a reality.—*IH* January, 1970

Superalloys for Supertools

At extrusion and forming temperatures above 1150° Fahrenheit, high temperature alloys carry on where hot-work tool and die steels leave off. Typical of these are Pyrotools, seven alloys which have found increasing acceptance for a wide variety of tooling applications. While most production experience has been in the hot extrusion of brass, engineers in other fields such as extrusion and hot-press-forming of titanium also report success.

The key to these pyroalloys is their retention of high hardness at elevated temperature. Rams and dummy blocks, mandrels, liners, and dies made from them offer high strength and great resistance to softening above 1200°F.—*MP*, April, 1970

Direct Measurement of Oxygen in a Bright Annealing Furnace

The measurement of oxygen content in gases is important industrially in two main applications. in the first of these, the oxygen content of the gas is a guide to the efficiency of a process, e.g., combustion of fuel in a furnace. In the second type of application, the oxygen content is a guide to the suitability of the gas for use in a process, e.g. as an inert atmosphere in an annealing plant.

Two years experience has demonstrated that the solid-state electrochemical oxygen concentration cell is a practical method of monitoring bright annealing furnace atmospheres under industrial conditions. The valuable operating information generated directly by such instrumentation is unobtainable by any other means.—*MEQ*, Feb., 1970

Effect of Partial Recrystallization on the Properties of Continuously Annealed Steel

The effect of an arrest in the recrystallization process upon the properties of cold-worked low-carbon black plate has been investigated in the laboratory and on a continuous strip annealing line. Variations in the carbon and sulfur analyses of the base steel were shown to produce changes in the response to annealing time and temperature. In partially recrystalized condition, the steel exhibited less directionality of properties than the cold-worked product and a work softening response on temper rolling.—*BFSP*, Nov., 1969

Tempered Martensite Brittleness in Extra-Low Carbon Steels

Tempered martensite brittleness is a phenomenon which has been found by impact toughness experiments to occur upon tempering medium-or-high-carbon steels in the vicinity of 300° to 400°C. The present study shows that it also appears in the tensile testing of extra-carbon steels. The observation made on electron micrographs suggest that the phenomenon is related to the alignments of elongated carbides which causes a significant reduction in the mobility of the dislocation remaining after tempering at 350°C. Furthermore,. these extra-low-carbon steels offer a better combination of strength and ductility in the as-quenched condition than after tempering at low temperatures. Finally, it has been established that an addition of 0.055 per cent Al has no effect on the occurrence of tempered martensite brittleness whereas an addition of five per cent Ni decreases the sensitivity of such embrittlement. —*JISI*, Dec. 1969

DOMESTIC & FOREIGN EXPORT PRICES

Table 1
CONTINENTAL STEEL EXPORT
Monthly Price Averages Sept. 1970 to Feb. 1971
(In U.S. $ Per Metric Ton)

	Sept.	Oct.	Nov.	Dec.	Jan.
Billets	90	87	86	86	83
Reinforcing Rounds (a)	97+	89+	94+	99+	100+
Merchant Bars	109+	102+	103+	105+	106+
Joists, Channels (Brit)	135+	—	125+	—	—
Channels (U.S.)	135+	—	—	—	124+
W.F. (Univ. beams)	145+	127+	132+	132+	132+
Wire Rods	130+	119+	118+	120+	119+
Hot Rolled Strip	122	—	—	113	117+
Tube Strip	119+	119+	115+	113	112
Heavy Plates (c)	125+	120+	126+	129+	130+
Medium Plates (d)	124+	116+	116+	117+	117+
Universal Plates	123	—	—	—	132+
Chequer Plates	127+	120+	121+	122+	122+
HR Sheets: 16 g. and up	132+	120+	130+	—	—
HR Coil (dry)	—	102+	103	103	102
CR Sheets: 17-20 g.	140+	131+	125	127	130+
Galv. Coils: 17-20 g(b)	171*(e)	171*(e)	171*(e)	171*(e)	171*(e)
Bright Wire	135	127	127	127	127
Galv. Wire: 5-16-1/2 g.	152	141	141	140	140
Black Annealed Wire	145	145	144	144	144
Barbed Wire	—	—	—	—	—
Wire Nails	—	—	—	—	—

Source: Metal Bulletin

+ 2 1/2% exporter's commission incl. * less $5; corrugated extra $2; flat sheets $3.

(a) Usual deformed bai premiums: structural $2, intermediate $3
(b) 4-ton coil
(c) 4.76 mm to 8 mm
(d) 3 mm to 4.75 mm
(e) Up to $16-21 special allowance, according to market

MB's appraisal Continental (ECSC) mills' basis (net unless stated) FOB export prices, ordinary Thomas Commercial quality. Markets, sizes, quantities, delivery, etc. can affect prices shown.

For the continental steel export quotation for Sept. through Jan. as shown in Table, most products showed a slight decrease in price ranging from 2% to 4%. This is with the exception of Galvanized coils which remained constant; Universal Plates which increased by 8% in Jan. Black Annealed Wire which declined by almost 1% in Nov. but remained steady till Jan. and Heavy Plates which increased in Jan. The general price situation is characterized by a totally erratic behaviour with marked decreases during these five months.

Table 2
JAPAN EXPORT QUOTATION
Iron and Steel Products
(In U.S. $ per MT, F.O.B. Japan)

	Sept. Ave	Oct. Ave	Nov. Ave	Dec. Ave
Plain Round Bars 3/8"	140	140	140	140
JIS G-3101 1/2"	135	135	135	135
5/8"-1"	135	135	135	135
Wire Rods				
JIS G-3501 5.5 m/m	130	130	130	130
Equal Angles 3 x 25 x 25 m/m	135	135	135	135
JIS G-3101 6 x 75 x 75m/m	135	135	135	135
Channels				
JIS G-3101 6 x 65 x 125	150	150	150	150
Joists				
JIS G-3101 7 x 100 x 200 m/m	145	145	145	145
Plates				
JIS G-3101 1/8" x 4' x 8'	—	—	—	—
1/4" x 4' x 8'	—	—	—	—
1/2"-3/4" x 5 x 10'	130	130	130	130
Hot Rolled Sheets				
USG 16 (1.6 m/m) x 3' x 6'	135	135	135	135
JIS G-3131, SPH Unpickled uncoiled				
Cold Rolled Sheets,				
Qty (Pickled, Oiled)				
JIS G-3310, SPC-1 U.S.G. 18 x 3' x 6'	155	155	155	155
Standard Pipes (Black P. E.)				
ASTM A-120 2"	140	140	140	140
Plain &/or Corr. Galvanized Iron Sheets				
JIS G-3302 U.S.G. 26 x 3' x 6'	170	170	170	170
Galvanized Iron Wire				
B.W.G. #8	167	167	167	167
Tinplates				
Electrolytic (107 lbs)	220	220	220	220
Hot Dipped (107 lbs)	245	245	245	245
Common Nail (Bright) (per 100 lbs)				
20D-50D	670	670	670	670
Hot Rolled Steel Hoop				
JIS G-3308 o.4-1.2 m/m x 1/2"-1"	180	180	180	180

Source: Japan Metal Bulletin

Japan Export quotation showed a definite price level from Sept to Dec. All the prices of the different products remained constant. The same is true with the non-ferrous metals as shown in Table 3.

Table 3
JAPAN EXPORT QUOTATION
Non-Ferrous Metals Products
(In US $ Per M.T., F.O.B. Japan)

	Sept. Ave	Oct. Ave	Nov. Ave	Dec. Ave
Copper Wire 1 m/m	1619	1590	1590	1590
Copper Rods 25 m/m	1752	1750	1750	1750
Copper Tubes 40 x 4 m/m 50 x 5 m/m	2057	2055	2055	2055
Copper Strip 150 x 2.0 m/m	1979	1977	1977	1977
Brass Rods 25 m/m	1279	1278	1278	1278
Brass Sheets SWG 16 14 x 48"	1390	1389	1389	1389
Brass Wire SWG #6-#13	1401	1400	1400	1400
Brass Tubes #23-#24	1723	1722	1722	1722
Brass Strip 150 x 2.0 m/m	1418	1417	1417	1417
Brass Flat Wires 0.035" x 0.16"	1445	1444	1444	1444
Bare Electric Wire of Copper 6 m/m	—	—	—	—
Aluminum Plain Sheet 2S SWG #19	667	667	667	667
Aluminum Corr. Sheets USG #32	681	681	681	681
Aluminum Circles 2S SWG 19 x 7"-25" dia.	722	722	722	722
Aluminum Wire 52S 6 m/m	708	708	708	708
Aluminum Rods 11S 25 m/m	955	955	955	955

Source: Japan Metal Bulletin

Table 4
FOREIGN DOMESTIC PRICE
For the month of September

	US	UK	JAPAN	BELGIUM	FRANCE	W. GERMANY	ITALY	CANADA
Non-Ferrous Metals c/kg								
Copper, electrolytic	132.41	124.78	126.39	123.28	125.09	126.67	139.87	128.67
Lead, common	33.03	28.44	32.50	—	28.18	29.39	33.65	33.58
Zinc	34.90	29.99	33.06	—	33.64	32.90	35.29	32.93
Tin	385.08	364.28	375.00	365.95	380.54	379.22	424.10	—
Mercury, $/flask	368.88	—	—	—	—	—	—	—
Aluminum, ingot	63.85	59.85	61.11	—	80.90	63.36	62.07	64.33
Nickel, cathode	281.85	288.12	500.00	—	284.54	—	—	300.95
Steel Products $/MT								
Billets, rerolling	116.60	108.04						97.97
Billets, forging	138.05							
Wire rods	168.30	129.39	125.00	132.00	119.63	127.50	152.40	—
Skelps	—			136.06	124.07	127.73	136.30	—
Shapes, standard	151.80			146.14	126.45	130.46	146.30	138.61
Shapes, wide flange	151.80			149.16	131.73	138.89	116.24	138.61
Sheet piling	—	134.27			138.18	147.54		
Plates	149.60		115.91	170.58	157.45	161.88	151.57	123.33
Reinforcing rounds	129.80		139.65	130.85	122.41	137.98	132.40	123.33
Merchant bars	—			143.90	125.61	122.61	148.20	
Bars, cold finished	212.30							
Sheets, hot rolled	165.00							113.50
Sheets, cold rolled	196.90		131.82	161.26	151.74	161.20		145.15
Strips, hot rolled	160.60	136.71						121.14
Strips, cold rolled	212.30	179.99						158.25
GI Sheets	187.00	186.58			190.90		200.50	
Black Plates	154.00	23.43*						
Tinplates, electrolytic	8.85x	25.33*		277.50				
Tinplates, hot-dipped	—	31.15*						
Pig Iron, basic	72.00							
Pig Iron, foundry	72.50							
Steel scrap	42.26		52.48					

Source: American Metal Market; Japan Metal Bulletin; CECA Publication

x per base box
* per S.A.T.
** per 100m²

Foreign domestic prices in general showed a declining trend from Sept to Dec except for some products which experienced a slight increase or remained constant in the different countries. USA followed by Japan and Italy registered the highest prices for non-ferrous as well as for steel products, as compared to other countries.

FOREIGN DOMESTIC PRICE
For the month of October

	US	UK	JAPAN	BELGIUM	FRANCE	W. GERMANY	ITALY	CANADA
Non-Ferrous Metals c/kg								
Copper, electrolytic	128.31	115.66	126.18	116.35	118.18	119.54	132.33	128.17
Lead, common	32.26	28.45	32.50	—	29.45	29.13	33.12	31.62
Zinc	34.90	29.65	33.05	—	33.64	32.92	35.29	32.71
Tin	384.80	367.06	373.26	366.05	382.18	378.86	426.66	—
Mercury, $/flask	355.00	—	—	—	—	—	—	—
Aluminum, ingot	63.86	61.73	56.80	—	80.90	63.36	62.07	64.33
Nickel, cathode	292.87	294.25	451.38	—	292.73		344.86	300.95
Steel Products $/MT								
Billets, rerolling	111.60	108.04						97.97
Billets, forging	138.05							
Wire rods	168.30	129.39	125.00	132.00	119.63	127.50	150.60	
Skelps	—			136.06	124.07	127.73	136.30	
Shapes, standard	151.80			146.14	126.45	130.46	145.70	138.61
Shapes, wide flange	151.80			149.16	131.73	138.89	136.34	138.61
Sheet piling	—	134.27			138.18	147.54		
Plates	149.60		107.41	170.58	157.45	161.88	151.57	123.33
Reinforcing rounds	129.80		130.56	127.49	122.41	137.98	132.70	123.33
Merchant bars	—			142.20	125.61	122.61	147.80	
Bars, cold finished	212.30							
Sheets, hot rolled	165.00							113.50
Sheets, cold rolled	196.90		112.65	161.26	151.74	161.20		145.15
Strips, hot rolled	160.60	136.71						121.14
Strips, cold rolled	212.30	179.99						158.25
GI Sheets	200.64	186.58			190.90		200.50	
Black Plates	154.00	23.43*		50.39**	45.63**	50.06**	47.89**	
Tinplates, electrolytic	9.65x	25.33*	277.50	58.15**	53.27**	57.10**	55.66**	
Tinplates, hot-dipped	—	31.15*		66.09**	63.09**	66.01**	64.80**	
Pig Iron, basic	72.00							
Pig Iron, foundry	72.50							
Steel scrap	44.53		50.15					

Source: American Metal Market; Japan Metal Bulletin; CECA Publication

x per base box
* per S.A.T.
** per 100m²

FOREIGN DOMESTIC PRICE
For the month of November

	UK	JAPAN	BELGIUM	FRANCE	W. GERMANY	ITALY	CANADA
Non-Ferrous Metals c/kg							
Copper, electrolytic	108.74	112.50	107.76	109.64	111.02	121.90	124.96
Lead, common	28.03	32.29	—	29.45	28.82	32.92	31.62
Zinc	29.34	33.06	—	33.64	32.30	34.93	32.71
Tin	367.54	372.22	366.19	380.54	379.13	426.66	—
Mercury, \$/flask	—	—	—	—	—	—	—
Aluminum, ingot	61.73	61.11	—	80.90	63.36	62.07	64.33
Nickel, cathode	299.16	437.50	—	292.73	—	351.68	300.95
Steel Products \$/MT							
Billets, rerolling	114.63						97.97
Billets, forging							
Wire rods	136.95	125.00	132.00	122.10	127.50	130.80	
Skelps			145.13	130.14	127.73	147.17	
Shapes, standard			146.14	126.45	130.46	145.70	138.61
Shapes, wide flange			149.16	131.73	138.89	136.34	138.61
Sheet piling	142.31			138.18	147.54		
Plates		105.24	170.58	157.45	161.88	149.70	123.33
Reinforcing rounds		123.14	129.17	122.40	137.98	125.77	123.33
Merchant bars			141.10	125.61	122.61	138.70	
Sheet, cold rolled		119.44				160.00	145.15
Sheets, hot rolled							113.50
Strips, hot rolled	144.75						121.14
Strips, cold rolled	188.78						158.25
GI Sheets	205.17			190.90		200.50	
Black Plates	24.99*		50.39**	45.63**	50.06**	47.89**	
Tinplates, electrolytic	26.88*	277.50	58.15**	53.27**	57.10**	55.66**	
Tinplates, hot-dipped	32.71*		66.09**	63.09**	66.01**	64.80**	
Steel scrap		40.89					

Source: American Metal Market
Japan Metal Bulletin
CECA Publication

x per base box
* per S.A.T.
** per $100m^2$

FOREIGN DOMESTIC PRICE
For the month of December

	UK	JAPAN	BELGIUM	FRANCE	W. GERMANY	ITALY	CANADA
Non-Ferrous Metals c/kg							
Copper, electrolytic	104.54	109.03	105.50	107.45	108.83	117.29	120.26
Lead, common	28.00	32.36	—	29.45	28.54	32.72	31.62
Zinc	28.97	33.06	—	33.64	31.68	35.28	32.71
Tin	352.24	372.22	355.65	370.00	368.45	413.83	—
Mercury, \$/flask	—	—	—	—	—	—	—
Aluminum, ingot	61.73	61.11	—	80.91	63.36	62.07	63.68
Nickel, cathode	299.16	416.67	—	292.73	—	356.09	300.95
Steel Products \$/MT							
Billets, rerolling	114.63						131.96
Wire rods	136.95	125.00	134.45	119.64	128.64	143.30	
Skelps			145.13	130.44	129.32	147.17	
Shapes, standard			141.77	126.45	132.17	146.80	138.61
Shapes, wide flange			145.13	131.72	141.16	136.34	138.61
Sheet piling	142.31			138.18	147.54		
Plates		104.78	170.58	157.45	164.28	149.71	127.69
Reinforcing rounds		113.58	129.17	122.41	138.25	122.70	123.33
Sheets, hot rolled							113.50
Merchant bars			142.10	125.61			
Sheets, cold rolled		116.98			123.46	141.90	
Strips, hot rolled	144.75					160.00	153.89
Strips, cold rolled	188.78						121.14
GI Sheets	205.17		173.75	243.62			158.25
Tinplates, electrolytic	26.88*	277.50					
Tinplates, hot-dipped	32.71*						
Black Plates	24.99*						
Steel scrap		38.89					

Source: American Metal Market
Japan Metal Bulletin
CECA Publication

x per base box
* per S.A.T.
** per $100m^2$

Table 5
JAPAN MONTHLY AVERAGE DOMESTIC QUOTATION
(In US $ Per MT unless otherwise indicated)
For 1970

	Sept. Ave	Oct. Ave	Nov. Ave	Dec. Ave
Iron and Steel Products				
Round Bars (Reinforcing)				
9 m/m	139.65	130.25	123.14	113.58
19 m/m	131.57	125.77	123.14	112.19
Flat Bars 6 x 50 m/m	134.34	128.24	122.22	118.06
Equal Angles 3 x 25 m/m	158.59	145.06	133.33	127.78
6 x 50 m/m	117.68	109.57	106.94	107.10
9 x 75 m/m	117.68	109.57	106.94	107.10
Channels 5 x 50 x 100 m/m	138.13	128.86	120.67	118.06
9 x 90 x 250 m/m	138.64	128.86	120.67	119.44
Joists 7 x 100 x 200 m/m	159.34	154.78	150.00	149.38
H Shapes 9/14 x 250				
250 m/m	138.13	133.64	128.24	132.41
Black Sheets (HR)				
(3' x 6') 1.6 m/m	117.93	109.88	105.55	105.56
Cold Rolled Sheets				
(3' x 6') 1.0 m/m	131.82	112.65	119.44	116.98
Plates 3.2 m/m x 4' x 8'	115.91	107.41	105.24	104.78
6 m/m x 4' x 8'	115.91	107.41	105.24	104.78
Tinplates (Electroplating)				
.257 m/m	277.50	277.50	277.50	277.50
Wire Rods 5.5 m/m	125.00	125.00	125.00	125.00
Plain Galvanized Iron Sheets (Per Sheet)				
U.S.G. 0.4 m/m 3' x 6'	0.93	0.93	0.93	0.93
0.25 m/m 3' x 6'	0.63	0.63	0.63	0.63
Corrugated G.I. Sheets (per Sheet)				
0.25 m/m 2.5' x 6'	0.65	0.65	0.65	0.65
Stainless Steel Sheets (SUS 27)				
18-8 0.3 m/m	1305.56	1305.56	1305.56	1305.56
Iron Wire BWG #8	141.67	143.06	141.67	141.67
Barbed Wire BWG #14	222.73	222.22	214.50	208.33
Common Wire Nail 4"	155.09	151.54	141.67	141.67
Wire Nettings (per 910 m/m x 30 m)				
Galvanized BWG				
20 x 15 mesh	5.56	5.56	5.56	5.56
Green Enameled BWG				
33 x 14 mesh	12.50	12.50	12.50	12.50
Steel Scrap (Special Grade)	52.48	50.15	40.89	38.89
Pig Iron Scrap	76.39	75.00	68.20	66.67
Non-Ferrous Metals				
Electrolytic Copper	1237.28	1192.89	1100.36	1026.22
Electrolytic Zinc	330.56	330.56	330.56	330.56
Electrolytic Lead	338.89	330.25	316.67	316.67
Primary Tin	3763.89	3750.00	3750.00	3722.22
Antimony	4583.33	3549.38	2654.31	2361.11
Nickel	5000.00	5000.00	4583.33	4166.67
Copper:				
Sheets 23 m/m	1696.75	1638.89	1549.39	1467.58
Tubes 40 x 4 m/m	1828.69	1771.61	1679.00	1614.19
Rods 25 m/m	1765.06	1709.89	1620.36	1530.86
Wire 6 m/m	1725.69	1684.89	1609.56	1509.25
Brass:				
Sheets 2 m/m	1182.86	1126.52	1032.42	1015.44
Tubes 40 x 4 m/m	1527.78	1479.94	1422.83	1342.58
Rods 25 m/m	1089.11	1050.91	1012.33	933.64
Wire 6 m/m	1247.69	1209.89	1158.94	1115.75
Aluminum Sheets				
(1 m/m x 400 x 1200)	824.08	848.77	861.11	861.11
Mercury	11759.25	10756.17	10617.28	10555.56
Primary Aluminum	611.11	611.11	611.11	611.11
Secondary Aluminum	530.56	528.69	525.00	525.00

Prices registered in the Japan monthly average domestic quotation showed a declining trend from Sept to Dec. This does not include prices of tinplates, wire rods and galvanized iron sheets which remained constant. The same downward trend was experienced by the non-ferrous metals ex-except for primary aluminum.

1971

Table 6
JAPAN MONTHLY AVERAGE DOMESTIC PRICE
(In US $ Per MT unless otherwise indicated)

	Jan. Ave.	Feb. Ave.
Iron and Steel		
Round Bar 9 mm	117.58	112.85
16-25 mm	114.54	109.38
Flat Bar 6 x 25mm	119.18	115.63
Equal Angle 6 x 50 mm	109.55	106.60
10 x 90 mm	110.07	107.64
Channel, 6 x 65 x 125 mm	116.93	112.50
H-Shape, 9/14 x 250 x 250 mm	133.68	130.56
Hot Rolled Sheet (3 x 6), 1.6 mm	113.72	111.81
Cold Rolled Sheet (3 x 6), 1.2 mm	123.87	122.92
Medium Plate 32 x 3 x 6 mm	111.28	105.21
Plate, 6 x 4 x 8 mm	110.07	104.86
9 x 4 x 8 mm	110.24	104.86
Gas Pipe (black), 15A (1/2 inch) per kg	0.13	0.13
Water pipe (white), 15A (1/2 inch) per kg	0.21	0.21
Galv. Sheet (per sheet)		
Plain. 0.25 (No. 32)	0.60	0.60
Corrugated. 0.25	0.56	0.56
Wire rod 5.5 mm	124.83	125.00
Round Nail. 100 mm	148.96	156.94
Iron Wire. No. 8	141.93	142.01
Annealed Iron Wire No. 8	144.84	145.49
Galv. Iron Wire No. 14	155.34	157.64
Tinplate. 90L (0.257 mm)	275.56	275.56
Wire Netting, 20 x 15 mm (1 roll)	5.32	5.32
Welded Steel Nettings (1 sq. meter)		
No. 4 (6 x 150 mm)	0.65	0.65
No. 8 (4 x 100 mm)	0.53	0.53
Special Steel		
Constructional Carbon Steel		
(SC) (per Kg)	0.15	0.15
Stainless Steel		
SUS 24 (18 CR)	—	—
Sheet (2-6 mm)	0.51	0.51
SUS 27 (18-8)	—	—
Sheet 0.3 mm	1.31	1.31
Steel Scrap		
Special for Electric Furnace	42.93	40.90
Pig Iron Scrap	67.71	67.24
Non-Ferrous Metals		
Electrolytic Copper	1021.69	1017.00
Electrolytic Zinc	330.56	329.16
Electrolytic Lead	317.53	314.58
Tin	3668.42	3625.00
Antimony	2118.06	1875.00
Nickel	4236.11	4027.78
Cadmium	5555.56	5486.11
Mercury	10708.33	10708.33
Aluminum	609.56	591.67
Copper Sheet 2.0 mm	1366.31	1254.63
Copper Tube, 50 x 5 mm	1528.36	1462.96
Copper Rod, 25 mm	1430.56	1342.59
Copper Wire, 0.9 mm	1407.42	1324.07
Brass Sheet, 2.0 mm	1001.75	958.33
Brass Tube, 50 x 5 mm	1269.67	1189.81
Brass Rod, 25 mm	817.31	865.74
Brass Wire, 6 mm	1076.97	1045.37
Aluminum Sheet (99%) 1.0 mm (400 x 1200)	861.11	861.11
Aluminum Circle 1.0 mm	902.78	902.78

The Japan Monthly Average Domestic Price for Iron and Steel suffered a decrease of 3% to 4% for the month of Feb. compared to that of the previous month. This is with the exception of some products whose prices remained the same or even increased. The same decrease was true for the non-ferrous metals except for Brass Rod which increased, aluminum sheet and circle which remained the same.

Table 7
DOMESTIC RETAIL PRICES OF SELECTED STEEL PRODUCTS
Source: Bureau of Commerce
September 1970 to January 1971

	Sept.	Oct.	Nov.	Dec.	Jan.
Galvanized Iron Roofing Sheet per sheet					
Local-Gauge No. 26-Apo & River Brand					
32" x 6' Corr.	7.50	8.20	9.60	9.60	9.90
7' "	8.62	9.50	11.20	11.20	11.50
8' "	9.75	10.80	12.80	12.80	12.60
9' "	10.87	12.10	14.40	14.40	14.85
10' "	12.00	13.40	16.00	16.00	16.50
36" x 8' Plain	9.75	10.80	12.80	12.80	13.20
Gauge No. 31-Apo & River Brand					
32" x 6' Corr.	5.75	6.02	7.50	7.50	7.50
7' "	6.65	7.01	8.75	8.75	8.75
8' "	7.55	8.00	10.00	10.00	10.00
9' "	8.55	9.07	11.25	11.25	11.25
10' "	9.50	10.00	12.50	12.50	12.50
36" x 8' Plain	7.55	8.00	10.00	10.00	10.00
Gauge No. 26 Union Brand					
6' Corr.	—	—	—	—	—
7' "	—	—	—	—	—
8' "	—	—	—	—	—
9' "	—	—	—	—	—
10' "	—	—	—	—	—
Aluminum Sheet, per sheet					
Gauge No.					
.016 x 33" x 8'	16.50	16.50	16.50	16.50	16.50
.019 x 36" x 8'	22.00	22.00	22.00	22.00	22.00
.024 x 36" x 8'	27.00	27.00	27.00	27.00	27.00
0.27 x 36" x 8'	30.50	30.50	30.50	30.50	30.50
0.32 x 36" x 8'	38.50	38.50	38.50	38.50	38.50
Square Bars					
3/8" x 3/8" x 20'	4.50	4.50	4.50	4.50	4.50
1/2" x 1/2" x 20'	8.40	8.40	8.40	8.40	8.40
5/8" x 5/8" x 20'	13.70	13.70	13.70	13.70	13.70
1" x 1" x 20'	40.00	40.00	40.00	40.00	40.00
Round Bars					
1/4" x 20' (5 mm)	2.00	2.00	2.00	2.00	2.00
3/8" x 20' (9 mm)	2.50	2.50	2.50	2.50	2.50
1/2" x 20' (11 mm)	4.50	4.50	4.50	4.50	4.50
5/8" x 20' (14 mm)	9.00	9.00	9.00	9.00	9.00
Flat Bars					
1/ 8" x 3/8" x 20'	2.60	2.60	2.60	2.60	2.60
1/ 8" x 1/2" x 20'	3.00	3.00	3.00	3.00	3.00
3/16" x 1/2" x 20'	4.00	4.00	4.00	4.00	4.00
1/ 4" x 1/2" x 20'	5.50	5.80	6.00	6.00	6.00
1/ 2" x 1" x 20'	18.50	18.50	18.50	18.50	18.50
1/ 2" x 1 - 1/2" x 20'	25.40	25.40	25.40	25.40	25.40
Angle Bars					
1/ 8" x 3/4" x 20'	6.00	6.00	6.00	6.00	6.00
1/ 8" x 1" x 20'	9.00	9.00	9.00	9.00	9.00
3/16" x 1" x 20'	13.20	13.38	13.50	13.50	13.50
1/ 4" x 1" x 20'	17.60	17.85	18.00	18.00	18.00
3/ 8" x 3" x 20'	80.00	80.00	80.00	80.00	80.00
Galvanized Iron Pipe					
1/2" x 20'	11.50	11.80	12.00	12.00	12.00
3/4" x 20'	16.00	16.60	17.00	17.00	17.00
1" x 20'	22.00	22.60	23.00	23.00	23.00
1-1/2" x 20'	37.20	37.68	38.00	38.00	38.00
2" x 20'	47.30	47.72	48.00	48.00	48.00
Black Iron Pipe, a piece					
1/4" x 20'	—	—	—	—	—
1/2" x 20'	9.80	9.92	10.00	10.00	10.00
1" x 20'	18.70	18.88	19.00	19.00	19.00
1-1/2" x 20'	31.60	31.84	32.00	32.00	32.00
2" x 20'	40.20	40.68	41.00	41.00	41.00
Barbed Wire, per roll, local					
70 lbs.	67.50	66.00	65.00	65.00	65.00
60 "	62.50	61.00	60.00	60.00	60.00
35 "	34.00	33.40	33.00	33.00	33.00
Machine bolts, with nuts, per kilo — All sizes	2.50	2.50	2.50	2.50	2.50
Common Wire Nails, per kilo					
1" - 1-1/2"	1.80	1.80	1.80	1.80	1.80
2" - 2-1/2"	1.70	1.70	1.70	1.70	1.70
3" - up	1.60	1.60	1.60	1.60	1.60

From the retail prices published by the Bureau of Commerce (Table 7) the prices of galvanized iron sheets from Sept. to Jan. showed an average increase of 10%, whereas GI pipes showed a 2% increase and Black Iron Pipe 2% increase. Barbed Wire showed a declining trend although it started to remain steady from Nov. to Jan. The rest of the steel products have definite price levels which remained constant during these months.

THE WORLD MARKET SITUATION OF COPPER

Copper has become an important metal of the industry as manifested by the marked increase of world demand in the latter part of the 1960's. The major factors behind its growth were the manifold accomplishments of the industry with regard to market and product development. Throughout these years, copper has been consistent in its pattern of penetrating established and new markets.

The copper industry has a variety of markets namely: building and construction, transportation, consumer products, industrial machinery and equipment, and the electrical industry.

The electrical industry is the largest copper consumer. Copper is used in electronic tubes, power tubes, communication, cable shielding, power generation and distribution and in electrical installations.

In building construction, users usually prefer alloys which provide ways of bringing in the beauty and durability of copper. They come in as laminated copper-plywood roofing, copper shingles and panels, copper sprinkler tubing and etched copper wall panels.

Automotive electrical components have depended on copper because of its conductivity. Electrical systems continue to grow in complexity as more lights and accessories are added to them. Copper is used in carbureto parts, radiator parts, bearing boxes, gears and lamp reflectors.

Copper has also found its way in cooking ovens and other home appliances because of its mechanical and electrical properties as well as for its appearance and corrosion resistance. The copper industry will benefit in areas like wiring, motors, and speed controls for power hand-tools and home shop tools.

Beryllium copper has replaced steel for plunger tips in aluminum die-casting machines while copper alloy molds are being used in plastic injection and molding machines.

The technical properties of copper like its high electrical conductivity, its malleability and its use as an alloy component account for the enviable status which it now occupies in the metal industry.

World Copper Mines

Large deposits of copper ore are found in the mines of America, Africa, Asia, Australia and Russia. Between the 15th and 17th centuries, most of copper mining were concentrated in Europe. The mine productions of Southern Germany and Sweden were at their peak in the 16th and 17th centuries, while those of Norway and Finland began operations in the 1930's with the discovery of valuable deposits.

In the East, some Indian mines have been worked on and off for many centuries. Quite a number of deposits are being mined in the main island of Japan and in China. The Philippines is considered one of the ten leading producers of copper ore with an average of 78.7 thousand metric tons which is only next to Japan.

The large copper mines of the United States which were exploited in the 1850's were found to produce a million tons of copper every year. The longest-lived copper mine is the Calument and Hecla Inc. with deposits on Keweenaw Peninsula of Michigan. Tremendous copper production has been continuous, making the United States the leading country producer of copper ore over a span of more than a century.

The total world mining production of copper is shown in Table 1.

Consumption

The average annual increase in the world consumption of primary copper from 1960 to 1969 was four and a half per cent as shown in Table 2.

The United States was the largest consumer, followed by Zambia, Chile, USSR, Canada, West Germany, Japan and the Republic of Congo.

As an additional contribution to the generally strong market demand of copper, a bulk of scrap is remelted and refined. This secondary copper amounts in some countries to more than one-quarter of its total consumption.

Supply

Total world smelter production increased from 5,106,127 tons in 1960 to 7,243,084 tons in 1969, at an average rate of four per cent as shown in Table 3.

In 1967, total world production decreased by 5.2 per cent compared to that of the previous year. This was due to the costliest and longest strike in the domestic copper mining and processing industries of the United States which lasted until the first quarter of 1968. The world stoppage is estimated to have caused the United States a refined copper production loss of around 800,000 tons. However, the years 1968 and 1969 showed a great recovery and increase of 12.7 per cent and 7.5 per cent respectively. The year 1969 gave a total output of 7.2 million tons. The United States, Canada, Chile and Peru accounted for 41 per cent of this; the USSR and West Germany, 24 per cent; Congo and Zambia 16 per cent and Japan, nine per cent. These ten countries have been the leading suppliers of primary copper from 1960 up to the present.

Projections

The total world production is expected to reach an output of about 8.4 million tons in 1973, growing at an average rate of four per cent per year. Reports reveal that there are adequate supplies of copper in the world to last for many years, despite the growing demand of the industry.

The production and consumption projections of copper are shown in Table 4.

Price

Table 5 shows the average annual copper prices of the two-price market system: United States producers New York Exchange (NYSE) and London Metal Exchange (LME)

From 1963 to 1966, average annual world refined copper prices (as measured on the LME) jumped 135 per cent following a four-year period in which the price was virtually unchanged. The rise in price was associated with an acceleration in the growth rate of consumption (from five to seven per cent per year) during a period when the rate of growth in world primary production was falling (from 5.5 to 4.5 per cent). From mid-1966 to mid-1968, a fluctuating pattern of prices occurred, caused in part by the nine-month US producers' strike and its conclusion. From January to July 1970, 60 cents and 69 cents per pound at the NYSE and LME respectively, were posted. This upward trend was caused by the London dock strike in the middle of July. After the settlement of the strike, however, prices started going down.

No definite consensus could be made in the world metal market on whether copper prices will continuously go down or recover. The copper market's stringency and strength in 1969 was caused by high industrial demand for the year. The current cooling down tendencies of economies around the world has apparently tampered the demand for copper. It is possible, therefore, that with anticipated rising inventories and threatened US strikes, copper prices would decrease further during the remainder of 1970.

Problems

The industry is presently being faced by problems which have to be overcome in order to cope with the increasing world demand for copper. Foremost is the expiration of labor contracts in some countries. In addition to this, copper producers have experienced operational difficulties, like shutdowns for repairs of furnaces, converter flue failures and anode furnace troubles. Other problems are the inequities and economic inefficiences caused by the two-price market and the present system of allocation, and the growing uses and applications of the other metals which makes them keen competitors of copper.

Plans

The pioneers in the copper industry have foreseen the intense competitive "battle of materials" and the resultant need and oportunity for significant industry-wide action market development. As a result, Copper Development Association Inc. (CDA) and the International Copper Research Association (INCRA) have set-up plans for short-range as well as long range industry wide development and growth.

A. Copper Development Association Inc. (CDA)

This Association was organized six years ago as an end-use market-oriented organization to help create new business opportunities, develop new applications and expand the markets for the entire copper and brass industry.

CDA functions to create new markets for the copper and brass industry through new uses of copper and copper alloys; to make it easier for customer industries to select and apply copper and copper alloys by supplying application data through individual requests, through the distribution of CDA handbooks, brochures and the computerzied Copper Data Center; and to inform customer industries of new marketing and technical development relevant to end-use markets.

B. International Copper Research Association (INCRA)

The main objective of this association is to develop new products for copper and expand its overall use. It is currently making a study to develop a range of copper alloys with improved properties and to improve the technology of diecasting copper and copper alloys. Another INCRA program is aimed at improving the effectiveness of copper compounds used as fungicides, algaecides, herbicides and molluscicides in order to develop new organic and inorganic copper compounds for their biological activity. Research on the feasibility of applying insulating coatings to copper wire and strip by electrophoresis; better known as electrocoating is likewise being made. These are the steps being undertaken by INCRA in order to develop a balanced program of product development, which would result in a broadened technology of the copper industry.

Outlook

The future of the copper industry is very promising. Consumption is expected to increase at an annual rate of 4.5 per cent a year. So-called under-developed countries, including some which

Table 1

TOTAL WORLD MINING PRODUCTION OF COPPER (1)

1964-1968

Year	*Total World Mining ('000 MT)*
1964	4,855.4
1965	5,068.8
1966	5,295.2
1967	5,057.9
1968	5,446.8

(1) Source: Report on Production & Investment Programs In the Copper Industry, CIPEC, Paris, Feb. 1970

Table 2

WORLD CONSUMPTION OF COPPER*(2)

1960 - 1969

Year	World Consumption (Short Tons)	% Increase or (Decrease)
1960	4,843,690	—
1961	5,066,311	4.6
1962	5,044.767	Nil
1963	5,327,357	5.6
1964	6,032,201	13.0
1965	6,240,748	3.5
1966	6,615,253	6.0
1967	5,939,816	(10)
1968	6,464,231	8.8
1969	7,073,061	9.4
	Average rate of growth	4.5%

(2) Sources: Metal Statistics, 1969
American Bureau of Metal Statistics, June 1970

Table 3

WORLD SMELTER PRODUCTION (3)

1960-1969

Year	Smelter Production (Short Tons)	% Increase or (Decrease)
1960	5,106,127	—
1961	5,150,336	1.0
1962	5,282,519	2.6
1963	5,425,200	2.7
1964	5,789,539	6.7
1965	6,066,380	4.8
1966	6,319,715	4.2
1967	5,982,521	(5.3)
1968	6,740,572	12.7
1969	7,243,084	7.5
	Average rtae of growth	4%

(3) Sources: Metal Statistics, 1969
American Bureau of Metal Statistics, June 1970

Table 4

PRODUCTION, CONSUMPTION PROJECTIONS

1970-1973

Year	Smelter Production (Short Tons) at 4% growth rate	Consumption (Short Tons) at 4.5% growth rate
1970	7,532,807	7,391,348
1971	7,834,119	7,723,959
1972	8,147,483	8,071,537
1973	8,473,380	8,434,756

Table 5

ANNUAL AVERAGE COPPER PRICES

1960-1970

Year	United Producers f.o.b Refinery (cents per pound)	London Metal Exchange Spot (cents per pound)
1960	32.1	30.8
1961	29.9	28.7
1962	30.6	29.3
1963	30.6	29.4
1964	32.0	44.0
1965	35.0	58.7
1966	36.2	69.0
1967	38.2	51.2
1968	41.8	56.1
1969	47.8	66.3
1970*	60.0	69.5

* Jan. to June
Source: American Metal Market (Section 2) Sept. 21, 1970 pp. 42

are major producers of copper, have long sought to raise their standards of living. If they do, it would mean new outlets for copper in these countries — for communications, electronics, building materials, transportations, etc. Reports on a Free World primary producer copper surplus of 555,000 tons by 1973 could be remedied by production cutbacks to help maintain some semblance of balance between supply and demand.

The large producers of copper and particularly their governments so dependent on copper exports for foreign exchange, are well aware of the dangers of over-production. Four countries — Chile, Zambia, Congo and Peru — have formed the Inter-governmental Council of Copper Exporting Countries, commonly known as CIPEC. These member countries produce anywhere from 40 to 45 per cent of the Free World's primary copper and provide 80 per cent of the export sales. Because of this, any decrease in price would result to curtailment of their production and a buying program to support the price of the London Metal Exchange.

Researches on the improvement of copper products and development of new uses and applications are being conducted to meet the challenges of substitute metals.

The copper industry being a diversified industry is essential to a growing technological society, and as such provides a basis of a bright future and a better prospect in the metals industry.

Sources: American Metal Market Section 2, Sept. 21, 1970
Yearbook of the American Bureau of Metal Statistics, June 1970.

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PISI TO BE REVITALIZED

Men at the helm of the steel and iron industry decided to revitalize the Philippine Iron and Steel Institute (PISI) during the reorganizational meeting held recently at the ASEC, SMC Building, Makati, Rizal.

The members of the PISI are determined to inject life and vitality to PISI which was impotent since its creation a few years back due to "lack of motivation."

In the same meeting, the Metals Industry Development Center was chosen as the secretariat of PISI which will provide manpower, service, facilities and other secretariat services.

Dr. Antonio V. Arizabal, MIDC director, who steered the discussions at the meeting also gave a status report of the MIDC and at the same time asked the private sector for continued support for the MIDC. Copies of the first issue of *Philippine Metals*, MIDC quarterly publication, were given to those who attended the meeting.

Pertinent proposals agreed upon are: to stabilize and rationalize the local market, to promote exports, to work for a more favorable restructuring of the tariff code, to work for the establishment of standards for iron and steel products, to work for the technical assistance requirements of the industry, to reorganize and disseminate information in the industry, and to formulate a development plan for the full integration of the iron and steel industry.

In addition, the PISI was restructured by making it a central body of such organizations as Philippine Steel Manufacturers Association, Philippine Foundrymen's Manufacturers Society, Base Metals Association of the Philippines and others.

The PISI shall be made to assume the responsibiilty of raising funds for the Philippine annual contribution, as a member country, to the South East Asia Iron and Steel Institute (SEAISI) with headquarters in Singapore.

Those who attended the PISI meeting were: D.J. de Jesus, vice-president and general manager, International Pipe Industries Corp.; A. Dumlao, Jr., president, Pipe and Tube Manufacturing Association of the Philippines, Dan Mijares, executive assistant, Philippine Blooming Mills; Antonio Concepcion, division manager, ELISCO/ELIROL; G.K. Mangalindan, production manager, Aircon Inc.; J. M. Jimenez, president, Philippine Society for Quality Control; C.V. Ventura, general manager for manufacturing, HONIRON; John B. Botelho, general manager, Santa Ines Mining & Steel Co.; Dionisio Chua, assistant general manager, Central Steel Manufacturing Co., Inc.; E. Ellanico, consultant, Marcelo Steel Corp.; Salustiano Oca, president, Oca Steel Mills, Inc.; M.R. Balauag, engineer, A.G. & P; P. Salvacion of PSMMC; L.C. Young of Philippine Iron Manufacturing Co.; J. Zabarte, Jr., manager, Mesma; V.C. Dacanay, Manager, FILMAG; G.T. Marcelo, vice-chairman, POLARIS; J.T. Marcelo, vice-president, Marcelo Steel; T. Motas, finance manager, Puyat Steel; Vicente Muñoz, Operation Group Manager (Foundry Div.), E.E.I.; and Maj. Laraño, Manager, Administrative Department, Oca Steel Mills.

NEEDED IN METALS: UP-TO-DATE INFORMATION

"A big problem of the Philippine Metals industry is the need for up to date technical information on copper alloys, and such others."

An engineer consultant from Australia, Sydney Kayess, pointed this out in an interview last April 16, at the MIDC seminar room, where he gave a lecture, complete with slides, on the prospect and developments of copper technology in Australia.

Kayess, 44, technical manager of the Copper and Brass Information Center in Australia, was here on an official visit for his Center. The Center provides technical services and information in metals — brass, copper, bronze, etc. — to all industries in Southeast Asia.

The Australian group is one of 20 such regional Centers in the world. The other 19 centers, actually are called Copper Development Associations (the Australia group took on a different name).

Kayess, noted that there is, for instance, a big gap between the pile of technical information of Australia and the little that the Philippines has.

According to him, this gap is due to two reasons; namely:

1. The Philippines has no basic copper and brass industries, as in Australia. The country has, for example, no copper fabricators; thus, there is a big gap between knowledge and industrial application.

2. The Philippines lacks technical researchers and facilities. The United States of America, for instance has about 250 men whose job alone is to record the latest discoveries, trends, techniques, prices and research findings on copper, brass and other metals.

ACTAR TO BE ESTABLISHED

The Southeast Asia conference on tax recently held in Manila has formed a study group to work on the formation of Asian Center for Tax Administration and Research (ACTAR).

This body will be a clearing house for the exchange of information on tax policy and reform in tax administration and revenue structure.

In the same conference, Secretary of Finance Cesar Virata sought for the removal of the territorial barriers among Southeast Asia countries to evolve a suitable tax system in the region.

He urged the conferees to adopt a regional tax system through skillful research in order to evolve tax policies and innovation attuned to the development of Asian countries.

PHILIPPINE IRON MAY GO TO COPPER, MOLYBDENUM MINING

Philippine Iron Mines, Inc. might go into copper, pyrite and molybdenum mining, according to Rene J. Neri, assistant to PIM President Jose Cuyugan.

PIM properties in Larap, Camarines Norte, contain copper, molybdenum, magnetite, pyrite and gold in addition to iron.

Molybdenum is a highly heat-resistant metal and cost a dollar more per pound than copper. To extract the two metals using PIM existing facilities, pieces of heavy machinery are needed as flotation circuits and has already been installed by PIM in the iron concentration plant.

Meanwhile, PIM is also considering an electrolytic process to produce copper plates whch will be of about the same quality as refined copper. This process is cheaper than having the copper concentrate smelted.

Should this process be feasible, Neri said, the corporation would apply with the BOI for pioneer status to meet local demands for copper plate which is being filled by importation.

OUTLOOK FOR OIL MINE EXPLORATION BRIGHT, FIRM SAYS

Mr. Jose Ma. Barcelona, president of the Oriental Petroleum and Mineral Corporation predicts that 1971 will be a "very active" year for oil and mineral exploration work.

This view was expressed by Barcelona in a report at the annual meeting of the OPMC at the Manila Hilton.

In his report, Barcelona cites the initial studies made by OPMC in exploration, development, acquisition, financing, and management of all kinds of petroleum and mineral properties in the Philippines.

In its search for oil, OPMC's management has decided initially to concentrate in the Palawan offshore areas.

The OPMC has completed the necessary exploration activities before drilling was conducted which include a seven month extensive geological investigation of Palawan, interpretation of the 8,000 line mile aeromagnetic survey ran over Palawan in 1969 and two marine seismic surveys which finally delineated the structure to be drilled.

In concluding his report, Barcelona said that they now enter 1971 with the corporate dedication and firm resolve to exert every effort to find the elusive "Black Gold".

CONSORTIUM PROPOSED FOR RP'S ALUMINUM PRODUCTION

The multi-million venture on an aluminum smelter project will be realized by the proposed consortium of private firms according to Jose Concepcion, Jr., president of the Republic Flour Mills, Inc., one of the big investors in the project.

The consortium is composed of Republic Flour Mills, 40 per cent; Reynolds Philippines, 40 per cent; Hooven Philipoines, seven per cent and Private Development Corporation of the Philippines, and the public, 13 per cent.

However, Concepcion said, the firm's equity participation may be reduced to accommodate Japanese investors. The Japanese equity participation in the venture is a feature of the purchase contract.

The proposed aluminum smelter project has received a big boost after Japan expressed desire to buy all of its initial capacity of 30,000 metric tons of aluminum ingots at $17 million.

The place where the smelter project will be established is not definitely known, but Concepcion said, most likely it will be in Mindanao.

He said the consortium will tap the power potential of Lake Lanao which has a potential generating capacity of 750,000 kilowatts. The aluminum project will utilize 16 per cent of Lake Lanao's power potential.

The smelter project will be operational before the end of 1973, Concepcion added.

FOREIGN INVESTMENTS NEEDED FOR ECONOMIC GROWTH

The role of direct foreign investments in the Philippines is still necessary for massive industrialization in view of the country's rapid population growth.

This was emphasized by M.V. Stolen, resident vice-president of the First National City Bank while addressing the Philippine Council of Industrial Communications.

Stolen pointed out two major advantages of direct foreign investments: Capital to accelerate the natural rate of growth and the technological aspects to upgrade the quality of labor.

The Philippines today, Stolen observed is faced with two major bottlenecks in the growth process, insufficient savings and technological lag.

He said that if the inflow of foreign capital is massive, the country can jump from merely natural growth rate to an accelerated rate of growth known as warranted rate.

WHARFAGE FEE BILL THREATENS MINING INDUSTRY

The Philippine Society of Mining, Metallurgical and Geological Engineers (PSMMGE) through its president, David P. Cruz, strongly criticized the wharfage bill pending in Congress.

Cruz said that the imposition of the wharfage fee would "badly hurt if not

David J. Desmond, a UNIDO Industrial Expert, lectures on Cusum Charts.

kill" the mining industry.

The defects of the measure lie in the fact that it does not admit any classification of mineral products and its applicability even over private piers, he said.

Conceding that some exported mineral command a sales value of $200 per ton or about ₱1,300 computed at the floating rate, Cruz held that there are other products especially iron ore and magnetite sand, which sell at $6.50 to $8 per ton or only ₱42 to ₱50 and which could not absorb the proposed fee without causing serious economic problems.

Cruz pointed out that at present all mining products including iron ore pay two per cent ad valorem and eight per cent export tax or a total of 10 per cent. The imposition of ₱1.50 per metric ton as wharfage fee would raise the marginal cost to 13 per cent to the prejudice of low-price products.

These overburdening taxes and other factors, like the discovery of iron ore deposits in Australia and India, makes the low-priced products uncompetitive in the international market, Cruz added.

To protect the mining industry, Cruz suggested that the bill contain the following exceptions: (1) that the fee be proportionately reduced according to the products' selling price; and (2) that the fee is to be imposed only if government piers are used to the exclusion of private piers.

BOI-APPROVED INVESTMENTS TOTAL ₱130 MILLION

A total of 120 firms registered with the Board of Investments from July to December 1970, under Republic Act 5445, including two international airlines, an oil exploration firm and an American oil company.

Of the firms registered under two classifications, ESSO Philippines showed the largest investment with ₱52,319,000.

Other firms registered with the BOI are: the Pakistan International Airlines Corporation, SABENA (Societe Anonyme Belge D' Exploitation de la Navigation Aerine), Dow Chemicals, Cleton International Exploration Corporation, Roche Pharmaceuticals and United Milk Products.

The types of business approved by BOI include evaluation and processing of applicants for employment, general administration work, mineral assaying, trade promotion, textiles, construction materials, financial consultancy and counselling services.

The amount of investment applications approved to do business within that period amounted to P3.3 million, according to records of the foreign business section while approved permissible investments totalled P127 million.

GOV'T PREPARING LONG RANGE ECONOMIC PLANS

The government is preparing a 15-year economic plan. Details of the new economic plan were not disclosed but it was believed that the National Economic Council (NEC) has already started preliminary studies.

The four-year economic plan will not be abandoned but it will be reconciled with the new long-term plan. The NEC Chairman said that because of the "redirective" efforts of major monetary policies implemented last year, the need for revising and re-evaluating the four-year plan (covering the period of 1971-74) has become imperative.

The NEC Chairman said that the economic development program is essentially one of the determining government projects for enhancing growth. This means raising resources and redirecting them to the areas of highest priorities.

NICKEL CONCENTRATE EXPORTED BY ACOJE

The Philippines recently became a nickel exporter with the shipment to Japan of $258,962 worth of nickel concentrates by Acoje Mining Co., Inc.

Jacob E. Cabarrus, Acoje executive vice president announced that the shipment totalled 607.86 DMT and contained, aside from nickel and cobalt, amounts of platinum and palladium, two rare metals.

The delivery was made to Nanyo Bussan Co. Ltd. of Japan with which Acoje signed in September 1969 a long-term sales and purchase contracts for its nickel concentrates production.

The Acoje nickel project is registered with the Board of Investments and carries certificate No. 69-112, dated December 11, 1969.

IMF FAVORS CONTINUANCE OF RP FISCAL DISCIPLINE

The International Monetary Fund (IMF) favors the Philippine government's continuance in self-discipline in the area of fiscal policy and fiscal administration.

In the report submitted to the Monetary Board recently, D.S. Savkar, Chief of the IMF mission to the Philippines said that it is in the area of fiscal policy and fiscal administration where the greatest efforts must continue to be made to effect the regional adjustment in the economy.

Savkar noted that important progress has been made during the 1970-71 fiscal administration. However, he said, experience has shown that short-run impairments are not easily sustained.

The IMF fiscal clarified that the Central Bank alone cannot carry the burden arising from deficiencies of fiscal policy and administration but the fiscal sector is also responsible for the stability of the nation's economy.

He pointed out that the imbalance in the government budget which was especially large in 1969 was largely responsible for the 15 percent increase in bank credit and was a major contributory factor to the pressure on the balance of payments and on domestic price.

SOUTHEAST ASIAN STEEL PLANT EYED

Possibilities for a Southeast Asian joint-venture plant to manufacture billets — in view of a world-wide shortage, growing demand and rising prices — are raised in a new report just issued by the Asian Industrial Development Council (AIDC).

In a report of its Bangkok session last month, the AIDC proposal that high-level steel billet mission be organized under its aegis to consult with governments and industries as possibilities for regional production to supplement existing national output.

The Council's report indicated that the Republic of China, Philippines, Singapore, Thailand, and possibly, Indonesia would be interested in receiving the mission. In addition, the AIDC — which works under the United Nations Economic Commission for Asia and the Far

East (ECAFE) — noted the possibilities for expanding Asian industries in other major fields.

The report reviewed the Council's recent discussions touching on a number of fields, including iron and steel; petrochemicals; forest-based industries; industries manufacturing agricultural machinery; development of agro industries; and standardization and industrial research.

"PHILIPPINES ENDORSE UNDP REORGANIZATION"

Ambassador Narciso S. Reyes of the Philippines endorsed the reorganization of the United Nations Development Program (UNDP) and urged a similar move by the other economic agencies of the United Nations.

Speaking before the recent session of UNDP's governing council, Reyes warned that the program target to double its present volume by 1975 could not be met unless the donor countries ir~reased the contributions.

UNDP's reorganization, as proposed, would align its activities with the development programs of individual countries with a resident director on the spot in the key role of a coordinator.

Reyes proposed to change the name of UNDP's Regional Bureau of Asia and the Far East to that of "Regional Bureau for Asia and the Pacific".

The term "Far East", he said, is reminiscent of the colonial era. The change of "Far East" to "Pacific" would abolish a continuing irritant to the Asian people and give proper recognition to the Asian island states, such as Indonesia, Singapore, Malaysia, the Philippines, Fiji and the donor government of Japan, Australia and New Zealand. Emerging governments of territories in the Pacific, namely: Western Samoa, Tahiti, Congo, Papua, and New Guinea will also be properly encompassed through the proposed change of name, Reyes stated.

"SEE TIGHT CREDIT, HIGH BORROWING COST IN 1971"

Availability of credit will be tight and the cost will remain high this year, says Eduardo Lichauco, president of the CCP Securities Corporation.

This outlook for credit was made during the concluding session of the First Annual Conference on Business Prospects for 1971, sponsored by the Ateneo de Manila University Graduate School of Business recently.

Lichauco theorized that the adoption of the floating rate system last year will result in the "redistribution of credits from high import dependent firms to lower import dependent firms, and more so in favor of export-oriented companies".

Consequently, he added, the present shortage will be magnified to certain business sectors as the full impact of the floating rate is expected to be felt this year.

Considered as a disturbing development in the credit horizon is "the Government's stepped-up drive in infecting high-yielding government securities into the market in the hope of topping noninflammatory funds for fiscal operations".

It was further explained that considering the "high rates on short-term paper, individual as well as business firms with excess funds will continue to find it more rewarding to commit these funds to short-term placements".

EXPERTS POINT ILLS MINE, OIL FIRMS

Two foreign experts making studies on the mining industries of the country have come out with the observation that amateurism and in some cases deceit plague many new mining and oil companies.

These observations were made by H.S. Scott and H.M. Zaldivia in an article published n the 1970 *Philippine Mining Yearbook*. Scott is a consulting geo-physicist and geologist of White Eagle Co. while Zaldivia is mining officer of Black Mountains Co. and Hercules Oil Inc.

Scott and Zaldivia observed:

1. Most of the new companies are potently opportunistic, expecting to make profits from the stock market rather than from serious mineral operations.
2. There is lack of competence and experience because family relationship is the deciding factor.
3. Most of the directors are brokers, lawyers, politicians, doctors and untored relatives who have little knowledge and experience in mining or oil.
4. Professionalism is kept out of the picture by having technical advisers who are attorneys in some instances.
5. Instead of purchasing equipment through agents in Manila, several directors make junkets abroad entailing high cost and delay.

These, the experts said, are reasons why the public is losing confidence in what should be a vigorous and dynamic industry. They explained that once people are misled, they naturally become wary of particular investments in these fields.

MMIC NEEDS GOV'T PARTICIPATION IN COPPER SMELTER PROJECT

The Marinduque Mining and Industrial Corporation's proposed copper smelting project needs government participation in view of the heavy capital inevestments according to Jacob Cabarrus, vice-president of the MMIC.

The smelter project requires approximately \$190 million for the construction of the complex aside from the raw materials worth about \$10,800,000 in stockpiles, Cabarrus said.

The MMIC executive expressed doubts as to the sufficiency of the capital generated by mining firms joining the project in relation to the amount to be incurred in the construction of the project and also the amount needed to sustain the project during the first year of operation.

In so far as foreign participation is concerned, Cabarrus added, most offers consist of loans for capital equipment and not equity participation or participation in operating expenses.

The smelter project is still under study by the Board of investments.

MICROLITE PRODUCTS MARKET INCREASING

The local market of the Microlite brand for engine parts manufactured by Philparts Manufacturing Co., is increasing. This is shown by many job orders made by various big firm customers using Microlite brands as replacement for damaged spare parts of their heavy machineries and equipment according to Mr. Leonardo B. Santiago, general-manager of Philparts.

The main Microlite brand products, Santiago said, are engine bearings, aluminum pistons, cylinder liners and precast iron. Others are also manufactured by Philparts on a lesser scale or quantity on special orders.

Santiago indicated that their products have already gained wide acceptance and approval of the local customers. He recalled that at the start of their establishment, they had to contend with the forces of skepticism and prejudice prevailing among engine owners because local-products are considered inferior. To use these products in machineries and equipment might result in great loss.

However, Santiago quipped, their products stood by itself and gradually overcame the skepticism and prejudices.

High quality control and workmanship are factors being emphasized and followed by Philpart in the manufacture of their products. Before the finished products are ready for market, they have to undergo extensive laboratory test in quality control, very rigid check and recheck by final inspectors in production line. Even raw materials used in the manufacture of these products which are all imported from reliable suppliers in U.K., Australia, Japan and Denmark do not escape chemical and metallurgical analysis upon arrival in the plant, in spite of the certified analysis made by suppliers.

Philparts is a pioneering venture in the field of metals industry capitalized and managed by Filipinos.

CESO OFFERS EXPERTS FOR PHILIPPINE METALS INDUSTRY

The Canadian Executive Service Overseas (CESO) is offering technical assistance to the metals industry of the Philippines as well as other industries.

This was disclosed by Mr. Norton J. Anderson, CESO director for the Far East.

Anderson said no fee will be charged and no string attached to firms who wish to avail of the services of CESO metal experts. Traveling expenses from Canada in going to and coming from their place of assignments are borne by CESO. The only responsibility of the recipient firms is to provide accommodation, meals and incidental expenses in the duration of the assignment.

CESO, Norton added, is a non-profit organization operated by a group of Canadian business leaders with the support of the Canadian Government through the Canadian International Development Agency (CIDA).

One of the main functions of CESO is to provide volunteer experts to developing countries to work with the management of different industries in improving their methods and practices in a mutual effort to promote efficiency and productivity, Anderson explained.

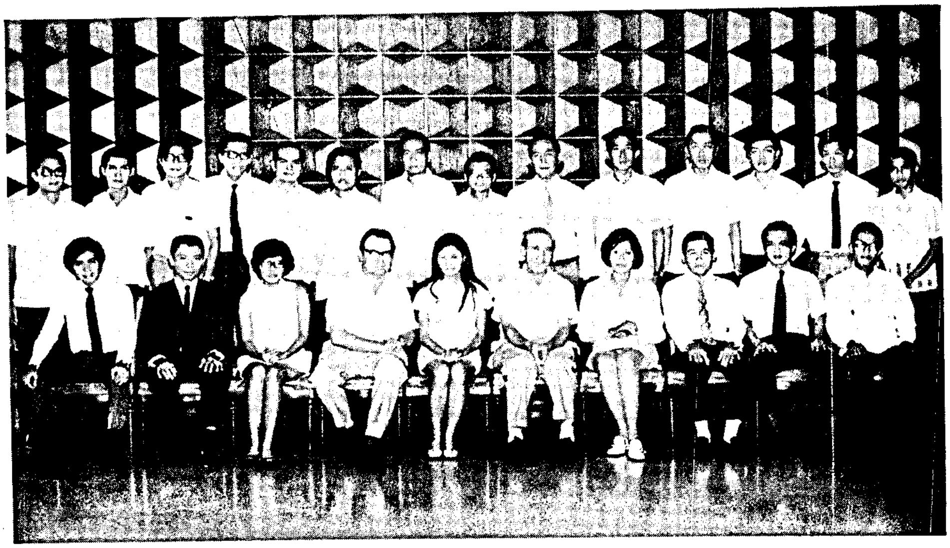
All CESO volunteer experts are men who have distinguished records of achievement in their fields and have held or are holding positions of great responsibilities in their companies or professions.

There are now 35 countries being served by CESO. In the Philippines, Anderson said, 20 volunteer experts are intended to be assigned.

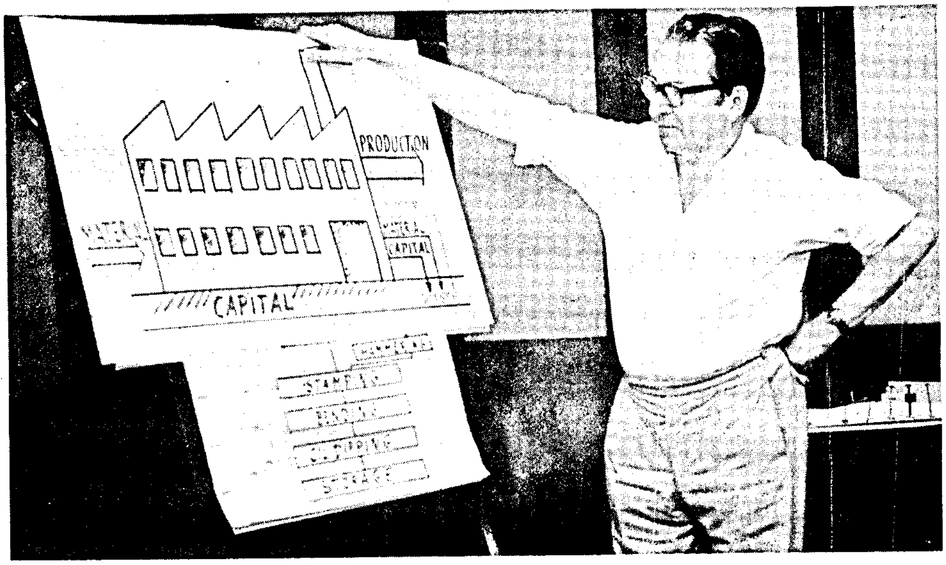
Anderson also said that expert services are offered not only to private sectors but also to Government or semi-government agencies. CESO, he clarified, is not here to compete with other foreign experts.

"For industries interested, we simply ask them to define what they want for a man and we will do our best to provide that man", Anderson concluded.

His office is located at Manila Bank Bldg., Ayala Avenue, Makati, Rizal.



Participants and Lecturers of the Seminar on Quality Control Methods & Applications in the Metals Industry held March 3-4, 1971.



Manfred Knayer, a UNIDO Industrial Expert. lectures on Waste Reduction in Industry.

ANGELES SPEAKS AT SEMINAR DINNER

Prof. Estanislao Angeles, Vice Chairman of the MIDC Board of Trustees, congratulated the 23 successful participants of the second MIDC seminar during their graduation dinner at the CAGE Supper Club in Quezon City last April 20.

The seminar, which dealt on "Heat Treatment of Metals," was held March 2 to April 20.

According to Angeles, the 23 seminar graduates meant that tomorrow, 23 plants and factories of the Metals Industry will be practicing the principles and techniques they learned in the seminar.

Angeles, a Mechanical engineer and consultant to a number of industrial firms, distributed certificates of completion to the seminar graduates.

MIDC officials present at the dinner were Winnie D. Deslate, Chief of the Information Exchange & Training Division and Estefanio M. Gacad, Metallurgical engineer.

The 23 seminar graduates are: Angel M. Alivio, Staff Engineer, Foundry Plant of Ysmael Steel Mfg. Co.; Ramon O. Arriola, Supervisor, Research & Design, and Florentino Manalastas, Supervisor, Rolling Mill Section, both of Marcelo Steel Corp.; Andres A. Azcona, Chemical Engineer, Technical Division, Welding Industries of the Philippines, Inc.; Manuel Basa, Head, Mold Fabrication, Farola Shop, and Porfirio Manalo, Asst. Engineer, Plastic Plant, both of San Miguel Corp.; Virgilio V. Cruz, Structural Engineer, Surigao Nickel Project, and Jose Ruben M. Socorro, Staff Engineer, Surigao Nickel Project, both of Marinduque Mining & Industrial Corp.; Marcial Corpus, Machinist, Manufacturing & Fabrication Shop, AFP Supply Center; Apolinario B. Domingo, Senior Sales Supervisor, Sales Department, Doer Marketing; Ernesto Foronda, Supervisor, Cold Mill Department, and Eduardo F. Soriano, Specification Engineer, Quality Control Dept., both of Iligan Integrated Steel Mills, Inc; Ludoviso L. Guzon, Manager RD & E, Philippine Sewing Machine Co., Inc.; Cesar B. Leal, Acting Supervisor, Eng'g. Section of Metalcasting Division, and Narciso B. Ramos, Heat Treater, Tool and Die Section, both of Marsteel Corporation; Benjamin Lubian, Mechanical Superintendent, Mechanical Department, Filmag; Jose M. Martinez, Plant Supervisor and Tomas F. Santos, Foreman, Maintenance Section, both of Super Industrial; Eduardo I. Mendoza, Head, Engineering Department, Kwikway Engineering; Harry L. Pastores, Quality Control Engineer, Manufacturing Division, and Eliseo D. Rosario, Senior Foreman, Machine Shop, both of Honiron Phils., Inc.; Eduardo S. Perez, Supervisor, Production Control Dept., Engineering Equipment Inc. and Horacio Teehankee, Senior Scientist, National Science Development Board.

MALAYSIAN ENGINEERS VISIT ELIZALDE PLANT

Two Malaysian engineers of the Malayawata Steel Berhad in Malaysia visited recently the ELIZALDE Iron and Steel Corporation in Pasig, Rizal.

They came to see the Elizalde Tinning Line because they're planning to put up a similar line in their iron and steel plant in Malaysia.

The two were Choo Keon Hin, electrical engineer, and Ooi Koon Beng, mechanical engineer.

Top officials and members of the Board of Directors of the South East Asia Iron and Steel Institute (SEAISI) listen intently to Dr. Toh Chin Chye, Minister of Science and Technology of Singapore delivering keynote speech at the Institute's inaugural meeting held March 8-10, 1971 at Singapore. In photo are (l-r) Messrs. Tan Kim Yeow, Malaysia; Goh Seong Pek, Singapore; Shintaro Tabata, Japan; U Nyun, executive secretary of the UN Economic Commission for Asia and the Far East; Bundit Watanasupt, Thailand (partly hidden); Eman Jogasara, Indonesia; and Dr. Antonio V. Arizabal, Philippines. The Philippines is one of the eight founding members of the SEAISI.

World Steelmakers Increase Blast Furnace Top Pressure

Operating with pressures of one to 1.5 atm., two Japanese blast furnaces are said to have averaged 5500 metric tons a day. On a single day last year, a third furnace reportedly turned out 6600 MT.

Due for operation next year at the Mizushima Works of Kawasaki Steel Corp. is a blast furnace designed for 2.4 atm. At Sparrows Point, Maryland, a furnace of Bethlehem Steel Corporation did operate at 0.8 atm. for a stretch. This pressure produced a record U.S. average of more than 4,200 tons a day. However, it also produced excessive wear of the charging system and necessitated early replacement of the large bell.

The Russians are using extremely high pressures — 1.7 and 2 atm. According to U.S. producers, these levels are achieved only at the expense of costly replacement and downtime.—*IAMWI*, February 1970

To Turn to Vacuum Metallurgy

Under the combined pressure of higher steel quality requirements and the necessity of reducing production costs, steelmakers in Europe, Japan and in the U.S. are paying increased attention to vacuum refining and similar metallurgical processes.

Vacuum degassing in particular the BV, DH and RH processes, was the starting point for many of the refining methods now being considered by Steel plants. With 56 Bochumer-Verein, 64 Dortmund-Horder and 33 Ruhrstahl-Heraeus installations in operation, vacuum degassing has become a widely-accepted technique to improve low-cost steel quality.

Foreign

For higher quality steel grades, vacuum arc remelting and vacuum induction melting are used. Extra-high purity metal can be obtained with electron beam melting, as has been proven in the 64 furnace installations now in operation in Europe.

Although most of these processes use vacuum, a few do not. One of the non-vacuum methods, electroslag remelting, is expanding rapidly. Slag is also used in the inductoslag melting method. Gases, rather than vacuum and electric arc, are the purging and heating media in yet another technique, argon-oxygen refining.—*IAMWI*, March 1970

Steel Industries Programmed for Mekong Region

The Mekong regions of Laos, Vietnam, Cambodia and Thailand were programmed as places for the development of steel industries in this part of the world.

Mr. Yasukawa of Nippon Kokan, who has made the first preliminary survey of that region in search for the feasibility of that program, disclosed that the Industrial Development Board of ECAFE is set to conduct its second survey works on a full scale sometime on February and March this year.

In his report, Mr. Yasukawa revealed that Thailand has an annual demand for steel reaching one million tons while its domestic supply totals just about 170,000-180,000 tons, thus depending largely on imports. South Vietnam has an annual demand for steel reaching 200,000-300,000 tons, Laos and Cambodia have much lower demands for steel.—*JMB*, January 26, 1971

Japan to Start Operation of Largest Casting Mill

Kawasaki Steel Corp. of Japan started up operation of the largest continuous casting mill with 1,200,000 tons production capacity a year at its Mizushima Works.

This is the second continuous casting mill at the Works. It has two strands, able to cast 200 tons at one time reaching 100,000 tons of slab a month. It has cost Kawasaki nearly 5,000 million yen, according to its officials.

In June, 1968, the first continuous casting mill was started with an annual output capacity of one million tons.

With the beginning of operation of the second but largest continuous casting mill, Mitzushima now has become an eight million ton per year steel works.—*JMB*, January 23, 1971

Filipino Ore For Pacific

The Japanese nickel producer, Pacific Nickel, has agreed to import lateritic nickel ore from Palawan, Philippines, starting in 1972. In the first year, Pacific will take 500,000 tons but this will be increased to 1.5 tpa within four to five years. Nickel reserves in Palawan are estimated at 200 metric tons of 1.2-1.5 per cent ore. Pacific Nickel plans to upgrade the ore by means of rotary kilns to 1.7-1.8 per cent purity prior to shipment.—*MB*, January 5, 1971

Predict Cut of Stainless Steel Output

Japan stainless steel firms predict the curtailment of their production most probably by 40 percent in February.

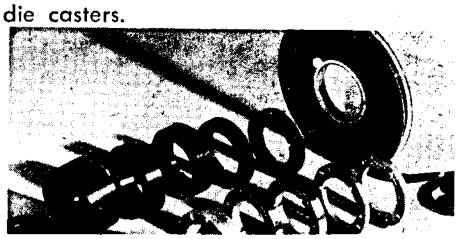
The reasons for the cut are the current high level of inventories estimated at 40,000-50,000 tons which is feared to remain for a while and the decreasing demands for their products due to slow business in general.

Nickel and chrome were hiked in January by 40,000 yen and 3,000 yen per ton respectively and the latter is slated to hike by 50,000 yen in April. This means an increase of 10,000 yen a ton of the production costs of US $27 and 5,000 yen a ton for US $24, the producers of stainless steel conclude.—*JMB*, February 4, 1971

Computer Industry Cited As Major User of Die Castings

New York — Investigations made by the American Die Casting Institute (ADCI) show that the computer industry is becoming the major user of die castings.

This was the conclusion of Richard E. Kellers, associate secretary of the association after a series of interviews with die casters.



THE DIE CASTING PROCESS is used to make these hubs for computer tapes. They are made to the highest standards of precision.

The International Business Machine Corporation, largest of computer manufacturers, is buying hundred of thousands of dollars worth of die cast components.

R.C. Ives of Central Data Corp. Minneapolis, a major computer manufacturer said that there had been a substantial increase in the use of die castings by his company. He predicted that the trend would continue.

A spokesman for the Univac Division of Sperry- Rand Corp., Blue Bell, Pa., reported that the number and weight of die castings used by the company doubled in the past year alone.

James Fleming, purchasing agent for Digitronics Corp., Albertson, L.I. found die cast more economical than other methods. His company found it can save money by ordering enough die casting.—AMM, October 13, 1970

Light Metal Reduced Maintenance of Barrier

New York — The Aluminum system of highway safety barriers has been found to require little or no maintenance.

This was proven by the State of Indiana, U.S.A. after more than two years of experience with aluminum highway safety barriers.

The barriers, which are designed to prevent vehicle crossovers into on-coming traffic and to prevent roadside collisions with signs, poles, and other potential hazards, are said to be resistant to corrosion and require no paint maintenance.

Performance of the aluminum railings has met all of the state's rigid requirements. Numerous impacts have been noted, according to officials, though few are officially reported. In numerous cases, inspection of barrier sites showed "signs of car tracks going into rail areas, with rail damage involving only scuffing" according to an official. The impacting automobiles apparently continued on remaining operable, it was noted.—AMM October 22, 1970

These aluminum alloy highway barriers have been effective in preventing traffic lane cross-over accidents.

Powder Metal Firms Show Interests in Foreign Research Plan

New York—The new projected research on powder preform forging and the development of related application and manufacturing data draws interests from iron powder makers, powder metal parts fabricators, forging companies and P/M equipment makers.

The research program as outlined to some 60 industry men at the Columbus Laboratories of Battelle Memorial Institute carries the proposed budget of $360,000.

The process, which combines the techniques of powder metallurgy and warm or hot forging, is attractive economically because it offers reduction in scrap lossess and requires fewer processing steps.

The research would stress the group approach. This is especially attractive because sponsoring companies obtain the results of the comprehensive study at modest cost. The result can be used by the sponsoring firms in making informed decisions on whether or not to commit large amounts of engineering manpower and capital to commercialize the preform forging process.—AMM October 23, 1970

Used Ferrous Cans Could Be Utilized

Washington D.C.—Dr. Dennies J. Carney, vice-president, applied research, U.S. Steel Corp., said that the American Steel industry could utilize all ferrous scraps available from the nationwide collection and processing of household solid waste, including food and beverage cans.

Appearing recently before the District of Columbia City Council, Carney pointed out that by 1976, American households will be generating 728 million tons of solid waste of which metal containers will comprise only about 8.5 million tons.

Dr. Carney expressed belief about the capability of the steel industry to consume ferrous scrap and even its ability to consume additional scrap in normal steel making cycle.

He urged the development of a comprehensive plan for sorting, preparing, and collecting solid waste materials for recycling, and also a program of education in the schools.

The ability of the steel industry to recycle ferrous scrap would include cans, Carney asserted that scrap will continue in importance as a vital raw material.—*AMM*, October 22, 1970

Search For New Chrome Ore Sources

Union Carbide Corp. and probably other suppliers of ferrochrome are vigorously pursuing the search for new chrome ore mines and also the development of new chrome alloy products based on lower grade ores.

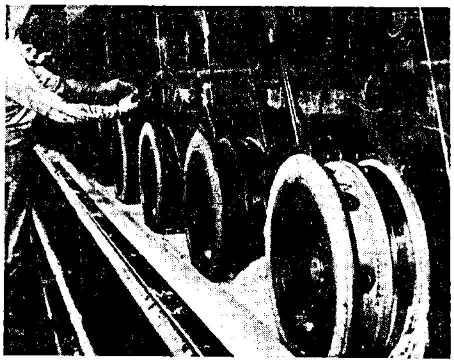
J. C. Stephenson, president of the Mining and Metals Division of the Corporation noted that the demand for chrome is growing and will probably continue to grow at about four percent per year through the 1970's. Higher prices based upon Russian ore and limited quantities of Turkish and Iranian ore can probably solve some of the availability problem for a while "but they cannot be considered as a satisfactory long-term answer" it was explained.—*AMM* October 22, 1970

Nippon Steel To Export Desulphurizing Know-How

The desulphurizing know-how called "KR" method by Hirohata works is imparted to Grengesberg Co. of Sweden through a technical aid contract. The method is reportedly able to reduce the sulphur content of the hot metal to one-tenth by use of a revolving wing in the hot metal that makes the melted steel come in contact with calcium and carbide desulphurizing agents.—*JMB*, November 19, 1970

Take-Off For Direct Reduction

Dr. Jack Miller, an iron and steel consultant, predicted the rapid progress of direct-reduction. He supported his forecast by citing the Hyl plant at Pueblo, Mexico which started in 1969. Originally designed to produce 500 metric tpd from lump ore, the operators switched to pellet last February and at the end of six months produced an average of 680 tpd; a reduction of gas consumption from 25000 cu. ft/ton of iron to 20,300 cu. ft.; an increase in metallization from 82.3 to 87.4 percent and higher reduction from 88.2 per cent to 91.5 per cent.



Worker at General Cable Corp. plant checks diameter of wire with micrometer as the wire is processed by heavy-duty drawing machine.

Dr. Miller said that this was a remarkable achievement bearing in mind the difficulties experienced in the first HyL project in Vera Cruz.—*MB*, November 20, 1970

Copper Clad Aluminum Wire Economical

General Cable Corp. reported that a new building wire called Copper Clad will be available for distribution. Copper Clad is only 10 per cent copper by volume, the remainder being aluminum. The company added that electrical construction users will save up to 15 per cent over traditional copper wire.

Walter C. Warr, General Cable's Construction and Mining products vice-president, told the press conference that Copper Clad provides electrical performance comparable to copper, with the aluminum-filled copper building wire combining the best features of both metals.—*AMM*, July 30, 1970

Effects On Lead Business Of The Proposed Ban On Leaded Gasoline

How do marketing men and metal traders feel about the proposed ban on leaded gasoline?

This question was raised in an interview with E. H. Frances of Philipp Brothers Division of Englehard Mineral's & Chemicals Corp. who said that any effect would be "very gradual" because of the protest by the lead industries. Most of the cars being used would still need leaded gasoline and it would be impossible to switch them over for one day to another.

Mr. Frances said that in 1971, some of the oil companies will offer gasoline for engines that can run on lead-free gasoline. In 1972, more such cars needing unleaded gasoline will come in the market. It might be a gradual phase out.—*AMM*, April 8, 1970

Japanese Steel Industry Propels Refractory Progress

A good part of credit for past progress in quality and quantity of Japan's refractories industries must go to the steel industry. According to Mr. Otsuki, managing director of the Japan Association of Refractories, this progress was due to the fact that in Japan, whenever a new, greater blast furnace or BOF or any other equipment is made, they conduct far-reaching research with assistance from engineers from refractory companies and then submit definite specifications of their own to refractory suppliers. Such new specifications are always very severe and call for exacting efforts on the part of refractory producers. This is in contrast with Americans where steelworks use what refractory suppliers say is good and not what they wish to have. —*AMM*, June 3, 1970

Versatility In The Heat Treatment Of Large Forgings With Program Controlled Luminous Wall-Furnace

The largest and most versatile luminous wall heat-treating furnace in the forging industry has been installed at the Pittsburg plant at Happenstall Co. Featuring automatic programmed control and a unique luminous wall heat treating system, the furnace can be heated to operating temperatures between 500 and 1950° Fahrenheit quickly then cooled in a matter of minutes.

The 250,000 pound capacity furnace is designed for such diverse operation as hardening, normalizing and annealing. Atmosphere can be controlled to produce one that is sufficiently reducing heat to minimize scale formation.—*IH*, March 1970

Nodular Iron Meets Variety Of Needs

More and more makers of farm, industrial, and earth-moving equipment are going to as-cast nodular iron, observes A.H. Rauch, manager, Metallurgical Div., Materials Engineering Dept., Deere & Co.

Foundry practices make it possible to melt a variety of special requirements in the as-cast condition.

For example, mold inoculation with ferrosilicon extend the range of section thicknesses; and where there is sufficient volume, nodular iron can be alloyed where higher -strength or hardness or heavier section castings are involved. Satisfactory engineering properties can be obtained by avoiding air hardening by cooling the castings in the mold until the temperature of the casting is below the critical temperature.

One of the newer developments in nodular iron practice is the use of magnesium coke as a technique for introducing the metal into a melt. With this approach, it is not necessary to add silicon or other elements. Also copper has been substituted for nickel as a pearlite stabilizer to reduce costs.—*MP*, October 1970

Waste Gas Purification Catalyst Developed

Mitsui Mining & Smelting Co. has developed a waste gas purification catalyst of manganese base and has begun testing it with automobiles. This new catalyst will make a great contribution to the control of air pollution in the future.

Meanwhile, Mitsui has signed contracts with the Ford Corp. and the U.S. National Air Pollution Control Administration for the supply of its samples and know-how of that newly developed catalyst to be tested with their automobiles. Mitsui is expected to supply them all the data obtained through its experiments—*JMB*, January 23, 1971

Japan Paced Asia's Industrial Advance

World industrial production—the output of mining, manufacturing, electricity, gas and water — expanded by 138 per cent over the 1958-1969 period and has continued to grow in the first half of 1970, according to the United Nations' monthly *Bulletin of Statistics.*

In the first half of 1970 the world industrial output increased by 4.4 per cent over the corresponding period in 1969 according to the UN publication. During the same period, the industrial production for the market economies as a whole increased by 3.8 per cent, expanding at a lower rate than total world production of the countries with centrally planned economies (8.9 per cent). This slower rate of increase was mainly attributable to the developed market economies.

While North America's output decreased by 1.4 per cent in the first nine months of 1970 over the same period of the previous year, the developed market economies gained 3.1 per cent over 1969 during this period, mainly attributed by the increase of 5.7 per cent of European developed market economies.

The region showing the greatest increase in industrial production was Asia, for which the output expanded by 12.6 per cent above that of the corresponding nine months of 1969. This mainly resulted from the expansion of industrial production in Japan.

Among the various branches of industry, heavy manufacturing tended to grow at around twice the rate of light manufacturing. The chemicals, petroleum, coal and rubber products, metal products and production of electricity and gas accounted for the major share of the increase in the developed and developing market economies as well as the centrally planned economies.

Nippon Steel Tops In World Steel Production

Nippon Steel Corporation was the world's No. 1 producer of crude steel in 1970 outstripping US Steel Corp., according to a list of ten top steel producers in the world prepared by a leading Japanese blast furnace steeler.

In the big ten list are three other Japanese steel producers. Nippon Kokan jumped from 7th place in 1969 to 5th place and Sumitomo Metal Industries from 10th to 8th place. Kawasaki Steel Corp. ranked 9th, the same as in 1969.

Nippon Steel's crude steel production increased from 29,090,000 tons (combined output of former Yawata Iron and Steel and Fuji Iron and Steel) in 1969 to 33,640,000 tons, surpassing U.S. Steel's production of 28,120,00 tons by a big margin.

British Steel Corp., with an output of 25,650,000 tons, dropped from 2nd to 3rd place, and Bethlehem Corp., with a production of 18,680,000 tons fell from 3rd to 4th place.

Fifth-ranking Nippon Kokan produced 12,890,000 tons.—*JMB*, February 13, 1971

Tekkosha Increase Chrome Production to Meet Demands

The increasing demand for metallic chrome prompted Tekkosha to speed up expansion works of its Yamagata works from the current 150 tons to 200 tons a month.

Although it boosted its monthly production of 30 tons to 150 tons in August last year, there has been a short supply due to the unexpected rapid increase in export. The expansion works are slated to be completed in May this year.

It was pointed out that importation costs of chrome ores have increased to $17 a ton, much higher than $10 a ton as predicted before. This is a drawback which makes it inevitable to increase the price of chrome sometime in the near future.—*JMB*, January 28, 1971

Export Prices of Bars, Angels Raised for April

Japanese Steel producers have quoted bars and angles for export to the U.S. in April-June at prices which are $10 higher on the average than heretofore, according to the trading companies exporting steel products to the U.S.

Some American importers have already accepted the new prices.

The price increase for the April-June shipments have been made in keeping with price increases effected by American steel producers. The price of wide flange in the U.S. has been raised by $11 per ton.

Emphasis will be placed on shipments to California on April-June with less shipments to other areas compared with the January-March period.

Talks on April-June shipments are expected to be completed on February, following which steel producers are expected to hold talks on exporting steel sheets for shipments in July-December.—*JMB* February 18, 1971

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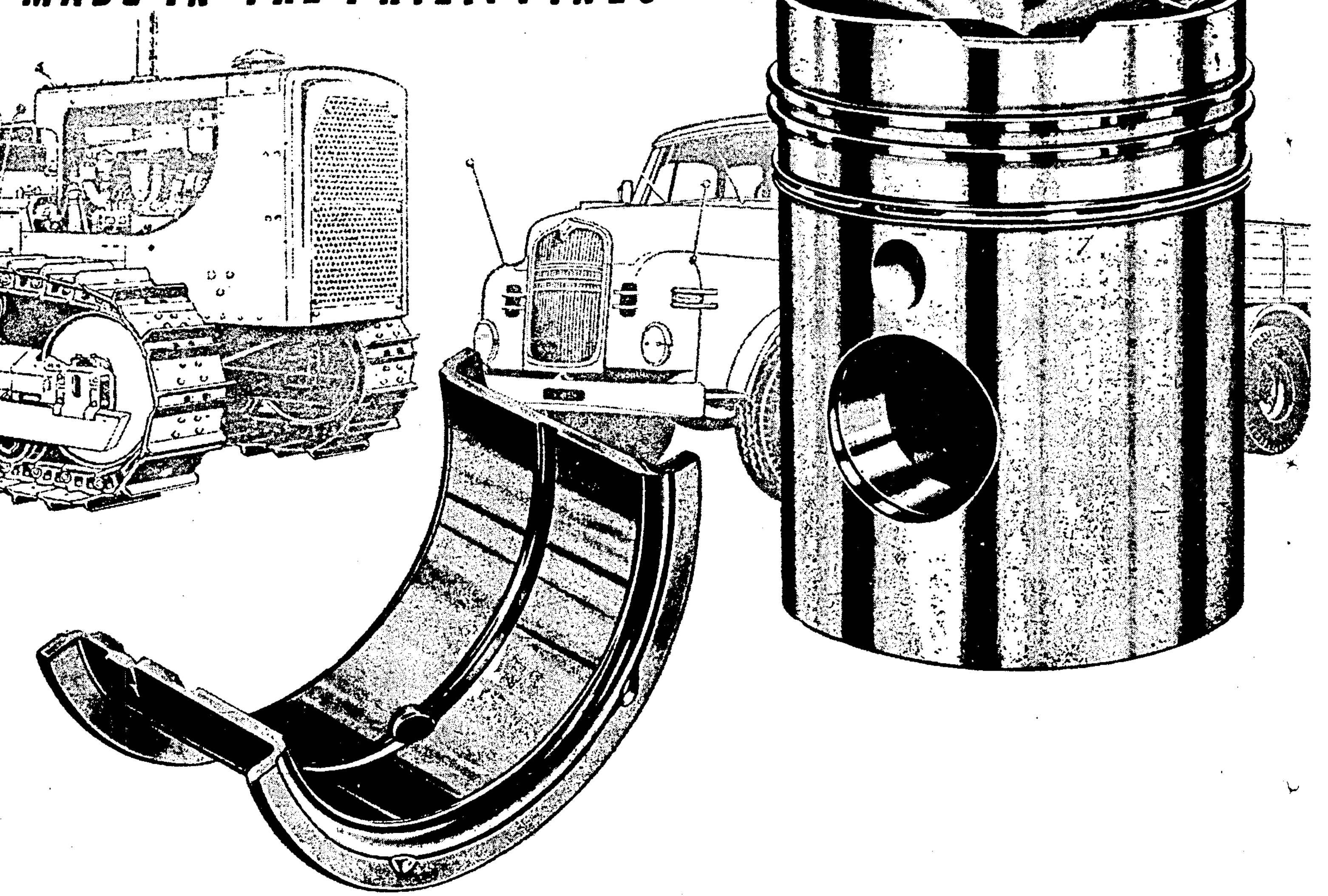
75. Modern Materials Handling
76. Philippine Architecture Engineering & Construction Record
77. Philosophical Transactions of the Royal Society of London
78. Proceedings of the Royal Society of London
79. Stal
80. Stal Und Eisen
81. Fontes et Aciers....

MADE IN THE PHILIPPINES—



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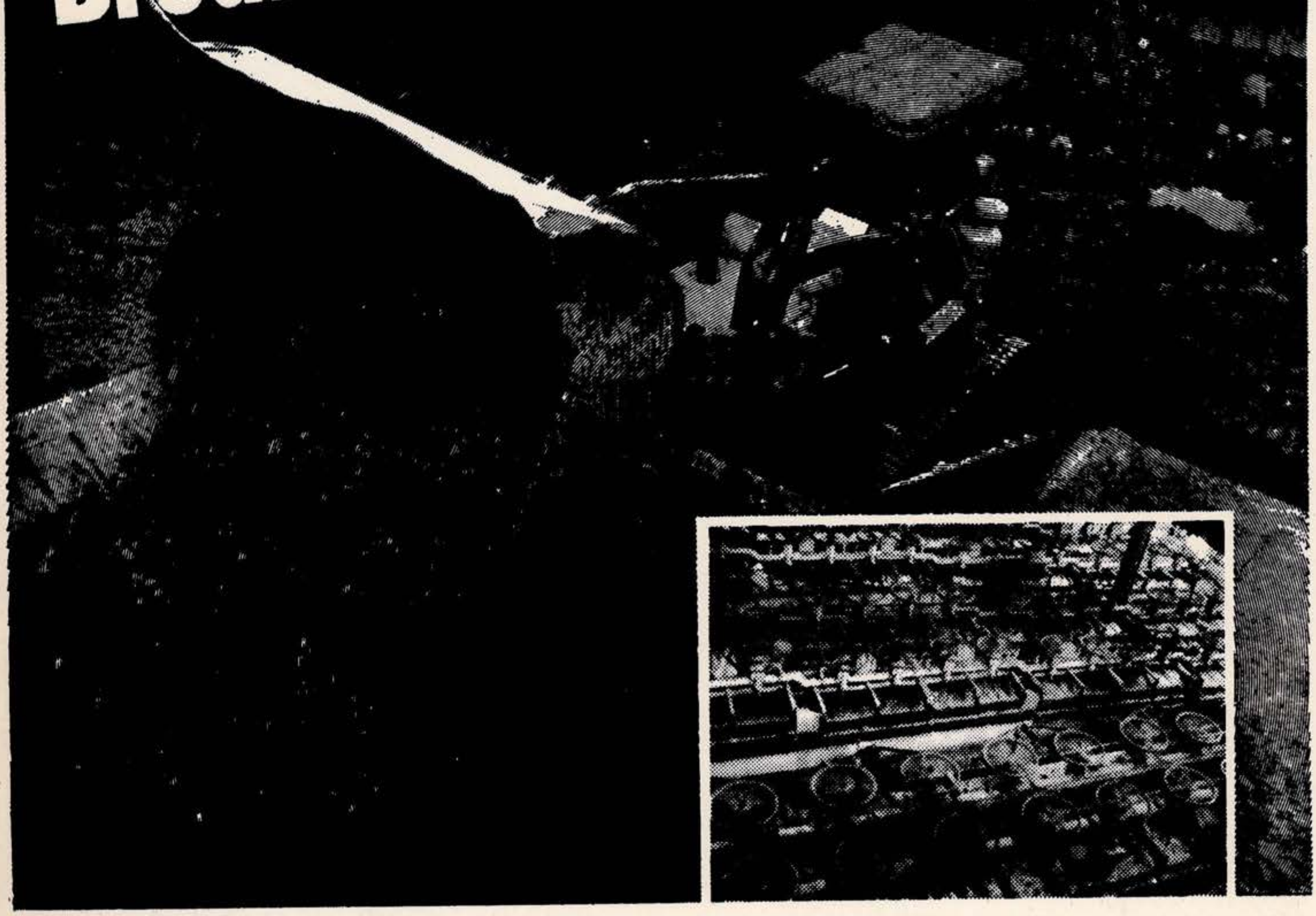
PHILIPPINE metals

QUARTERLY MAGAZINE OF THE METALS INDUSTRY DEVELOPMENT CENTER

VOL. 1, NO. 3 JULY-SEPT. 19

Breakthroughs in Mining—



Through the teamwork of men and machines

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In 1970 alone, this industry's production output reached an all-time high of ₱1.72-billion. Of this amount, ₱84-million went to the Treasury. This money has financed many projects; among others, the construction of schoolhouses and miles and miles of roads.

The industry also provided employment for 50,000 people. At the same time, it earned for the country more than $279-million in foreign exchange.

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XANTHATE – Another quality product of Union Carbide.

UNION CARBIDE
THE DISCOVERY COMPANY

PHILIPPINE metals

JULY-SEPTEMBER 1971 VOLUME 1 NUMBER 3

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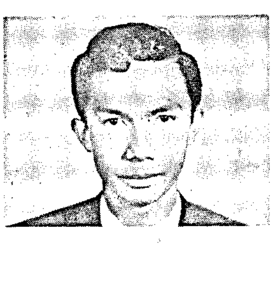
CONTRIBUTORS

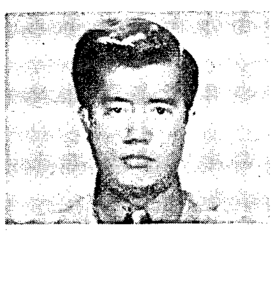
ESTEFANIO M. GACAD

Estefanio M. Gacad, a former Metallurgical Engineer of the NASSCO Jose Panganiban Smelting Plant, was a recipient of an industrial training grant on iron and steel plant operations by the French government and also of a training grant in experimental blast furnace operations and in formed-coke processing (from non-coking coals) by the Belgian government at Liege, Belgium. He is presently coordinator of MIDC's Training Division



RODOLFO M. ALUYEN

Rodolfo M. Aluyen, who holds a bachelor's degree in social science from the Ateneo de Manila University (he is presently working for master's degree in his Alma Mater), is MIDC's press and publicity man. He is a veteran journalist having gone up the ropes writing for several metropolitan newspapers and magazines and editing professional publications. Teaching is also second nature to him.



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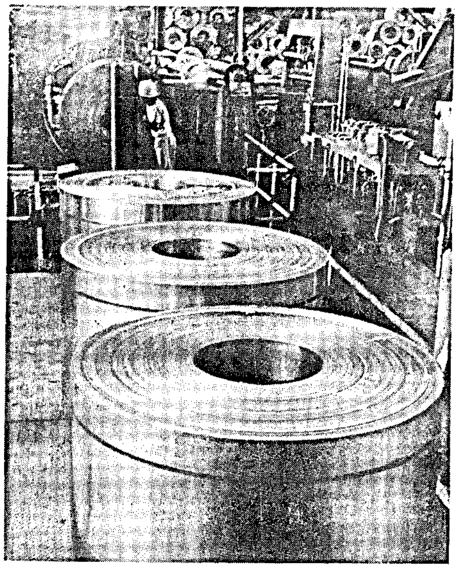


Up - ended coils having just passed through the Electro-lytic Clean-ing Line of ELIZALDE ROLLING MILLS INC. and are to be transported by conveyor to the Annealing Section.

WHAT THE READERS SAY . . .

"We found the magazine highly informative and educational."

Florencio A. Medina
Chairman
National Science & Development Board

"I have read this new magazine and wish to congratulate the MIDC for launching an important publication which will be of great service to all those who participate in the industrialization of the Philippines."

O. M. Partain
Managing Director
Chrysler Philippines

"Your journal and association are welcome and badly needed arrivals on the local manufacturing scene."

J. Laurence Pickup
Corporate Development Planner
AIRCON, Inc.

"I am happy to note that we now have a good magazine. This should also be made as an outlet for either basic or applied research that local schools or industries have done and are willing to share."

Dr. Eduardo M. Sacris
Foundry Metallurgist
Atlas Consolidated Mining & Dev. Corp.

"We find this official organ of the MIDC replete with technical and economic information relevant to the metals industry in the country now."

David R. Ines
General Manager
National Shipyards & Steel Corp.

INDEX TO ADVERTISERS:

editorial

NEEDED: ADEQUATE FINANCING FOR LOCAL EQUIPMENT MANUFACTURE

Time was when the universal plaint was the scarcity of local manufacture. But times have changed for we now have local companies who have developed the capacity to produce machinery and equipment — and add to the industrial growth of the country.

But for a bottleneck in our financing structure, locally-manufactured goods could well flood the domestic market as well as fill up the needs of the export mart. Government incentives, like pertinent provisions of the Investment Incentives Act (R.A. 5186) and the Exports Incentives Act (R.A. 6135) provide the local manufacturer the enjoyment of a 10-year tax credit for the manufacture of capital equipment to be used for BOI-registered enterprises, as well as the buyer in the purchase of said equipment.

But, at this point, both the local manufac turer and the buyer may well only dream and perhaps, hope for a better turn of events. The local manufacturer today is hampered not by the problem of production as in yesteryears but by the problem of selling his goods: he can't sell because local commercial banks cannot give long-term financing to buyers of capital equipment. If anything, his goods, must perforce sell or rust.

This is the problem that calls for immediate remedy if we want the local manufacturing industry to survive. If this is not looked into, our prospective buyers will turn to foreign manufacturers and suppliers who can easily provide the needed financing. Some reform is needed. Legislation must be made to amend the Central Bank charter to provide for the extension of the maturity of credit which is eligible for a rediscounting (maturity, according to present regulations ranges from 180 to 270 days) to assist the Filipino producer as well as purchaser — and any other means which would encourage commercial banks to give necessary financing to local equipment manufacturers. If nothing is done about this, the Investment Incentives Law, as well as the Export Incentives Law, may well be a dud.

MIDC corner

News Coverage of Important MIDC, NSDB, PISI & SEAISI Happenings.

Photo shows Jose S. Sason, MIDC Metallurgical Engineer, boarding the plane enroute to Russia for his in-plant training on Iron and Steel.

Staff Engineers to Russia; Bulgaria

Engr. Jose S. Sason, a junior metallurgical engineer of the Metals Industry Development Center, is now in Zaporozhye, Russia attending the Seventh In-Plant Group Training Programme for Technicians in the Iron and Steel Industry from May 10 – October 30, 1971. He is one of four representative participants from the Philippines, the others being Renato Sta. Ana Bartolome, Manager, Maintenance and Services Division, Elizalde Iron and Steel Corporation; Panfilio M. Tejada, Department Head, Mills and Annealing Department, Elizalde Steel Rolling Mills, Inc.; and Ruben C. Bartolome, Casting Superintendent, Engineering Equipment, Inc.

The Philippine participation in the training program set up for technicians in the iron and steel industry in Russia was made possible at the behest of UNIDO Vienna. UNIDO provided fellowships to cover the cost of round-trip, economy class air transportation between airport of departure in the home country to Russia. The USSR Government will provide necessary money in Soviet Roubles to cover costs of board lodging and internal travel of participants during their stay in Russia.

Nominee to Bulgaria: Anacleto F. Sanchez, Jr., MIDC senior metallurgical engineer, is one of six local candidates nominated by the Philippine Government to attend the United Nations Development Organization Seminar on Promotion of the Machine Tool Industry at Varna, Bulgaria, Oct. 18-27, 1971. The five other nominees are – Raul M. Consunji, Vice President, Engineering Division and Manufacturing Sigma Engineering Corporation; Prospero Z. Salvacion, Factory Manager, Philippine Sewing Machine Manufacturing Corporation; Jose Ma. Galza, Director, Management Development Department, Economic Development Foundation, Inc.; Abelardo D. Viray; Chief Analyst, Board of Investments; and Jose Singson, Industrial Consultant, Presidential Economic Staff.

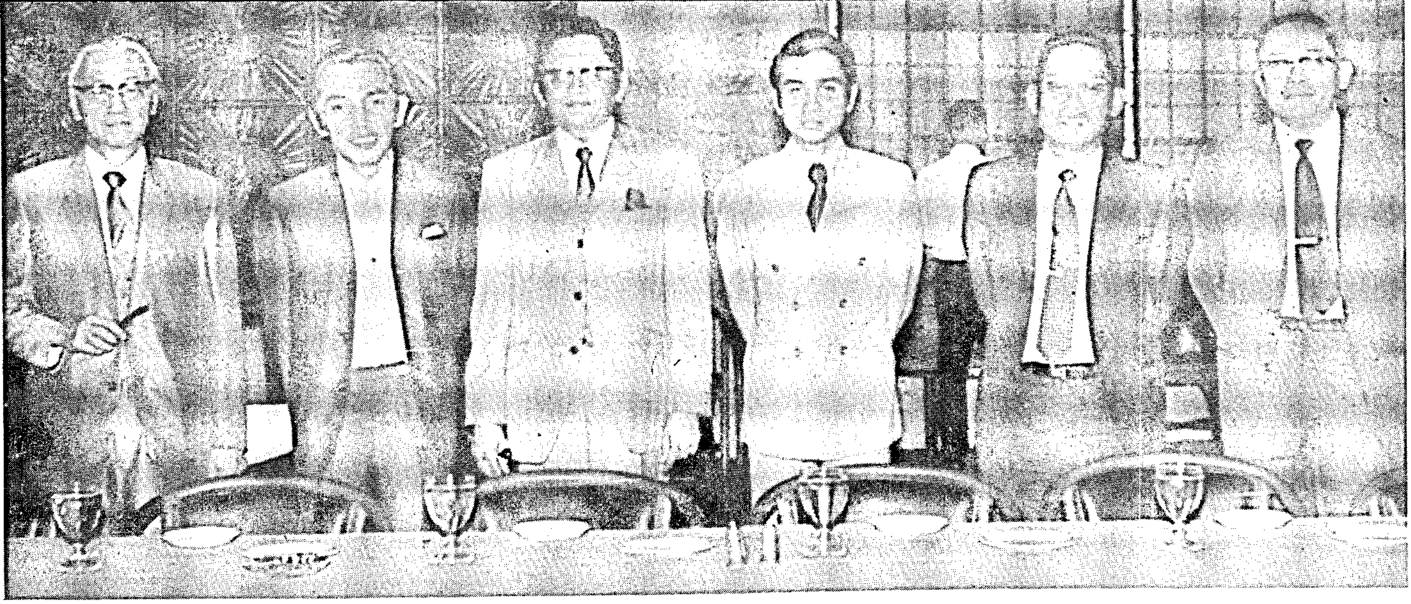
UNIDO will select two candidates: one involved in policy matters, and the other in the technical field (design, utilization, maintenance and repair of machine tools.) UNIDO will provide fellowships to cover the cost of round trip, economy class air transportation between home country and Bulgaria, plus subsistence allowance in the United Nations standard rate for the duration of the seminar.

Sydney Kayess, Technical Manager, Engineering Department of the Copper and Brass Information Center of Australia spoke on "Prospects and Developments of the Copper Technology in Australia," during an MIDC Seminar held last April 16, 1971.

Merle E. Johnson, Chief Engineer of Johnston Manufacturing Company, was an MIDC Seminar speaker on "Heat Treatment Facilities" last April 15, 1971.

JOHNSON

KAYEES



Officers of the Philippine Iron and Steel Institute (PISI) pose at the Manila Polo Club (l-r): Jose Quema, Dante Santos, board members; Dominador de Jesus, president; Jose T. Marcelo, Jr., vice president; Nicanor Villaseñor, board member and Antonio V. Arizabal, ex-officio member. Not in the picture: Lauro Cruz, board member; L. C. Young, treasurer; Jose Martel and Gonzalo Puyat II, board members.

American, Australian Savants Speak in MIDC-Sponsored Information Seminars

The most recent MIDC-sponsored information seminars were on "Heat Treatment Facilities" and "Prospects and Developments of the Copper Technology in Australia." These seminars were held on April 15 and 16 respectively, at the MIDC Seminar Room, Delta Motors Building, West Avenue, Quezon City.

Speaker on "Heat Treatment Facilities" was Merle E. Johnson, Chief Engineer of Johnston Manufacturing Company, an American manufacturer of metal processing furnaces, necessary equipment and also renders engineering services. He spoke on heat treatment processes, equipment and facilities including the latest trends and developments in these fields. Sydney Kayess, Technical Manager, Engineering Department of the Copper and Brass Information Center of Australia, spoke on the trends and prospects of copper technology in his country, Australia. He emphasized his points with the aid of slides.

Institute Holds First General Meeting in Three Years

The first Philippine Iron and Steel Institute (MIDC is its secretariat) in the first general meeting in three years held at the Manila Polo Club last May 19 elected its Board of Trustees; decided on industry projects to be submitted to the Southeast Asia Iron and Steel Institute (SEAISI), the local extension (The Philippine National Committee) of which has been adopted by PISI; planned its major activities and accepted the application for membership of some 24 firms connected one way or another with the iron and steel industry.

Elected members of the PISI Board of Trustees were *Dominador de Jesus* of International Pipe Industries Corporation, President, *Jose Marcelo Jr.*, Marcelo Steel Corp., vice president; *L. C. Young*, Philippine United Foundry, treasurer, and *Nicanor Villaseñor* of Elisco/Elirol, *Jose Martel* of Marsteel Corp., *Lauro Cruz* of Atlantic Gulf and Pacific Co. of Manila, Inc., *Jose Quema* of Atlas Consolidated Mining and Industrial Corp., *Dante Santos* of Philacor, and *Gonzalo Puyat II* of Puyat Steel. *Dr. Antonio Arizabal*, director of Metals Industry Development Center (MIDC) is an ex-officio member of the Board.

Various activities were plotted in that meeting, PISI projects to be submitted to SEAISI based in Singapore, include:

1. Standards for iron and steel products to be adopted in the Philippines and in Southeast Asia in general.
2. Basic raw materials and supplies for the iron and steel industry in the region.

The two major projects to be undertaken by PISI are:

1. To work for a favorable restructuring of the tariff code.
2. To formulate standards for iron and steel products.

The following companies became official members of PISI: Apollo Steel Mills, AG & P, Atlas Consolidated Mining and Development Corp., Elisco/Elirol, Engineering Equipment, Inc., Globe Steel, Honiron (Phils), Inc., International Pipe Industries, Marcelo Steel Corp., Marsteel Corp., Master Steel Products, Inc., Merchants Steel, Pacific Engineering Co. Inc., Pag-asa Steel Works, Philacor, Philippine Blooming Mills, Philippine Iron Mines, Inc., Philippine Sewing Machines Manufacturing Co., Philippine United Foundry, Singer Industries Phils. Inc., Sta. Ines Steel and Mining Co., and Union Steel Mfg., Co., Inc.

New individual members include Eddie Chanco of Far East Wire and Cable, Eustaquio Acero, Laguna Trading, I. O. Hidalgo, Filmag and Felipe Calderon, University of the Philippines.

NSDB

Conference for Consolidation of NSDB Libraries Held

A conference for the consolidation of NSDB libraries was held at the NSDB Board Room, PTRI Building at the Science Community in Bo. Bicutan, May 10, 1971. The conference was attended by different NSDB agencies including MIDC. Representing MIDC were *Winnie D. Deslate*, Head, Programming and Evaluation Department, *Rodolfo M. Aluyen*, Public Information Officer and *Corazon Tallo*, Librarian.

The meeting was presided over by NSDB Chairman Florencio A. Medina, Mr. Salvador F. Zaide, Science Information Officer of NSDB, made the introductory remarks. This was followed by a lengthy discussion by Mr. Quintin A. Eala, Technical Consultant on Science Library and Documentation, citing a memo distributed last March — on the need for centralizing NSDB libraries. On top of a centralized NSDB

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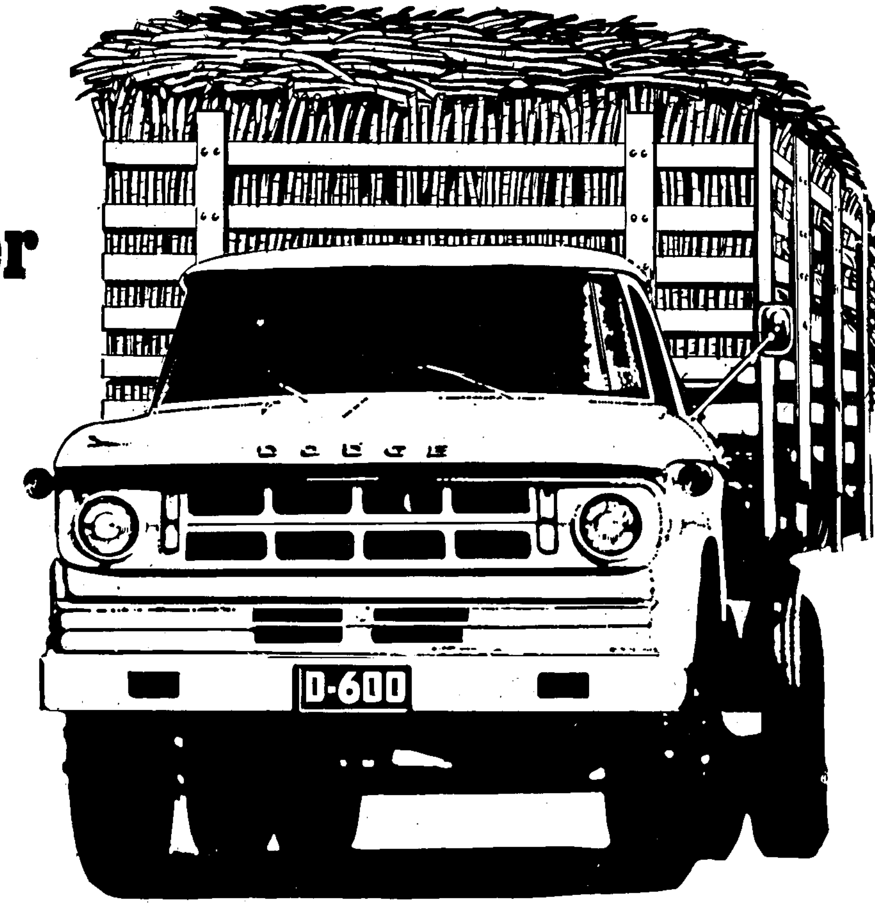

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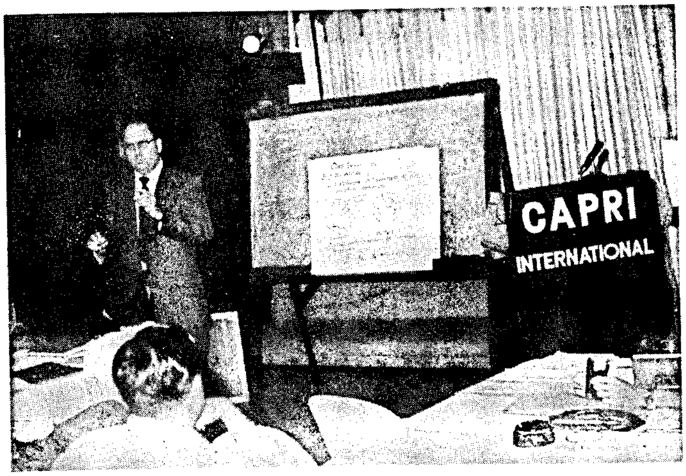
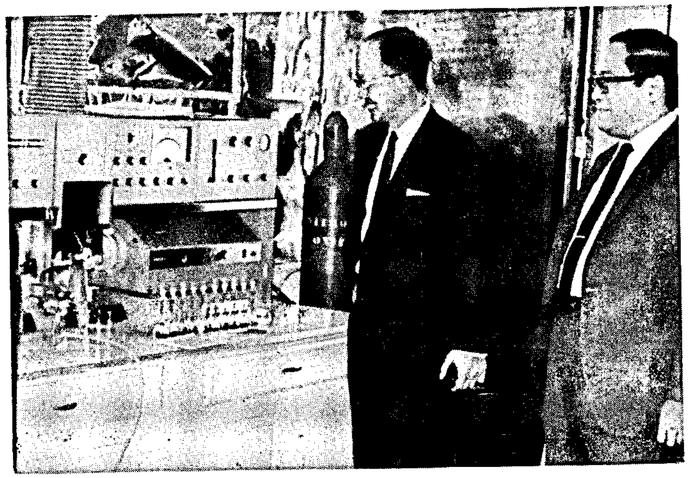


Dr. Milton E. Wadsworth speaking at the jointly sponsored MIDC-PISI Seminar on "The Technical Aspects of the Direct Reduction Processes," to an audience composed of representatives from local steel companies at the Capri International last June 21, 1971.



Mr. Shintaro Tabata, Executive Director of the Japan Iron and Steel Institute is shown viewing the spectrophotometer at the MIDC chemical laboratory with MIDC Director Antonio V. Arizabal at right.

library system, he explained would also be a centralized agency for the acquisition and cataloguing of books and periodicals in order to avoid duplication and in order to be of better service to scientists and other researchers needing them.

Mr. Medina, who steered the discussions during the meeting spoke on plans to revive the prewar National Science Library ("the best library on this side of Suez Canal") incorporating changes — a centralized science library with shuttle service for NSDB member agencies — to be called "Central Science Library and Documentation Center" (CSLDC). Under this set-up any new subscription by NSDB member agencies must be first directed to the central library for approval — to avoid duplication of subscriptions. The CSLDC will endeavor to improve library service and will pass on information regarding new acquisitions.

Mr. Zaide, who manages the NSDB Printing Press at Herran, announced the organization of a centralized media group for NSDB that will pass on pertinent information about the science community to the public via the mass media. Public relations officers of all NSDB member agencies were requested to submit every other day materials and press releases to Mr. Zaide's group who will in turn prepare the materials for publication in the metropolitan newspapers or for news broadcast in the Voice of the Philippines. On the part of the MIDC, *Mrs. Beatriz D. Orinion*, Chief of the Information Exchange & Statistics Division, was designated to be the contact man for Mr. Zaide's group.

Other salient points taken up in the meeting; Commissioner *Jose Velasco* suggested an interchange of science and relevant information on the international level especially among Southeast Asian Countries . . . Chairman Medina suggested that the earnings of the NSDB Printing Press instead of handing it over to the general revolving fund, should be plowed back for the improvement of the printing outfit, such as, the hiring of more printing hands to fill a day and night shifts of printing work so that the backlog of work will be done away with altogether.

Dr. Arizabal at Singapore Meet

The Board of Directors of the Southeast Asia Iron and Steel Institute held its second meeting last June 28-30 in Singapore. Directors from member countries were present including Dr. A. V. Arizabal, MIDC acting director and director for the Philippines.

Mr. Hu Schin-tschang of Taiwan was appointed Chief Executive Officer of SEAISI after due deliberation on the merits and qualifications of the applicants. The new Executive Officer is expected to arrive in Singapore before August 15. The appointment of the Senior Technical Officer was postponed for the next board meeting.

Dr. Arizabal submitted to the Board of Directors two projects recommended for study by the Philippine National Committee. For the first project, "Study on Standards", the Convening Officer, A.K. Mcleod of Australia will ask the Economic Commission for Asia and the Far East to determine what standards are in use in the region for iron and steel products. An expert from ECAFE will be requested to examine the standards problems by conducting a survey through the member countries. The second project, "Study on Basic Raw Materials", will be considered by the Technical Committee of SEAISI.

It was announced in the meeting that the Mini Mill Symposium, a major project of SEAISI will be held in Singapore on September 7 to 11, 1971.

Japan Steel Executive Visits MIDC Laboratories

Shintaro Tabata, Japan Iron and Steel Institute Executive Director and SEAISI Director for Japan visited the Philippines for the first time last July 1-6, 1971.

He toured the newly installed MIDC laboratories temporarily housed at the NSDB-PTRI building, at Bicutan, Taguig, Rizal. He was guided around the chemistry, physical metallurgy, mechanical testing and sand testing laboratories by MIDC Acting Director and SEAISI Director for the Philippines, Dr. Antonio V. Arizabal. A brief seminar on Japan's Iron and Steel Institute followed at the NSDB conference room, with the MIDC personnel participating.

PISI Seminar on Direct Reduction Processes

The Philippine Iron and Steel Institute (PISI) sponsored a seminar on the Technical Aspects of the Direct Reduction Processes last June 21, 1971 at the Capri International Restaurant with Dr. Milton E. Wadsworth, a consultant of the Ford Foundation, as speaker. The seminar, attended by Dr. Howard R. Mills and Mr. Donald R. Cartwright, both consultants of the W.S. ATKINS AND PARTNERS and officers and members of the PISI, was considered significant in the light of the present clamor for an immediate setting up of an integrated steel plant.

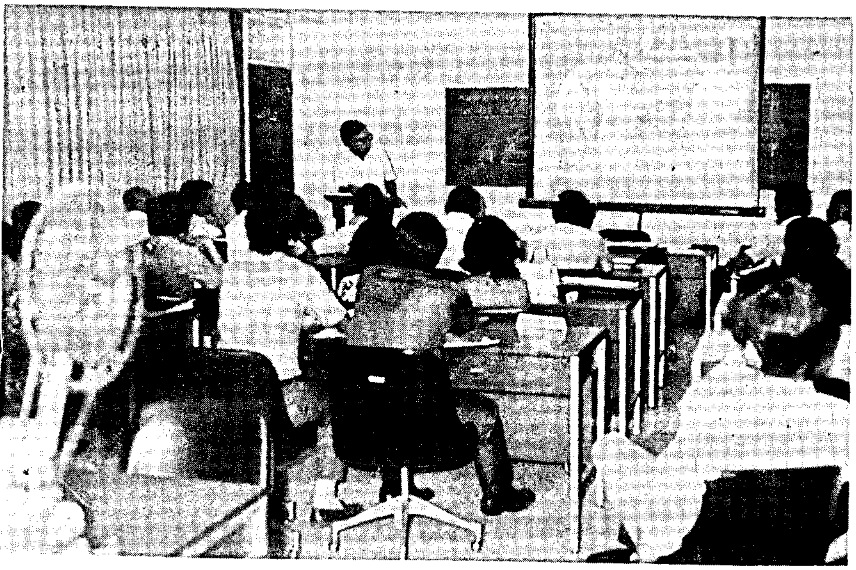
Dr. Wadsworth who teaches metallurgy at the University of the Philippines under the Ford Foundation Exchange Program sounded optimistic on the capability of the country to sustain a flourishing iron and steel industry.

PICTORIAL REVIEW

MIDC Sponsors "A First Course in Industrial Engineering for Middle Management" Seminar

The MIDC seminar room at Delta Motors Building, Quezon City was the scene of the recently-concluded MIDC training seminar on "A First Course in Industrial Engineering for Middle Management" which was held from May 25 to July 8, 1971.

Invited to give light to topics such as: Principles of Organization and Management, Cost Analysis, Methods Analysis and Improvement, and Human Factors were: Dr. Luis Pascual, Professor in Industrial Engineering, College of Engineering, University of the Philippines; Messrs. Arturo Tolentino and Lemuel Miravalles, Instructors in Industrial Engineering, College of Engineering, University of the Philippines; Dr. Alberto Ilano, Chairman



Seminar participants are shown viewing a film on Time-Motion Economy as Dr. Luis Pascual gives an explanation on the principles involved.

Rolando T. Viloria (see above photo), Mechanical Engine of MIDC and Col. Leandro A. Riveral (lower photo), A sistant Director, Armed Forces of the Philippines Supp Center receive their certificates from Prof. Estanislao A geles, Sr. assisted by Dr. Antonio V. Arizabal.

After the Awarding of Certificates the participants and guests posed for a photo. Seated, left to right are: Professor Estanislao P. Angeles, Vice-Chairman, MIDC Board of Trustees; Dr. Luis Pascual, lecturer, UP Professor; Zenaida Vendiola, Metallurgical Engineer, MIDC, Beatriz D. Orinion, Chief, Information Exchange & Statistics Division, MIDC; Dr. Antonio V. Arizabal, Acting Director, MIDC; and Bonifacio V. Abdon, Product and Systems Department Cadet Engineer, Engineering Equipment, Inc.. Standing left to right are: Maximo L. Vito Cruz, Shipping Superintendent, Mabuhay Vinyl Corporation; Romulo C. Abrogar, Production Manager, Chrysler Philippines Corporation; Rolando T. Viloria, Mechanical Engineer, MIDC; Marcelo Villanueva, Metallurgical Engineer, MIDC; Col. Leandro A. Riveral, Assistant Director, Directorate for Maintenance, Armed Forces of the Philippines Supply Center; Florentino Cuasay, Metallurgical Engineer, MIDC; Guillermo Gragasin, Production Development Engineer, Honiron Philippines, Incorporated; Alejandro A. Lucas, Production Supervisor, Foundry & Machining Departments, Singer Industries Philippines, Inc., and Antonio L. Abastillas, Head, Planning & Control Section, Metal Casting Division, Marsteel Corporation. Not in photo are: Major Luis C. Cabrera, Directorate for Maintenance Engineer, Armed Forces of the Philippines Supply Center; Evaristo A. Panganiban, Department Head, Winding & Quilling Dept., United Textile Mills, Inc., Apolonio C. Rana, Industrial Engineering Manager, Chrysler Philippines Corporation; and Antonio A. Gimenez, Teresita H. Hizon, Alma M. de Jesus, Carlito V. Mariñas, and Rogelio P. Santos, all from MIDC.

of the Department of Business Economics and Statistics, College of Business Administration, University of the Philippines; and Dr. Patricia Licuanan, Chairman of the Psychology Department, Ateneo de Manila University. Participants were representatives from different metal companies, the Armed Forces of the Philippines and members of the MIDC technical staff.

The awarding of certificates to successful participants took place at the Cage Restaurant, Quezon City last July 13, 1971 with Prof. Estanislao Angeles, Sr. Vice Chairman of the MIDC Board of Trustees as guest speaker. Mention is made of Mr. Estefanio Gacad, MIDC Training Supervisor who coordinated proceedings during the entire seminar. This spreaa brings in pictures of that recently-concluded seminar.

Compass to Determine Data Processing Needs of Science Community

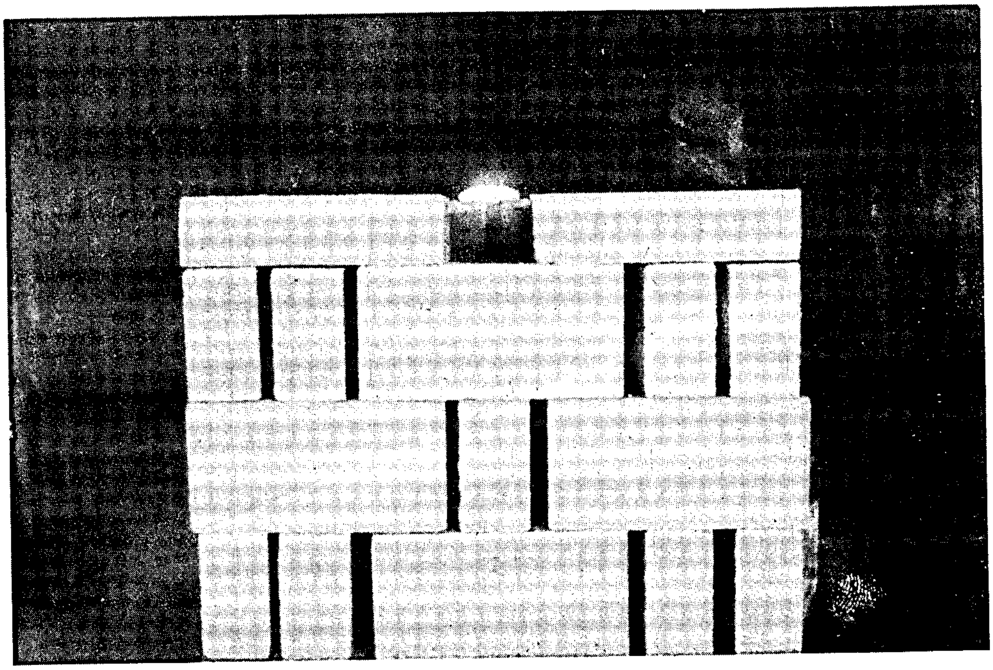
The Computer Associates, Inc. (Compass) will undertake for the National Science Development Board a four-month study of the best systems design to suit the needs of the Philippine science community. The study is aimed at providing computer support to government agencies performing basic, scientific and engineering research and development.

NSDB Chairman Florencio A. Medina said the Compass was awarded ₱30,000 outright grant to determine (1) the data processing needs of NSDB and related agencies; (2) the data processing system which will answer these needs; (3) the computer configuration which can support the system and (4) the feasibility of computerization in the different agencies.

The announcement of the study grant to Compass came close on the heels of the formal conversion of the existing PES-DND Computer Center at Camp Aguinaldo into a National Computer Center, a new joint project of the original center's directorate, the Department of National Defense, the Presidential Economic Staff, and the premiere government science agency headed by Chairman Medina.

PART II

STATUS OF THE REFRACTORY INDUSTRY IN THE



Firebricks as they enter kiln for firing.
Courtesy of Diamond Ceramics.

PHILIPPINES

TERESITA H. HIZON

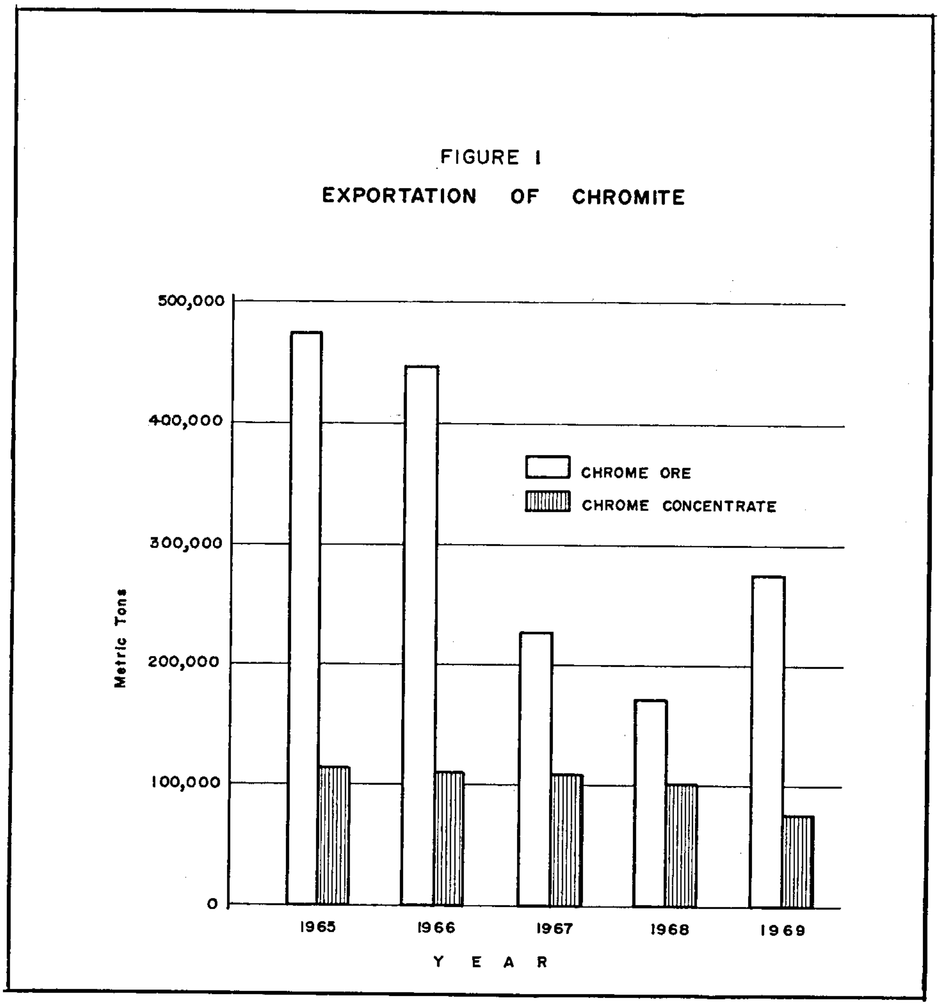
The Philippines has abundant raw materials for the manufacture of refractories. Deposits of chromite ore, quartz and fireclay of all types are scattered throughout the country. In fact, most of the U.S. requirements for chromite comes from the Philippines.

Investigations show that there are excellent prospects of manufacturing chrome, chrome-magnesite, dolomitic, fireclay and silica refractories. The Philippines cannot manufacture economically high alumina refractories, because no commercial deposits of bauxite have yet been discovered.

The principal constituents of the main deposits of aluminous laterite show the following average chemical analysis:

34.40% Al_2O_3
9.59% Fe
35.23% SiO_2

The low percentage of alumina and the high iron content make the deposits non-economic as high-alumina refractory raw material.



I FIRECLAY GROUP

Chemically, clays are all hydrous silicates of alumina and occur widely distributed. They are identified as being plastic when in a wet and finely dissolved state (as by pulverizing, wetting and mixing), rigid when dried and vitreous when heated to a sufficiently high temperature. Clays may be residual or sedimentary, and have been formed by the natural decomposition of feldsphatic rock. Ordinary varieties contain high percentages of combined water and impurities that render them unfit for use as high temperature refractories. The species used as a refractory material is known as fireclay.

Refractory clays consist mainly of the clay mineral kaolinite, which has the general formula $Al_2O_3 . 2SiO_2 . 2H_2O$ corresponding to 39.5% alumina (Al_2O_3), 46.5% silica (SiO_2) and 14% water (H_2O). Pure kaolinite has a P.C.E. value of Cone 35, corresponding to a softening temperature of about 3245° F (1785° C). However, even the purest flint clays and kaolin contain small amounts of impurities such as iron oxide, lime, magnesia, titania, soda and potash, while plastic clays in general contain greater percentages of the same impurities.

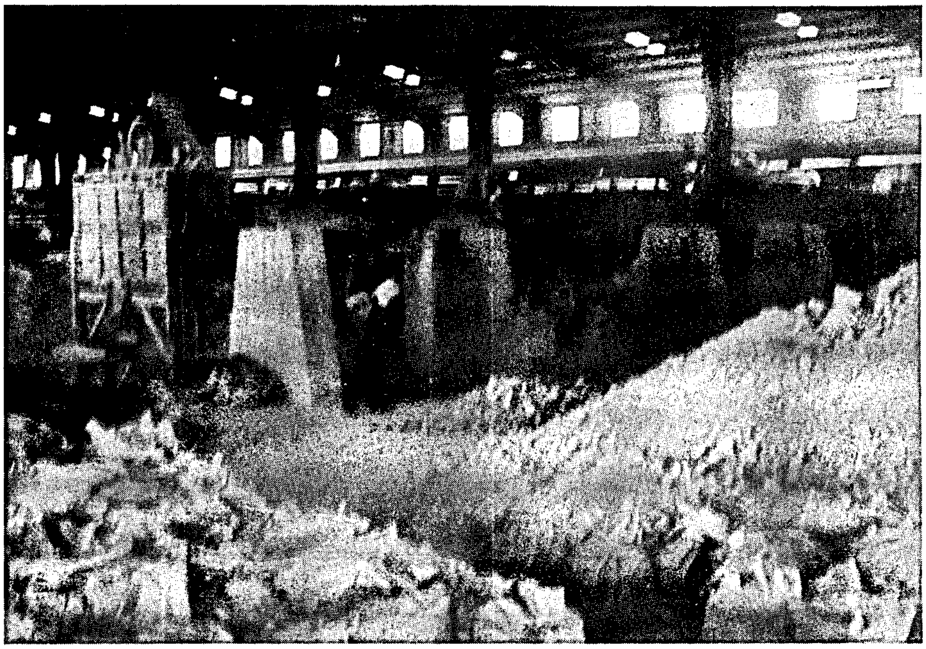
In testing the refractory properties of the clay, the amount of inorganic impurities present is analyzed. All inorganic impurities have fluxing effects on the fireclay in varying degrees. Sodium and potassium oxides are very harmful to the brick even in small quantities. Iron oxide content is normally between 1 and 3 per cent and may be as high as five per cent. A greater percentage of iron oxide decrease considerably the refractoriness of the clay. At high temperatures free quartz becomes an active fluxing agent, hence its presence in the clay is not desirable. Titania is not given much importance in the analysis of fireclay. The amount of fluxing agent, excluding quartz should not exceed five to seven per cent.

The types of clay used in the local manufacture of fireclay refractory bricks are: sedimentary fireclay and kaolin of hydrothermal origin. The Geological Division of the Bureau of Mines tested samples for chemical analysis, P. C. E. and load tests. The samples were found suitable for intermediate duty refractory bricks. Local clay is classified as refractory clay if the P. C. E. value is Cone 29 or above. The estimated fireclay reserve is 244,913,740MT. A list of refractory clay materials prepared by the Bureau of Mines is shown in Table 1.

II SILICEOUS GROUP

The raw material in the manufacture of silica refractories consists of ganister (quartzite) or quartz pebbles. Deposits of quartz and alkali bearing silicates are found in the Philippines. The presence of soda, potash, alumina and titania in the raw material reduces its refractoriness. The total percentage of alkalies, alumina and titania must not exceed 0.5 to one per cent for superduty and conventional silica brick, respectively. Silica bricks containing up to 2.5% total alkalies, alumina and titania are used to a limited extent. Another impurity which affects the melting point of silica is lime. The addition of lime up to 1% reduces the melting point by 27 per cent. However, further additions of lime have no reducing effect in the melting temperature. On the other hand, a second liquid analyzing 27.5 per cent lime is formed. The addition of iron oxide and lime must be kept to a minimum to obtain best results.

The Bureau of Mines has reported that the Philippines has 2,700,500MT of quartz, 17,688,600MT of silica rock and 80,612,900MT of silica sand.



Crushing and grinding of clay to proper grain size. Courtesy of Firestone Ceramics.

III CHROMITE GROUP

Pure chromite is a mineral composed of 32 per cent FeO and 68 per cent Cr_2O_3. However, in a chrome ore, the commercial refractory material, these oxides are replaced in part by magnesia and alumina. The composition ranges from 30 to 48 per cent Cr_2O_3, 12 to 30 per cent Al_2O_3, 12 to 15 per cent FeO and about 17 per cent MgO along with some impurities.

Refractory chrome ores may be regarded as naturally occurring mixtures of two components: (1) the essential component, a highly refractory chrome-containing spinel; (2) accessory components, consisting mainly of magnesium silicates which constitute five to 25 per cent of the ore, are of complex and widely varying compositions.

The spinel minerals have the general formula RO. R_2O_3 where the RO consists of the ferrous oxide (FeO) and magnesium oxide (MgO) and the R_2O_3 of Cr_2O_3, Al_2O_3, and Fe_2O_3. The proportion of Fe_2O_3 is relatively small.

The refractoriness of the chrome ore depends largely upon the character and amount of silicates present. The SiO_2 content should not exceed seven per cent while the CaO content must be kept below 1.5 per cent.

The quality of Philippine chromite is known to be among the best in the world. Exports of this material amounted to 357,522MT in 1969 as shown in Fig. 1. However, it is unfortunate that we are a leading exporter of the raw material and not a manufacturer of chrome refractories. Abundant deposits of refractory chromite ore are found in Zambales and in several other provinces. Estimated reserves of the Consolidated Mines in Masinloc, Zambales alone, amounts to 10,000,000MT of an average grade of 32.08 per cent chromate.

The Bureau of Mines classifies as refractory, chrome ores with the following specification:

Cr_2O_3	32 to 34% or more
Cr_2O_3 and Al_3O_2	57 to 63% or more
SiO_2	5% or less
FeO	10% or less
MgO	not more than 20%

On this basis, the total estimated reserves of refractory chromite ore is 12,159,309MT.

IV MAGNESIA-LIME GROUP

Natural Magnesite

Natural magnesite, $MgCO_3$ is rarely found in a pure state, but contains varying percentages of silica, alumina, iron oxide and lime, so that on calcination the magnesia (MgO) content generally ranges from 80 — 85 per cent. Silica is the most objectionable impurity and varies from four to 10 per cent. The mineral magnesite in theoretical purity would contain 47.6 per cent MgO and 52.4 per cent CO_2.

The Philippines has an available magnesite deposit of 1,233,400MT. The great bulk of these deposits are located in Davao. Other magnesite deposits are in Zambales, Lanao, Palawan and Sibuyan of the Romblon group of islands but reserve tonnage are not yet available for information purposes.

The magnesite deposits are for the most part of cryptocrystalline and or amorphous variety. It is massive, fine-grained, showing no cleavage, usually snow-white and the hard and compact masses exhibit conchoidal hardness of three to five.

Dolomite

Dolomite is a double carbonate ($CaCO_3.MgCO_3$), which calcines, evolving 47.8 per cent as CO_2 leaving 30.4 per cent CaO and 21.7 per cent MgO. Principal impurities are silica and alumina. For best refractory service, a dolomite should contain more than 21 per cent MgO, less than one per cent SiO_2 and less than 0.5 per cent Al_2O_3 in a crude state.

Dolomite in the Philippines occurs as dolomitic limestone and are found abundantly in Negros and in the Cebu islands. The prospects of utilizing these dolomitic deposits for refractory purposes is encouraging. High grade samples of dolomite having MgO content of at least 19-20 per cent warrant a pilot test run to determine its amenability to produce dead-burned dolomite.

Philippine dolomites are associated with tertiary limestones. At present, except for the limestone needs of some glass plants, dolomite is not being used. Dolomitic limestone deposits are found east and west of Cebu especially in Danao and Carmen. Total reserve is estimated to be 219,000,000MT.

V MISCELLANEOUS GROUP

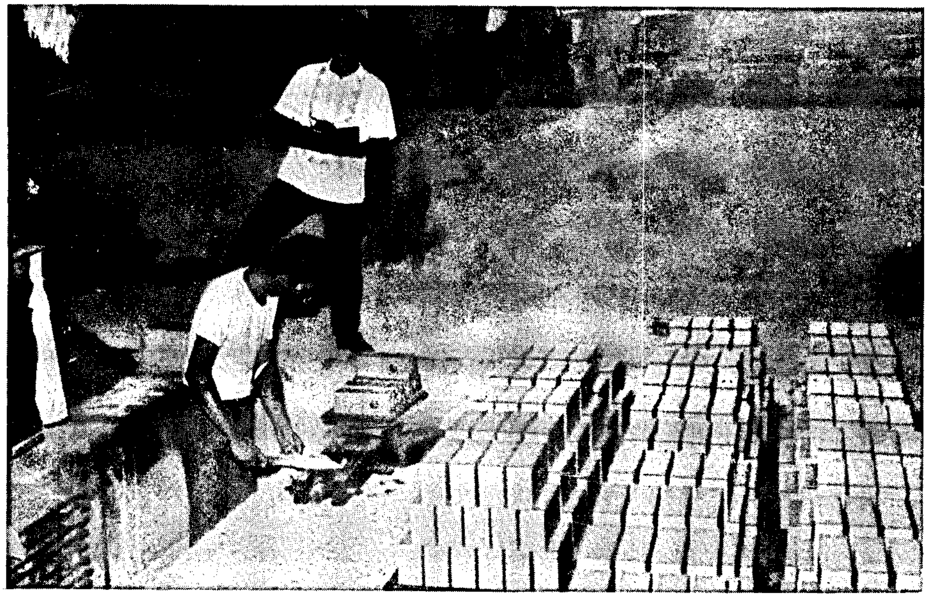
Miscellaneous refractory material consists of the following:

Beryllia	(99% BeO)	Beryl
Zirconia	(96% ZrO_2)	Zircon sands
Thoria	(99% ThO_2)	Monazite sands
Silicon Carbide (SiC)		
Fused Alumina		Bauxite

These refractories are usually used for certain special small scale work, chiefly in the form of crucibles.

All the above-mentioned materials are naturally occuring except for silicon carbide which is a crystalline product of the electric resistance furnace.

No sizeable occurrence of the raw materials for these special group of refractories, except for fused alumina, have yet been discovered in the Philippines.



Handmade process is employed in shaping bricks to desired form. Steel lined wooden molds are used. A molder strikes off excess clay and smooths top surface. The shape is then removed from the mold.
Courtesy of Firestone Ceramics.

REFRACTORY TECHNOLOGY

I. MANUFACTURE OF REFRACTORIES

Refractories are used in a wide variety of forms, the preparation of which may vary from little more than the operation of mining to highly complex grinding, screening, molding and firing procedures demanding precise control throughout. The preparations which will be discussed here will be limited to refractory bricks. Discussions will be concerned mainly with the production of fireclay brick as the basic principles and processes for making all kinds of refractory brick are similar.

Fireclay Brick Manufacture

The first step in the manufacture of refractory bricks is the mining of raw materials. Mining methods depend upon the location, size and uniformity of deposits. For the most parts, deposits are underground and mining methods are similar to those employed in various types of underground mining and quarrying. Following mining, some purifying steps may be necessary.

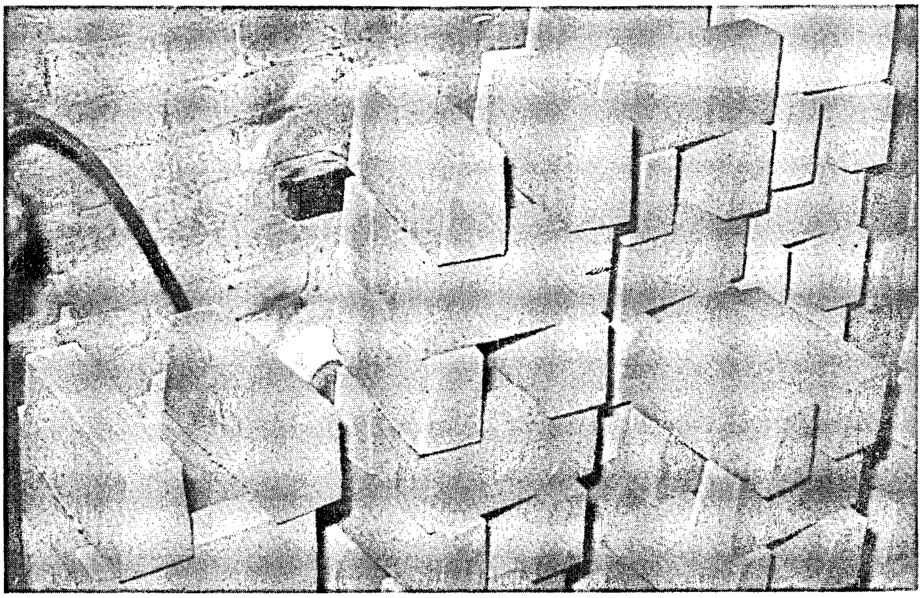
The next step is one of crushing and grinding. These are important operations, as, in large measure, they control the density, porosity, strength, spalling resistance and thermal characteristics of the brick. Usually, the clay is crushed in a jaw crusher or gyratory crusher which breaks all lumps down to pieces smaller than two or three in. in diameter. The crushed clay is then either stored in bins or fed directly into a "dry pan" for further grinding. A "dry pan" is a rotating pan-shaped grinding mill, having slotted openings in the bottom.

The clay is then passed over screens of the desired mesh, and the grains too coarse to pass through the screens are returned to the dry pan for further grinding. The clay which passes through the screens is stored in bins ready for mixing and tempering.

Three general molding processes are used for forming refractories. These are: (1) the handmade method, (2) the extrusion or stiff mud method and (3) the power press or dry press method. Certain shapes are formed by airramming, others by impact processing. The handmade method, which is the oldest method, has been replaced by the extrusion and the power press methods. Only the most complicated shapes, which cannot be made by another process are made by the handmade process. Power press bricks are the most uniform in size and usually show little warpage. They have good resistance to spalling and may be used in cupolas, ovens, furnaces and checker work, where rapid temperature changes occur.

In the power press process, the clays, taken from storage, are mixed and tempered either in a pug mill or in some form of a wet pan. Five to eight per cent moisture is added depending on the type of clay used and variations in operation. After tempering, the batch is conveyed to a mixing hopper directly above the press. The relatively dry mixture is fed to the power press, where measured quantities are pressed in shape under pressure varying from 1,000 to more than 10,000 pounds per square inch.

In making bricks by the extrusion process, the clays are ground in a dry pan, mixed wet or dry in a mixer, brought to the proper consistency in a pug mill and extruded through the die of an auger machine in the form of a stiff column. The air is removed from the clay before extrusion by a dearing system within the auger



Refractory shapes are arranged in kiln car prepartory to drying and firing.
Courtesy of Firestone Ceramics.

machine chamber. The column is cut by means of wires into bricks which are usually repressed to give them sharp corners and edges and smooth surfaces.

The green brick formed by any of the processes described are then either set directly in periodic kilns or placed on tunnel kiln cars and put into driers, preparatory to firing in tunnel kilns.

In periodic firing, the dried green brick are set in the kiln, the kiln is gradually brought to the required temperature, held at that temperature for the proper period of time, cooled and drawn. Total time for such a cycle will range from about two to four weeks, with a production of about 25,000 to over 50,000 standard 9-inch bricks per cycle.

In tunnel kiln firing, the green brick loaded on small cars are passed slowly through a long tunnel-shaped brick structure, divided successively into pre-heating, firing and cooling zones, generally taking three to five days for the trip. Products of combustion from the fuel burned in the firing zone pass into the pre-heating zone (countercurrent to the direction of travel of the cars) and give up their heat to the oncoming loads of bricks.

Correct firing is necessary to fully develop the most desirable physical properties of the brick. Firing drives off combined water, oxidizes and removes carbonaceous materials and sulfur, effects shrinkage of the clays and develops a strong ceramic bond within the brick structure.

Silica Brick Manufacture

The raw material consists of ganister (quartzite) or quartz pebbles. It is ground in a dry pan and screened to desired sizings, which will make a dense, strong body. In order to obtain enough fine material, a ball mill is used to grind a portion of the batch. The different sizes are kept in separate bins and mixed in exact percentages before being charged into a batch type mixer. To the silica material, lime and an organic bond is added, and the entire mixture is tempered with a small amount of water.

The prepared batch is transported by conveyor to the brick forming machines. Most silica bricks are formed by the power press process. Shapes which cannot be formed by the power press are hand molded.

One different step from the fireclay brick operation is the handling of silica brick after they are formed in the power press. Rubber padded mechanical fingers, located on each side of the brick as it comes up, out of the press, are squeezed together by air pressure, clamp the brick safely and securely, lift it up, move it forward onto a pallet on the table and place it down before releasing it. These fingers then go back with the charging box, ready for the next brick. The press operators carefully place the pallets on the drier cars. The green (unfired) bricks are dried in tunnel or compartment driers at a temperature of 160 to 190° F. In drying, the bonding agents harden the brick enough to permit safe handling. The dried brick are fired to either tunnel kiln or periodic kiln.[1]

Basic Brick Manufacture

Basic brick in general are formed at high pressure in mechanical presses from ground, sized and blended raw materials — dead-burned magnesite, chrome ore, olivine, and other minerals — with or without minor amounts of bonding agents. Some basic brick are bonded by firing; others are bonded chemically. Most magnesite, chrome, chrome-magnesite and forsterite brick are fired; most magnesite brick are chemically bonded. Many basic brick, especially chemically bonded magnesite-chrome, are encased in containers made of 15 to 20 gauge steel sheets.

The brick to be bonded by firing are first dried in humidity-controlled driers, then placed in continuous tunnel kilns and subjected to a soaking heat at a sufficiently high temperature to cause the grains to bond strongly together. For some types of refractories, the firing temperatures are 3000° F or even higher.

In manufacturing chemically-bonded brick, the bonding constituents are blended with the ground materials before pressing, and the bond is developed by curing in special tunnel driers. Later, after having been placed in service, chemically-bonded brick undergo changes at high-temperatures, and their desirable characteristics approach and in some properties even surpass those of brick which have been fired at high temperatures.

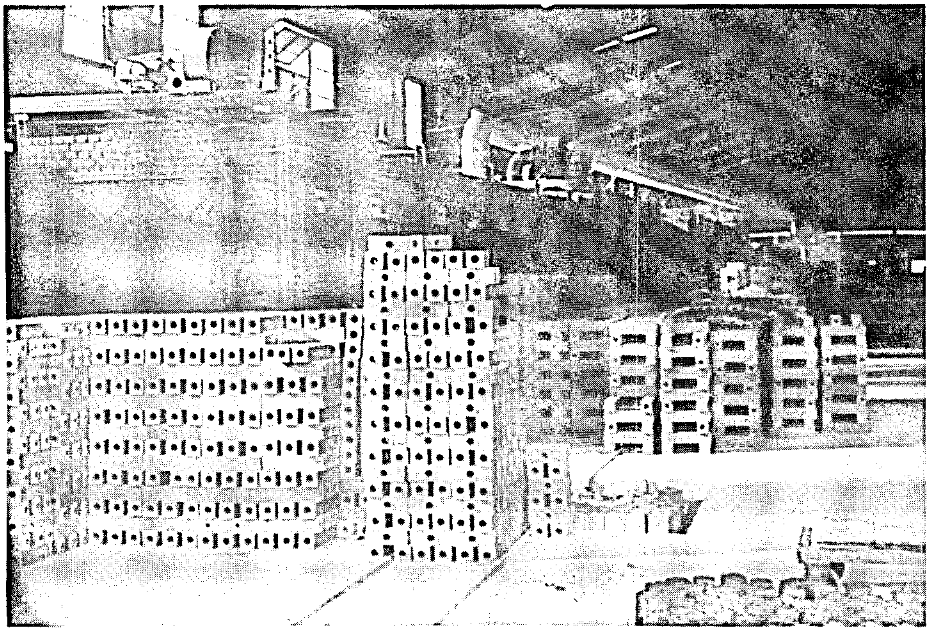
II. QUALITY CONTROL AND PROCESS INSPECTION

The successful manufacture of refractories is essentially dependent on two predominant factors. The first of these is high quality raw materials and the second is process control.

Control of Raw Materials

Refractory raw materials follow natures fundamental law of variability. Fireclay is merely a special type of earth. As such, it has been subjected to the whims of nature. Much time and effort and a variety of tests must be done to insure that the fireclays used in the manufacture of refractories are those of top quality.

Hard or flint clays constitute the essential raw material for the manufacture of most superduty and highduty fireclay refractories. A single deposit of clay may constitute as many as three types of flint clay. To check the quality of the clay to be used, each truckload of material is weighed and sampled upon receipt. The samples are classified as (1) "lump samples" of any material that may indicate a change in type or appear questionable for any reason, and (2) "average samples."



Long tunnel-shaped kiln where combined water and carbonaceous materials are removed and oxidation takes place. Courtesy of Firestone Ceramics.

"Lump samples" are fired in a test kiln. Visual examination the following morning indicates the relative density of the fired lumps and shows the presence of harmful impurities.

"Average samples" are tested promptly for refractoriness (as measured by the P. C. E. test) and for firing shrinkage. Later when they are used in manufacture, they are blended on the basis of the test to obtain mixtures of desired refractoriness and burning properties.[2]

Control in Raw Materials Preparation

Calcining. High alumina diaspore clays, flint fire clays and kaolins are calcined for use in making brick and other products. This heat treatment effects the mineral decompositions and recombinations and it brings about volume changes which would otherwise occur later when the brick are fired.

Since one of the purposes of the calcining processes is to shrink the material and thus make possible the closer control of the dimensions of the brick, the density of the calcines is the common control test.

Crushing, grinding and screening. The raw materials for refractories are ground and screened to the proper sizes for use in brick making or incorporation in ramming and castable compositions. The properties of the finished refractories are influenced to a large degree by the grain sizing; that is the relative proportions of particles of different sizes. Research has determined the effect of grain sizing on such properties as resistance to spalling, strength density and shrinkage at high temperatures, and has established a standard size grinding for each product. The quality control program includes regular screen analyses of all products throughout the grinding and screening processes.[2]

Batching and mixing. Each material used in a batch is weighed, the weighed batch is delivered to the mixer where water and other bonds are added at definite intervals, and finally the prepared batch is delivered to the presses or other equipment in which the brick are formed.[2]

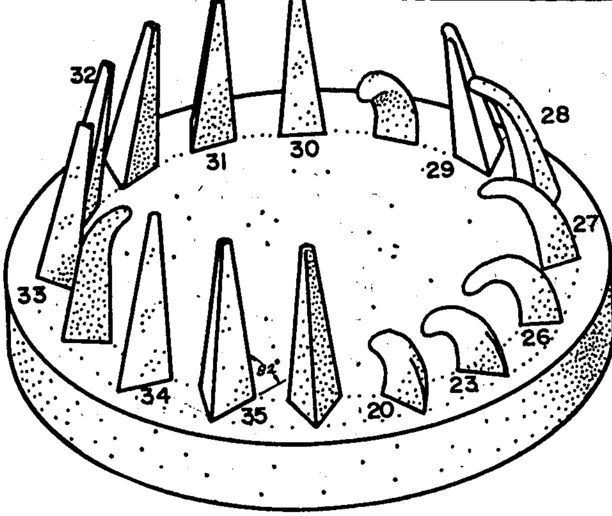
Control in Manufacture

Emphasis must be placed not only on the raw materials but also on the manufacturing processes.

Pressing and forming. Control in manufacture can be illustrated by the power-press process. The carefully prepared batches are fed into the mold boxes and the bricks are formed under high pressures. The forming operation is an important control point in the manufacturing process. If the pressure is too low, the brick may be low in density or strength; if the pressure is too high, the brick may be laminated or "pressure cracked". Undersized or oversized brick may result if the wrong amount of materials is charged to the mold.

A supervisor weighs and measures samples of the bricks being made regularly. The weight of brick and its thickness are plotted on control charts. So long as the points fall within the limits set, the process is "in control" and a satisfactory product is made. Should the points fall outside the range, the process is "out of control". Production is interrupted, and the cause is sought for, found and remedied.

Drying. The drying of refractory brick is a critical step in the manufacturing process, and must be carefully controlled. The control instruments on the driers should include recording hydrometers, base metal thermocouples, recording and indicating thermometers, pressure gauges and recording ammeters (which indicate the load on the fans). Re-



Method of mounting tests cones and appearance after partial heat treatment.
Source: Refractories Manual, p. 23.

gular determination of the moisture content of the brick coming from the driers serve as a guide to the drier operation.

Firing. The time, temperature and other conditions of firing determine many of the important physical properties of the products. As they pass through the tunnel kilns, the brick are heated gradually to a maximum temperature and held there for a definite length of time. The brick are then cooled to the temperature at which they are removed from the kiln. In the firing of refractories there are critical temperature ranges in which the rates of temperature change must be carefully controlled. It is, therefore necessary to heat and cool the ware in accordance with time-temperature schedules based on the firing properties of the particular kind of brick. The kiln atmosphere also affects the properties of the brick and must be properly controlled. Modern tunnel kilns include operating control instruments such as recording and indicating pyrometers, air-fuel ratio instruments, automatic pressure controls and draft and pressure gauges. These instruments also serve as control in periodic kiln firing.

Quality control tests regularly used to check and control the burning operation and coordinated with other manufacturing procedures are size, bulk density, apparent specific gravity, porosity and modulus of rupture of the burned brick. Use of the tests for control of burning involves the comparison of the properties of brick taken from different parts of the setting and of brick coming from the kilns during successive periods of time.

Product Testing

The finished product should also be subjected to numerous tests to insure that only refractories of the highest possible quality reach the consumers. Tests of the refractory products are numerous and varied. A brief description of ASTM tests for refractoriness follows:

P.C.E. or fusion point test. To determine the fusion point, a cone is made of the refractory and placed in a furnace with standard cones and the temperature raised to specified rate until the refractory cone fuses down. The standard cone fusing at the same time is noted and this cone is the Pyrometric Cone Equivalent of the refractory. A typical P.C.E. test arrangement is shown in figure above.

Re-heat Test. It is important that a firebrick or tile does not shrink at the operating temperature of the furnace and allow the wall to open up. The re-heat test is made to determine the resistance to shrinkage. In this test, samples are accurately measured, placed in a suitable furnace and the temperature raised to a prescribed temperature at a prescribed rate depending on the quality of the brick being tested and the temperature is held there for five hours. The bricks are then allowed to cool and again measured. The difference in length is expressed in per cent of original length. Most firebrick specifications call for a brick that does not shrink more than one to 1.5 per cent in the re-heat test.

Load Test. The P.C.E. test determines the temperature at which a refractory actually fuses and flows, but refractories start to soften at lower temperatures. Excessive compression and distortion in the load tests indicate that the refractory is made of poor quality fireclay, or contains high amounts of impurities. The load test is made by heating a firebrick standing on an end under a 25 psi load at 2462°F (1350°C) for 1-1/2 hours and the percent contraction after this treatment is measured. Most specifications for high quality brick require that they shall show less than 1.5 percent deformation in the load test.

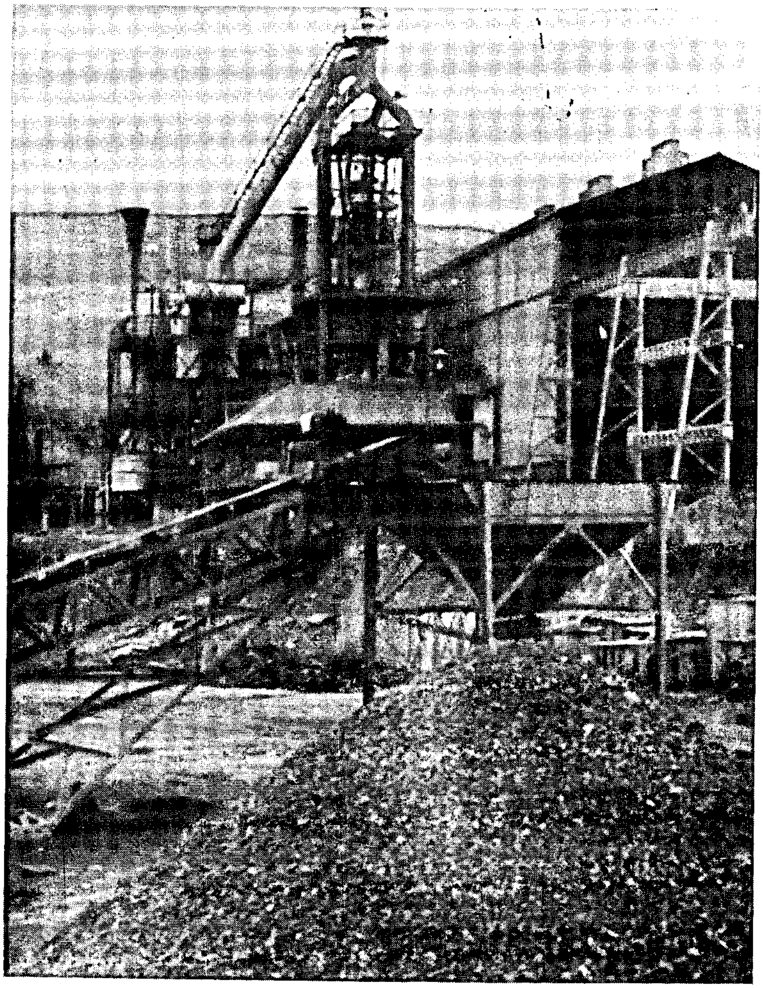
Panel spalling test. The test is made by building a 14-brick panel of the test brick, consisting of two rows of 7 bricks each, with the 2-1/2" x 9" face of the brick exposed and the panel thoroughly insulated. This panel is placed in front of a specially constructed furnace and heated to 2912°F (1600°C) for 24 hours. It is then transferred to a second furnace and heated to 2552°F (1400°C) for 10 minutes and subjected to an air and water blast for 10 minutes, making a 20-min. cycle, and this cycle is repeated 12 times. The bricks are weighed before and after the test and the results expressed in % loss in weight.

The local refractory industry today is faced with many problems. There exists a big market for refractories as evidenced by our continued importations. However, locally manufactured refractories cannot meet the service requirements of the various industries. In order to produce quality refractories which could compete with the foreign brands, extensive research must be undertaken. Efforts should be concentrated in developing a sound testing procedure that will select satisfactory refractories, eliminate unsatisfactory ones and point out to superior ones.

REFERENCES ON PAGE 42

by
ESTEFANIO M. GACAD

LOW SHAFT FURNACE SMELTING OF FERRUGINOUS MATERIALS



A general view of the NASSCO-J. Panganiban low-shaft furnace and casting hall from the ore stock yard.

We are publishing the first installment (in a series of three) of a research study on the low-shaft furnace-smelting of ferruginous materials. A lengthy work — the result of painstaking inquiry by our very own **Philippine Metals** technical editor — space does not permit publication of the entire article. — Ed.

The concept of smelting in vertical shaft furnaces with low stack height was developed and extensively used in Germany. The first recorded smelting tests using a low shaft furnace was done at Bunzlau, Eastern Germany, by the "Humboldt-Klockner-Deutz Werke" before the second world war. The plant was built to utilize local deposits of low grade fuel and acidic ores. This plant, however, and most of its records were destroyed during the war.[1]

During the war another low-shaft furnace was built in Trostberg, Eastern Bavaria, by the "Suddeutsche Kalkstickstoff Werke" to utilize the cheap hydro-electric power available and the waste oxygen from an air separation plant which provides nitrogen for a fertilizer plant. This furnace was initially used for smelting Austrian Erzburg iron ore and later for trial production of ferro-chrome from low grade Bavarian chrome ores mixed with Erzburg ore.[1] After the war the plant was shutdown.

After the partition of Germany, the Federal Republic of Germany (FRG) and the German Democratic Republic (GDR) pursued independent development of, and smelting tests in low-shaft furnaces.

In the Federal Republic of Germany, experimental smeltings were carried out in 1944-1945 by the "Klockner-Humboldt-Deutz A.G." at Koln. The tests were essentially the smelting of briquettes composed of non-coking coal, ore fines and limestone with tar pitch as binder. The low-shaft furnace pilot plant with a capacity of 12 tons of pig iron per day was constructed at Koln-Kalk in 1948. Based on the successful test results, a commercial low-shaft furnace with a maximum capacity of 100 tons of pig iron per day was constructed at Treirdorf near Koln by the "Demag-Humboldt Niedershachtofen G.m.b.h." using the one-stage Demag-Humboldt process.

Another low-shaft furnace was reconstructed from an experimental blast furnace at Oberhausen in 1951 by the "Gute Hoffnungs Hutte". This low-shaft furnace was utilized for the production of ferro-alloys with oxygen enrichment of the blast[1].

In 1949, the German Democratic Republic (GDR) possessed only 5.1% of the iron mines and about 6% of the iron and steel industry compared to the Germany of 1936. Its iron ore deposits are mostly low grade, the best of which contains up to 40%Fe. Its coking coal deposits are also limited but it has large reserves of lignite.[2] The coke manufactured from lignite by the Bilkenroth Rammler Process, developed in the GDR, are of low strength and suited only for low-shaft furnaces. These are the principal reasons for the extensive development and utilization of low-shaft furnaces in the GDR.

Smelting tests in small experimental furnaces were carried out in 1949 to 1950 with the aim of utilizing highly siliceous ore, which contain from 16 to 40% SiO_2 and 19 to 27% Fe, and lignite-coke. After the successful smelting tests a commercial low-shaft furnace with a working volume of 49.9 m^3 and a capacity of 80 tons pig iron per day was built in 1950 in the "VEB Maxhutte Bergbau and Hutten Kombinat" to work out the technology of smelting in low-shaft furnaces and also for training personnel for such operations. The results obtained formed the basis for the construction of the "V.E.B. Neiderschachtofen Werk Kalbe" where 10 low-shaft furnaces similar to the Maxhutte low shaft furnace were constructed from 1951 to 1953. The first tapping of furnace No. 1 was on October 15, 1951 and on March 9, 1953, furnace No. 10 was blown in. The Kalbe furnaces have a total annual capacity of 220,000 tons, each furnace producing from 40 to 85 tons per day.[3] The capacity of the Maxhutte low-shaft furnace was increased to 100 tons per day in 1957. Smelting tests for the production of spiegeleisen (ferro-manganese) was conducted in the same year. The Maxhutte and Kalbe low-shaft furnaces are characterized by their rectangular cross section.

In 1966, another low-shaft furnace with circular cross section was commissioned in the Kalbe plant which has a production of 50% more and a coke consumption 10% less than its rectangular counterpart. No details however are available about this furnace.

In 1951, seven European countries: Austria, Belgium, France, Greece, Italy, Luxembourg and the Netherlands founded the 'Association International pour les Recherches au Bas Fourneau d' Ougrée (A.I.R.B.O., the International Association for Research on Low-Shaft Furnace at Ougrée).

The low-shaft furnace and auxiliary plants were set up at Ougrée, near Liege, Belgium. Construction of the low-shaft furnace was started in 1952. It was fired on May 13, 1953. It was characterized by its oval section and cylindrical form from the hearth floor to the top.[4] Its inner profile was modified in 1954, 1955 and 1956. In 1965, the furnace was reconstructed into a smaller one with a circular cross section.

At Gerlafingen, Switzerland, experimental smelting tests were conducted in 1954 using local ore and coal with high volatible matter content in a low-shaft furnace which was actually a reconstructed cupola. The tests were carried out with oxygen-enriched blast.[1]

The Scientific Research Department, Pao-T'ou Metallurgical Combine of the People's Republic of China constructed in 1955 an experimental furnace with a 0.76 m^3 working volume to investigate the smelting characteristics of iron ores of the Pao-T'ou deposit. These ores have an iron content varying between 20 and 45% with high flourine content (about 4%). After two unsuccessful smelting tests conducted in November, 1955, the furnace was modified and the working volume was increased to 0.96m^3. This furnace was blown-in on April 23, 1956.[3]

The National Metallurgical Laboratory of India established the Low-Shaft Furnace Pilot Plant at Jamshedpur in the late fifties to conduct smelting tests utilizing raw materials from the major deposits of the different states of India which are not suitable feed for blast furnaces and to study the feasibility of putting up commercial low-shaft furnaces at or near these deposits. The low-shaft furnace pilot plant was based on the single stage Demag-Humboldt process.[5]

The Panganiban low-shaft furnace was constructed in 1962 at Jose Panganiban, Camarines Norte as a part of the NASSCO-J. Panganiban Smelting Plant Project which was established by Republic Act 1395 to utilize indigenous raw materials for the production of pig-iron. The low-shaft furnace was first fired on January 22, 1966. The furnace was operated intermittently for short periods varying from a few days to three months. Eight operational "campaigns" were conducted from January 22, 1966 to March 27, 1969. The plant was shutdown after the eight campaign because the operation of the plant was not economical due to the high cost of coke (62% of direct material cost) and high overhead cost.

Smelting tests in low-shaft furnaces were also undertaken in Japan and the U.S.S.R. but there is no available literature about these tests.

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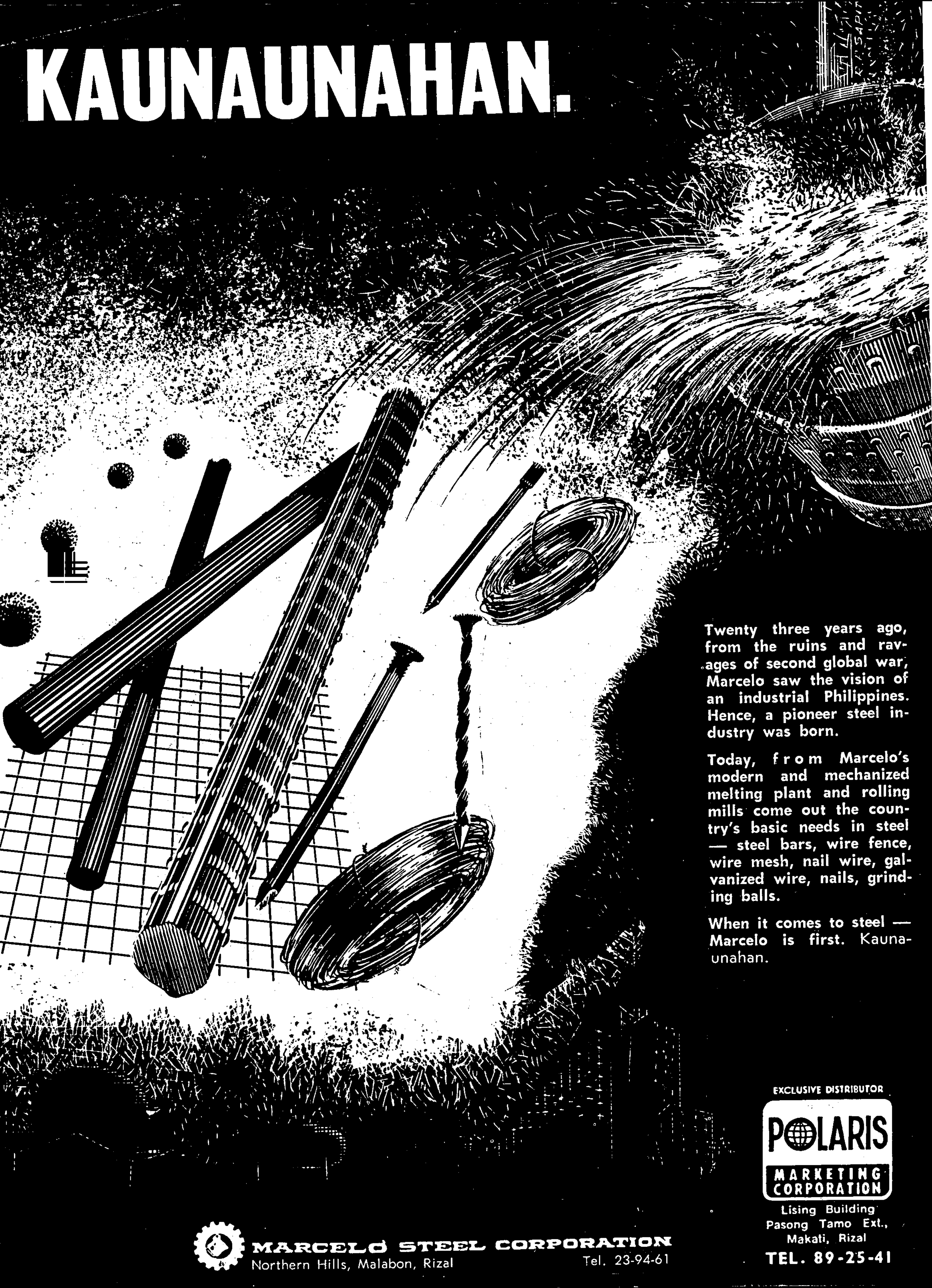
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IN LINE WITH THE UN's DEVELOPMENT STRATEGY

S. E. A. S. I. FACES DECADE OF CHALLENGE

by
RODOLFO M. ALUYEN

Photo taken during the inaugural meeting of the SEAISI Board of Directors held at Singapore last March 8 to 10, 1971. Listening to U Nyun, Executive Secretary of ECAFE deliver the keynote address are (l-r) Messrs. Tan Kim Yeow, Malaysia; Dr. Toh Chin Chye, Minister of Science and Technology of Singapore; Chi Shih Chi, Republic of China; Goh Seong Pek, Singapore; Shintaro Tabata, Japan; Bundit Matanasupt, Thailand; T.K. Duncan, Australia; and Dr. Antonio V. Arizabal, Philippines.

The inaugural, first official meeting of the South East Asia Iron and Steel Institute (SEAISI) at Singapore last March 8-10 attended by a distinguished group of government and industrial leaders in Southeast Asia (the Philippines was represented by MIDC's Dr. Antonio V. Arizabal) stressed the vital role that SEAISI hoped to carry in promoting the development of iron, steel and allied industries in Southeast Asia, especially among ASEAN member countries.

The SEAISI, which counts on six member countries — Republic of China, Malaysia, Singapore, Indonesia, Thailand and the Philippines — and two supporting member countries, Japan and Australia, first held a preparatory meeting in Singapore last October 1970 in which all member and supporting member countries were represented and at which initial decisions were taken including the financial contributions to be made by member and supporting member nations and

SEAISI Member Countries

1. **Australia***
2. **Indonesia**
3. **Japan***
4. **Malaysia**
5. **Philippines**
6. **Singapore**
7. **Taiwan**
8. **Thailand**

* Supporting member countries.

arrangements for the interim administration of the affairs of the Institute. Although the March 8-10, 1971 conference was the second SEAISI meeting of international significance, it is considered a first in that it was the initial Board of Directors Meeting of the Institute, the Board comprising one director from each of the eight member countries. The speeches delivered during this meeting by ECAFE's Executive Secretary U. Nyun, Dr. Toh Chin Chye, Minister for Science and Technology of Singapore and officials of the SEAISI were expressions of hope and welcome, of courage and concern.

U Nyun's message sounded the need for "positive collective action" to bridge the large gap that — in terms of current indigenous production of crude steel and rolled steel products, as set against steel imports in 1969 — exists between domestic steel production and steel consumption. He called on the SEAISI to lead the collective action towards expansion of the steel industry in Southeast Asia. U Nyun said, of the role of SEAISI:

"This Institute could well become the central source of information on the latest trends in iron and steel technology. It could assist in acquiring facilities for the training of much-needed operational, technical and managerial personnel. Through its technical committees and seminars it could serve as a forum in which high-level steel technicians and experts of the region and their counterparts elsewhere could exchange views on the relevance of the latest techniques to this part of the world, and the best means of applying them locally. It could also for example, arrange seminars on such topics, as market research, sales promotion, organization and planning.

"At this period when our world is expanding by excursions into space, the founding of the Institute bears witness to the fact that Asia's government and industrial leaders are now fully prepared to co-operate amicably across their frontiers. I have no doubt that your institute will form an effective link among the steel producers of the region and foster their co-operative efforts to promote the industry's rapid development."

The SEAISI has adopted a development strategy that now seeks a comprehensive approach to the promotion and development of the iron and steel industries among the member nations and the encouragement of regional cooperation in the area. This is embodied in the objectives of the Institute which include:

1) Provision of a forum for the exchange of knowledge for the benefit of the iron and steel industry, including the setting up of technical committees;

2) Provision of advisory service and the study of scientific, technological and economic aspects of the industry in the region; and

3) Establishment and extension of training programmes for personnel and promotion of steel product standardization and utilization in the area.

"This is an opportune moment for countries in the region," Minister Toh Chin Chye said, "to pool their resources towards co-ordinating the development of iron and steel industries and although the South East Asia Iron and Steel Institute which is sponsored by ECAFE has still a long way to go, nontheless, it can well act as the catalyst for a future iron and steel community in this region, and promote economic expansion just as the coal and steel community has done for Europe."

HISTORY

Actually, the South East Asia Iron and Steel Institute appeared in the embryo in a report made by an expert group commissioned by the Asian Industrial Development Council of the UN's Economic Commission for Asia and the Far East (ECAFE) in 1967 to survey prospects for the development of the iron and steel industry in Southeast Asia. Based on findings in this report, the Australian and Japanese governments each made available an expert from industry to discuss the idea of putting up an iron and steel organization with interested parties in a number of countries in the area. The idea was accepted and adopted at an ECAFE meeting in Bangkok late in 1969 at which the interested countries were represented. The South East Asia Iron and Steel Institute or SEAISI was born!

Following this, arrangements were put in hand for the establishment of national committees in each of the member countries including the Republic of China, Indonesia, Malaysia, Singapore, Thailand, and the Philippines and the supporting countries, namely, Japan and Australia. The national committee in the Philippines is the Philippine Iron and Steel Institute, whose secretariat or clearing house is the Metals Industry Development Center (MIDC) with Dr. Antonio V. Arizabal as acting director. Dr. Arizabal has been the Philippine representative to the SEAISI from its inception.

The complete line-up of SEAISI officers follows: *A.K. McLeod,* convening officer; *T.K. Duncan,* representing Australia; *Shintaro Tabata,* Japan; *Dr. Antonio V. Arizabal,* Philippines; *Goh Seong Pek,* Singapore; *Chi Shih Chi,* Taiwan; *Eman Jogasara,* Thailand; and *T. Sivagnanam,* and *Tan Kim Yeow,* Malaysia.

SIGNIFICANCE

Towards the accomplishment of its ojectives, important actiivities in which the Institute will involve itself include:

1) The collection and compilation of reliable iron and steel industry statistics;

2) The production of publications containing technical articles appropriate to the state of the industry in Southeast Asia;

3) The organization of international meetings, conferences and seminars to facilitate the presentation of papers and inter-change of views among interested people; and

4) The setting up of technical committes to investigate particular problems involving field studies and research.

Under the set-up, the supporting member countries, Japan and Australia, will assist in the development of the iron and steel industries of the five member countries, by way of financing, examination of industry problems, training of personnel and making available raw materials and capital equipment. Doing the drum-beating for SEAISI is Convening Officer A.K. McLeod who toured Southeast Asia last May for the purpose of finding out how national committees were going along, especially in the recruitment of member firms. Member firms include companies producing or processing steel, manufacturers of equipment for the industry, enterprises involved in the mining of steel industry raw materials, government agencies responsible for industrial development, technical institutes, research organizations and individuals.

A. K. McLeod also collected data on individual steel firms in each SEAISI member country and made a first hand look-see on the projects that the national committees would want SEAISI to do for them.

PHILIPPINE PARTICIPATION

Dr. Antonio V. Arizabal, Director of the Metals Industry Development Center and head of the Philippine National Committee for SEAISI is a TOYM awardee in iron and steel. He described to this writer the advantages to be gained from Philippine membership in the Institute. Dr. Arizabal said:

"SEAISI is a good intermediary for our getting more technical assistance from developed countries. It will also help us get up-to-date marketing information for iron and steel products within the ASEAN region and South East Asia. This would greatly help us in our desire to export iron and steel products."

In reviewing the decade past, Dr. Arizabal pointed out that the total economic performance of the country's iron and steel industry, if measured solely in terms of aggregate growth in output, has been a success. "We have an overextended iron and steel industry with a 50 per cent surplus in manufacturing capacity," Dr. Arizabal said. "Hence, we are in a position to export our iron and steel products."

According to Dr. Arizabal, of the ASEAN member countries (a regional grouping composed of Thailand, Indonesia, Malaysia, Singapore and the Philippines) our country leads in iron and steel production. SEAISI member countries Japan and Australia, are of course, in the forefront, followed by Taiwan. The Philippines and Taiwan are about even in iron and steel output.

LOOKING AHEAD

One of the many ECAFE-backed development projects for Asia and the Far East, SEAISI is hitched on the United Nation's development strategy for the Second Development Decade that began this year with the avowed goal of doubling the standard of living for all people in the developing countries over a time span of some 20 years.

The question is asked: Will SEAISI as a regional agency be instrumental in fostering among its member nations as well as supporting member nations a sense of identity in the task

U Nyun addresses delegates to the Ministerial Conference of the ECAFE on regional economic cooperation at the inaugural ceremony held in Manila in November 1965. Sitting in the background (l-r) are H. Kitamura, Chief of Research and Planning Division of ECAFE; A.G. Menon, Chief of Industries Division, ECAFE; and President Diosdado Macapagal. Photo courtesy of the United Nations Information Center.

of peace-building through iron and steel industry development — part of the global peace effort of the United Nations?

"A project," as Executive Secretary U Nyun explains, "will be most successful only when there is a general understanding of the nature and a conviction of its worth. Often this means proceeding slowly until the opposition is enlightened and national position and policies are more favorable."

Yet, it must be noted that SEAISI's counterparts in the Americas operate on a different plane. For instance, the ILAFA (Instituto Latinoamericano del Fierro y el Acero) promotes the iron and steel industry in Latin American countries through the introduction of technologies developed in the United States and Europe rather than the exchange of those technologies developed within the area. "Such tendency cannot but make the Institute a place for sales competition of technologies," observes Shintaro Tabata, Japan's representative for SEAISI. "I would not like to see our institute, SEAISI, to become such place of competition."

Will there be competition among SEAISI member and supporting member nations arising from inner incentives of the respective industries of each country? And if there were, would competition contravene the aims and objectives of the SEAISI which does not purportedly belong to any single nation but is an international institute?

Perhaps it will be a matter for the SEAISI members and supporting member nations to decide. Perhaps ECAFE which gave impetus to the creation of SEAISI can best settle any controversy arising from competition. The ECAFE is in a position to do so as the driving force behind this and many other development projects in the ECAFE region, which extends from Iran in the West to Outer Mongolia, in the North, to the far reaches of the eastern Pacific and down under Australia and New Zealand.

Trends are that ECAFE has her thumbs up for any effort that would bring about regional trade and prosperity. The ECAFE, for instance, is currently promoting an Asian Clearing Union and programs for trade liberalization and payments arrangements. Under this set-up, we can for instance buy Indonesian fertilizers using Philippine pesos and Indonesians can buy Philippine iron and steel products using their currency. According to the guideline of the plan at least five nations are needed to establish the clearing Union (ASEAN member countries — Indonesia, Thailand, Malaysia, Singapore and the Philippines — fit into this plan) although 11 countries have already expressed their readiness to participate. Executive Secretary U Nyun, who worked for this arrangement explained that the Central Bank of each of the countries joining the clearing Union will provide a credit line to the other members. Clearing will be made using the currencies of the Union members. Furthermore, SEAISI will work for the development of the ASEAN market.

And so SEAISI faces the Second Development Decade with challenges. It will not be smooth sailing to be sure. Japan is now feeling the pinch of competition in iron and steel production right in her front-yard, Southeast Asia. But as Executive Secretary, U Nyun, points out, "That which is considered impossible today becomes the accepted way tomorrow."

In that spirit member countries of the United Nations may yet become really united. And SEAISI can be that moving force, in a decade of challenge.

THE MIDC-NSDB TIE-UP

Two buildings will soon rise at he Science Community site at 3o. Bicutan, Taguig, Rizal for he Metals Industry Development Center consisting of the main building and the pilot plant.

The first one to be constructed will be the pilot plant building. Construction started recently and will be finished by around December. Having a floor area of 2,100 square meters, it will house he metalcasting, metalworking, machine and metal finishing shops. These shops will be equipped with the latest, modern and sophisticated equipment and instruments.

Consisting of a two-storey, reinforced concrete building with structural allowance for a third floor extension, the main building will have a total floor area of 2000 square meters. The first floor will house the chemical, metallographic, physical testing and nondestructive testing laboratories which will be equipped with modern labor-and time-saving equipment and instruments. The second floor will house the administration offices, training and conference rooms, and the library. All these in due time will generate the throbbing hum of activities for the vigorous development of the metals and allied industries.

The Government took the bold step of establishing the Metals Research Center for the purpose of promoting the advancement of he country's metals and its utilization. If fully developed, this industry will, undoubtedly, be a major if not a top factor in the country's economic stability and growth and would bring rapid industrialization.

HISTORY

MIDC came into existence by virtue of R.A. 4724, "An Act to Develop the Metals Industry of the Philippines by Establishing the Metals Industry Development Center, Providing Funds Therefore, and for Other Purposes." It was designed to be a semi-government, semi-private organization, autonomous under the authority of its Board of Trustees and conceived of as a means of creating close rapport between the government and the private sector in order to foster the advancement of the metals, engineering and allied industries in the country.

In the concrete, the Center was created by law "to provide both the government and the private sector with professional management and technical expertise on such vital activities for the development of the industry as training of engineers and technicians, information exchange, trade accredition service, quality control and testing of metal products, research and business economic advisory services.

The implementation of R.A. 4724 was delayed, although approved on June 18, 1966, the reason being as in newly created government agencies, the non-availability of funds.

The law envisioned a scheme of funding for MIDC's operations. But what good is the scheme if there is no fund? For its part, the private sector which is supposed to contribute financially to MIDC was not ready at that time to assume its obligation. This situation made MIDC not only impotent but indeed a born-dead entity.

Despite the odds at work against the Center, the situation was not entirely hopeless. Sometime in January 1967, NSDB Chairman Juan Salcedo took the initiative by constituting the MIDC Board of Trustees with members all coming from the government sector. The idea was to consider the implementation of R.A. 4724 and to plan ways of raising funds for the metals research center.

Having agreed on certain proposals, in April 1967, NSDB in coordination with the Economic Development Foundation, Inc. (EDF) put up a project for the organization of the Center's initial working staff. The NSDB extended a "grant-in-aid" fund to MIDC thru the EDF in the amount of ₱43,000.00. For its part, the private sector in July 1968, contributed ₱35,000 as assistance to the working staff, consisting part of their first year contribution to the Center as provided for by R.A. 4724.

Recognizing MIDC's important role in nation-building, NSDB appropriated and released ₱1.5 million from the Special Science Fund for the Fiscal Year 1968-1969. For the next FY 1969-1970 the amount of ₱1.3 million was appropriated but only ₱832,000 was actually released. Then for FY 1970-1971 MIDC received ₱540,000 from the Special Science Fund, ₱800,000 from the General Fund and ₱700,000 from the Export Tax Fund.

THE TIE-UP

As already pointed out, MIDC is supposed to be autonomous in its operation and hence a separate and distinct organization under the Office of the President. While this is true, its function is allied with that of the NSDB which is charged primarily for the promotion and development of science and technology in the country.

In the crucial and transition stage of MIDC, the assistance given by the NSDB was not only a welcome relief but more than that, such assistance became vital and indispensable. In addition, NSDB extended its facilities and personnel services just to make the metals research center start operating. Hence, the present tie-up between the NSDB and MIDC.

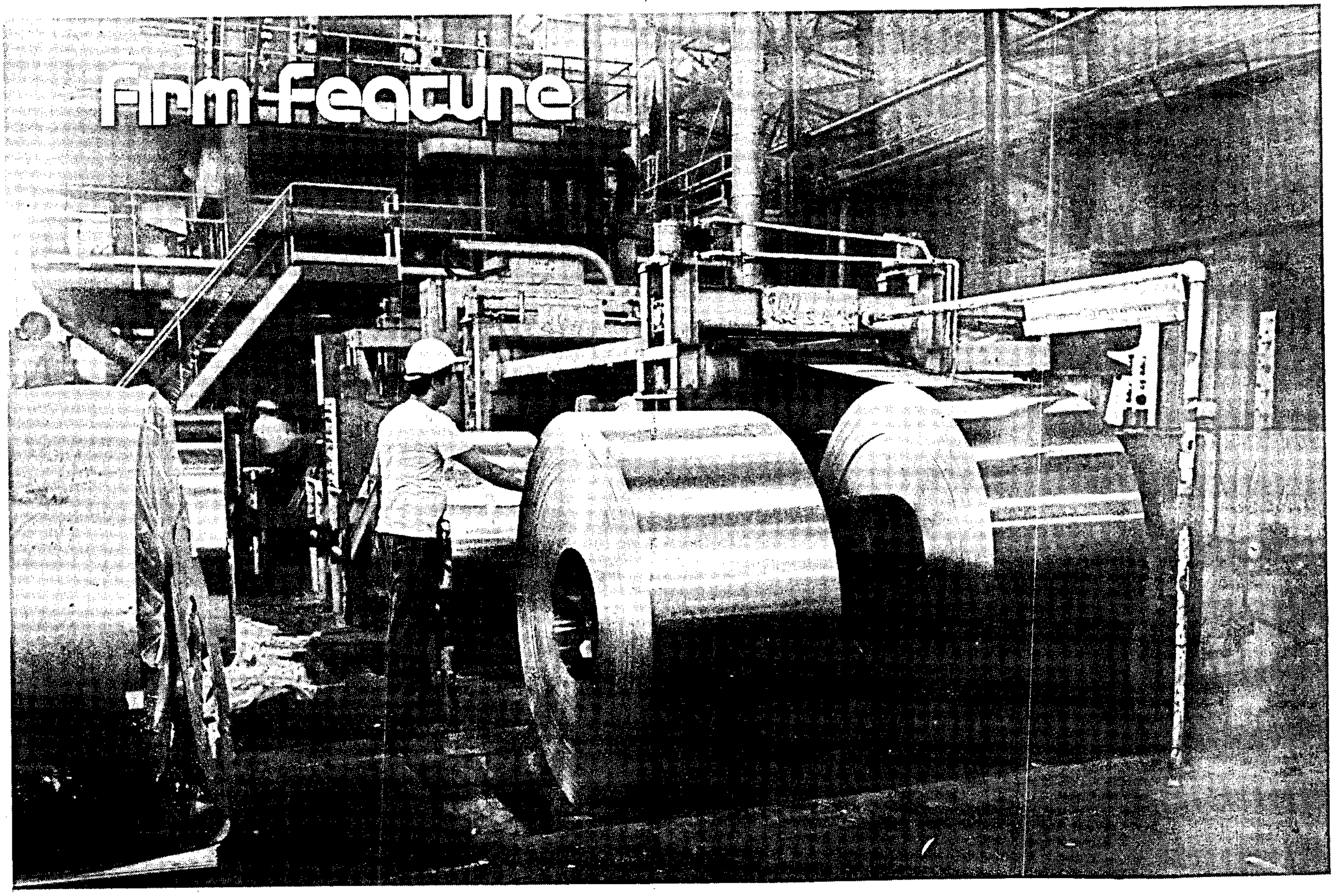
In the process of MIDC establishment, the NSDB has had a direct responsibility, which responsibility may well continue even after the transitional period, as provided for in paragraph 2, Section 5 of the aforementioned Republic Act 4724 creating MIDC, and we quote a pertinent portion:

"During the first four years of its organization, the chairman of the National Science Development Board shall be the chairman of the board. The Vice-Chairman shall be a representative of the private sector who shall be chosen by them among themselves: provided, that during the fifth to the seventh year, the chairmanship shall come from the private sector and the vice-chairman shall be the chairman of the National Science Development Board. Provided, further, that after the seven years the board shall be automatically dissolved and the private sector shall have the discretion to reorganize a new board with the chairman of the National Science Board being retained as an ex-officio member."

MEN AT THE HELM

Dr. Antonio V. Arizabal, MIDC Acting Director is at the helm of the Center's management. At the same time, he is also the Board of Investment director on metals and mining.

The MIDC Board of Trustees is composed of the following: Gen. Florencio A. Medina, Chairman of NSDB; Vice-Chairman — Estanislao P. Angeles, Sr., Consultant, Feati Industries, Inc.; Members — Fernando S. Busuego, director, Bureau of Mines; Jones R. Castro, vice president, Surigao Nickel Project, MMIC; Dr. Jose M. Lawas, acting director, Office of National Planning, NEC; Pablo A. Silva, Jr. assistant vice-president, CPJ Corporation and Isabelo A. Tapia, assistant general manager, NASSCO.



Entry section of the electrolytic tinning line of ELISCO. At foreground are coils of tinmill blackplate, one being fed to the tinning line and the other on reserve.

ELISCO-ELIROL

ELISCO

Elizalde Iron and Steel Corporation (Elisco), the first tinplate manufacturer in the Philippines was organized in 1961. Previous to this, all tinplate users had to import tinplate for their requirements. Problems were encountered regarding importation due to stringent dollar retention regulations of the government. The formation and establishment of the tinning lines of Elisco relieved these companies from complete dependence on foreign suppliers, and at the same time saved precious dollars for the government.

Elisco passed through the difficult stage of a starting industry. The quality of the product was established, local demands met, a protective tariff obtained, and finally a competitive pricing worked out.

The putting up of the tinning plant marked the beginning of the reverse integration program of Elisco.

In 1968, Elisco, feeling the vast potential market for cold rolled steel products both local and foreign, revived an earlier study to investigate the feasibility of erecting a second phase, the cold rolling plant. The study gave favorably results and this led to the formation of Elizalde zalde Steel Rolling Mills, Inc. (ELIROL).

Tinplates from Elisco are exported to various countries in the Middle East and Southeast Asia.

How Tinplate is Made

The Electrolytic Tinning Line

Tinplate is produced by rolling mild steel in sheet or strip form to a finished thickness of about 01 inch and coating it with tin either by dipping in molten tin or by electrodeposition. Available in different grades, tinplates carry coatings as low as 0.000015 inch thickness as in the electroly-

An annealed coil is being checked by an operator, prior to processing at ELIROL's Temper Mill for the desired hardness.

OPERATIONS

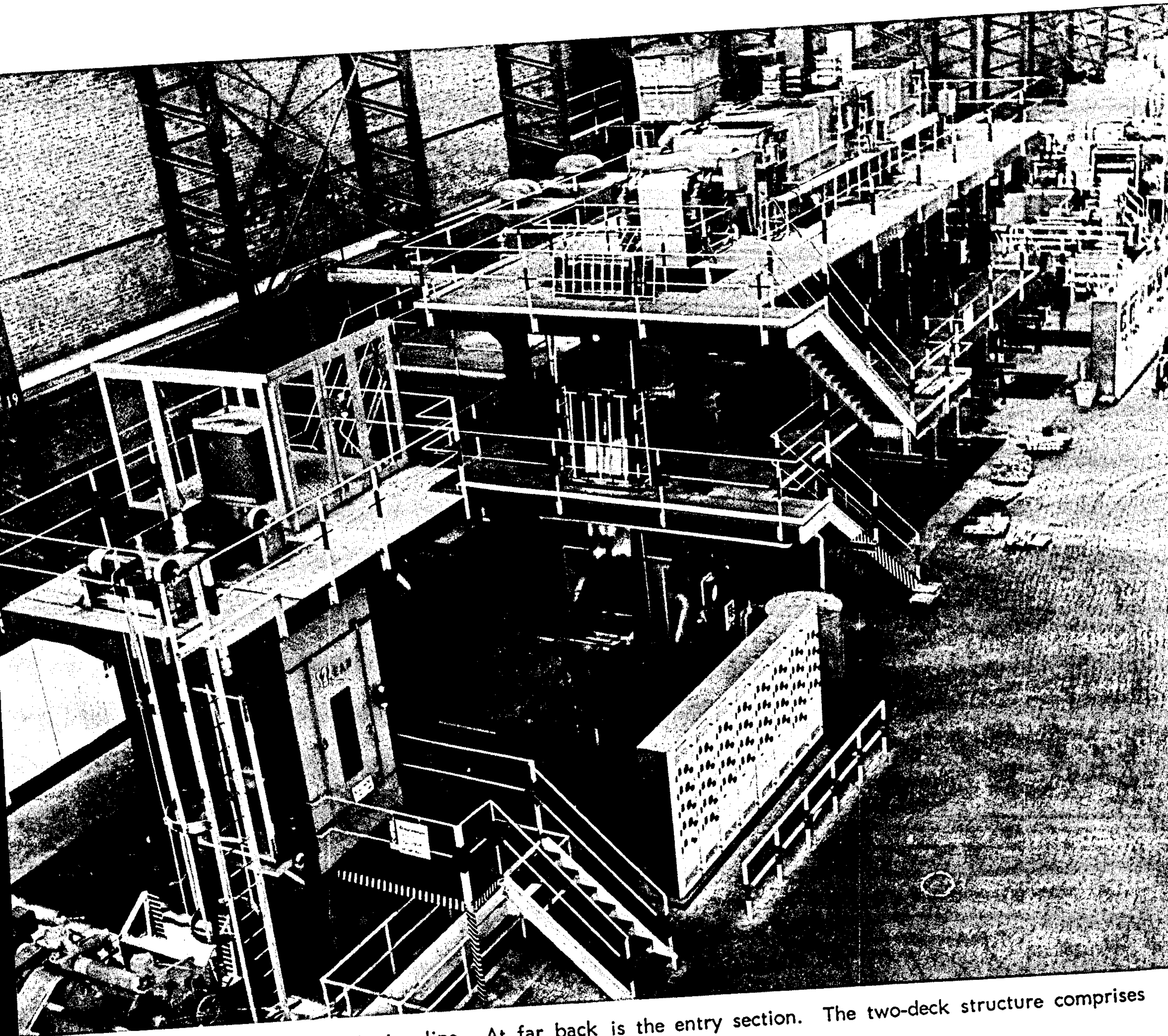
tic process or as high as 0.0008 inch or more in the hot-dip process.

The electrolytic tinning line is of the halogen type which in terms of world tinplate production is the second major electrolytic process. This process accounts for about 20 to 25 per cent of world production. The major distinctive engineering feature of the Halogen line is that the strip is handled as a horizontal band, instead of as a series of vertical loops.

The Elisco electrolytic tinning line is the first successful low-speed Halogen line. The line has a fairly conventional entry section, but the remainder is simplified to conform to the needs of Elisco. The horizontal plating section has six cells, three on each deck, followed by flow melting, passivation and oiling. The maximum line speed is 450 feet a minute and the line is equipped with in-line shearing and three-stage sheet classifier. The rated annual capacity is an average of 75,000 tons (100,000 MT for high gauges and 60,000 MT for low gauges) and can handle coils of 11.0 tons as long as the outside diameter does not exceed 64.0 inches. The maximum length and the maximum width of sheets that can be handled by the line is 18" and 37", respectively.

The electrolytic tinning line handles the strip in a continuous strand through all the operations of the tinning process described below.

Entry Section — This is made up of two decoilers, an electric welder and a looping pit. The leading end of one coil is welded to the trailing end of the previous coil to ensure a continuous strip. Welding takes less than 20 seconds and during this time the entry section is at a stop while the rest of the line is running at low speed automatically. The 50 feet-looping pit serves as a storage for 100 feet of uncoiled strip to assure a continuous sup-



A full view of the electrolytic tinning line, At far back is the entry section. The two-deck structure comprises the tinning section, and at foreground is the electrostatic oiler.

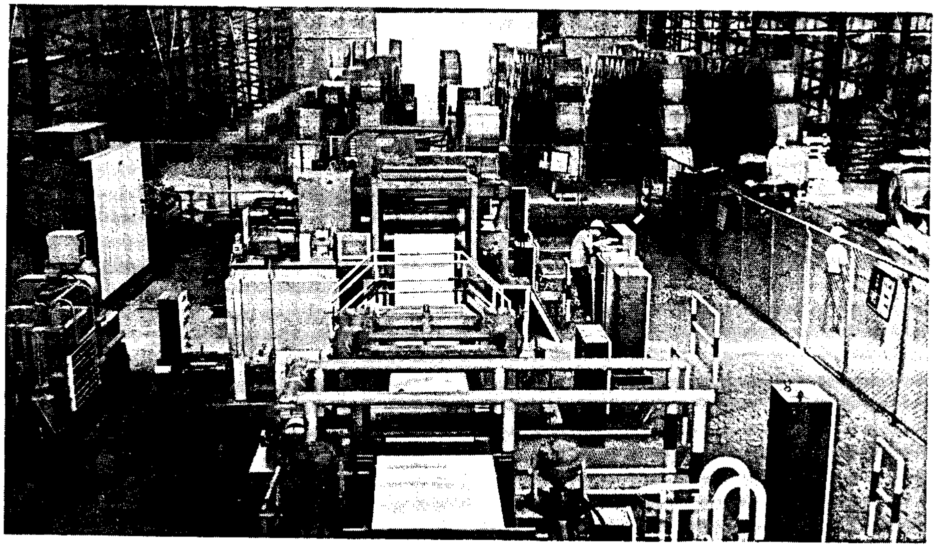
ply to the line during the welding operation.

Cleaning and Pickling — The strip is passed to a cleaning tank where oil and grease are removed by chemical reaction. The degreased strip then passes to the pickling tank containing sulphuric or hydrochloric acid. Pickling effects the removal of rust and oxides and other impurities prior to tinplating. The iron content and concentration of the solution is always set at their ideal percentages.

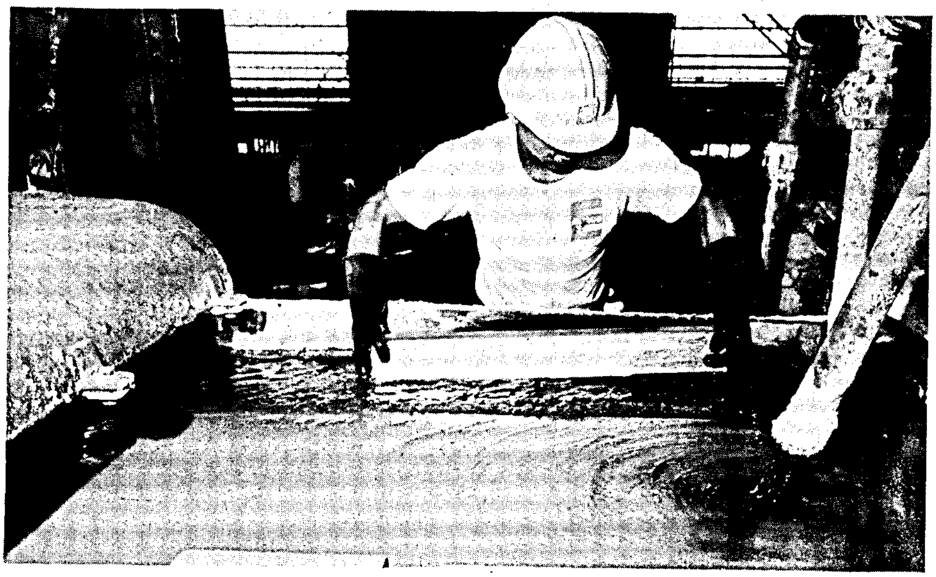
Tinplating — The strip passes into the plating section of which there are three cells each in the lower and upper tiers. Tin is deposited on the lower surface of the strip as it passes over the anodes in the lower tier. Through the use of deflector rolls, the strip passes over the plating cells of the upper tier to have the opposite surface plated.

The moving steel strip forms the cathodes and the electrical contract with the strip is made through a series of conductor rolls. At the entry and exit ends of each plating level and between adjacent individual plating cells, the strip passes between a pair of horizontal rolls. The bottom roll of the pair is rubber-covered and spring loaded and hold the strip firmly against the upper conducting rolls. This, sometimes called the cathode roll, is an arrangement of commutators and brushes at the end which connect it to the negative pole of the D.C. source. All the pairs of conductor rolls are motor-driven at line speed. By suitable electric linkages, the line speed is monitored and a feedback signal is fed to the plating current source so that the current is automatically matched to the line speed at any moment. In this way, the desired thickness of tin is accurately deposited at all line speeds. Moreover, if the load on one cell fades off, say due to an increase in internal resistance, the other cells will pick up the load until the fault is corrected.

The electrolyte for plating is continuously circulated through the system and through a large storage tank. It is brought from the storage tank into each cell, by a series of circulating pumps.



Shown are rubber pinch rollers guiding the cold rolled steel strip into the tinning line.



A tin anode being loaded into one of the electrolytic plating cells.

The third deck of the plating section comprises the electrolyte recovery and rinsing arrangement. Any electrolyte recovered in the first tank is returned to the main storage tank. Rinsing in the second tank is by a system of hot water sprays and wringer rolls. The strip passes through a hot air dryer to complete the operations in the plating section.

Flow-Melting — The next major operation is flow-melting which requires the heating of the strip to a temperature only slightly above the melting point of tin followed immediately by quenching. The time during which the coating is actually molten must be extremely short to avoid discoloration of the surface, excessive alloy build-up, etc. Flow melting is done to impart a bright appearance to the normally dull finish of electrolytic tinplate unless orders stipulate this "as-coated" matte finish.

Finishing — After flow-melting, the tinplates passes forward through a passivation treatment section. This chemical treatment gives the strip a stronger resistance to corrosion and enhances workability on the surface finish. Then, the tinplate passes through the Electrostatic oiler, where the proper quantity of oil is applied.

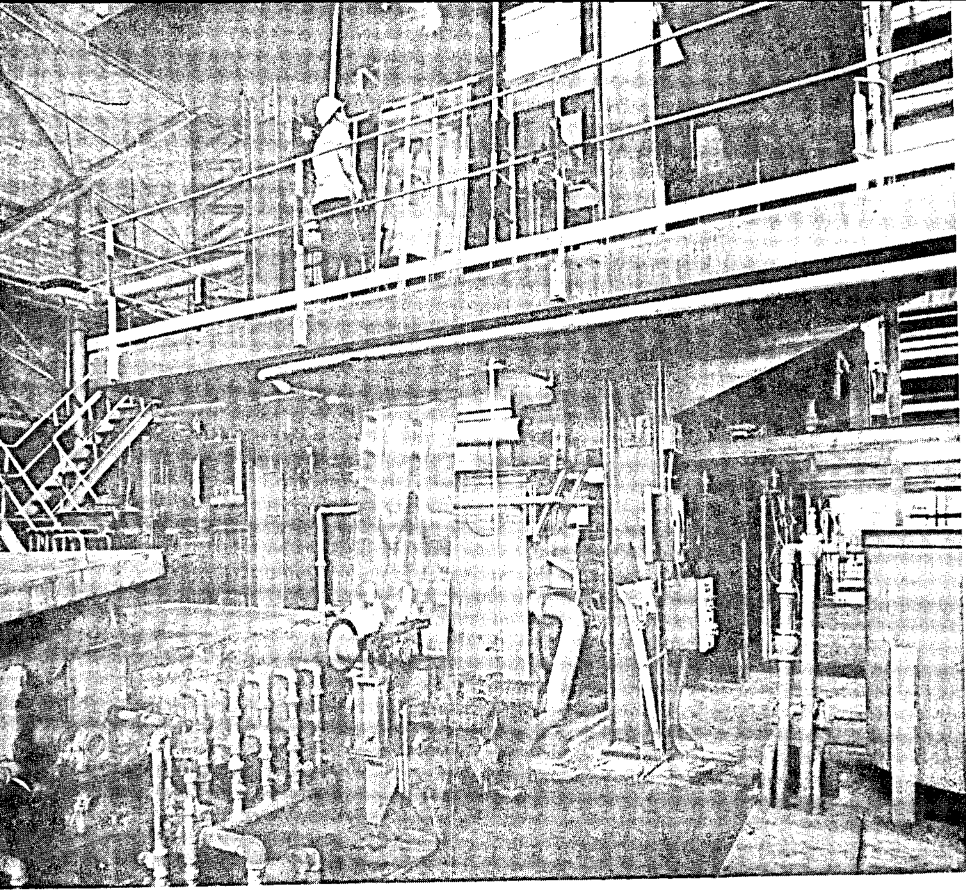
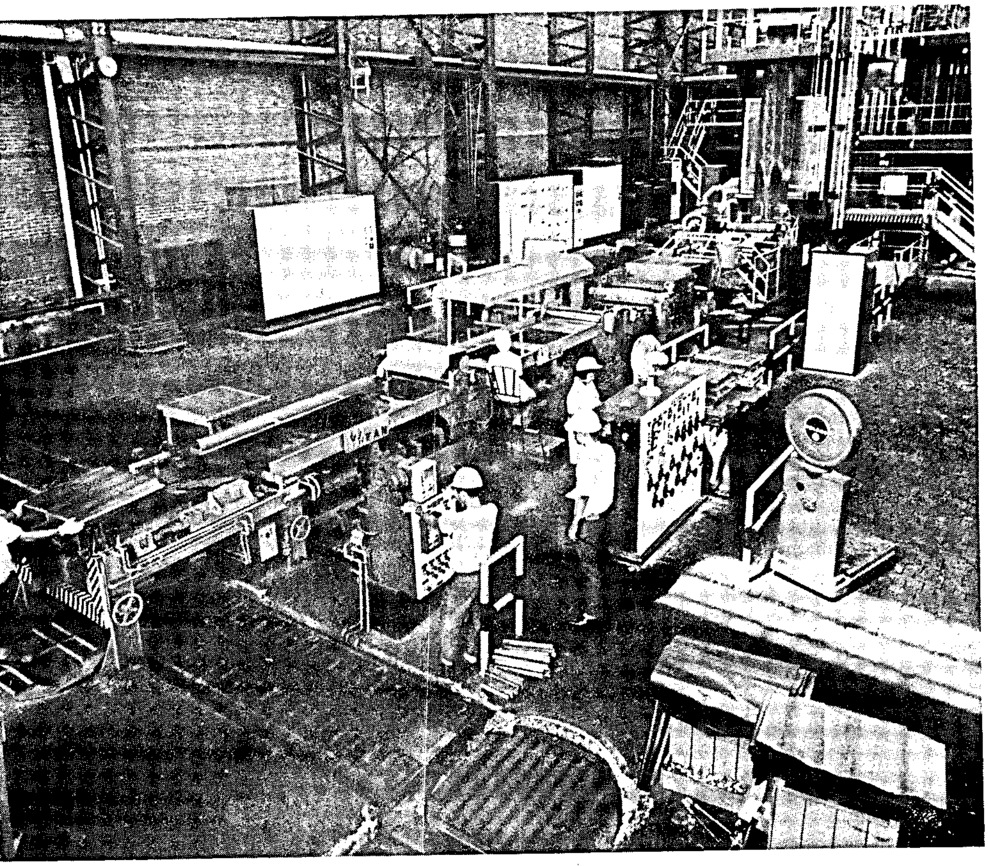


Photo shows the strip emerging from the flow- brightening section.



Shown here is the shearing section where tinplates are cut into sheets.

The tinplate is then passed through a series of rollers where the strip is levelled. The strip is cut to the desired length by a rotary shear. The tinplate then passes on a conveyor where they are inspected. Prime tinplates go to the prime piler and the others to different piles depending on their grades. As soon as the number of sheets required are met, the tinplates on a wooden skid are packed water-proof paper with mild steel angulars on the edges, metal cased and steel strapped.

The Hot Dip Tinning Line

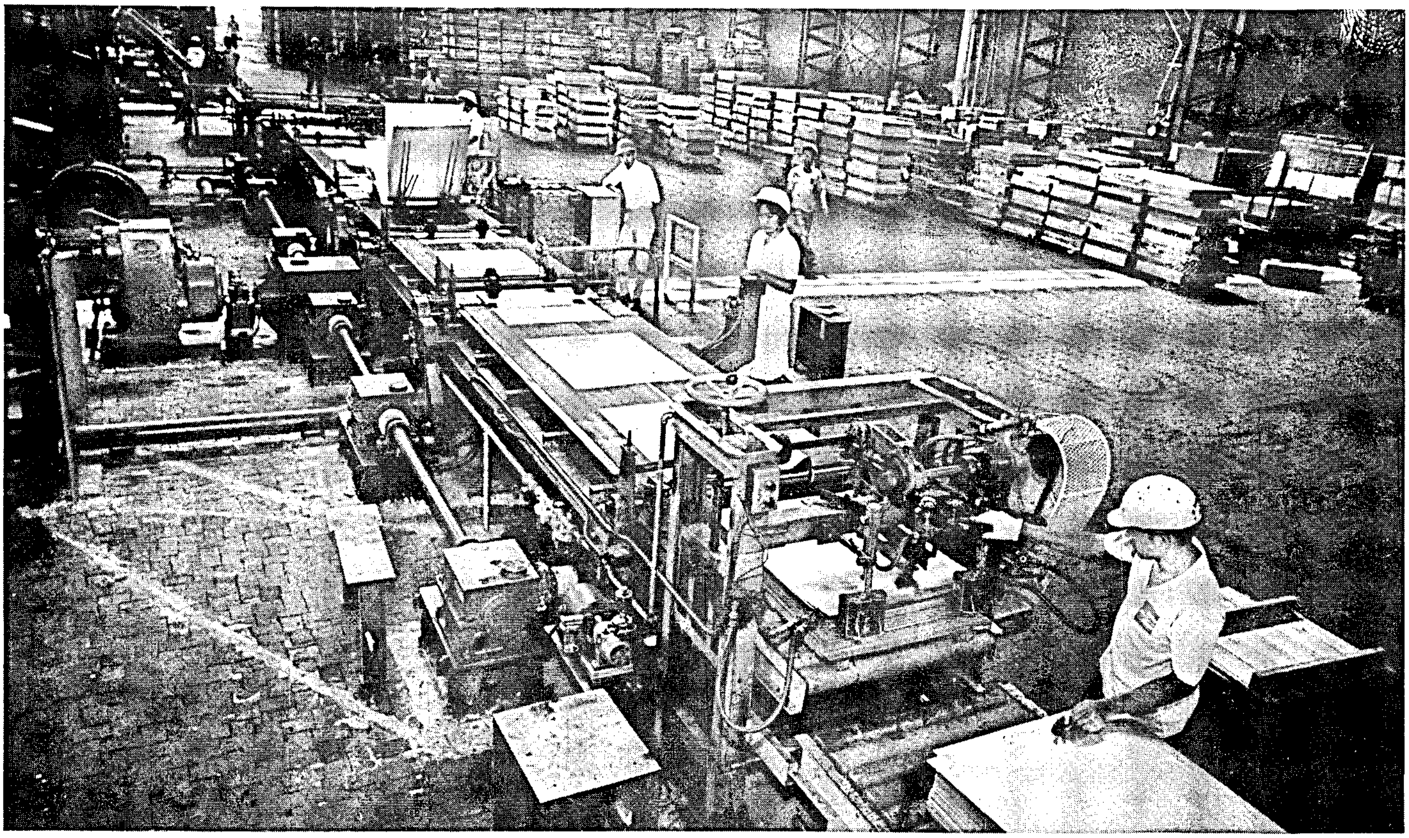
In Elisco, instead of using cold-rolled sheets as raw materials, tinplates from the electrolytic tinning which have already been cleaned, pickled and have a minimum coating are utilized, thus eliminating the pickling process at the hot-dip lines.

Sheet by sheet, the tinplates are fed by a feeder machine to a hot-dip unit. This unit comprises a thermostatically-controlled vessel of molten tin in which is submerged a mechanism of rollers and guides for conducting the sheets downward, through a layer of tinning flux into the molten tin and then upwards and out of the tin bath through a thick covering layer of palm oil. During this passage through the molten palm oil, the sheets are subjected to the squeezing action of the tinned steel rollers which serve to regulate and control the final coating on the sheets. After emerging from the tinning machine, the tinned sheets are cooled and then cleaned and polished, usually by a combination of alkaline detergent washing and dry absorbent cleaning in bran or wood meal. At the exit section, the sheets are classified, where acceptable prime quality tinplate sheets are manually piled and counted.

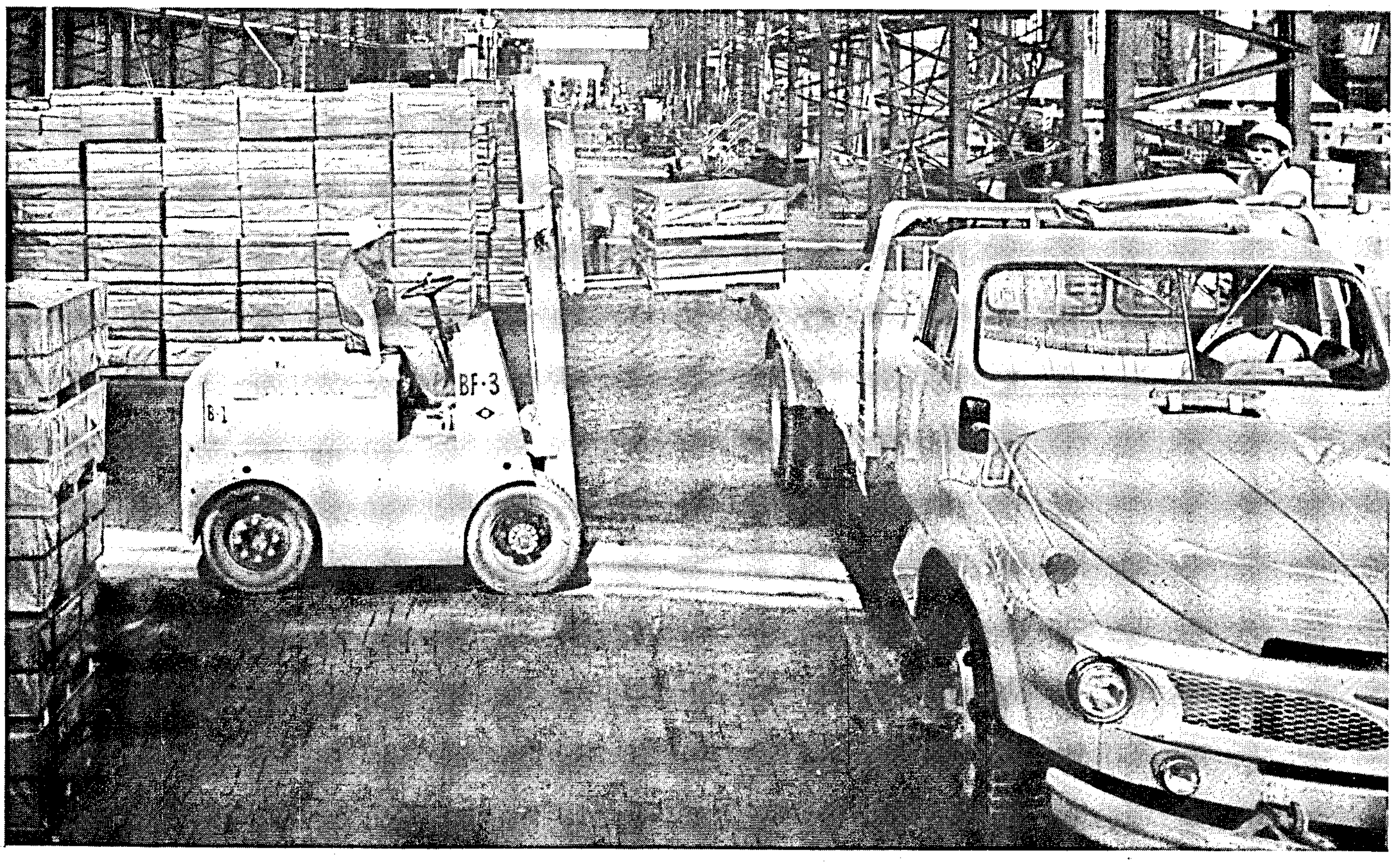
There are four hot-dip tinning lines of Japanese manufacture with an estimated average annual capacity of 14,000 tons at Elisco. Due to the current limited market demands, the hot-dip lines are producing below their rated capacities.

The Finished Product

The finished product called tinplate is a mild or low-carbon steel



This is the inspection line, where tinplates are classified according to quality.



Picture shows packed tinplates ready for delivery on storage.

strip or sheet coated with commercially pure tin on both faces, thus incorporating in one inexpensive material the strength and formability of steel and the corrosion resistance, solderability and good appearance of tin.

The many uses of tinplate arise from a combination of advantages unrivalled by any other material. Tinplate is cheap, light and strong; it is easily fabricated into intricate shapes and can be soldered at high speeds. It has an attractive appearance and can be decorated by lithography. It has some unique electrochemical properties, which make it remarkably corrosion resistant under suitable conditions and it is non-toxic. The mechanical and chemical properties clearly distinguish tinplate as a material for containers in general and for food packages and food handling equipment in particular. Today ninety per cent of the world's tinplate goes into containers for foods, oils, paints, powders, grease, cosmetics, tobacco, etc. The remainder, covering kitchen utensils, domestic hardware, toys, trays, bottle closures and advertising novelties.

The following are the quality gradings of Elisco tinplates: (1) Primes — these are tinplates which are free from defects, visible to the unaided eye, and of which the entire surface is usable; (2) Waste-waste — these are tinplates which may be slightly or partly defective but which are usable or partly usable and (3) Unassorted Waste-Waste — these are tinplates which may be partly defective but cannot qualify as waste-waste or be downgraded to scrap.

ELIROL

The manufacturing operation of ELIROL (Cold Rolling Mills) consists of six major processes, namely: pickling, cold rolling, cleaning, annealing, tempering and finishing.

The Continuous Pickling Line

The first processing line that the hot-rolled coil (raw material) undergoes is the continuous pickling line, to remove the oxides, scales, rust and other impurities which would be detrimental to the final appearance of the finished product. At the entry section, defective lead and tail-ends of the hot coils which are harmful during cold rolling are removed by means of the up-cut shear, then the flash butt welder is used to weld each coil to the end of the preceding coil to build up coils to the required size. However, if welding is not necessary the ends are coupled by the stitcher to have a continuous flow of the strip, the stitches being removed at the delivery section. Prior to the passage of the strip through the pickling tank or acid solution, the strip is bent by several rolls in succession (thus breaking down the scales on the strip surface and producing minute cracks which facilitate the penetration of the acid solution) and then go to the looping pit with water, thereby giving a uniform speed of passage through the pickling tank.

The pickling tank consists of three tanks with acid concentration gradually increasing from the first to the last tank. The pickling process is cascading wherein the addition of water, acid and inhibitor is done in the last pickling tank, thus the flow of the liquid is in the opposite direction to the movement of the strip. After leaving the tank, the strip is washed and dried. The edges are trimmed, coating oil is applied and the strip is wound by the upcoiler to be transferred to the next process.

The Cold Rolling Process

From the pickling line, the pickled coils are sent to the reduction mill to be cold reduced by giant rollers under pressure. The strip is passed repeatedly through the rolls until the required thickness has been obtained. To reduce the friction at work between the rolls and strip during rolling, lubricants with high cooling performance and lubricating properties are applied on the strip. X-ray thickness detectors are installed at the mills to ensure thickness precision.

Elirol has two reduction mills for this purpose. One is the Reversing Mill, usually used for thin gauges and narrow width coils (40 inches and below), and the other one is the Combination Mill, used for thick gauges and wider width coils (50 inches width).

Electrolytic Cleaning Line

After cold reduction, the reduced coils are delivered to the electrolytic cleaning line. Electric cleaning is used to remove the rolling lubricant and other impurities and dirt adhering to the surface of the strip and to align coil edges so that tightly-wound coils can be attained for annealing.

Before a reduced coil is put into the feed reel, the lead end (off-gauge portion) is cut by a sheer. The coil is then placed into the mandrel and unwound. The preceding coil and the coil following it are lap-welded together, so that the strip will be able to travel continuously through the electrolytic cleaning line. After welding, the strip is first given a rough alkali cleaning by passing between brush rolls, sprayed with dilute alkaline solution to wash off the oil. Then the strip is de-oiled by electrolysis wherein the strip acts as one of the electrodes. The oils are removed mechanically by the hydrogen or oxygen gases produced during electrolysis.

After leaving the electrolytic cleaning tank, the strip goes to the scrubber where the alkali is removed, then washed with hot water and dried by hot air before transfering to the annealing furnaces.

Annealing

In annealing (using box-type annealing furnaces), the cleaned coils are heat-treated to render them suitably soft and ductile to improve the workability and remove its internal stresses.

Up-ended (eye vertical) coils from the cleaning line are piled up to a stack with a suitable height on bases. The products are heated after a cover made of steel plate is put over them, and the inside of the cover is filled with a protective gas to prevent oxidation. The heating time varies depending upon the tonnage of the charge, temperature setting, strip size, state of circulation of the atmospheric gas, holding time and on the specific application for which the strip is to be used. The tonnage per batch depends upon the size and width of the coils. There are 36 annealing bases for this purpose.

Tempering

After annealed coils (dead soft steel) coming from the annealing furnaces are cooled to the desired temperature, they are sent to the temper mill for tempering to give the strip certain properties, particularly hardness, and to impart desired surface finish including product shape.

During tempering, the strip is passed between two rolls under pressure, performed within a reduction range of from 0.5 per cent to three per cent. Oiling is done at the temper mill if needed.

Finishing Lines

From the temper mills, the tempered coils are then transported to the finishing lines where they are processed in the coil preparation line, slitting line or shearing line.

In the coil preparation line, the coils are either cut or welded together to achieve the required tonnage of the products. Final quality inspection of the product is done in the line.

Primarily, the slitting line is used in processing slit coils, wherein the strip is made to pass through parallel slitter blades, thus dividing the coil width into the required slit dimensions.

The shearing line is used for processing cold-rolled sheets from 20" to 144" lengths. The strip is cut by a guillotine shear and made to pass through successive levellers. The line is equipped with an automatic counter to determine the number of sheets delivered to the prime piler.

Quality Control

Quality control starts from the time the raw materials are ordered. Their properties and chemical compositions are explicitly specified. Strict adherence to the required specifications are tested in the laboratory for chemical compositions, ductility, tensile strength and hardness.

Photo shows the delivery section of the continuous pickling line. Hot bands undergo first major processing in this section.

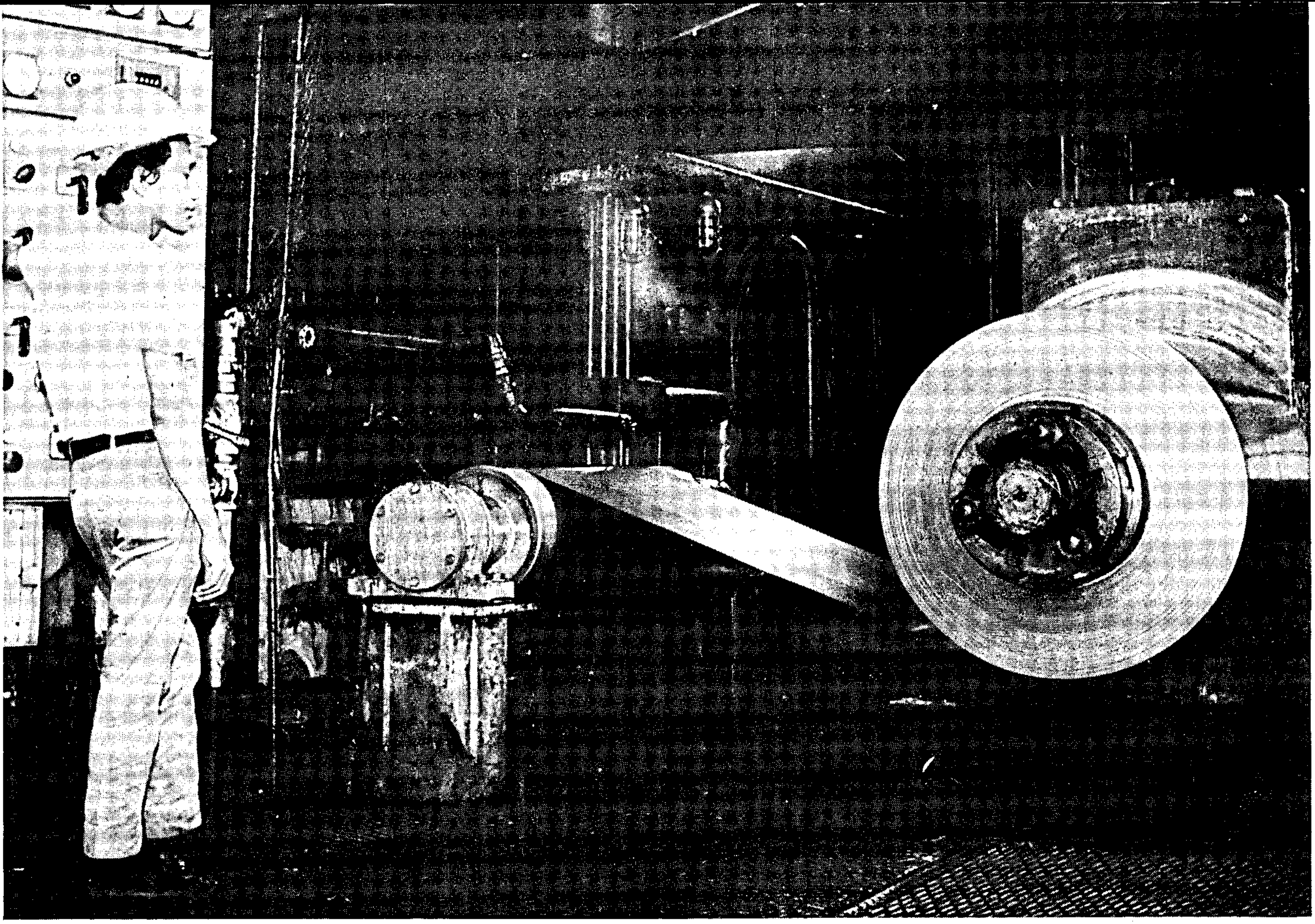
For tinplating, conformity with required concentrations is a must in the electrolyte, the cleaning, pickling and chemical treatment solutions. Tests are done on a routine basis by the quality control department. For the different specified properties required by the customer, the following are the equipment used for each: (1) Tin Coating — Bendix deplater or Electron Stripper, (2) Oil Film — Hydrophil balance or Donart Ellipsometer, (3) Ductility — Ericksen or Olsen Tester, (4) Bending Test — Jenkin Tester, (5) Lacquer adhesion property — Nokanishi Lithography Bench, and (6) Hardness — Rockwell Superficial Hardness Tester.

The quality check-up made on the tinplates are done on a routine basis. If and when finished products are of doubtful quality, these are subjected to rigid quality check-up so that the quality of the tinplates delivered to the customer may be guaranteed.

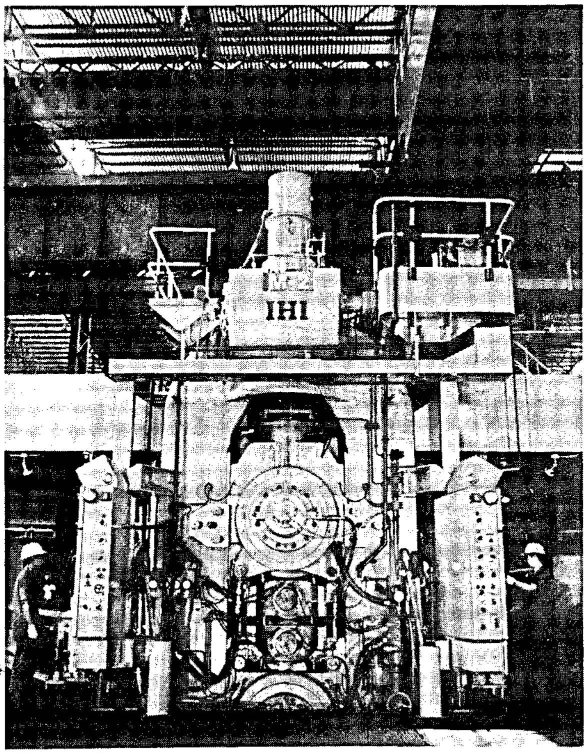
Control During Processing

The laboratory analyzes the concentration of the pickling acid and sees that it is maintained over an allowable limit. Quality inspectors insure that the appearance of the emerging strip is acceptable for the next process.

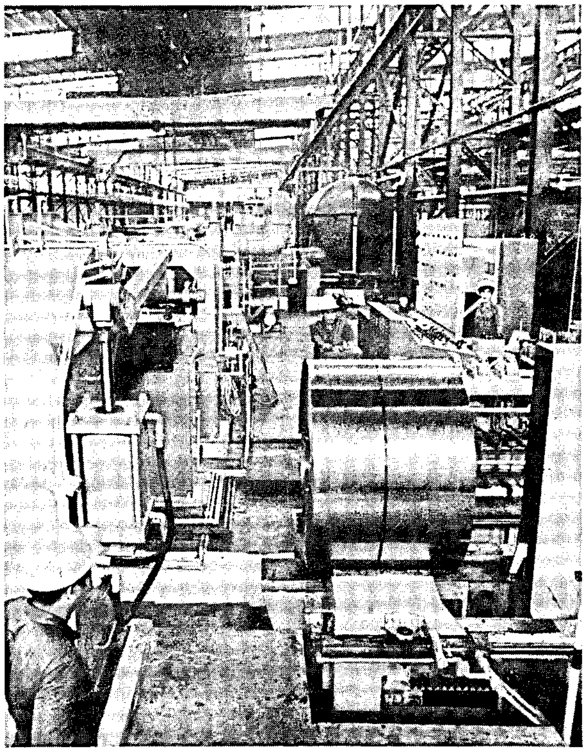
Following the pickling process is cold reduction. Nothwithstanding the x-ray thickness detectors being used, quality inspectors are present to check on the actual thickness of the reduced strip. This inspection is complemented by the laboratory analysis of the



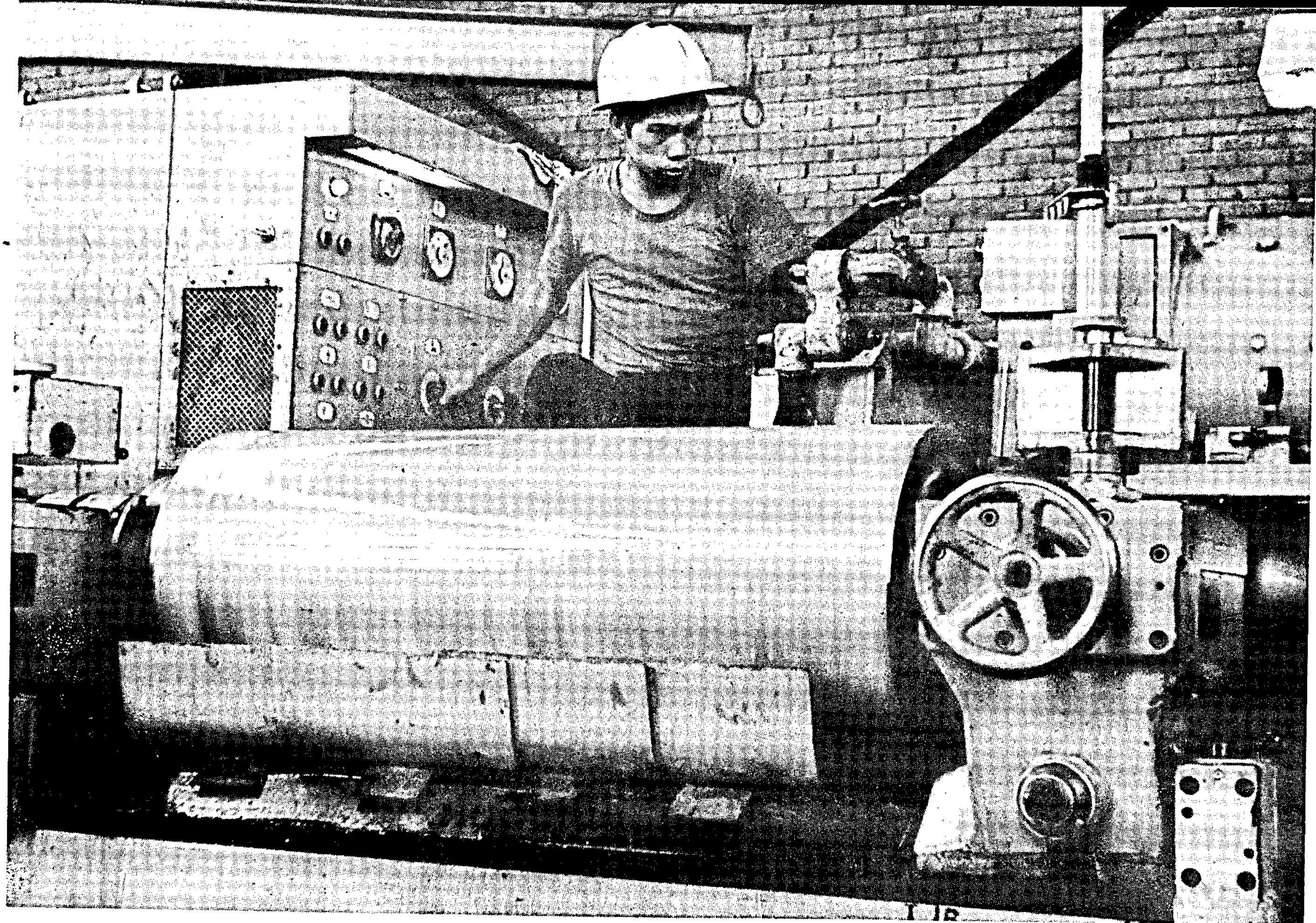
Steel strip from the reduction mill is shown being wound in the mandrel.



Steel coil from the electrolytic cleaning line is placed on the up-ender for stacking prior to annealing.



The four-inch combination mill used either for reduction rolling or temper rolling.



Shown in photo is the roll grinding machine used in the maintenance of work rolls, back-up rolls and bridles.

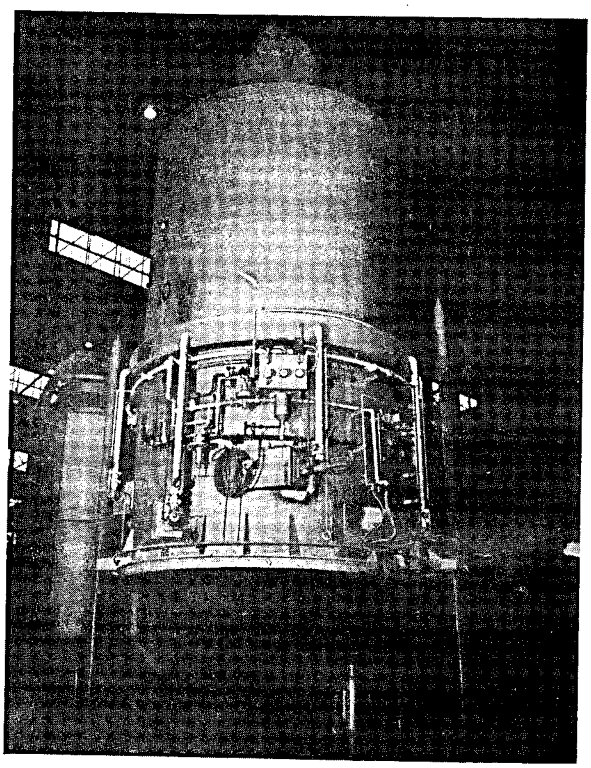
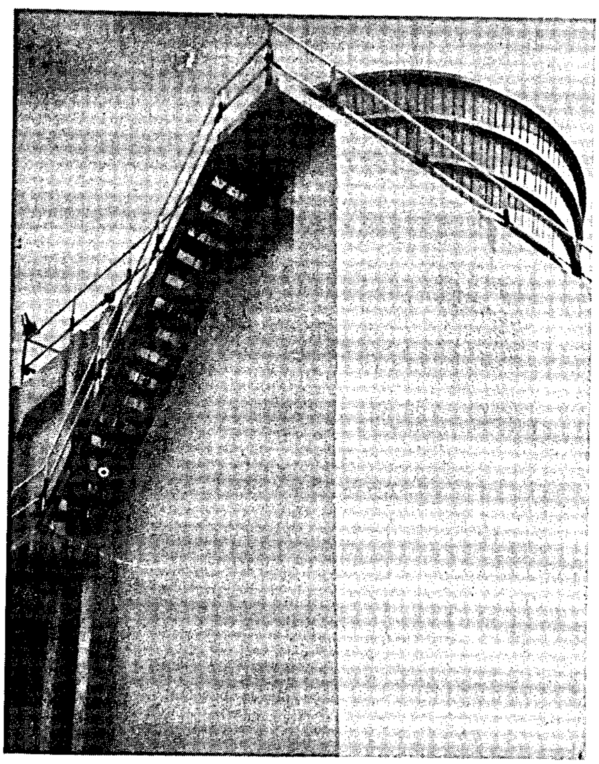


Photo shows one of ELIROL's annealing furnaces. Between the furnace and the coils is a protective inner cover.



This is the concrete housing of the cooling tower. Filtered water for cooling purposes is recirculated in this tower.

rolling oil or roll coolant of the reduction mills. The laboratory analysis of the oil serves to indicate when replenishment or fortification on the oil is in order. The oil is analyzed for viscosity, saponification and acidity using internationally accepted procedures.

As the strip emerges from the reduction mills, it is dirty with oil. It is therefore cleaned using alkaline detergents. The detergent is analyzed in the laboratory while the strip is inspected for defects by quality inspectors. After cleaning, the strip in coil form is annealed to relieve the stresses and strain imparted by the rolling operation to the steel. At this point, the quality control department analyzes and controls the annealing gases using the Shimadzu Gas Chromatograph GC-2C.

Quality control for Elirol does not stop at this junction, but continues as the coils are processed at the temper mill. Hardness is taken using Rockwell Superficial Hardness Testers or the Shimadzu Hardness Testers.

At the finishing lines (coil preparation line, sheet shearing line and slitting line) the coils are inspected and classified as to their final quality. A quality inspector is assigned to ensure that only coils of the required quality are passed and properly packed as finished products.

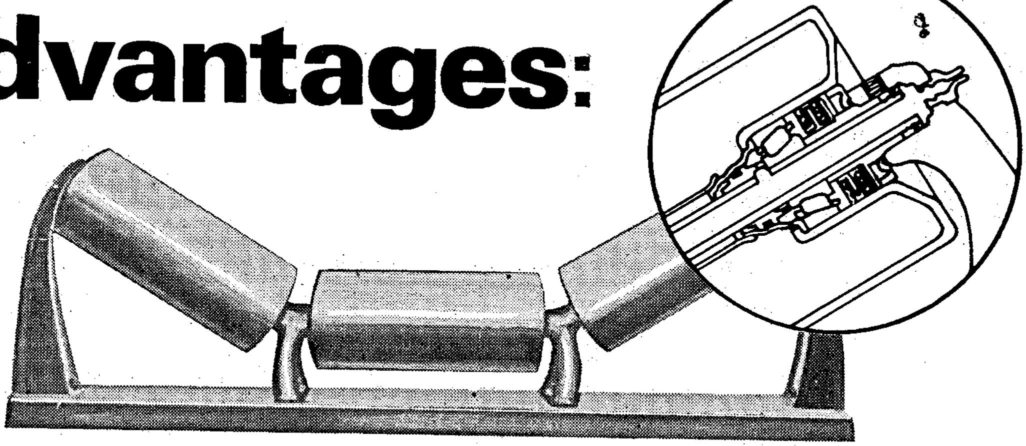
STATUS OF THE . . .

(Continued from page 19)

References

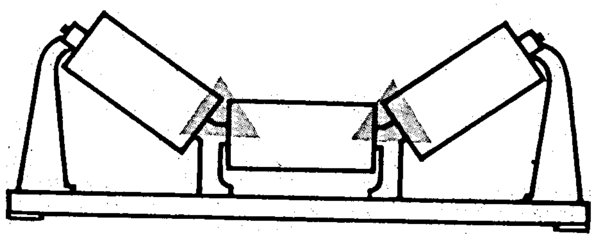
1. *Refractories Manual.* Illinois: The American Foundrymen's Society, Inc. 1963, 111 pp.
2. *Modern Refractory Practice.* Cleveland: Harbison-Walker Refractory Co. 1961, 107 pp.
3. Bureau of Mines. *Summary of Refractory Materials in the Philippines,* Geological Survey Division, Manila 1966.
4. Cotes, P.S. *Marketing Philippine Ores and Concentrates.* Philippine Bureau of Mines, Information Circular 13. September 13, 1952.
5. Santos, Luis, et al. *Geology Structure of Magnesite Deposits at Piso Point, Lupon, Davao.* The Philippine Geologist, Vol. 15, No. 3, Sept. 1961.

HEWITT ROBINS IDLERS
give you all these advantages:

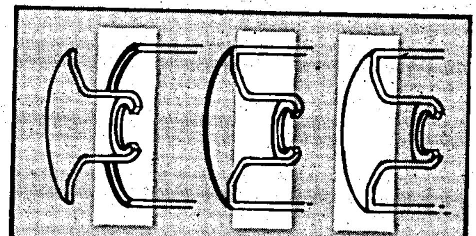


1 - POINT LUBRICATION FOR INCREASED PRODUCTION TIME
All bearings are lubricated through one fitting on one side of the conveyor. Lubrication time is substantially reduced due to longer intervals between lubrication periods. Every bearing is properly lubricated through grease fitting. No need to reach under belt or climb over belt to lubricate the other side.

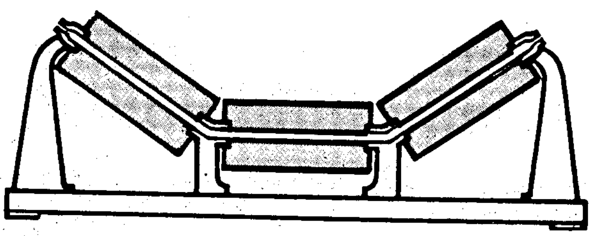
AVOID COSTLY BELT DAMAGE
Small separation between idler rolls prevents pinching of belt thereby assuring longer carcass life. Allows belt to properly bridge gap thus preserving the bottom cover of the belt.



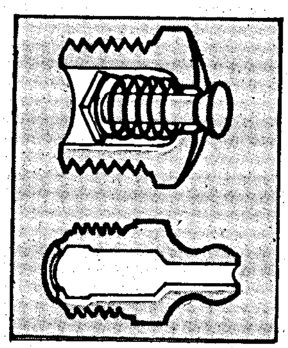
MAXIMUM ROLL WEAR
All rolls are engineered for maximum concentricity and positive bearing alignment. Full life roll wear achieved due to uniform wall thickness for entire length of roll. Rounded ends avoid pinching of belt between rolls



RESIST BOWING UNDER HEAVIEST LOADS
Rigid truss construction combined with high-strength base frame virtually eliminates idler bowing even when belts are overloaded. All bolted construction allows easy replacement of parts. No cotter pins, clips or rubber inserts to loosen or lose.



EQUALIZED INTERNAL PRESSURE
Special open grease fitting and pressure relief valve equalize internal grease pressure. Grease coming through pressure relief valve visually alerts maintainance men that lubrication is complete. Grease escapes at a point where it cannot come in contact with the belt.



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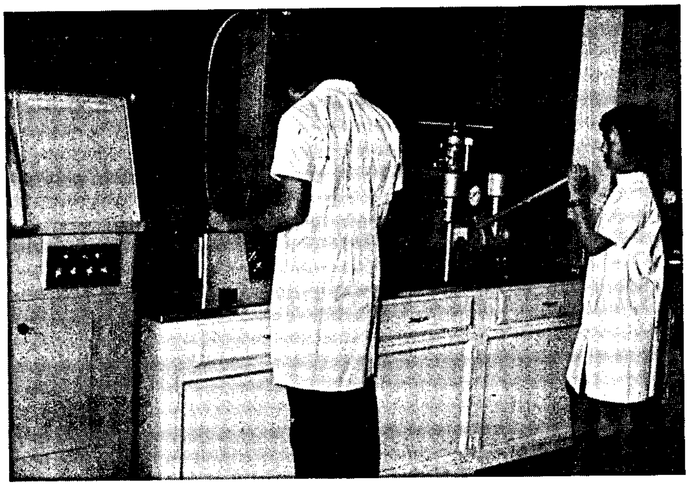
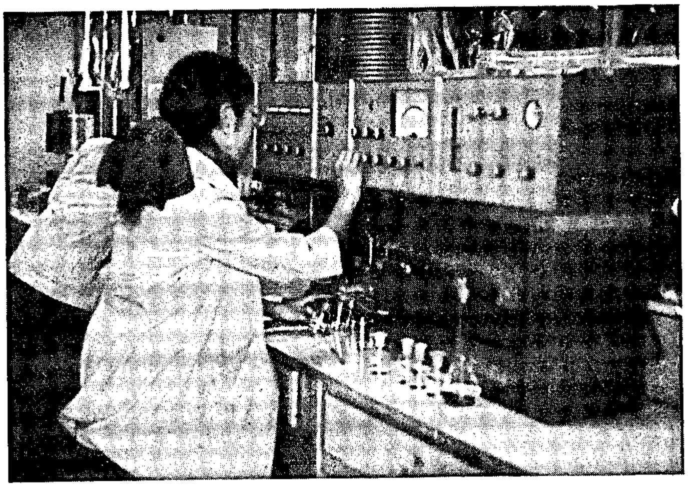
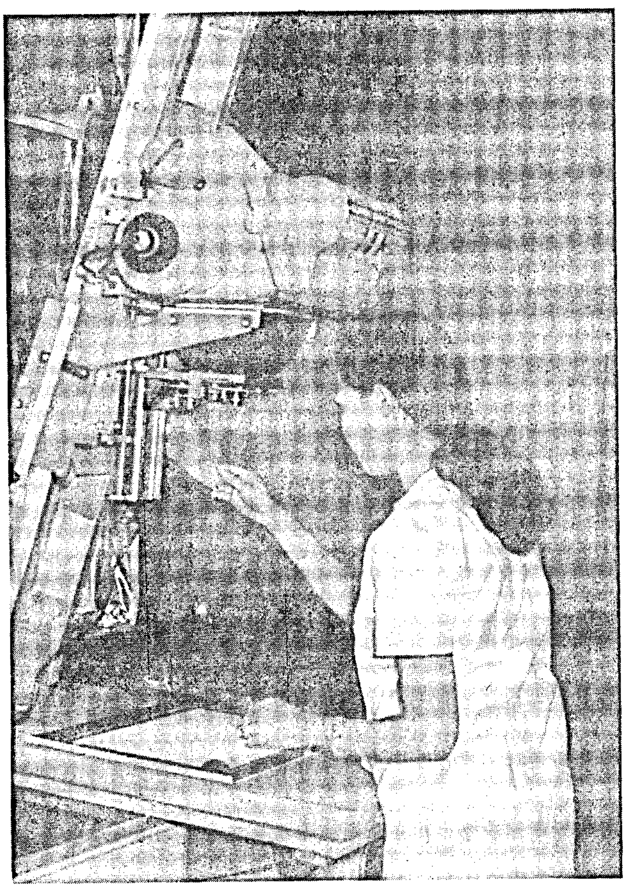
TECHNICAL SERVICES AVAILABLE AT MIDC







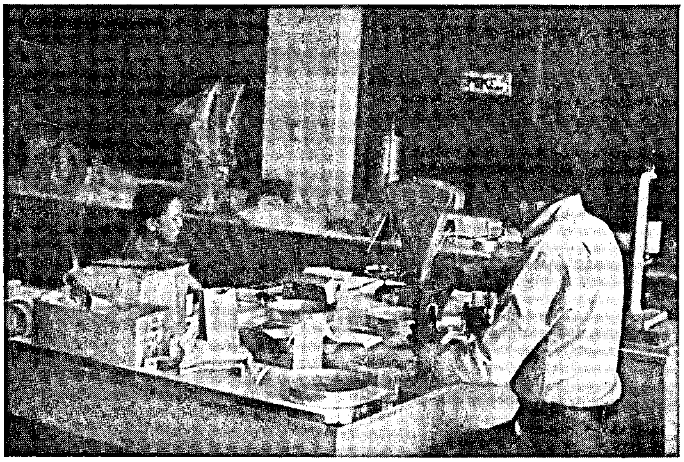
I. ENGINEERING SERVICES
   A. Feasibility Studies
   B. Design and Drafting
   C. Estimation
   D. Material Specifications
   E. Equipment Specifications
   F. Process Specifications

II. OPERATIONS CONTROL
   A. Planning and Scheduling
   B. Material Control
   C. Cost Control
   D. Material Handling

III. MATERIAL TECHNOLOGY
   A. Chemical Analysis of Products, Materials and Semi-finished Products for the following Elements:

1. Copper	11. Mercury
2. Gold	12. Aluminum
3. Silver	13. Nickel
4. Lead	14. Manganese
5. Zinc	15. Magnesium
6. Silicon	16. Bismuth
7. Arsenic	17. Molybdenum
8. Iron	18. Sodium
9. Chromium	19. Phosphorous
10. Tin	20. Sulfur

21. Carbon



B. Metallographic Analysis of the following Alloys:
   1. Plain Carbon Steel
   2. Medium Alloy Steel
   3. Special Steel
   4. Gray Iron
   5. White Iron
   6. Nodular Iron
   7. Malleable Iron
   8. Copper Base Alloy
   9. Aluminum Base Alloy
   10. Other Non-ferrous Alloy
C. Micro-photography
D. Destructive Testing of Products and Semi-finished Products for the following properties:
   1. Hardness (macro and micro)
   2. Tensile Strength
   3. Impact Strength
   4. Compressive Strength
   5. Elongation
E. Non-destructive Testing of Products and Semi-finished Products by the following methods:
   1. Magnetic Particle
   2. Dye Penetrant
   3. X-ray
   4. Sonic (available by January 1, 1972)
   5. Gamma-ray (available by January 1, 1972)
F. Calibration and Maintenance of Laboratory Equipment
G. Pattern Making
   1. Wood Pattern
   2. Metal Pattern
   3. Plastic Pattern
H. Sampling of Stocks

IV. SAND TESTING
   A. AFS Grain Fineness
   B. Standard Permeability
   C. Standard Hardness
   D. Standard Strength
   E. Clay Content
   F. Shape
   G. Composition
   H. Optimum Mixtures

V. HEAT TREATMENT
(available by September 1, 1971)
   A. Annealing
   B. Hardening (Quench)
   C. Cyaniding
   D. Nitriding
   E. Carburizing
   F. Malleabilizing
   G. Solution Hardening

Other services like Metal Casting, Metal Forming, and Metal Plating will be made available after the necessary equipment shall have been installed in the MIDC pilot plant.

METAL STATISTICS & ECONOMICS

DOMESTIC & FOREIGN EXPORT PRICES

Table 1
CONTINENTAL STEEL EXPORT
Monthly Price Averages Feb. 1971 to May 1971
(In US $ Per Metric Ton)

	February	March	April	May
Billets	86	86	85	—
Reinforcing rounds (a)	101+	100+	101+	101+
Merchant bars	108+	107+	108+	108+
Joists, channels (Brit)		—	—	—
Channels (US)	124+	124+	124+	124+
Joists, channels (Con't.)	—	—	—	
W.F. (Univ. beams)	132+	132+	132+	132+
Wire rods	119+	116.5	119+	119+
Hot rolled strip: 1 in.	115	114.5	114.5	114.5
Tube strip	112	112	112	112
Heavy plates (c)	132+	132+	132+	132+
Medium plates (d)	119+	119+	119+	119+
Universal Plates	132+	132+	132+	132+
Chequer Plates	121+	120+	119.5+	119+
HR sheets: 16 g. and up		—	—	130
HR coil (dry)	105	105	105	105
CR sheets: 17-20 g.	312+	132+	133+	132+
Galv. coils: 17-20 g. (b)	171* (e)	171* (e)	171* (e)	171* (e)
Bright wire	127	127	127	127
Black annealed wire	144	144	144	144
Galv. wire: 5-16-1/2 g.	139	138	138	138
Barbed wire		—	—	—
Wire nails		—	—	—

Source: Metal Bulletin

+ 2-1/2% exporter's commission incl. * less $5; corrugated extra $2; flat sheets $3.
(a) Usual deformed bar premiums; structural $2, intermediate $3
(b) 4-ton coil
(c) over 8 mm
(d) 3-8 mm
(e) $ 25/$30 special allowance, according to spec.

MB's appraisal Continental (ECSC) mill's basis (net unless stated)
FOB export prices, ordinary Thomas Commercial quality. Markets, sizes, quantities, delivery, etc. can affect prices shown.

Table 2
JAPAN MONTHLY AVERAGE DOMESTIC PRICE
(In US $ Per MT unless otherwise indicated)
(March – May 1971)

Iron & Steel Products	March Ave.	April Ave.	May Ave.
Round Bar 9 mm	99.44	92.77	92.94
16-25 mm	96.08	89.41	89.35
Flat Bar 6 x 50 mm	102.60	100.64	99.54
Equal Angle 6 x 50 mm	95.35	90.48	96.22
10 x 90 mm	96.35	89.87	97.18
Channel 6 x 65 x 125 mm	99.10	93.89	102.16
H – Shape 9/14 x 250 x 250 mm	122.74	119.97	129.63
Hot R. Sheet (3 x 6) 1.6 mm	102.22	95.95	96.18
Cold R. Sheet (3 x 6) 1.2 mm	117.22	114.24	114.24
Medium Plate 3.2 x 3 x 6	96.98	92.16	92.16
Plate 6 x 4 x 8	97.08	91.70	92.36
9 x 4 x 8	96.84	91.81	92.36
Gas Pipe (black) 15 A (1/2 inch) (per Kg)	0.13	0.13	0.13
Water Pipe (White) 15 A (1/2 inch) (per Kg)	0.21	0.21	0.21
Galv. Sheet (per sheet)			
(plain) 0.25 (No. 32)	0.60	0.59	0.59
(Corrugated) 0.25	0.56	0.55	0.55
Colored Sheet (per sheet)			
(both side, Plain) 0.27 (No. 31)	0.84	0.84	0.84
(one side, Corru) 0.25 (No. 32)	0.66	0.66	0.66
Wire Rod, 5.5 mm	125.00	125.00	125.00
Round Nail, 100 mm (4 inches)	157.29	152.63	149.34
Iron Wire, No. 8	140.45	133.45	129.82
Annealed Iron Wire, No. 8	141.74	131.86	127.28
Galv. Iron Wire No. 8	157.99	155.09	151.58
Barbed Wire No. 14	206.25	203.24	203.40
Tinplate, 90L (0.257 mm)	275.56	275.56	275.56
Wire Netting, (20 x 15 mm) one roll	5.32	5.32	5.32
Welded Steel Netting, (1 sq. meter)			
no. 4 (6 x 150 mm)	0.65	0.65	0.65
no. 8 (4 x 100 mm)	0. 53	0.53	0.53
Special Steel			
Constructional Carbon Steel (SC) per Kg	0.14	0.14	0.14
Stainless Steel			
SUS 24 (18 CR)			
Sheet (2-6 mm)	0.48	0.48	0.48
SUS 27 (18-8)			
Sheet 0.3 mm.	1.20	1.20	1.20

NonFerrous Metals	March Ave.	April Ave.	May Ave.
Electric Copper	1,082.43	1,235.82	1,203.01
Electric Zinc	329.16	328.47	328.01
Electric Lead	311.81	311.11	311.11
Tin	3,651.04	3,688.08	3,722.22
Antimony	1,843.06	1,828.70	1,736.11
Nickel	3,859.03	3,704.86	3,631.94
Selenium	24,479.17	24,340.28	24,340.28
Bismuth	14,375.00	14,375.00	14,375.00
Cadmium	5,347.22	5,312.50	5,312.50
Mercury	10,708.33	10,668.98	10,300.92
Aluminum	591.67	588.89	588.89
Rolled Copper & Brass			
Copper Sheet, 2.0 mm	1,329.44	1,496.91	1,5[illegible]1.67
Copper Tube, 50 x 5 mm	1,522.22	1,646.61	1,6[illegible]5.93
Copper Rod, 25 mm	1,412.04	1,568.29	1,598.77
Copper Wire, 0.9 mm	1,388.43	1,463.35	1,570.99
Brass Sheet, 20 mm	1,031.02	1,204.09	1,237.14
Brass Tube, 50 x 5 mm	1,244.91	1,370.75	1,398.00
Brass Rod, 25 mm	987.96	1,130.79	1,066.36
Brass Wire, 6 mm	1,083.61	1,195.22	1,233.02
Rolled Aluminum			
Sheet (99) 1.0 mm (400 x 1,200)	854.17	818.87	805.56
Circle, 1.0 mm	895.83	892.94	881.94
Steel Scraps			
Special For Electric Furnace	37.27	34.55	35.23
Pig Iron Scrap	62.64	61.60	61.46
Copper Scrap			
No. 1 Copper Wire (Berry)	1,075.00	1,187.44	1,096.68
No. 2 Copper Wire (Birch)	1,039.65	1,148.5[illegible]	1,048.84

Source: Japan Metal Bulletin

Table 3A
FOREIGN DOMESTIC PRICES
For the Month of January

Country	US	UK	Japan	Canada
NONFERROUS METALS: c/kg				
Copper, electrolytic	110.91	102.82	106.94	117.28
Lead, Common	29.73	26.42	31.79	30.53
Zinc, electrolytic	34.90	28.61	33.06	32.71
Tin, electrolytic	–	346.56	363.89	–
Mercury, $/flask	–	–	–	–
Aluminum, ingot	63.86	61.73	61.11	64.33
Nickel, refined	292.87	299.16	416.67	300.95
STEEL PRODUCTS: $/MT				
Billets, rerolling	116.60	114.63	–	131.96
Billets, forging	138.05	–	–	–
Wire rods	168.30	136.95	124.83	–
Skelps (Coils)	–	–	–	–
Shapes, standard	151.80	–	–	138.61
Shapes, wide flange	151.80	–	–	138.61
Plates	149.60	–	110.07	127.69
Black plate	–	24.99*	–	–
Bars	212.30	–	–	–
Reinforcing bars	129.80	–	117.58	123.33
Merchant bars	–	–	–	–
Sheet piling	–	142.31	–	–
Sheet, hot rolled	165.00	–	113.72	113.50
Sheet, cold rolled	196.90	–	123.87	153.89
Strips cold rolled	212.30	188.78	–	158.25
Strips, hot rolled	160.60	144.75	–	121.14
GI Sheets	205.70	205.17	–	–
Tinplate, electrolytic	9.65**	26.88*	275.56	–
Tinplate, hot dipped	–	32.71*	–	–
Pig Iron, basic	74.00	–	–	–
Pig Iron, foundry	74.50	–	–	–
Steel Scrap	–	–	–	–

SOURCES: American Metal Market
Metal Bulletin

* per S. A. T.
** per Base Box

Table 3B
FOREIGN DOMESTIC PRICES
For the Month of February

Country	US	UK	Japan	Canada
NONFERROUS METALS: c/kg				
Copper, electrolytic	110.91	101.73	102.78	112.22
Lead, Common	29.73	26.53	30.93	29.44
Zinc, electrolytic	34.90	27.20	33.06	32.71
Tin, electrolytic	360.03	346.15	361.11	–
Mercury $/flask	359.50	–	–	–
Aluminum, ingot	63.86	61.73	59.26	64.33
Nickel, refined	292.87	299.16	411.11	300.95
STEEL PRODUCTS: $/MT				
Billets, rerolling	116.60	114.63	–	–
Billets, forging	138.05	–	–	–
Wire rods	168.30	136.95	125.00	–
Skelps, (Coils)	–	–	–	–
Shapes, standard	151.80	–	–	138.61
Shapes, wide flange	151.80	–	–	138.61
Plates	149.60	–	104.86	127.69
Black Plate	–	25.39*	–	–
Bars	212.30	–	–	–
Reinforcing Bars	129.80	–	112.85	123.33
Merchant bars	–	–	–	–
Sheet piling	–	142.31	–	–
Sheet, hot rolled	165.00	–	111.81	113.50
Sheet, cold rolled	196.90	–	122.92	153.89
Strips, hot rolled	160.60	144.75	–	121.14
Strips, cold rolled	212.30	188.78	–	158.25
GI Sheets	205.70	205.17	–	–
Tinplate, electrolytic	9.65**	27.32*	275.56	–
Tinplate, hot dipped	–	33.24*	–	–
Pig Iron, basic	74.00	–	–	–
Pig Iron, foundry	74.50	–	–	–
Steel Scrap	40.75	–	–	–

SOURCES: American Metal Market
Metal Bulletin

* per S. A. T.
** per Base Box

Table 3C
FOREIGN DOMESTIC PRICES
For the Month of March

Country	US	UK	Japan	Canada
NONFERROUS METALS: c/kg				
Copper, electrolytic	110.91	112.36	105.00	111.19
Lead, Common	29.73	26.70	30.56	29.43
Zinc, electrolytic	34.90	28.18	33.06	33.70
Tin, electrolytic	368.63	351.79	361.67	–
Mercury $/flask	348.69	–	–	–
Aluminum, ingot	63.86	61.73	58.33	64.32
Nickel, refined	292.87	299.16	376.67	300.88
STEEL PRODUCTS: $/MT				
Billets, rerolling	116.60	114.63	–	–
Billets, forging	138.05	–	–	–
Wire rods	168.30	136.95	125.00	–
Skelps (Coils)	–	–	–	–
Shapes, standard	162.80	–	–	138.61
Shapes, wide flange	163.90	–	–	138.61
Plates	162.80	–	97.08	127.69
Black plate	–	25.39*	–	–
Bars	212.30	–	–	–
Reinforcing Bars	129.80	–	99.44	123.33
Merchant Bars	–	–	–	–
Sheet piling	–	142.31	–	–
Sheet, hot rolled	165.00	–	102.22	113.50
Sheet, cold rolled	196.90	–	117.22	153.89
Strips, hot rolled	160.60	144.75	–	121.14
Strips, cold rolled	212.30	188.78	–	158.25
GI Sheets	205.70	205.17	–	–
Tinplate, electrolytic	9.65**	27.32*	275.56	–
Tinplate, hot-dipped	–	33.24*	–	–
Pig Iron, basic	74.00	–	–	–
Pig Iron, foundry	74.50	–	–	–
Steel Scrap	37.82	–	–	–

SOURCES: American Metal Market
Metal Bulletin

* per S. A. T.
** per Base Box

Table 3D
FOREIGN DOMESTIC PRICES
For the Month of April

Country	US	UK	Japan	Canada
NONFERROUS METALS: c/kg				
Copper, electrolytic	116.43	125.66	125.00	115.17
Lead, Common	29.73	26.81	30.55	29.44
Zinc, electrolytic	34.90	28.42	33.05	33.80
Tin, electrolytic	372.20	356.27	367.36	–
Mercury $/flask	336.39	–	–	–
Aluminum, ingot	63.86	61.73	58.33	64.33
Nickel, refined	292.87	299.16	361.11	300.95
STEEL PRODUCTS: $/MT				
Billets, rerolling	116.60	121.95	–	–
Billets, forging	138.05	–	–	–
Wire rods	168.30	147.92	125.00	–
Skelps (Coils)	–	–	–	–
Shapes, standard	162.80	–	–	146.25
Shapes, wide flange	163.90	–	–	146.25
Plates,	162.80	–	91.70	135.33
Black plate	–	27.53*	–	–
Bars	212.30	–	–	–
Reinforcing bars	129.80	–	92.77	123.33
Merchant bars	–	–	–	–
Sheet piling	–	154.51	–	–
Sheet, hot rolled	165.00	–	95.95	127.69
Sheet, cold rolled	196.90	–	114.24	161.53
Strips, hot rolled	160.60	158.17	–	127.69
Strips, cold rolled	212.30	198.53	–	168.07
GI Sheets	205.70	219.99	–	–
Tinplate, electrolytic	9.65**	29.46*	275.56	–
Tinplate, hot-dipped	–	34.15*	–	–
Pig Iron, basic	74.00	–	–	–
Pig Iron, foundry	74.50	–	–	–
Steel Scrap	34.90	–	–	–

SOURCES: American Metal Market
Metal Bulletin

* per S. A. T.
** per Base Box

Table 3E
FOREIGN DOMESTIC PRICES
For the Month of May

NONFERROUS METALS c/kg				
Copper, electrolytic	—	113.66	122.22	115.71
Lead, Common	29.73	26.51	30.55	29.44
Zinc, electrolytic	34.90	28.39	33.05	33.80
Tin, electrolytic	—	353.88	371.29	—
Mercury, $/flask	—	—	—	—
Aluminum, ingot	63.86	61.73	50.33	64.33
Nickel, refined	292.87	299.16	—	300.95
STEEL PRODUCTS: $/MT				
Billets, rerolling	116.60	121.95	—	—
Billets, forging	138.05	—	—	—
Wire rods	168.30	147.92	125.00	—
Skelps (Coils)	—	—	—	—
Shapes, standard	162.80	—	—	146.25
Shapes, wide flange	163.90	—	—	146.25
Plates	162.80	—	92.36	135.33
Black plate	—	27.53*	—	—
Bars	212.30	—	—	—
Reinforcing Bars	129.80	—	92.94	123.33
Merchant bars	—	—	—	—
Sheet piling	—	154.51	—	—
Sheet, hot rolled	165.00	—	96.18	127.69
Sheet, cold rolled	196.90	—	114.24	161.53
Strips, hot rolled	160.60	158.17	—	127.69
Strips, cold rolled	212.30	198.53	—	168.07
GI Sheets	205.70	219.99	—	—
Tinplate, electrolytic	9.65**	29.46*	275.56	—
Tinplate, hot-dipped	—	34.15*	—	—
Pig Iron, basic	74.00	—	—	—
Pig Iron, foundry	74.50	—	—	—
Steel Scrap	—	—	—	—

SOURCES: American Metal Market
Metal Bulletin

* per S. A. T.
** per Base Box

Table 4
DOMESTIC RETAIL PRICES OF SELECTED STEEL PRODUCTS
Source: Bureau of Commerce
February to May 1971

	February	March	April	May
Galvanized Iron Roofing Sheet, per Sheet				
Local Gauge No. 26 – Apo & River Brand				
32" x 6' Corrugated	10.73	10.80	10.80	10.50
7' Corrugated	12.51	12.60	12.60	12.25
8' Corrugated	14.30	14.40	14.40	14.00
9' Corrugated	16.09	16.20	16.20	15.75
10' Corrugated	17.88	18.00	18.00	17.50
36" x 8' Plain	14.30	14.40	14.40	14.00
Gauge No. 31 – Apo & River Brand				
32" x 6' Corrugated	7.50	7.50	7.50	7.50
7' Corrugated	8.75	8.75	8.75	8.75

	February	March	April	May
8′ Corrugated	10.00	10.00	10.00	10.00
9′ Corrugated	11.25	11.25	11.25	11.25
10′ Corrugated	12.50	12.50	12.50	12.50
36″ x 8′ Plain	10.00	10.00	10.00	10.00
Gauge No. 26 – Union Brand				
6′ Corrugated	–	–	–	–
7′ Corrugated	–	–	–	–
8′ Corrugated	–	–	–	–
9′ Corrugated	–	–	–	–
10′ Corrugated	–	–	–	–
Aluminum Sheet, per Sheet				
Gauge No.				
.016 x 33″ x 8′	16.50	16.50	16.50	16.50
.019 x 36″ x 8′	22.00	22.00	22.00	22.00
.024 x 36″ x 8′	27.00	27.00	27.00	27.00
.027 x 36″ x 8′	30.50	30.50	30.50	30.50
.032 x 36″ x 8′	38.50	38.50	38.50	38.50
Square Bars				
3/8″ x 3/8″ x 20′	4.50	4.50	4.50	4.50
1/2″ x 1/2″ x 20′	8.40	8.40	8.40	8.40
5/8″ x 5/8″ x 20′	13.70	13.70	13.70	13.70
1″ x 1″ x 20′	40.00	40.00	40.00	40.00
Round Bars				
1/4″ x 20′ (5 mm)	2.00	2.00	2.00	2.00
3/8″ x 20′ (9 mm)	2.50	2.50	2.50	2.50
1/2″ x 20′ (11 mm)	4.50	4.50	4.50	4.50
5/8″ x 20′ (14 mm)	9.00	9,00	9.00	9.00
Flat Bars				
1/8″ x 3/8″ x 20′	2.60	2.60	2.60	2.60
1/8″ x 1/2″ x 20′	3.00	3.00	3.00	3.00
3/16″ x 1/2″ x 20′	4.00	4.00	4.00	4.00
1/4″ x 1/2″ x 20′	6.00	6.00	6.00	6.00
1/2″ x 1″ x 20′	18.50	18.50	18.50	18.50
1/2″ x 1 1/2″ x 20′	26.40	26.40	26.40	26.40
Angle Bars				
1/8″ x 3/4″ x 20′	6.00	6.00	6.00	6.00
1/8″ x 1″ x 20′	9.00	9.00	9.00	9.00
3/16″ x 1″ x 20′	13.50	13.50	13.50	13.50
1/4″ x 1″ x 20′	18.00	18.00	18.00	18.00
3/8″ x 3″ x 20′	80.00	80.00	80.00	80.00
Galvanized Iron Pipe				
1/2″ x 20′	12.00	12.00	12.00	12.00
3/4″ x 20′	17.00	17.00	17.00	17.00
1″ x 20′	23.00	23.00	23.00	23.00
1 1/2″ x 20′	38.00	38.00	38.00	38.00
2″ x 20′	48.00	48.00	48.00	48.00
Black Iron Pipe, a piece				
1/4″ x 20′	–	–	–	–
1/2″ x 20′	10.00	10.00	10.00	10.00
1″ x 20′	19.00	19.00	19.00	19.00
1 1/2″ x 20′	32.00	32.00	32.00	32.00
2″ x 20′	41.00	41.00	41.00	41.00
Barbed Wire, per roll, local				
70 lbs.	65.00	65.00	65.00	65.00
60 lbs.	60.00	60.00	60.00	60.00
35 lbs.	33.00	33.00	33.00	33.00
Machine bolts, with nuts, per kilo				
All sizes	2.50	2.50	2.50	2.50
Common Wire Nails, per kilo				
1″ – 1 1/2″	1.80	1.80	1.80	1.80
2″ – 2 1/2″	1.70	1.70	1.70	1.70
3″ – up	1.60	1.60	1.60	1.60

THE PRICE TREND OF STEEL CONSTRUCTION MATERIALS

The rapid industrial advancement of the Philippines following the last World War continues today as more construction projects are being negotiated. However, the economic difficulties prevailing in the country has hampered the growth of the construction industry. The devaluation of the peso resulted in an increase in price of major construction materials which in turn led to a decrease in the number of projects being undertaken. In this connection the MIDC conducted a survey of seven biggest contractors in the country to analyze the price trends of construction materials and its effects on the construction industry.

The survey was mainly concentrated on the following iron and steel products: reinforcing steel bars, GI sheets, and structural shapes and sections. The sizes of steel bars widely used for buildings are 3/8" and 5/8", while 7/8" and 1" are used for bridges. The standard size for GI sheets is Gauge 26, eight feet long. Structural shapes include wide flanges, beams, angles and channels.

The uses of steel by project classification are as follows: buildings, roads and bridges, piers, and metal fabrication.

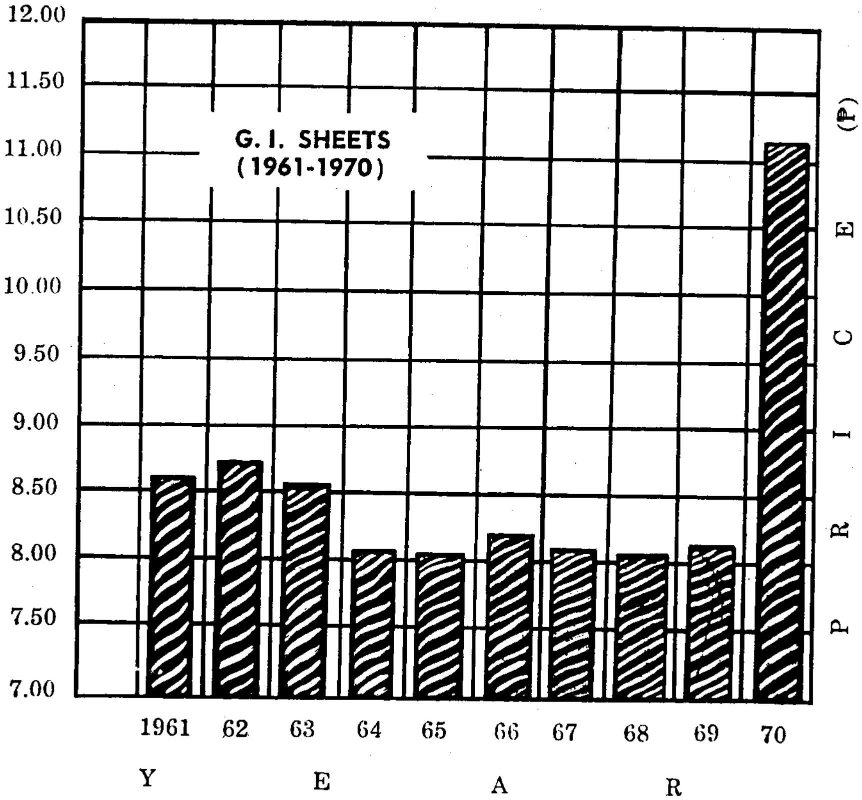
Prices of most steel construction items have remained stable from 1961 through 1967 with slight changes in some cases. A gradual upward trend, however, was exhibited from 1968 to 1970 due to the increase in the standard of living and the devaluation of Philippine currency in 1970.

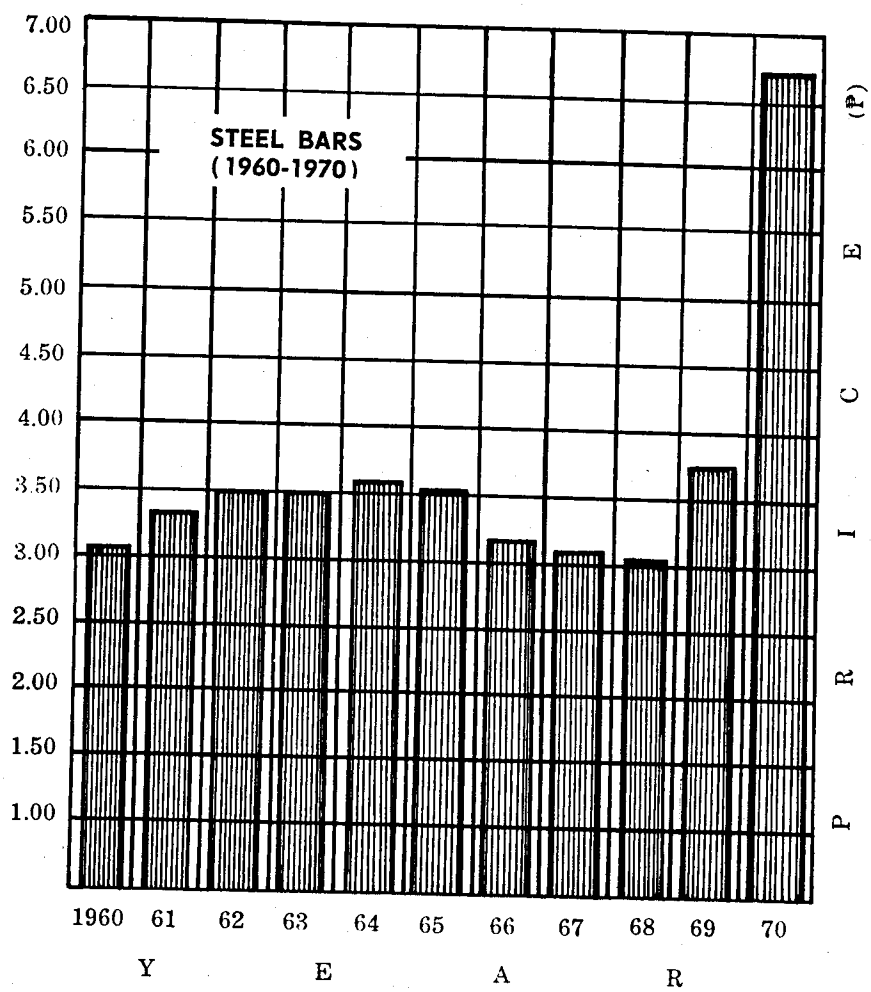
The boom in the industry came about in 1967 with the establishment of commercial and industrial buildings in the Greater Manila Area particularly in Makati as well as with the road-building program undertaken by the present administration. Added to these are the construction of a number of hotels as a step to promote tourism, the establishment of more warehouses to store agricultural products, and the building of factories in the suburban areas. No significant increase in price was noted during this period. This may be attributed to the adoption of a relaxed monetary policy and the incentives offered by the Government to the industry.

A gloomy picture of the industry was presented in the year 1970. During this period, contractors generally experienced an increase in price of materials from 50 per cent to as much as 85 per cent. This abnormal situation was attributed to the following: "floating rate of the peso", the increase in the minimum wage law which resulted in a 35 per cent increase in total cost, the increase in freight costs and the difficulty in opening letters of credit.

The increasing price trends discouraged many industrial users. Contractors were hesitant to sign contracts for long periods because of the unstable price situation. Any sudden increase in price in the middle of a project would force them to alter previous agreements or suffer losses. Steel manufacturers, on the other hand, refused to quote prices good for 30 days. A cash basis policy was adopted to minimize bad debts caused by the contractor's inability to pay. Owners of buildings were also beset by serious problems due in part, to the tight credit situation. The limit or ceiling imposed by loan associations like the SSS, GSIS, DBP and PNB hampered their borrowings. In addition, any building owner would be reluctant to enter into a contract without knowing the exact amount of the cost of materials.

These problems besetting the different sectors of the industry resulted in unnecessary delays in construction as well as a decrease in the number of projects. Construction registered a marked decrease of 3.5 per cent. Construction of factories and commercial buildings suffered a decline of 14.2 per cent. A drop was also experienced in construction of residential houses because of the in-





crease in the cost of real estate.

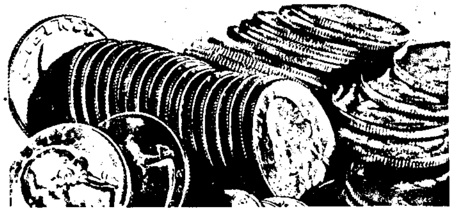
The demand for construction materials is there but the purchasing power of owners could not meet the high prices. On the other hand, ending inventories of the products were piling up and the problem of disposing them became a burden to manufacturers. In order to solve the situation, which would remedy not only their internal problem but that of the industry as well, manufacturers were forced to reduce prices despite the decline in profits in order to increase purchases and in turn eliminate storage costs and reduce overhead expenses.

The decline in price to as much as 10-15 per cent was a relief to owners and contractors. A brighter prospect was pictured in the succeeding years. However, such decrease is not enough to alleviate the plight of the industry. The close cooperation between the Government and the private sector to help carry on more construction projects is needed to boost the weakening industry.

The establishment of an integrated primary steel plant will make the country a manufacturer of primary steel products such as steel bars, shapes, sheets and plates, tubes, etc. It is also hoped that the current difficulties of obtaining imported semi-finished products be minimized if not totally eliminated by the operation of the plant. This in effect would encourage expansion of local manufacturing in view of the increasing cost of imported finished steel products.

ENGINEERING & TECHNOLOGICAL DEVELOPMENTS

technical abstracts



U.S. coinage is probably the best known examples of an everyday use of a clad metal.

Clad Metals to Adapt New Uses

Clad metals, two or more metals or alloys metallurgically bonded into composite form, are being selected for a number of new applications. Key to their growing recognition as useful engineering materials is their capability to provide combinations of properties and characteristics not available in one metal alone.

Clad metals are now available in tube, wire, strip and plate. They are widely used in automobile trims and in electrical and electronic products such as conductors and wires. They find wide applications in small appliances, coins, architectural trim and hardware. *Materials Engineering, March 1971*

Making Production More Efficient in Ferrous Metallurgy

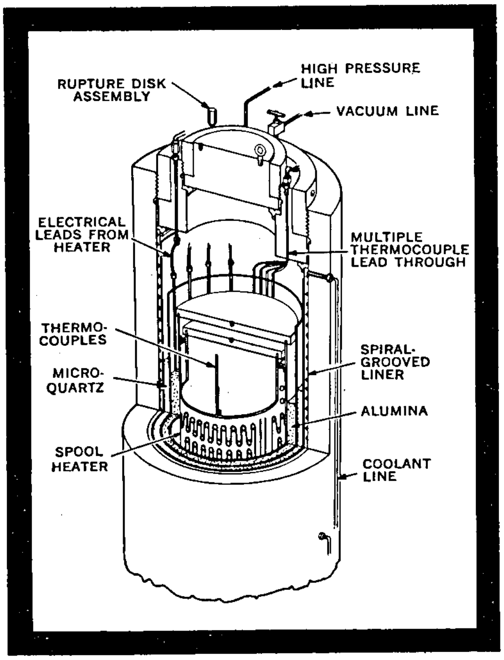
Production is constantly becoming more efficient in ferrous metallurgy. However, the rate of increase in efficiency is falling. The principal means of making production more efficient is to accelerate the tempo of technical progress by improving the quality of products, integrating plants, improving and introducing new technological processes, and mechanizing production and bringing in automation. The reasons for the drop in the rate at which labor productivity is increasing are analyzed. Recommendations are made for increasing the tempo. The effectiveness of certain new technological processes is considered. *Stal in English, September 1970*

Increasing the Scaling Resistance of Steel Ingots by Coating With Aluminium

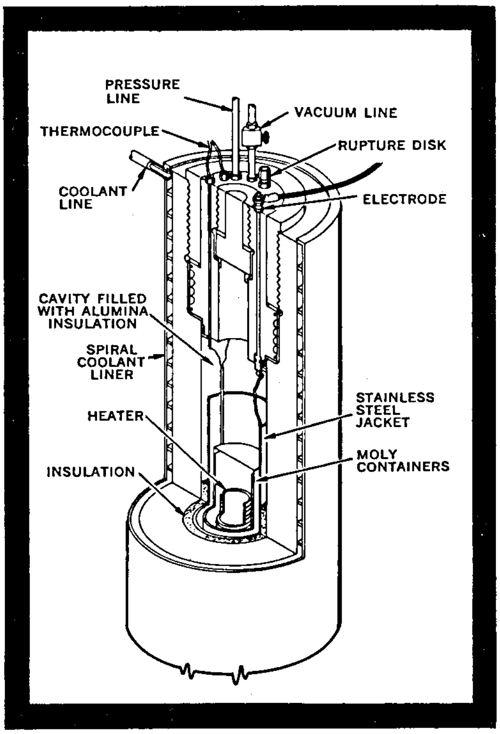
An aluminium coating composition and a method of applying it has been developed. This improves the scaling resistance of ingots of grades 10 and 40 steels. The coating consists of the alloying element, powdered aluminium, (40-50%), a catalyst for the diffusion of aluminium into the the steel, this being ammonium chloride (1-3%), and the KVS-2 film-forming product, a mixture of the carbohydrate part of soluble dry-distilled resin with fillers and binders (40-50%). When ingots to which the coating has been applied are heated to 1,000°C or over, aluminium diffuses to a small depth in the steel to form a heat-resistant layer of intermetallic substances and a strong film. Tests were made in which 850 kg. ingots with the coating (brushed on) were heated in continuous furnaces under semi-industrial conditions. The melting losses were reduced by 67% (from 20 to 0.6%). *Stal in English, September 1970*

Hot Aluminum-Coating of Plate Steel

A better coating of aluminum, with a thin layer of brittle intermetallic substance (Fe_2Al_5) can



High-temperature cold wall autoclave.



High-pressure high-temperature gas autoclave.

be provided if mild steel plate is immersed for a short time in molten aluminum, at 700-710°C, containing 6-8% Si. Several variations of preparation of the steel surface for aluminum coating have been considered. High-quality coatings are applied if the steel is first treated in a reducing atmosphere (removal of the oxides during annealing in an atmosphere of nitrogen and hydrogen). Aluminum coating greatly improves the corrosion resistance of steel (figures are given for its corrosion resistance in different media by comparison with that of zinc-plated steel): heat resistance is also improved. The coating retains its outward appearance unchanged when heated to 500°C. *Stal in English, September, 1970*

Hot Isostatic Processing

The hot-isostatic-compaction or bonding process has been developed for the fabrication of ceramic, cermet, and metal components. The process has been applied to the powder compaction and consolidation of materials and to the solid-state joining or bonding of ceramic and metal components. The unique application of large cold-wall pressure vessels for achieving isostatic gas pressures to 150,000 psi and elevated processing temperatures to 5000° Faranhiet has created an entirely new materials-processing technology. *Mechanical Engineering, February 1971*

Analysis of the Life of Rolling Mill Rolls

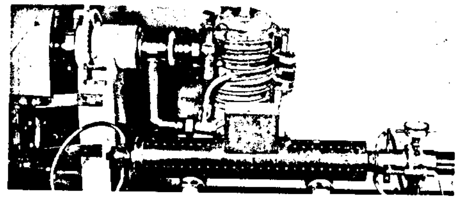
The analysis of roll life at the Magnitogorsk metallurgical combine, using a computer, enabled the work expended on gathering information on the operation of the rolls to be reduced, a sufficiently complete analysis of roll operation to be made, and the conditions of rational service and differentiated utilization of cold-rolling rolls with different hardnesses to be determined. *Stal in English, October 1970*

Experience in the Start Up and Mastering of An Installation for Making Sponge Iron

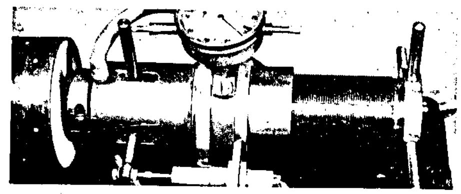
A shaft furnace, designed by the All-Union Research Institute of Metallurgical Heat Technology (VMIIMI), for making sponge iron with almost 100% reduction from raw Tukansk ore and Sokolavka-Sarbai mining beneficiation combine (SSGOK) pellets has been put into operation at the Beloretsk combine. Reduction is carried out with hot reformed natural gas fed in through a diameter manifold in the lower base of the furnace. The design provides for carbon dioxide reforming in the recirculation cycle. The finished product is continuously discharged by a rotating table. Three periods of experimental operation in 1967-68 confirmed that correct design decisions had been taken and showed that the main equipment was reliable in service. The productivity of the furnace, 16.1 m³ in useful volume, was raised to 60t/d. The improvements planned are considered. *Stal in English, October 1970*

Breakdown of Pellets During Reduction

Experiments were carried out at Uralmekhanobr to study the reasons for the breakdown of Sokolovka-Sarbai mining-beneficiation (SSGOK) and laboratory pellets during their reduction by the Linder method, their tendency to breakdown being assessed from the yield of 30-0 and 1-0 mm fraction and the reducibility. On the basis of data obtained a change in the pellet-firing schedule at the SSGOK was recommended towards a higher temperature of the heat-carrier gas and a longer retention time in the high-temperature zone (1275-1375°C, together with a lower heating rate in the 800-1000°C range (in which there is most gas evolution). The Linder method was also used to investigate SSGOK pellets from different periods of operation of the combine. The pellet was found to be considerably improved when a more suitable firing schedule was adopted, and this is also confirmed by results of blast-furnace trials at the Magnitogorsk Combine (MMK). *Stal in English, October 1970*



Medium-frequency induction furnace and complete test apparatus.



Compression cylinder, dial gage and inductive transducer.

Expansion Pressure of Gray Iron Castings

Gray iron undergoes expansion during its eutectic solidification. The expanding iron exerts pressure on the surrounding mold. On the other hand, reaction forces from the mold material determine how much the casting can expand.

The maximum pressure which solidifying iron exerts on an obstacle is equal to a counter pressure which is just sufficient to halt its growth. This pressure showing the relation between iron expansion and external restraining forces was determined for irons of different chemical compositions. Maximum expansion pressure depend strongly on iron composition. *American Foundrymen's Society Cast Metals Research Journal, March 1971*

Copper-Nickel Alloy With Better Solderability

A new copper alloy called 725 the 89 Cu-9 Ni-2Sn alloy that can resist oxidation which interferes with solderability was developed by Bell Telephone Labs in connection with Anaconda and H.K. Porter Mfg. Co. Available in sheet, strip, tube, small rod and wire, the alloy was developed to improve the reliability of springs and connectors used in telephone systems.

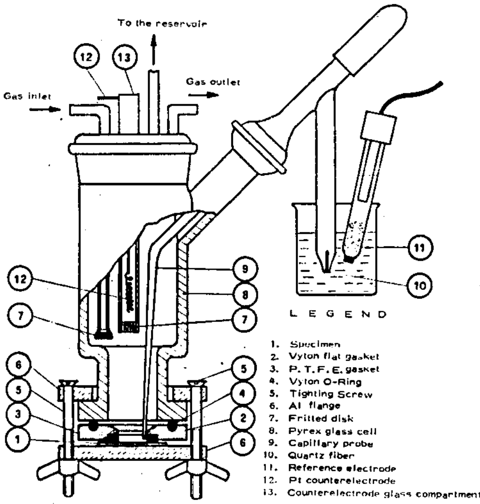
Alloy 725 builds up a natural surface film which imparts superior corrosion resistance, making possible soldering without tin, gold or silver plating, thereby reducing losses. *Materials Engineering, January 1971*

The Evolution of Process Control in the Mining Industry

The mining and processing mineral ores is a very old industry, steeped in tradition. Rising demand for metals has recently forced the exploration of lower-grade ore bodies which requires extensive beneficiation. The high capital expenditures involved, together with market pressures for high-quality concentrates and pellets have forced the development of new process technologies which are heavily dependent on automatic process control. Development of suitable instrumentation has been rapid and it is being applied to mining processes today with a high degree of sophistication. The drive for higher efficiency and profitability goes on and has reached a level at which modern digital computers appear to be the only answer. However, the efficient application of a digital process computer is extremely complicated and is therefore approached by the mining industry with considerable hesitation. Some of the benefits promised by the digital computer can be obtained today by other means, which are more manageable and can provide immediate pay-off. The result would be a building-block system which would use the digital process computer as its final component, to perform true plant optimization free from routine chores. *Canadian Institute of Mining & Metallurgy Bulletin, January 1971*

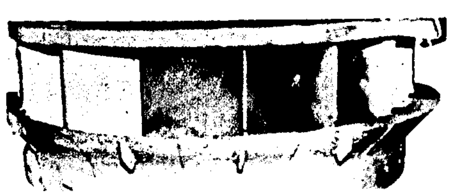
The Mechanism of Atmospheric Rusting and the Effect of Cu and P on the Rust Formation of Low Alloy Steels

The oxidation process of Fe (II) hydroxo-complexes to A, B and C FeOOH and Fe_3O_4, which are important atmospheric products of steel, and the effect of Cu^{+2}, PO_4^{-3} ion on the oxidation of the Fe (II) hydroxo-complexes in aqeous solutions have been investigated. The mechanism of atmospheric rusting deduced from the results obtained in the present investigation has been used to explain the difference in behavior between ordinary mild steels and low alloy steels during atmospheric exposure. It is concluded that Fe (II) complexes are transformed to amorphous C-FeOOH by the catalytic effect of Cu and P present in steel. The amorphous C-FeOOH forms a compact rust layer that enhances corrosion resistance of the steel. *Corrosion Science, January 1971*



Schematic diagram of the polarization cell.

Bottom of test casting for comparing three grades of chromite sand and one zircon sand.



Chromite sand used as facing in no-bake cores for this casting provided chilling effect and eliminated the use of chills.

Electrochemical Evaluation of the Corrosion Behavior of Tinplate

The corrosion kinetics of tinplate in a number of inorganic and organic solutions having different pH and in some typical acidic food products were evaluated electrochemically through potentiodynamic polarization measurements. Some general features in corrosion behavior of tinplate have been pointed out that show the effect of the nature and pH of the medium. On the basis of the anodic branches of the experimental polarization curves, a a dynamic picture was drawn of the electrochemical stability of tinplate, outlining for the various environmental conditions the potential ranges of practical immunity, resistance, slow corrodability and definite attack. *Corrosion Science, December 1970*

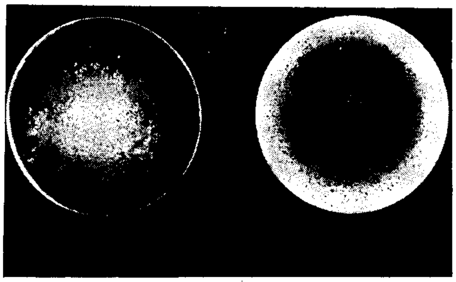
How to Use Chromite Sand

The use of this specialty sand for molding and coremaking in production of ferrous castings is growing each year. Chromite provides a chill effect, does not react with metallic oxides, has low linear expansion, and eliminates penetration. Best results are achieved with chromite sand that has been washed and graded with all serpentines removed. Sand mixes for various applications are suggested. *Foundry, March 1971*

Circle of Light Used for Stress Relieving Pipe Welds

When pipes are welded together, an internal stress is built up in the metal and it is necessary to apply a uniform heat around the weld to relieve these stresses.

Thermostatics of Orangevale, California utilizes tungsten-halogen lamps to relieve pipe weld stresses in the $2.8 billion California State Water Project. *Industrial Heating, January 1971*

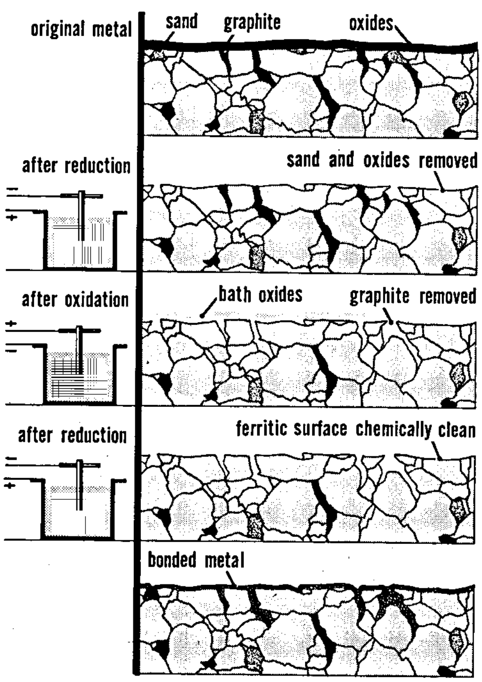


In photo showing greater depth of hardening of new powder is clearly apparent.

New Low-Carbon Sheet Steel Easily Formed

New-carbon superforming sheet steels that can withstand more streching and bending during forming than previously available steels are now offered by Jones and Laughlin Steel Corporation, Pittsburgh.

J & L announced that the steels, which have yield strengths of 30,000 to 40,000 psi, can give manufacturers significant cost savings. By controlling the cooling rate during hot rolling, J & L has obtained a grain structure that, it says, is balanced for strength and stretch forming. Superform 30, for instance, is recommended by J & L for uses where good stretch formability is a primary requirement. Another steel, Superform 40, with a carbon content of 0.15% is recommended where improved formability is needed for parts cold-formed to a tight-bend radius. In some applications, the sheet can be bent double without cracking. *Product Engineering, January 4, 1971*



Subsequent cycle of free and burned-in sand oxides removal

Rotovert Nears Perfection

At IRI's Metallurgical Research Centre at Castel Romano, Italy, the finishing touches are being put to the Rotovert Steelmaking process.

The Rotovert process uses a vertically rotating converter charged with a combination of hot metal and scrap. When the converter speed reaches about 80 rpm, pure oxygen is injected through a special nozzle. The carbon in the pig iron combines with the oxygen and a flame burns in the center of the vessel where a hollow space is formed by centrifugal force. This flame acts mainly on the slag and molten metal, affecting the refractory lining only slightly.

Promising results have been obtained in trials using a 6-ton converter. Among the chief advantages of the process are a greater flexibility as to the charge. A greater range of steels can be made and a considerable reduction in production costs can be obtained. *Metal Buletin, January 5, 1971*

Pre-Alloyed Steel Powder Improves Hardenability

A.O. Smith-Inland recently produced a new low alloy steel powder, developed specifically for larger and thicker powder metal (PIM) parts, to provide greater hardenability, good compresibility and dimensional stability.

Given the name EMP46F2, the new powder is pre-alloyed with manganese, nickel and molybdenum by atomizing process.

Aside from improved hardenability, the new powder was developed to provide high tensile strength by standard sintering and heat treating practices. *Materials Engineering, January 1971*

Chemical Cleaning of Ferrous Castings

Applied originally to hydraulic casing, salt bath cleaning can be advantageous in other casting cleaning operations as well.

A chemically reducing cycle removes free and burned-in sand and oxides from ferrous castings. Subsequent processing can prepare the surface for bonding operations.

Because the molten salt has a fluidity similar to that of water, it works well even with intricate castings. *Foundry, March 1971*

SCRATA Fumeless Decarburisation

The United Kingdom of Great Britain Steel Castings Research and Trade Association (SCRATA) has developed a process permitting fumeless decarburization of molten steel. The process consists of injecting a powdered metal oxide directly into the liquid steel batch which promotes a vigorous carbon boil without the emission of brown fume normally associated with oxygen lancing.

According to SCRATA, the process has been used successfully on arc furnaces up to 120 tons, open hearth up to 250 tons and active hot metal mixers up to 600 tons.

The process has been accepted by Alkali Inspectorate, the Chief Inspector considering that "fume emission is so small as to be acceptable without fume cleaning plant" during decarburisation. *Metal Bulletin, January 8, 1971*

Uncommon Metalworking Methods

Ordinary manufacturing methods can produce any shape that a designer needs. Yet there are times when available processes cannot form the part exactly as specified or cannot form the part at a reasonable cost.

Discussed in this article are uncommon processes that were developed specifically to overcome the major drawback of ordinary machining, casting or forming. These processes are completely beyond the capability of conventional methods but they turn out parts faster and cheaper than their conventional counterparts.

The methods presented are: metal flo, squeeze casting, autoforge, gatorizing, zero/zero, blowmolding, STEM drilling, electrostream drilling, ultrasonic machining, and abrasive jet machining. These enable the production of parts of almost impossible strength and toughness, yet having thin walls or difficult shapes. Some also make possible the drilling of very smalll holes through unmachinable materials. *Machine Design, January 21, 1971*

The Changing Role of Hydrometallurgy

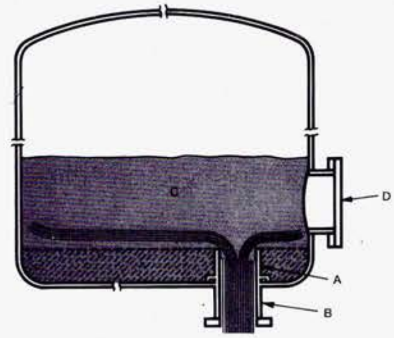
This paper is mainly concerned with the present and probably future role of hydrometallurgy in the production of base metals. The economic and technological bases of the hydrometallurgical plants built and operative in the mid-fifties are compared to those in production in the mid-sixties. The trends observed are extrapolated and some estimates are made concerning the probable size and type of hydrometallurgical plants which will be operatixe in the mid-seventies.

The impact of emerging socio-economic factors such as pollution control and the market demand for specialized metal products which favor hydrometallurgical recovery process are also discussed. *Canadian Institute of Mining & Metallurgy Bulletin, February 1971*

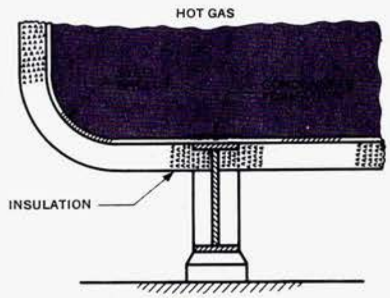
New Reforming Process Yields High Purity Gas in Single Step

The development of a single step reforming process which yields high purity reducing gas at significant economics and efficiency was recently announced by Lummers Co., a subsidiary of Combustion Engineering, Inc.

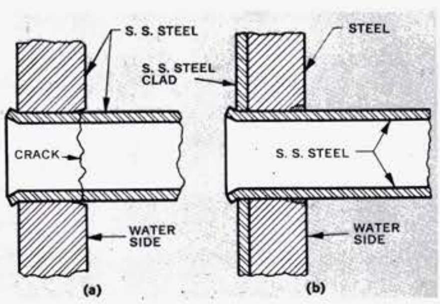
The Lummers Reforming Process operates at very low steam to carbon ratios and generates hydrogen plus carbon monoxide of 95 volume per cent purity (wet basis) at temperatures up to 1850°F. The ability to produce such high purity reducing gas in a single step permits the reformer exit gas to be used directly in the iron ore reducing process.



Removal standpipe over bottom outlet in a storage tank to avoid cutting tank bottom.



Condensation formation inside a hot vessel caused by chill effect of support.



Chloride stress-corrosion of a stainless tube-to-tube sheet joint and a corrective solution.


Miniaturized relay illustrate today's tendency toward smaller components.

When steam and natural gas were reacted, there was no troublesome carbon deformation nor was there an increase in pressure drop. *Industrial Heating, February 1971*

For Plant Management Corrosion Control Techniques

It is essential that plant management become corrosion-minded and fix this responsibility in the plant organization. Simple procedures and applications of fundamentals for corrosion control in plant engineering and maintenance plus some sophisticated solutions to illustrate in-plant benefits. *Mechanical Engineering, January 1971*

Continuous Heat Treating Line Increase Pearlite Malleable Castings

Industrial Castings Division of of Midland-Ross Corporation recently installed a continuous heat treating facility which processes 200 tons of high quality malleable castings weekly. These pearlitic malleable castings are used to house bearings in railroad cars, and are well-known for their high strength and resistance to wear.

The line of equipment consists of a four-row radiant tube, a pusher roller tray malleablizing furnace, an automatic dumping mechanism, an automatic cross-transfer mechanism, a cast alloy continuous belt-type draw furnace and NX generator equipment.

The first stage furnace utilizes multi-cycle heat treatment for pearlitic malleable with temperatures ranging from 1250 to 1750° Fahrenheit and has eight zones of temperature control. Quenching follows after the heat processing cycle wherein control is done to move the castings as swiftly as possible from the furnace into the quench to reduce cooling effects. Contamination is avoided by the use of NX inert gas generator which provides protective atmosphere to the furnace and other equipment. *Industrial Heating, February 1971*

Iron Oxide Recovered From Furnace Fumes

A method of recovering iron oxide in the form of agglomerates from fumes produced in refining processes has been developed by the Bethlehem Steel Corporation.

Fume containing iron oxide, includes sulfur, zinc and/or lead oxide. A carbonaceous material such as coal and flux material is heated in a rotary kiln to a temperature of 2200 to 2700°F. Zinc and/or lead oxide are reduced by coal to the metallic state, some of which together with sulfur vaporize. Iron oxide, magnesia and lime compose the agglomerates. *Blast Furnace and Steel Plant, February 1971*

Predicting Behavior of Metals

Scientists at Bell Laboratories have found a way to use a computer to simulate the behavior of metals during the manufacturing process. As a result, metallurgists and metal producers are now one step closer to be able to predict and control physical and mechanical properties of metals without conducting extensive experiments.

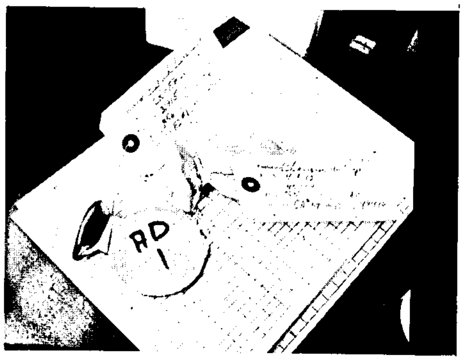
Stimulated by the computer study, Bell Labor Scientists Gilbert Y. Chin, Robert R. Hart and Bud C. Wonsiewiez developed a process for strengthening copper alloys, thus permitting the design of small components and consequently savings in material costs. *Mechanical Engineering, February 1971*

ANACONDA's Smelting Breakthrough

ANACONDA's studies on producing copper by hydrometallurgical means as opposed to conventional pyrometallurgical methods, are bearing fruit.

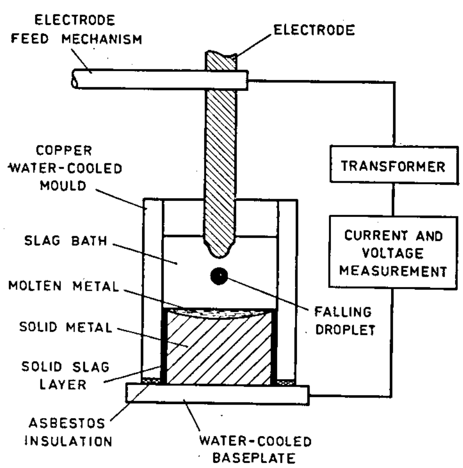
In cooperation with Treadwell Corp., a new process, named Anatread, has been designed to produce copper faster, more economically and with less air pollution than previously thought possible, according to Treadwell's vice-president E. P. Caldwell, in a recent address to AIME in Phoenix.

Perforated graphite plunger packed with damp sand can be used to introduce hydrogen into the molten iron.



Radiograph is examined as a final step in total quality control program.

Prior to pouring a melt, a spectrocopic button is cast in a special bookmold, then taken to the spectrometer room for analysis as soon as it has cooled.



Schematic diagram of the electroslag refining process.

The Anatread process utilizes water, acids and other chemicals, instead of high temperatures, to refine copper. It is claimed that the process can recover more than 99 per cent copper from concentrates, against 97.5 per cent by conventional method. *Metal Bulletin, February 19, 1971*

Heat Conductivity of Molding Sand and Quality of Casting

The authors developed a test wherein cylindrical compacts of green sand are dipped into molten lead. They measured time between the moment of dipping and the moment steam pressure in the testpiece exceeds metallostatic pressure. Steam evolves explosively, especially when additives are in the sand. Pouring tests indicate that factors promoting improved heat conductivity of the sand also promote formation of blowholes. *American Foundrymen's Society Cast Metals Research Journal, March 1971*

Effect of Section Size on the Mechanical Properties of Copper Base Alloy Castings

This continuing study reports the effects of section size on mechanical properties of manganese bronze castings designed to be "just sound" using different criteria of soundness.

Tensile properties of manganese bronze castings are not significantly affected by section size or solidification rate. Where property differences exist, they relate to the presence of porosity or the entrapment of dross inclusions.

The soundness criterion used to establish maximum sound length of a casting has a significant effect on tensile properties obtained. No significant difference was found between feeding efficiency of open and blind risers. *American Foundrymen's Society Cast Metals Research Journal, March 1971*

Making Malleable With High CE Iron

Tellurium additions permit white iron suitable for malleablizing to be cast with up to four per cent CE, with the following advantages: High CE iron can be melted in ordinary cupolas, it anneals rapidly and shows less checking than conventional malleable iron. The key to reducing tellurium requirements is addition of hydrogen. *Foundry, February 1971*

Growth of Malleable Iron Castings During Annealing

A study is made of the amount of growth which can be expected in malleable iron castings due to the conversion of combined C to graphite (Gr) under different annealing conditions. A number of conclusions are arrived at, including a graph indicating the additional shrinkage allowance which should be taken into account, beyond the normal 1/8 in. per ft. All the raw data was computerized to determine the validity of the findings and indicate in which direction further investigation might lead to additional knowledge. *Modern Casting, March 1971*

Effect of Sulfur on Nitrogen Content of Liquid Cast Irons

The solubility and rate solution of Ni in carbonsaturated Fe-S alloys have been measured over the temperature range 1300-1600C. Sulfur does not influence the solubility of N but markedly decreases the solution rate coefficient. These results are discussed in terms of observations on commercial melting practice. *Modern Casting, March 1971*

Non-Destructive Testing of Mine Equipment

The non-destructive testing of mine equipment has recently seen wider application. This paper describes the principles of the most common methods — ultrasonic, magnetic particle, dye penetrant, radiography and magnetic anomaly detection. The field procedures and instrumentation of these methods are emphasized, along with an appreciation of their limitations. *Canadian Institute of Mining & Metallurgy Bulletin, March 1971*

SRC Process

Showa Denko will utilize technology for pre-reduction of chromium ore known as the SRC process in their newly installed 60,000 ton per year facility. Having finished trial operations, this new facility is now ready to start full scale production estimated to be around 4,500-5,000 tons per month.

The SRC process reduces electric power consumption needed for the production of high carbon ferrochrome by half, compared with the conventional method. *Metal Bulletin, April 16, 1971*

Mechanism of Electroslag Refining

The paper present both a review of the novel electroslag refining (ESR) technique and new data based on bench-scale experiments with an ESR unit. In the review the mechanism and chemistry of the process are emphasized.

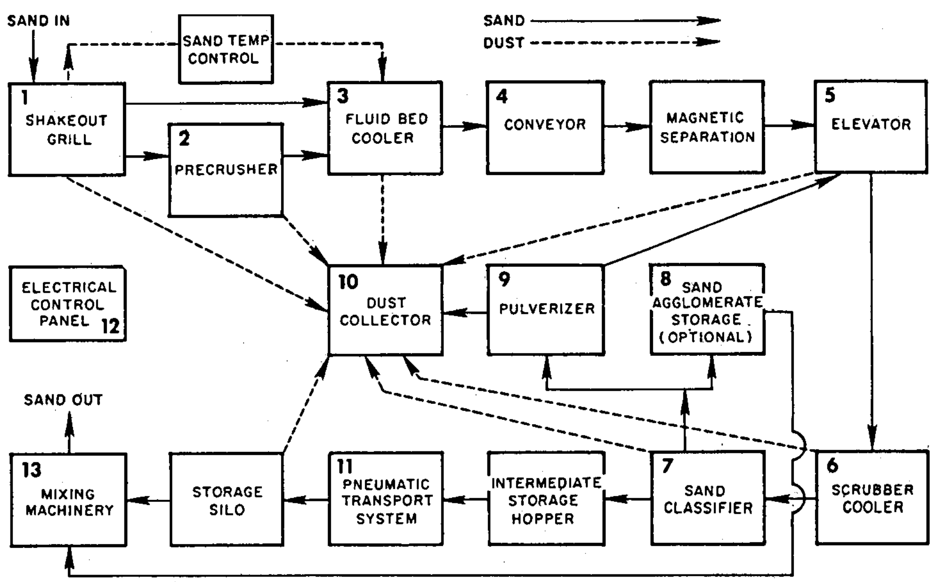
The bench-scale experiments were carried out on mild steel, plain-carbon tool steel, and high-speed tool steel using a 250-amp. a.c. ESR experimental unit. With slag containing 50 per cent CaF_2, 30 per cent Al_2O_3 and 20 per cent CaO, sulfur removal from the steel up to 46 per cent was achieved, but phosphorous removal proved unsuccessful even in the presence of five per cent FeO. ESR gave a reduction in the size and number of inclusions and more uniform distribution.

A severe quench was used to freeze-in the concentration gradients that existed in the metal during operation, and the gradients were measured at the electrode/slag interface using an electron-microprobe.

No concentration gradients in manganese, tungsten or chromium were observed but silicon concentration gradients were measured. The conclusion is drawn that approximately 50 per cent of the refining occurs at the electrode/slag interface, and it is inferred that the remainder occurs at the ingot/interface. *Journal of the Australian Institute of Metals, February 1971*

New Plating Process Provides Cheap Corrosion Protection

Manganese codeposited with aluminum, has been found to provide durable and inexpensive, yet uniform coatings on a variety of parts including those with complex shapes. "This is due to the improved throwing power of the plating bath," says William H. Safranek of Battelle Memorial Institute.



Process flow sheet of used molding sand regeneration process.

Typical mechanical properties of new stainless steel

Condition	UTS	0.2% Y.S. ksi	% Elong	% Red of area	Hardness Rockwell
Hot rolled	149	124	20	31	R_c33
1800F (Annealed)	124	67	35	42	R_c26
2100F (Annealed)	99	47	71	69	R_b88
Cold Reduced 36%	183	165	11	39	R_c 42
Cold Reduced 57%	218	210	6	26	R_c44
2150 F / 1500 F	40	21	77	65	

*Annealed at 1500 °F

The plating system is capable of providing smooth, pore-free deposits in layers from 0.3 to 0.5 mil. Accelerated corrosion studies on the plating indicate that its protective capability is outstanding. The alloy coating is also said to provide greater resistance to abrasion, scratching and wear. *Machine Design, March 4, 1971*

INCO's New Grade

A new high-strength, low alloy steel called "Nicuage Type 1" has been developed by International Nickel. It is claimed that the new steel, which contains nickel, copper and columbium, is four times more resistant to corrosion than ordinary steel, with a low carbon content which gives it outstanding cold-formability and weldability.

In the as-rolled condition, Nicuage Type 1 has a yield strength of 540MN/m² which can be increased to 680 MN/m² by low-temperature heat treatment. *Metal Bulletin, April 23, 1971*

No-Bake Molding Pays Off in Europe

European foundries have taken the lead in utilizing no-bake technology for molding. One reason is development of an effective means of reclaiming or regenerating the used molding sand. Benefits include greater production from the same work area with reduced labors plus higher casting yields, less scrap and a cleaner foundry. *Foundry, February 1971*

Progress Foundries Analyze Aluminum Before Pouring

Complete melt analysis before pouring now is a reality for the small foundry. A small, rugged, relatively inexpensive direct-reading spectrometer has made it possible. Easy to operate, it can produce an analysis in minutes, allowing metallurgical adjustments to be made before any scrap castings are poured. *Foundry, March 1971*

New Stainless Steel Has Double Strength of 304

A new austenitic stainless steel, containing 15 per cent Cr and 17 per cent Ni, called Armco 15-16 WR, offers superior resistance to galling, seizing, cracking and oxidation. It has better corrosion resistance than type 304 and its annealed strength levels are double that of type 304.

Due to its good galling resistance, it will be used in applications where rubber contact is prevalent. Properties obtained from tests conducted on one inch diameter or smaller bar stock are outlined in the table. *Materials Engineering, March 1971*

metals NEWS

& RELATED EVENTS

ATLANTIC GULF & PACIFIC CO., MANILA, INK CONTRACTS WITH FOREIGN FIRMS

Roberto Villanueva, Chairman of Atlantic Gulf & Pacific Co. of Manila bared that AG & P has signed its first steel fabrication contract abroad worth about $1 million.

The contract was for the fabrication of the steel bridge navigational span of six bridges for the U. S. government in South Vietnam.

Villanueva said that the project is in line with the new policy of AG & P to develop aggressively the construction activities of the company in Southeast Asian countries to earn more dollars for the Philippines.

The steel portion to be fabricated by AG & P is 520 feet long by 36 feet wide comprising three spans for each bridge. At the center of the bridge is a lift-out span 56 feet in length which may be removed in time of emergency to open the waterway navigation of large vessels.

The remaining spans of each of the six bridges will be of prestressed concrete girders.

AG & P signed the contract with the RMK-BRJ, a four-company combine under contract with the U. S. government for construction in South Vietnam.

In a related development The Private Company for Asia (PICA) S. A. and the Atlantic Gulf and Pacific Company of Manila (AG & P) signed an investments contract recently in PICA headquarters in Tokyo, Japan.

The investment contract calls for PICA to invest a total of $628,240 in AG & P.

Dr. W. A. Ravesteiyin, president of PICA and Roberto T. Villanueva, chairman of AG & P signed for PICA and AG & P, respectively.

Under the agreement, PICA's investment will begin at a point when AG & P internationalizes its ownership and acivities.

While expressing his appreciation for PICA's latest investment offer, Villanueva said that the new financing from the multinational investment organization will be principally for expanding the technical capacity of his company and for services to other countries in Southeast Asia. AG & P is going to construct several steel bridges in South Vietnam with Filipino technology and Japanese materials, Villanueva added.

AG & P is a construction and engineering firm. In 1969, it reported sales totalling ₱109.6 million, making it the 25th largest corporation in the country, saleswise.

HONIRON EXEC BARES FIRMS NEW PROGRAMS

Jan War, vice president and general manager of Honolulu Iron Works, one of the largest manufacturing companies in the Philippines said that his firm is set to embark in a new manufacturing program.

The program, War indicated, is designed to increase the share of manufacturing operation in its total revenue.

Emphasis would be placed in an expansion or maximizing value-added to the new products which would be produced.

In the same program according to War, another objective is to alter the present image of Honiron which image linked the company engaging primarily in the fabrication of sugar milling facilities.

Actually, Honiron activity in the sugar mill facilities is only 28 per cent of the total revenue of the company.

Formerly known as the Earnshaw Docks of Honolulu Iron Works, Honiron was included among the top 150 corporation in the country in 1969 with a net income of ₱3,856,463 and sales of ₱46,891,506.

In point of assets, Honiron was listed in 1969 as having assets totalling ₱64,130,220.

EXIMBANK LOANS FOR MACHINERY, SERVICES

Eximbank's financing operations has made loans available to the country's small and medium-sized industries and agricultural sectors. This was disclosed by Henry Kearns Eximbank chairman and president who was in the Philippines recently on a two-day visit.

Kearns said that the Eximbank should be able to give new credits to as low as $10,000 to several Philippine companies. This new privilege would enable small firms to buy equipment, machinery, machine and agricultural tools and technical services. To implement this program, Kearns said that Eximbank would establish the Cooperative Financing Program under which financing requirements of local projects would be undertaken on a 50-50 basis, by Eximbank and local financial institution.

In the proposed agreement between the Eximbank and local financing institutions, dollar credits would be given to small industries at the usual six per cent interest rate for the purchase of capital goods and services.

NASSCO BIDDED BY FILIPINO-JAPANESE FIRM

National Shipyards and Steel Corporation's Jose Panganiban Smelting Plant in Camarines Norte is being bidded jointly by a Filipino-Japanese firm with six other private companies.

David R. Ines, NASSCO general manager, said the bidder's list is in the Office of Economic Coordination. According to Ines, the bidding papers were submitted by the NASSCO board to the OEC for action. Other bidders known are the Thocaris Company and Pedro Valdez, a contractor and official of a large corporation.

Ines said that Filipino automotive experts believe the NASSCO plant could provide the means for fabricating automotive component parts. The plant facilities would write off added costs of importing fabricated automotive parts from Japan once production starts, he added.

The Smelting plant which was more of a "burden" to the NASSCO, has not received the much awaited ₱5-M subsidy from Congress.

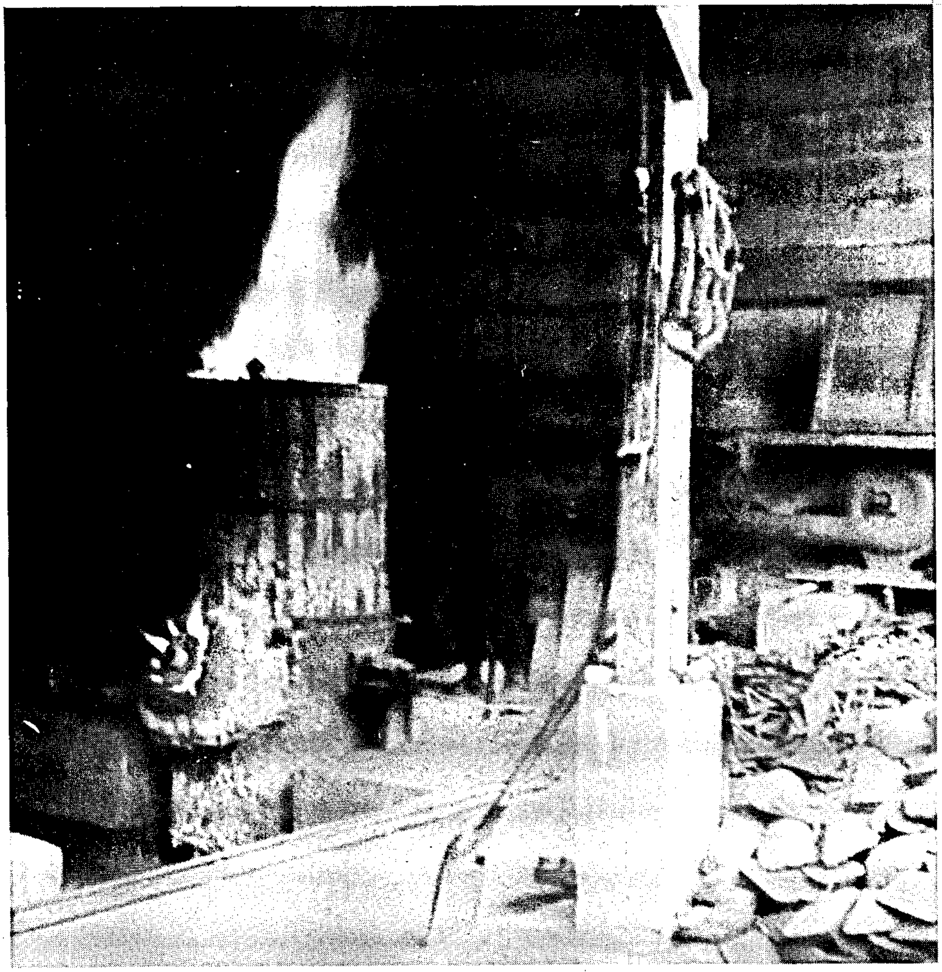
IMCO PLANT STARTS OPERATING

The International Metallurgical Corporation (IMCO) plant for the conversion of low-grade coal into high-grade coke, a process assumed to be the first of its kind of the world, will soon be operating at full commercial scale. The process which was invented by Indalecio J. Elago, President of the IMCO, is registered with the International Patent Office and the Philippine Patent Office.

According to IMCO Chairman of the Board and General Manager Teofilo Abeto, the process involves the manufacturing of metallurgical coke briquettes from low-carbon, low-grade coal with the use of the "Metallurgical Briquette Process". Abeto expressed optimism that the full-blast operation of IMCO would help boost the country's major industries like mining, coal carbonization, steel and iron, lime, chemical and other allied industries.

The 100 per cent Filipino business venture will make use of coal deposits in Cagraray and Batan Islands, estimated at 27 million tons, which is estimated to last 20 years at an average yearly output of 500,000 tons of metallurgical coke.

IMCO's plant is located at Port Misibis, Bacacay, Albay, a coal harbor.



The heating value of the metallurgical briquettes produced by the International Metallurgical Corporation were tested in this cupola and was found to be 16,000 BTU, much higher than those coming from abroad.

JAPAN STEEL EXECUTIVE CITES ROLE OF IRON & STEEL INDUSTRY

"It is very important and necessary to develop the iron and steel industry without whose development other industries would be very hard to promote."

Mr. Shintaro Tabata, Executive Director of the Japan Iron and Steel Institute and top official of the Southeast Asia Iron and Steel Institute (SEAISI), stated during a conference of the PTRI Building at Bicutan, Taguig, Rizal last July 2, 1971.

Tabata explained that the progress of the industry depends much on advanced technology which in some measure can be acquired from the experience of other advanced countries.

When asked the primary cause for the rapid progress of Japan's steel industry Tabata said it is due mainly to a highly developed technology resulting in low production cost and subsequently a competitive price for steel products, lower labor cost and free exchange of information. In Japan, he added, steel firms hold periodic meetings where there is a free exchange of ideas and technological breakthroughs leading to discoveries of new techniques.

Commenting on the role of SEAISI, Mr. Tabata said that it is "vital and good for Southeast Asian countries. It had a good start, very solid support behind it and is run by most qualified and able persons."

Tabata was introduced by Dr. Antonio V. Arizabal, acting director of the Metals Industry Development Center who is also SEAISI director. He was here primarily to observe the manufacturing practices of the local steel firms and to discuss the function of the Japan Iron and Steel Institute.

Mr. Shintaro Tabata, flanked by Dr. Antonio V. Arizabal and Dr. Felipe Calderon, before MIDC personnel at the NSDB conference room.

EEI ACQUIRES VITAL EQUIPMENT; SETS ON EXPORTATIONS

The Foundry Division of Engineering Equipment, Inc. has recently acquired a 120-inch vertical boring mill and a 15-ton heat treatment furnace. These major additions will fill the existing market for larger and heavier castings previously available only from overseas sources.

The 120-inch vertical boring mill is the biggest machine tool of its type operating in the Philippines; it can handle castings up to 10 feet in diameter and 48 inches in height.

The 15-ton heat treatment furnace increases the foundry's heat treating capacity by 100 per cent. It will also improve efficiency through automatic temperature control and overfiring-underfiring burner system. The recently installed furnace is the largest and most modern heat treatment facility in the country today.

Ten additional high frequency grinders with more efficient speed performance are also being installed. Their dustproof capability will permit considerable savings in repair and maintenance cost.

Engineering Equipment, Inc. will soon deliver to Indonesia 12 sets of cast manganese steel bowl and mantle liners through P. T. Indonesian Marine Corporation Ltd. (Indomarine). EEI recently granted Indomarine the exclusive right to solicit orders for its products within Indonesia.

Indomarine is an Indonesian sea transport company engaged in manufacturing, banking and finance. The contract covers the sale of EEI products manufactured by its Construction and Foundry Divisions. Construction Division product lines include general contracting services, storage tanks, bulk transport carriers, pressure vessels, structural steel, marine vessels, pipings and ductwork, mechanical and instrumentation services, refinery works, air conditioning and refrigeration systems and water treatment. Foundry Division's products consist of manganese steel, high and low alloy steels, stainless steel, and non-ferrous castings for the mining, cement, sugar and other basic industries.

BOI APPROVES COPPER TUBE PLANT

The Board of Investments recently approved a ₱15 million copper tube manufacturing project, most likely to be joined by local firms using copper tubes in their manufacturing operations, as a pioneer venture. The project which will be handled by the Industrial Copper Corporation, organized by Concepcion Industries will have its plant in Muntinlupa, Rizal.

EEI and Indomarine executives sign contract granting the latter the exclusive right to solicit orders for EEI products within Indonesia. They are, seated, left to right: Ventura O. Ducut, EEI senior vice president; Wisnoentoro Martokoesoemo, Indomarine managing director; and Leocadio I. Dominguez, EEI executive vice president. Standing, same order, are: Vicente R. Prieto, vice president and general manager, Machinery Division; and Felicito C. Payumo, vice president for administration, EEI.

The proposed plant has a rated capacity of 1,200 metric tons a year and when fully integrated will cause foreign exchange savings of ₱12 million a year over a 10-year period, excluding potential export earnings. The plant will undergo three phases: 1) production of copper tubes from imported shell tubes by the end of 1972; 2) manufacture of shell tubes from imported copper billets; and 3) refining of copper cathods from copper ingots and billets through a melting process.

Since the raw material is chiefly copper, the project is expected to provide impetus to the setting up of a copper smelting project It is also expected to reduce substantially the importation of finished copper products, since the plant will process these materials.

At a press conference, Mr. Jose Concepcion, Board Chairman and Raul T. Concepcion, President, explained that the project is designed to manufacture copper ingots and billets, copper shell tubes and copper tubes having diameters of 3/8 to two inches, with possible adjustments if the market demands for it.

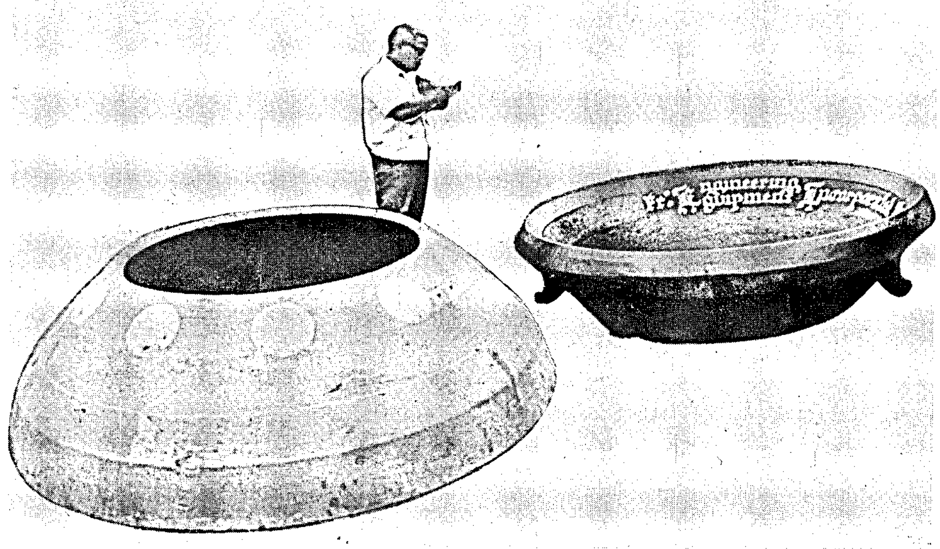
The market demand is 700 metric tons but the plant will produce 1,200 metric tons by 1976 with an allowance for exporting 40 per cent of production.

WHITE EAGLE FINDS UNIQUE COPPER

A unique type of copper ore was discovered by the White Eagle Overseas Oil Company in Zambaonga del Sur, according to H. S. Scott, second vice-president of the firm.

Scott explained that a unique type of copper consists of a bed of volcanic sediment up to 35 feet thick, by copper-bearing ore and other sulfides. One lens, according to Scott is 15 feet thick and contains an estimated worth of $500,000.

According to the vice-president of White Eagle, previous copper ore finds in the Philippines are either large, low-grade deposits



A set of 7-foot bowl and mantle liners (compare sizes with man in foreground), the biggest so far produced by EEI's Foundry Division.

described as disseminated like those of Atlas, Marcopper and Marinduque, or small, high-grade deposits like Lepanto's. The White Eagle find in Zamboanga del Sur is neither one of the two, hence unique.

ATLAS MILL NOW OPERATING

Atlas Consolidated Mining and Development Corporation, has completed its second copper concentrator plant in Biga, Toledo City, Cebu, boosting its milling capacity to 65,000 tons of ore a day. This ranks Atlas among the largest mines in the world.

In setting up the new concentrator plant, a gravity dam, new line plant, tailings pipeline and a modern power plant were also constructed. The Biga plant has a daily average copper production of 220,000 pounds.

A 26.5 megawatt power plant and foundry expansion was also added to the project.

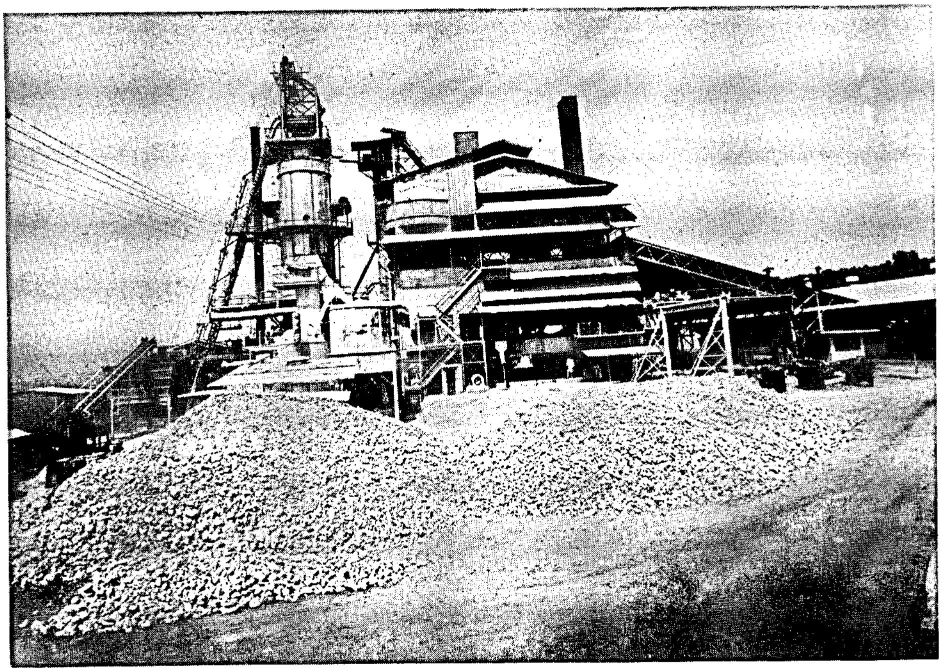
2ND BIGGEST NICKEL MINE CONFIRMED

After three years of exploratory work, the mining division of Soriano y Compania have discovered a rich nickel deposit in Barrio Bering, Quezon, Palawan equivalent to 100 million tons with a recovery nickel content of 1.4 percent. Exploratory work is nearly completed and full-blast work is projected to start next year. Soriano mining officials are just waiting for results of the analyses of mineral sample sent abroad to determine the processing system that would apply best to the particular ore and area.

Soriano y Compania is also completing exploratory and geological work in its other nickel mining claim in Barrio Pujada, Mati, Davao del Sur.

FIRST HAND TOOL FACTORY TO OPEN SOON

The Securities and Exchange Commission has approved the increase in authorized capital of Elisco Tool Manufacturing Corporation (Elitool) from ₱1 million to ₱20 million. The approval facilitates the establishment of the country's first hand tool manufacturing plant in Pasig, Rizal which will start operation in July, 1972.



The Maria Cristina Chemical Industries Inc. has recently expanded its plant facilities at Assumption Heights, Iligan City in view of its plants to export ferro-alloys. MCCI is utilizing indigenous products for its raw materials.

Elitool is registered with the Board of Investments with a measured capacity of 1,000 metric tons and when operational will manufacture hammers, pliers, screw drivers, knives and wrenches.

The project will contribute to the country's $2 million in dollar savings from non-importation of tools.

PROFESSIONAL CONCEPT OF METALLURGY BEING EXPANDED

Two professors from the University of Missouri stressed the necessity of developing new methods for the recovery of metals from waste to expand the new professional concept of metallurgy called "metal salvage engineering."

They presented projected trends on the world needs or production for iron ore, copper and zinc and on population growth. According to the Missourians, the U. S. and Western Europe alone use one-half ton of steel per capita, on the worldwide basis less than one-tenth ton per capita. This obviously means mining of lower grades of ore, and therefore increased energy and manpower for mining and processing.

METALS RECOVERY COSTS PREDICTED TO RISE

John C. Hall, president of Anaconda Co., predicted an adequate supply of metals to meet demands for several decades, but at higher costs.

The Anaconda president sighted steeply rising metal demands to the year 2000. According to his data, iron ore use will rise from 460 million short tons in 30 years.

Herbert Kellog, Stanley-Thompson professor of chemical metallurgy at the Columbia University Henry Krumb School of Mines called for new and improved processes to extract metals from the earth. According to him, the development of improved processes is the principal problem facing extractive metallurgy, now and in the future.

HIMER SHIPMENT PASSES TEST

Australia's Hamersley Iron says that a further step in its plans to set up a 1.4 million ton per year SLRN direct-reduction plant in Western Australia, was reached when a 650-ton sample made at Stelco's plant in Canada arrived in Japan. The sample of Himer (Hammersley's trade name), is said to represent the first significant shipment of direct-reduced ore in a bulk carrier.

Doubts have often been expressed about the problems of shipping the D R ore because of dangers of dioxidisation. Tests showed that no unusual steps were necessary compared with ordinary iron ore except to ensure that the cargo was kept dry at all times. The 650-ton sample made the 48-day voyage from Canada under normal conditions and is said to have arrived in Japan in the as-loaded condition.

JAPAN'S BLAST FURNACES SET RECORDS

The worlds largest blast furnace was kindled last April 28, 1971 at the Fukuyama Works of Nippon Kokan Co. This is the No. 4 Blast Furnace with a capacity of 4,197 cubic meters, boasting of a daily production of 10,000 tons of pig iron.

With this huge, 97-meter high blast furnace operating, the crude steel production of Fukuyama Works now is increased from eight million tons to 12 million tons, the largest single steel plant in the world.

Nippon Steel Corporation which has been trying to lower the percentage of coke used in blast furnaces to cut down production cost, announced that its No. 2 blast furnace at NSC's Muroran Works in Hokkaido had set an average coke ratio of 355 kg. in February, which is a new world record.

The company also disclosed that the nine blast furnaces at its Nagoya Works and Kimitsu Works had recorded a coke ratio of 300 kg. level in February, which is better than the average for January.

Nippon Steel has altogether 24 blast furnaces operating at seven steel works.

STEEL MILL DUST RECYCLING PROCESS PERFECTED

Yasuhiro Inazaki, heir to Nippon Kokan, has commercialized successfully his invention of a steel mill dust recycling process for the extraction of lead, zinc and cadmium. The process cover the continuous reduction, vaporization and oxidation in one rotary kiln at about 1,200° Centigrade. It was found out that dust collected at mills, dependent on secondary grade scrap of junked automobiles with die-cast parts on torn zincplates, contained 18 to 25 per cent iron, 20 to 25 per cent zinc, 3 to 6 per cent lead, 4 to 7 per cent chloride and about 0.01 per cent cadmium. The process is not applicable to dust from all steel mills; definitely unfit for operation is dust from shops that handle only topnotch grade scraps with the least impurities.

The Japanese government has decided to license Mr. Inazaki's know-how for the construction of two larger recycling plants in Nagoya and Osaka.

FLUIDIZED BED REACTOR BURNS OFF UNWANTED MATERIALS

A fluidized bed reactor said to have heat transfer rates as much as 10 times faster than conventional heat treating furnaces is now available from Lindbergh Hevi-Duty, a division of Sola Basic Industries.

The furnace which can heat up to 1500-1600° F can be applied to burn off polymers and electrical insulation (in the metal recycling field), to ordinary heat treating, slab-pre-heating process, annealing and simultaneous quench-oil burn-off and tempering.

1970 STEEL PRODUCTION

Production of crude steel in Japan for 1970 totaled 92,286,600 tons, a 6.2 per cent increase from 87,026,200 tons of the previous year, according to the Japan Iron and Steel Federation.

Of this total, 81,155,000 tons were covered by ordinary steel and 11,241,600 tons special steel.

Open hearth furnaces accounted for 3,180,700 tons; converters, 78,507,300 tons and electric furnaces, 15,708,600 tons.

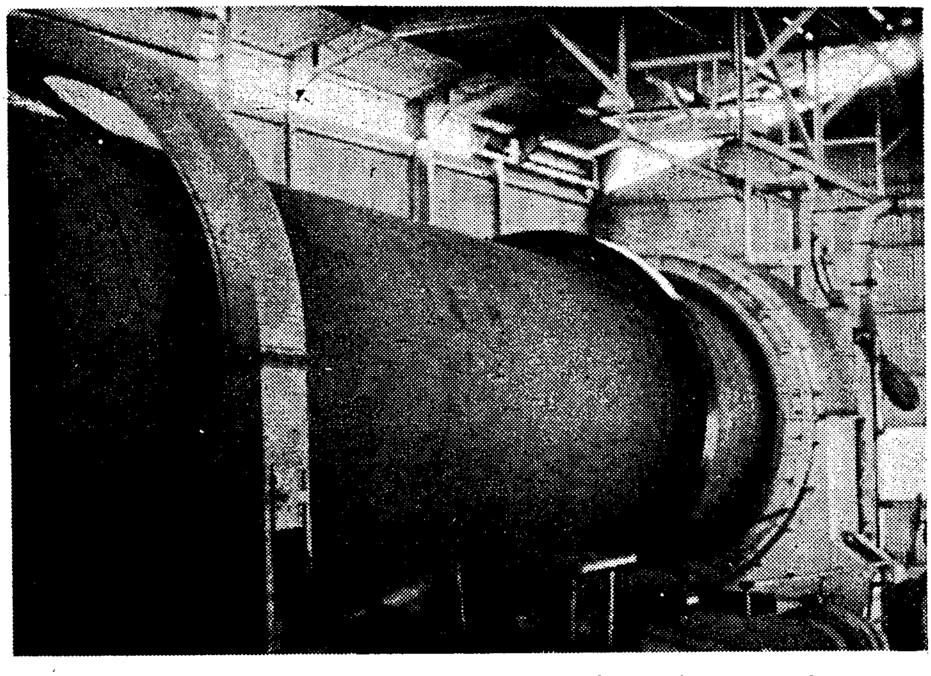
Production of pig iron by blast furnaces totaled 69,023,400 tons, a 13 per cent increase from 61,138,100 tons were pig for steel making while 1,885,300 tons were for cast steel production.

INDONESIA SEEKS AID IN DEVELOPING IRON SAND DEPOSITS

Japan's Nikko Engineering Co., has sent a survey team headed by its Managing Director H. Wantanabe to Indonesia to conduct survey works on its iron sand deposits.

The Government of Indonesia has asked the Japanese firm to make this survey in a district some 120 kilometers east of Chalachap Mine which is expected to export 300,000 tons of iron sand to Nippon Kokan in 1971. If the new deposits are developed, the Indonesian Government expects that some one million tons of iron sand will be exported annually to Japan.

The steel industries in Japan are expected to import a total of two million tons of iron sand from Panama, New Zealand as well as Indonesia in 1971.

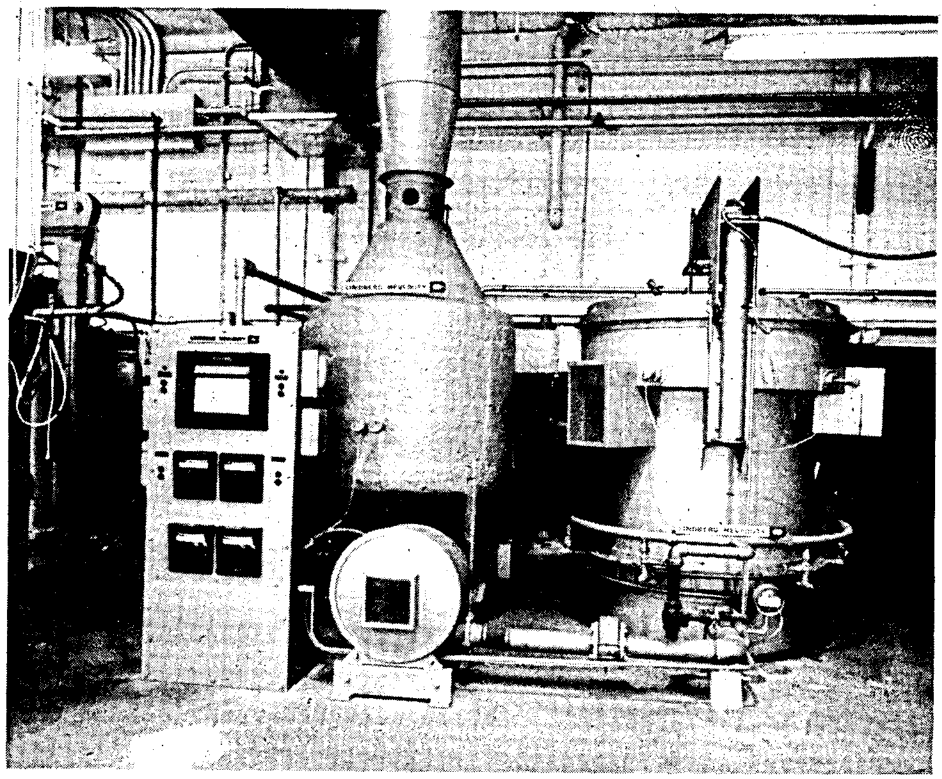


Rotary kiln processing dust from open hearths and electric furnaces for extraction of lead, zinc and cadmium at Inazaki's Chita plant.

JAPAN STEEL INDUSTRY HAS 9 STEEL SCRAP CARTELS

The Fair Trade Commission, formally approved last February 25 the establishment of four additional steel scrap cartels and the reorganizing of the five existing cartels by the iron and steel industry for the purpose of rationalizing procurement of steel scrap. The nine cartels have a total membership of 133 steel firms and works.

The nine cartels (officially called Steel Scrap Supply and Demand Committee) under the new set-up are: Blast Furnace Steel Scrap Committee, seven firms; Special Steel Scrap Committee, 14 firms; Kanto Steel Scrap Committee, 30 firms; Kansai Steel Scrap Committee, 20 firms; Chubu Steel Scrap Committee, 15 firms; Hokkaido



Instrumentation and control unit of fluidized bed reactor introduced by Lindberg Hevi-Duty Division of Sola Industries.

Steel Scrap Committee, four firms; Tohoku Steel Scrap Committee, 17 firms; Chugku Shikoku Steel Scrap Committee, 13 firms; and Kyushi Steel Scrap Committee, 13 firms.

SHORTAGE OF UNDERGROUND MINERALS FEARED

Japan will run out of most of its essentially poor underground mineral deposits in about 10 to 20 years if it keeps tapping them without sizeable new finds according to a new stastistical survey of the country's mineral deposits for 1970 released by the ministry of International Trade and Industry.

The survey covered 233 mineral mines excluding collieries. According to the survey, a majority of the mines were found to have decreased 4.8 to 10.8 per cent in mineral deposits in terms of pure ore content compared with the preceeding 1968 survey.

At the present rate of mining going on in Japan, the deposit of iron now totalling 29,000,000 tons (22 million in re-content terms) will disappear in 11 years, it was predicted.

"MIRACLE MILL" PRODUCES UNUSUALLY THIN TIN PLATES

A rolling mill, dubbed "miracle mill" is now available commercially at Jones & Laughlin Steel's Stainless and Strip Division.

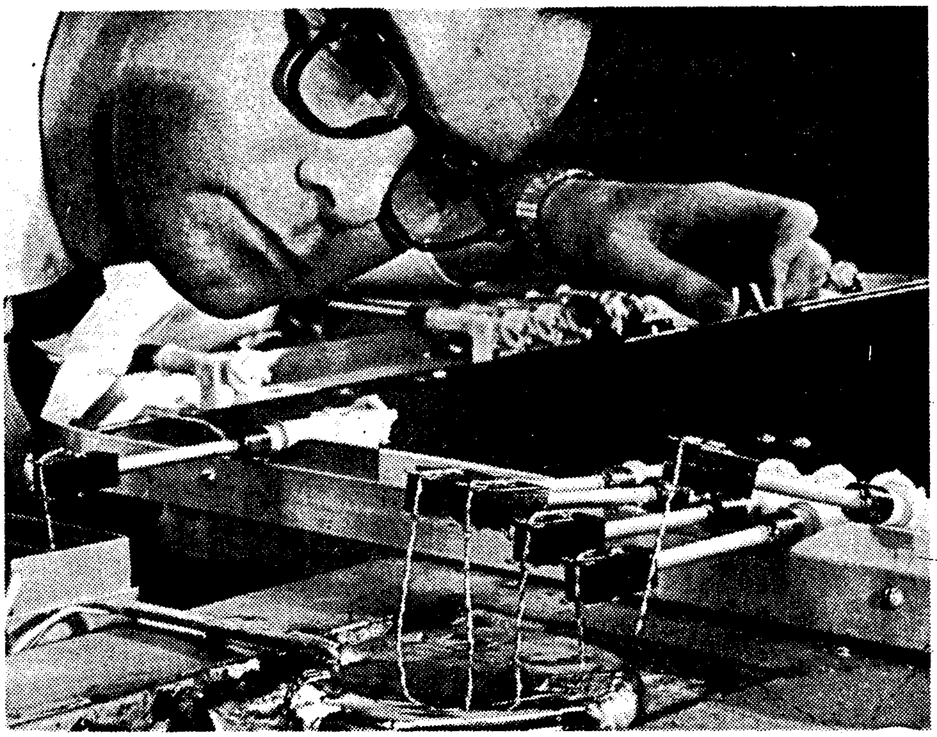
Like any other cold-rolling mill, the Taylor mill reduces the thickness of the strip by a combination of rolling pressure and stretch tensioning, however the strips they produce have uniform thickness and are remarkably flat. The secret of the mill's ability to produce steel strips up to a thinness of 0.002 inch — if the starting material is single reduced tin plate or tin-free steel — is the ability to vary the torque applied to the working rolls. Unlike the conventional cold rolling mill, the working rolls do not have the same diameters, one is one-half the diameter of the other and the force applied to each roll vary considerably. The smaller roll, of forged steel, can be bent backward or forward to conform to the shape of the strip entering the rolls.

The Taylor mill can be used to roll any kind of metal strip, including thin tin plate, tin free steel, stainless steel strip and both high and low carbon steel strip.

TITANIUM SLAG PRODUCED FROM ILMENITE

Sumitomo Metal Mining Co. has succeeded in producing titanium slag from ilmenite at its test plant built at the Hyuga Refinery in Naojima, Miyazaki Prefecture. In addition to its use as raw material for producing sponge titanium and titanium oxide, titanium slag contains no iron so that there is no need of sulfuric acid treatment which causes pollution.

Sumitomo metal expects considerable demand for titanium slag because of the high price of rutile from which sponge titanium is produced.



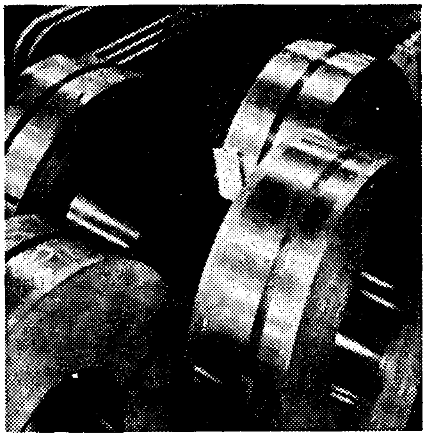
ALCOA's new corrosion-resistant soldering materials for aluminum will be introduced at the 1971 Design Engineering Show in New York.

LOW-TEMPERATURE ALUMINUM SOLDER DEVELOPED

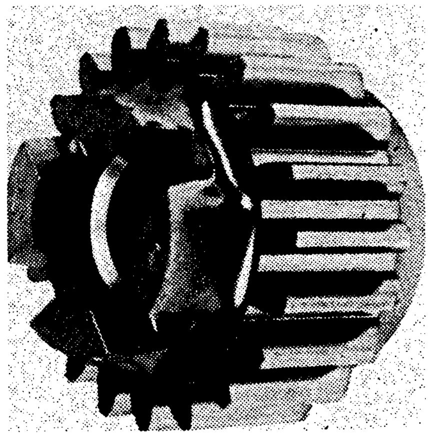
A liquid flux and low-temperature solder for joining aluminum and dissimilar metals has been developed by the Aluminum Company of America (ALCOA).

The combined action of the new liquid flux and low-temperature greatly improved corrosion resistance and electrical stability of soldered aluminum joints. Special flux formation minimizes electrical tracking, making the soldered joint more reliable and useful in electronic equipment manufacturing.

The solder which melts at about 500 degrees Farenheit can be used with all commercial soldering methods.



These steel strips can still be made more flat and thin by the "miracle mill."



A consistently uniform density on the four lugs of this washing machine gear is necessary to prevent breakage during test..

JAPAN INDUSTRIAL STANDARD ON GALVANIZED SHEETS TAKES EFFECT

The Ministry of International Trade and Industry recently set a new Japan Industrial Standard (JIS) in the production of white and colored galvanized sheets for the purpose of improving their quality.

Under the new JIS, the amount of zinc coating on white galvanized sheets will be increased.

The tensile strength of structural sheets will be increased so with testing time with brine spray.

Sheets with more zinc coating prescribed by the new JIS will be used for coloring. Colored sheets will be graded in accordance with their degree of resistance to corrosion instead of guarantees for coated film as at present.

TOMAKOMAI TO RECOVER RARE METALS FROM SULFIDE ORE

Tomakomai Chemical Co. which made its debut recently plans to recover valuable rare metals from sulfide ores as by-products of sulphuric acid and pellet at its projected plant in Tomakomai City, Hokkaido. Founded jointly by Nippon Mining Co. and Mitsubishi Metal Mining Co., Tomakomai Chemical estimates that it can recover 71 tons of copper, 128 tons of lead, 230 tons of zinc, 200 tons of arsenic, 1,500 tons of gypsum as well as gold, silver, cobalt, cadmium and other rare metals from 24,000 tons of sulphide ore which will be treated monthly.

ARMCO INTRODUCES NEW TYPES OF STAINLESS STEEL ALLOY

Armco Steel Corporation, introduced three types of steel alloys at the 1971 design engineering show held at the New York Coliseum April 19-22, 1971.

A new ferritic chromium stainless steel alloy "18 SR", is said to have scaling resistance superior to the types 442 and 446 although it costs less. According to Armco, "18 SR" which can be formed as readily as type 430, has better bend ductility than type 446 and can be bent flat without cracking.

Armco's "22-13-S" stainless steel is a new Cr-Ni-Mn alloy said to have exceptional corrosion resistance. Samples have not shown adverse effects after being exposed to five per cent sulfuric acid for 10 days or ferric chloride for 50 hours. Sea water immersion for 9 months did not also damage a sample of the alloy.

The low nickel austenitic stainless steel, "18-2Mn", is said to have twice the yield strength of type 304 and has comparable corrosion resistance. It is described as an ideal material for cold and warm heading applications requiring high torque strength.

APC'S COMPACTING PRESS UPS MACHINE GEAR PRODUCTION RATE

RB & W Metal Product, Inc., U.S.A., was able to increase their production rate for washing machine gears and get a consistently uniform density on the four lugs of the gear. This was brought about by the ability to shift the density in the compacting of powder metal parts by the use of a 250-ton automatic, hydraulic powder compacting press manufactured by Alpha Press Company. In addition to a greater increase in parts per hour, rejects or breakage of the parts were virtually eliminated.

Because of the movements built into the Alpha Press, the size and density of the gear could be controlled without interrupting the output. The density of the compact on the four lugs can be positioned exactly where it was needed most.

TAIWAN, THAILAND BUILD STEEL MILLS

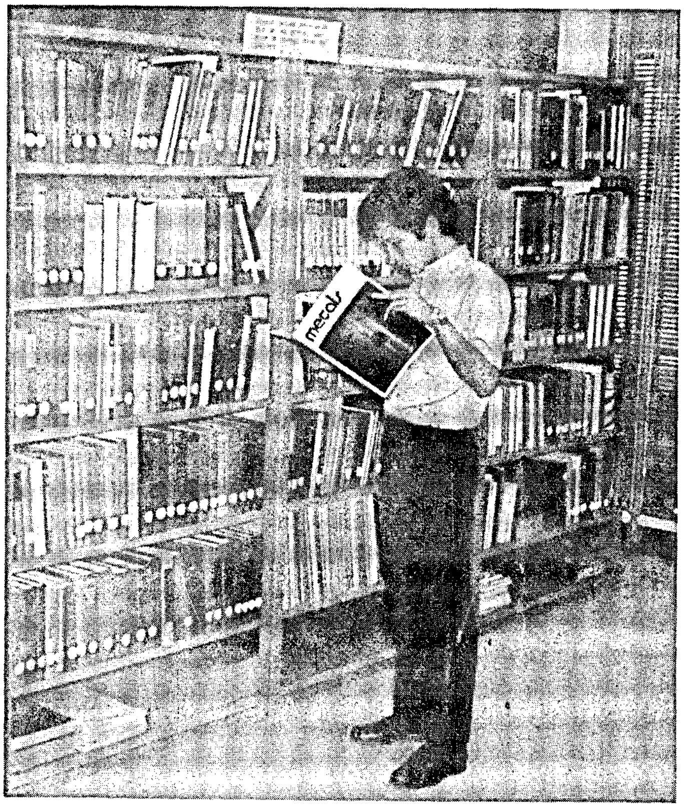
Taiwan Economic Minister Sun Yun-Suan disclosed that his government is undertaking a program to promote heavy and precision industries instead of those that demand high labor utilization. According to Sun at present, plans are being laid down to build an integrated steel mill in cooperation with foreign steel companies, and expand the shipbuilding, petroleum, aluminum, copper, and machinery industries.

To promote the heavy and precision industries foreign technology would be brought in and a fund for this purpose would be set up tentatively at US $500,000.

Likewise, Thailand looks forward to having an integrated iron and steel mills. Nippon Steel Corporation, Nippon Kokan Co., Kawasaki Steel Corporation and Sumitomo Metal Industries of Japan will be making a preliminary investigation on the feasibility of constructing an integrated iron and steel mill in Thailand upon the request of the Thai Government and with the cooperation of four Japanese trading firms; Mitsui Bussan, Mitsubishi Shoji, Marubeni-Iida and C. Itoh.

new arrivals at the MIDC library

(Continued from Philippine Metals Vol. I No. 2)



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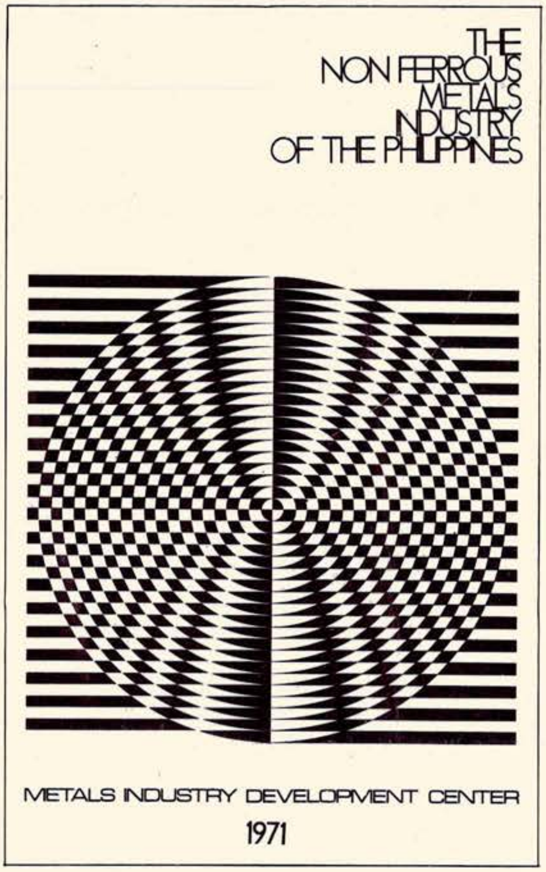

Sometime last year the research staff of MIDC's Industry Study Section embarked in the task of researching, doing surveys, interviewing authorities, and viewing actual operations of metal plants. This was in line with the avowed aim of MIDC to play a vital role in the country's economic growth by promoting the development of metals and allied industries.

Our first published industry study — and many more industry studies will be put out — is on the nonferrous metals.

We are now in a position to deal realistically with problems that have long plagued industry in the Philippines. Problems especially related to metals, manufacturing, engineering and related enterprises. At present we are researching, studying and evolving programs in all these areas, and solutions are beginning to emerge.

METALS INDUSTRY DEVELOPMENT CENTER

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PHILIPPINE metals

QUARTERLY MAGAZINE OF THE METALS INDUSTRY DEVELOPMENT CENTER   VOL. 1, NO. 4 OCTOBER-DECEMBER 197

Cover Story:
A tapper is shown opening up a tap hole by means of an electric "pencil". Calcium carbide is collected in cast iron pans mounted on wagons.

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CONTRIBUTORS

LEONARDO B. SANTIAGO

Leonardo B. Santiago, a certified civil engineer from the Mapua Institute of Technology, is the General Manager of Philparts Mfg. Co., Inc. He underwent on-the-job training along this line at Toho Piston and SMC Metals in Tokyo, Japan. He also took up an extension course in metallurgy at the Metals Engineering Institute of the American Society for Metals in 1968.

STIG R. SAMUELSSON

Stig R. Samuelsson, a mechanical engineer specialized in tools and heat treatment, is presently heat treatment consultant for ASSAB (Associated Swedish Steels AB) of Stockholm, Sweden, covering areas in Southeast Asia, Australia, Japan and parts of South America. He served as a UN consultant to MIDC Singapore in 1966-67.

editorial

MIDC:

TECHNOLOGICAL BANK FOR THE DEVELOPMENT OF THE CAPITAL GOODS INDUSTRY

In the fourth meeting of the Association of Southeast Asian Nations held in Manila last October, the U.N. economic advisory team for ASEAN mentioned that the speed of industrialization of underdeveloped countries would depend primarily on their rate acquisition of capital equipment and technology. This rate would in turn depend on the quality of human resources, the foreign exchange position and the availability of investment funds in these underdeveloped nations. To achieve the maximum growth rate over a long range period, say twenty years, it is necessary to optimize the combination of industries, productive facilities, and infrastructure projects that will be set up within the period.

This optimum combination could best be attained by a judiciously planned and programmed development of an indigenous capital goods industry. This will increase the local content of capital equipment being installed in the country within the plan period so that the usage of available foreign exchange for industrial development can be maximized. The capital goods industry is further characterized by its need for large numbers of highly skilled workers, technologists and scientists. The capital goods industry has also multiple linkage effects with the primary and other secondary industries thereby exerting a catalytic effect on the establishment of these industries.

There are two prerequisites that would make for the development of our capital goods industry: financing and technology. The latter appears to be at least as important as the former although less appreciated. A particular feature of equipment manufacturing, for instance, is the involvement of many steps such as the processing of basic raw materials, the manufacture of components, the formation of sub-assemblies and the final assembly of components and sub-assemblies into finished products. Delving into the nature of equipment manufacturing, we unearth a vast number of necessary component parts that may run into tens of thousands. To be competitive in the limited markets of underdeveloped countries, equipment manufacturing based on a horizontal scheme of integration presents greater advantages in most cases than the schemes based on vertical integration. This then justifies the establishment of hundreds of small to medium-sized component manufacturers who are highly specialized in certain product lines. However, difficulties can snag production such as the shortage of capital, lack of managerial ability, and the inadequacy of technological know-how in the smaller firms. Technological assistance could come though from the large equipment manufacturers themselves or from technological centers such as the Metals Industry Development Center.

To illustrate the role of MIDC by way of technological assistance, we bring in the much-discussed progressive car manufacturing program. For it to work out here, the car manufacturers would have to start negotiating with various existing local foundries and machine shops for components. Many of these may have the equipment but not the technical know-how to produce parts according to quality specifications. Technological assistance is needed but most of these shops cannot afford to pay the price. The car manufacturers would either have to give that assistance or an alternative source could be the MIDC.

Just as we need financial banks, we also need technological banks to assist industry. MIDC can serve as a technical bank for the development of the capital goods industry. It can provide, among other things, technological direction in the form of engineering consultative services, quality control, manufacturing standards and the training of skilled and technical manpower.

The government and the private sector in this country should provide the capital goods industry the backing it deserves. We should all be reminded that the countries of the West have attained a high degree of industrial development because of a massive technological revolution centered on the modernization of the capital goods industry. Aware of its deficiency in natural resources, Japan has relied almost exclusively on technology and manpower development to push through its industrialization.

How do we in the Philippines stand? The capital goods industry here has to be set up on a horizontal basis consisting of a manageable number of equipment makers supported by a relatively large number of small manufacturers. This scheme can only succeed if technological management guidance could be extended to the smaller firms. Metals Industry Development Center (MIDC) created by virtue of R.A. 4724 to promote the vigorous development of the metals, engineering and allied industries, can provide that guidance. In order to industrialize, we have to mechanize. Where there are machines and metals, there MIDC will be.

from the
Editorial Staff

"Doc" ARIZABAL
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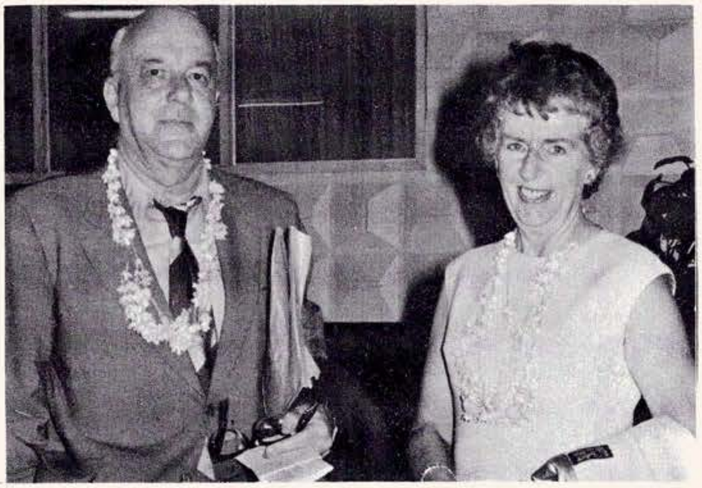
MIDC corner

News Coverage of Important MIDC, NSDB, PISI & SEAISI Happenings.



Mr. and Mrs. Fernand Dugal at the Manila International Airport.

UNIDO PROJECT MANAGER FOR MIDC ARRIVES

Fernand Dugal, UNIDO Project Manager in the execution of MIDC-UNDP assisted projects arrived last October 21, 1971, to assist MIDC in the organization and in rendering consultative services to local foundries, metal fabrication and rolling shops regarding their techno-economic needs and problems. He will also assist in the formation of guidelines for the development of the metals industry in the preparation of sectoral studies of the metals and allied industries, and in training local manpower along his line of specialization.

Mr. Dugal is a mechanical and industrial engineering graduate with post graduate studies in physical metallurgy at McGill University, Montreal, Quebec, Canada.

RAUL P. SULIT TO INDIA

Assistant Department Head and Officer-In-Charge of MIDC's Industrial Technology Department Raul Paras Sulit will participate in the UNIDO Workshop on the "Creation and Transfer of Metallurgical Know-How" which will be held in Jamshedpur, India from December 6 to 19, 1971.

Mr. Sulit will visit MIDC Singapore with Mr. Fernand Dugal, MIDC Project Manager from December 1 to 3 and from there proceed to India.

MIDC ENGINEERS TO WEST GERMANY

Two engineers, Marcelo B. Villanueva and Rolando T. Viloria, of MIDC's Industrial Technology Department left for West Germany last December 1, 1971. The 18-month training course is sponsored by the Philippine and German governments on a bilateral agreement.

Marcelo B. Villanueva, a metallurgical engineer, is a 1969 graduate from the University of the Philippines. At present he is MIDC's mechanical metallurgist in charge with the operation of the Destructive and Non-destructive Laboratories. In Germany, he will undergo training in metallurgy specializing in ✓Quality Control and Inspection.

Rolando T. Viloria, a junior mechanical engineer, graduated from the University of Santo Tomas in 1967. He is now the assistant engineer for MIDC's general machine shop and is being groomed as tool and die engineer for the Metal Forming Division. He will specialize in Tool and Die Making and Design Techniques in Germany.

Villanueva

Viloria

Mr. Lemuel Miravalles explaining Linear Programming techniques to participants of Operations Research seminar.

APPLIED OPERATIONS RESEARCH

A seminar designed for plant managers, superintendents, supervisors and other technical personnel is going on at MIDC. The course will strive to develop among the participants an understanding of and the right attitude to the use of quantitative techniques and models as tools in solving operational problems faced by the management in modern enterprises; an awareness of the usefulness, potentials and limitations of quantitative technique; and basic skills in the methods and techniques of operations research.

The scope of the seminar covers the following: nature of operations research, linear programming, inventory systems, waiting lines models, operations scheduling, operations simulation and administration and implementation.

The entire course will consist of 17 sessions held Tuesdays and Thursdays, from 6:00 to 8:00 P.M. The seminar started last Oct. 19, 1971 and will end on Dec. 16. The lecturers are Dr. Luis Pascual, and Professors Lemuel Miravalles, Narciso Silverio and Arturo Tolentino, all from the Department of Industrial Engineering and Operations Research, University of the Philippines.

Participants to this seminar are Benito Mauricio and Alberto Abanilla of Marsteel Corporation; Porfirio Gemoto of the AFP Supply Center; Ricardo Alonzo of Mackay Machinery; Servillano Lim of Master Steel; and Salvador Salas, Edgardo Lapuz, Manuel David and Leandro Ocampo of AG&P.

NEW TRENDS IN FOUNDRY TECHNOLOGY

The Productivity and Development Center (PDC), the Philippine Iron and Steel Institute (PISI) and the Metals Industry Development Center (MIDC) sponsored a seminar on "New Trends in Foundry Technology" last November 10 to 19 at the MIDC Seminar Room.

Guest lecturer was Tetsuji Hasegawa, a foundry expert and President of Intercasting Engineering, Inc. of Japan, who expounded on recent development in foundry technology and local application. Mr. Hasegawa has published several articles on foundry techniques and has rendered technical services to several foundry plants in Japan and Korea.

HEAT TREATMENT SEMINAR

A seminar on heat treatment of metals was held last August 14, 1971 for MIDC technical personnel. Speaker was Stig R. Samuelsson, heat treatment consultant for ASSAB (Associated Swedish Steel AB), who is a mechanical engineer and specialist in tools and heat treatment. He was accompanied by Pedro G. Soria, technical consultant for ASSAB and Engr. Edgar Artates of Ekman.

The seminar which lasted for one hour and a half was held at the MIDC seminar room.

Customs Commissioner Rolando Geotina is shown with guests and members of the PISI Board of Trustees. From left, L. C. Young, Jose Quema, Jose Marcelo, Jr., Dominador J. de Jesus, A. Africa, Dr. Antonio Arizabal and Lauro Cruz.

PISI SPONSORED SEMINARS

The Philippine Iron and Steel Institute (PISI) sponsored a series of seminars, wherein members and other invited guests were given the opportunity to present their ideas and discuss common problems affecting the iron and steel industry.

A seminar on "Customs Duties and Procedures" was held at the Savoy Hyatt's Mindanao Room last August 20, 1971, with Customs Commissioner Rolando Geotina as guest speaker. He stressed the significance of standardized classification and valuation of customs duties. With Commissioner Geotina were his staff which included Augusto Africa, Customs Collector for South Harbor; Rolando Manuel, Officer-in-Charge, Public Relations Department, Bureau of Customs and Armando Filamil of the Customs Bureau.

On September 24, 1971, a seminar on "Central Bank Policies and Procedures" was held at the Army and Navy Club with Assistant Director Guillermo V. Soliven as guest speaker. He discussed commodity classification, commodity loans and foreign borrowings.

PISI is presently working for the restructuring of the Tariff Code. To this end, a seminar was held October 22, 1971 at the Visayas Room of Savoy Hyatt Hotel with Mrs. Razon T. Haresco, Tariff Commission and Tolomeo T. Estepa, Technical Assistant, Tariff Commission as speakers. Mr. S. P. Bacalzo, Appraiser of the Bureau of Customs also attended the seminar.

PISI LAUNCHES OFFICIAL PUBLICATION

The Philippines Iron and Steel Institute (PISI) has recently launched its official monthly publication, the **PISI Bulletin.** The first issue came out last September, 1971.

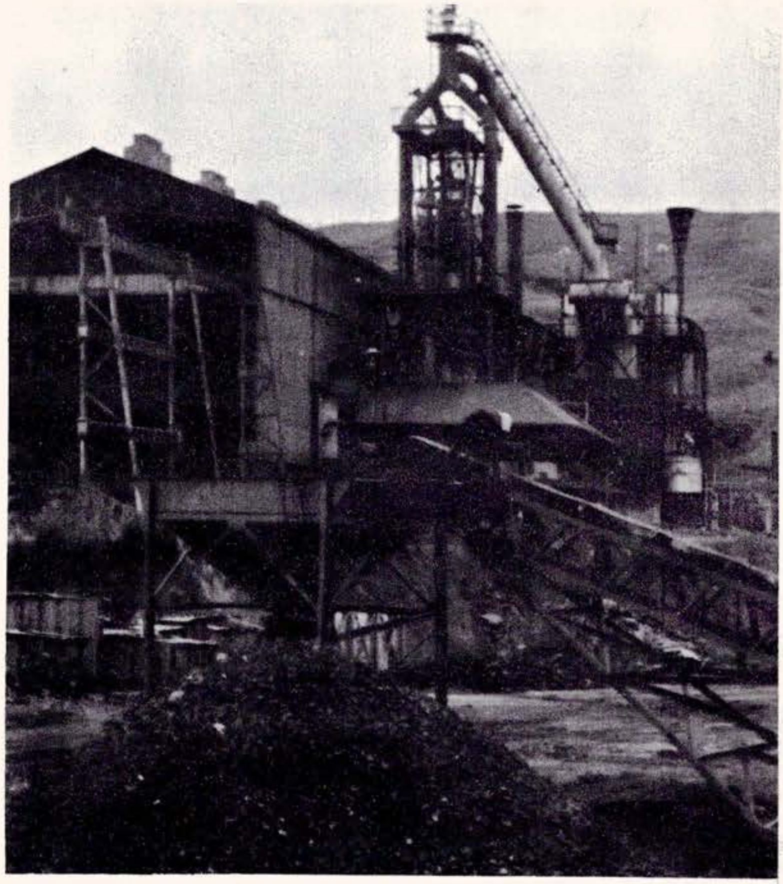
The bulletin contains articles on the local steel industry, news round-up of recent improvements and developments in iron and steel companies, the price list of steel products and news regarding PISI activities.

Tariff Commissioner Corazon Haresco, addressing the local iron and steel sector at the PISI seminar.

PART II

By ESTEFANIO M. GACAD

LOW SHAFT FURNACE SMELTING OF FERRUGINOUS MATERIALS



A general view of the NASSCO-J. Panganiban low-shaft furnace and casting hall from the ore stock yard.

I. DESCRIPTION AND RESULTS OF SMELTING IN LOW-SHAFT FURNACES

A. PIG IRON PRODUCTION IN LOW-SHAFT FURNACES

1. THE BUNZLAU LOW-SHAFT FURNACE (1)

The plant was built to utilize local deposits of low grade fuel and acidic ores. The furnace was circular in cross section, 0.9 m in diameter, with parallel sides of 6 m overall height, 2.4 m working height (the height from tuyere level to the top of the shaft) and equipped with 6 tuyeres of 76 mm inside diameter. The shell was refrtctory-lined from the top to 0.76 m above the tuyeres. There was no refractory lining below this level but the shell exterior was extensively water-cooled. A natural lining of frozen slag was formed which reached a thickness of about 15 cm.

During the early experiments lignite and anthracite briquettes were charged separately from the ore fines and the blast was enriched with oxygen on a large scale. The metal produced was of poor quality, containing 6% Si, 1% P, and 1.4 S. Later the coal and the ore fines were briquetted together with tar pitch as binder. This plant was totally destroyed during the war.

2. THE TROSTBERG LOW-SHAFT FURNACE (1)

The "Suddeutsche Kalkstickstoff Werke" built this experimental furnace during the 2nd World War at Trostberg, Eastern Bavaria to utilize the oxygen from an air separation plant which provided nitrogen for fertilizer production. The furnace had a circular cross section with a diameter of 1.98 m, 3.76 m high from the hearth floor to the top of the stack, 2.74 m working height, had parallel-sided walls and equipped with 6 tuyers. The slag notch was 61 cm below the tuyere level. The furnace was operated with oxygen-enriched unheated air blast. The charge consisted of coke and Austrian Erzburg ore with the following composition:

Fe	41%	SiO_2	7%
CaO	14%	Al_2O_3	4%
MgO	8%	Mn	2%

The furnace was operated continuously for 4 weeks. Initially, coke screened to +76-100mm was used while the oxygen content of the blast was gradually increased to 36%. The iron produced was low in carbon and manganese. Later coke crushed to minus 38mm containing 25-30% fines was used but the furnace became choked. Finally, screened coke of 20-38mm was used and satisfactory results were achieved. Table 1 shows the results of these smelting tests.

TABLE I — SUMMARY OF SMELTING TEST RESULTS OF THE TROSTBERG L.S.F.

Oxygen in Blast	21%	36%	42%
Coke size, mm	76-100	76-100	20-40
Pig iron composition			
C, %	3.5-3.8	2.0-3.0	3.8
Mn, %	2.5-3.0	1.0	2.1
Mn in slag, %		4.0-6.0	2.2

The top gas contained 42.3% CO when the blast was enriched to 42% oxygen, with a calorific value of about 1,300 kcal/m^3 and at a temperature of 200-300°C. The pig iron contained 0.02%S and 0.09%P. The coke consumption was about 1,360 kg. per ton of pig iron.

3. THE KOLN-KALK LOW-SHAFT FURNACE (1,6)

This experimental furnace and auxiliary plant was developed in 1948 by "Klockner-Humboldt-Deutz A.G." at Koln-Kalk as an attempt to remove the necessity to use lump ore and metallurgical coke by briquetting a charge of non-coking coal and ore fines using a suitable binder for smelting in the low-shaft furnace. In the earlier experiments, Salzgitter ore containing 25-30% Fe was briquetted with non-coking coal or lignite with sulphite lye, tar pitch and lime as binders.

The low-shaft furnace was oval in cross section with an oval-cylindrical shaft of 4.0 m overall height (from hearth floor to top of stack) and a working height of 3.2 m. The hearth measured 2.1 m and 0.91 m along its major and minor axes, respectively. The capacity of the furnace was 12 tons of pig iron per day.

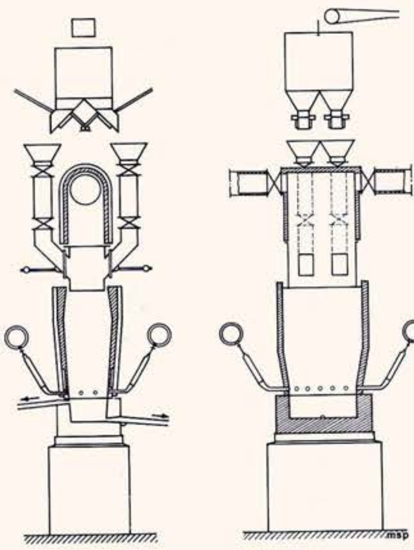


Fig. I Vertical Cross Sections of the Demag-Humboldt Low Shaft Furnace.

Smelting has been achieved satisfactorily with a fuel rate of 1.28 tons of gas coal (having 35% volatile matter) per ton of pig iron although more coal is required for really smooth running conditions. The calorific of the top gas was 1,300-1,420 kcal/ m^3 and contained 30% CO and 5% CH_4. The successful smelting results from this furnace was the basis for constructing the Treirdorf low-shaft furnace.

4. THE TREIRDORF LOW-SHAFT FURNACE (1,6,7)

In 1952 the "Demag-Humboldt-Niederschachtofen G.m.b.h" constructed at Treirdorf near Koln, the first semi-commercial low-shaft furnace using the single stage briquetting-smelting process developed at Koln-Kalk. This furnace had a maximum capacity of 100 tons of pig iron per day. It was characterized by its rectangular cross section with a hearth measuring 2 m × 4 m, equipped with 10 tuyeres of 140 mm inside diameter each, and a stack height of 5.5 m. The taphole and slag notch were located on the opposite long sides of the hearth. Figure 1 shows cross sections of this furnace. Many operating difficulties were encountered in this furnace. The one-stage smelting of composite briquettes was found out to be not feasible in commercial scale. The best results were obtained with a charge consisting of:

(1) ore-coal flux briquettes containing sufficient carbon for the reduction of iron oxides;
(2) coarse limestone for slag adjustment;
(3) medium-sized coke for heating purposes.

The overall operation of the plant proved to be very uneconomical so that it was stopped. (8)

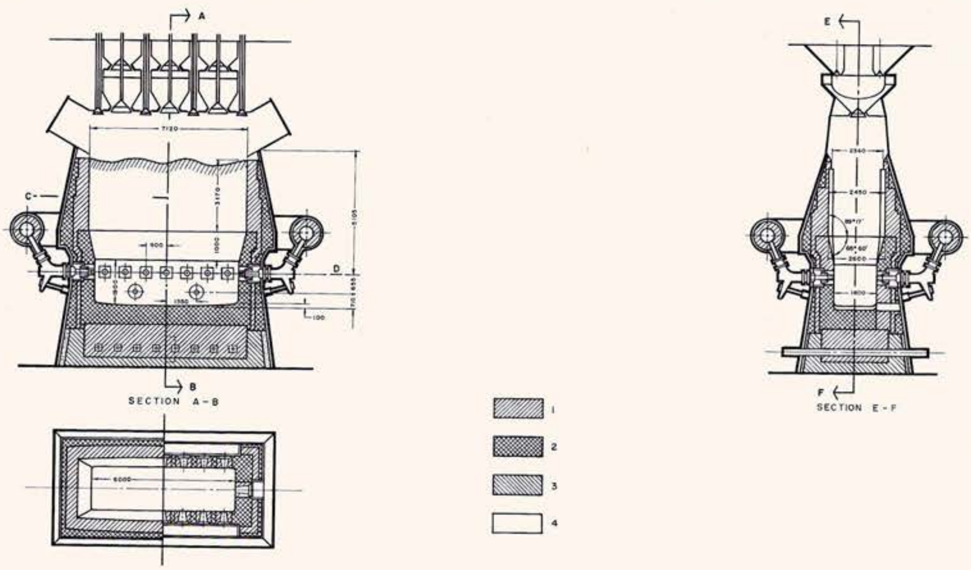


Fig. 2 - Furnace No. 10 at the West Kalbe plant (built in 1956).
1) firebrick ; 2) carbon lining ; 3) red brick ; 4) infusorial earth.

5. VEB NIEDERSCHACHTOFENWERK KALBE (1,3)

This plant had ten low-shaft furnaces constructed from 1950 to 1953. The first-tap of furnace no. 1 was done on October 15, 1951 and furnace no. 10 was blown in on March 9, 1953. The furnaces, all with rectangular cross sections, are arranged in 2 batteries with 5 furnaces in line per battery. Each battery is served by a common charging platform.

TABLE II — CHARACTERISTICS OF THE LOW-SHAFT FURNACES AT KALBE

Furnace No.	1 & 2	3-10
Hearth section	6.4 m x 1.5 m	6.5 m x 1.8 m
Working volume	43 & 53 m^3	75 m^3
Total volume	72 & 100 m^3	120 m^3

The rectangular cross section was adopted for economy in construction. The superstructures and refractories of rectangular furnaces are simpler than than those of round or oval cross sections. The characteristics of the furnaces are shown in Table II. Figure 2 shows the profile of low-shaft furnace no. 10.

Each furnace had 3 charging mechanisms, 16 tuyeres 120 mm inside diameter each (one tuyere at each end and 7 at each side of the tuyere belt), two slag tuyeres on one side and a taphole on the other side of the hearth.

There are two cowper stroves with a total heating surface of 18,000 m^2 for each furnace. The stoves are heated by the combustion of cleaned low-shaft furnace top gas. The hot blast temperature is from 800-850°C. Each furnace has its own blower.

Foundry pig iron is produced by the furnaces using Badeleben, Buckenberg, Braunesumpf and Krivoi-Rog (from the U.S.S.R.) ores, scraps and brown coal ash. The flux used are open hearth slag, ferromanganese slag and limestone. The compositions of the principal charge materials are shown in Table III. The granulometry of the charge varies from 6 to 80mm.

The fuels utilized are Zwickau coke (produced from the Zwickau coking coal deposits), gas works coke (by-product of the Magdeburg gas plants) and high temperature coke from lignite manufactured at the Lauchhammer coking plant bw the Bilkenroth-Rammler process.

The latter coke has low cohesion and abrasion indeces. The Zwickau coke and gas works coke have acidic ash while the high temperature coke from lignite has basic ash. The proximate analyses of these coke are shown in Table III. The granulometry of the coke used varies from 20 to 80 mm.

Typical operating characteristics of the low-shaft furnaces, the raw materials consumption, the composition of the pig iron, slag and top gas produced are also shown in Table III.

6. THE OUGRÉE LOW-SHAFT FURNACE (4,9,10)

In 1951, the "Association International pour les Recherches au Bass Fourneau d'Ougrée (A.I.R.O. or the International Low-Shaft Furnace Research Association) was founded by seven European countries,

TABLE III — OPERATING CHARACTERISTICS OF THE 75.5 CU.M. LOW-SHAFT FURNACE AT KALBE (MARCH, 1957)

A. RAW MATERIAL ANALYSES

Component, %	Iron Ores Bade-leben	Buchen-berg	Braune-sumpf	Brown Coal Ash	Open Hearth Slag	Ferro-Manganese Slag
Fe (total)	18.24	19.53	22.27	18.97	11.48	1.35
Mn	0.31	0.32	0.40	0.40	5.75	17.59
P	0.31	0.12	0.22	0.08	0.73	0.02
S	0.03	0.17	0.13	1.31	0.33	0.43
CaO	0.92	24.83	20.71	27.08	44.16	13.99
MgO	0.87	1.21	1.24	3.22	6.96	4.31
SiO_2	43.83	16.20	18.74	20.90	18.00	42.55
Al_2O_3	6.34	3.23	3.97	7.23	3.56	10.20
Ignition				—	—	—
Loss	5.77	23.20	19.30	—	—	—
Moisture	18.00	3.26	2.57			

Component	Zwickau Coke	Gas-works Coke	Lignite Coke
Moisture, %	13.8		3.1
Volatile Matter, %	1.1		3.0
Ash, %	11.7		10.1
Fixed Carbon, %	71.6		83.0
Sulfur, %	1.9		0.9

B. RAW MATERIAL CONSUMPTIONS

	Kg/t pig iron	% Fe
Badeleben iron ore		
Buchenberg iron ore	938	18.24
Braunesumf iron ore	1323	19.53
Brown coal ash	677	22.27
Open hearth slag	87.5	18.92
Ferromanganese slag	61.5	11.48
Scale	46.7	1.35
Pig iron scrap	19.1	66.70
Bought scrap	27.6	88.54
Limestone	330	93.31
Lignitic coke	791	0.53
Gas-works coke	1173	2.38

C. OPERATIONAL DATA:

Blast rate	23,000 SCM*/hr
Blast pressure	225-275 mm Hg
Blast temperature	800-820°C
Stock height	4.4-5.0 m
Pig iron production	85.7 t/day
Pig iron temperature	1350°C
Slag yield	2020 kg/t pig iron
Slag temperature	1450°C
Top gas yield (calculated)	8960 SCM/t pig iron
Top gas pressure	150-200 mm H_2O
Top gas temperature	270-290°C
Degree of indirect reduction	30%

D. PRODUCT ANALYSIS

	Weight %
1. Pig iron:	3.5 — 4.2
C	2.3 — 3.0
Si	1.0 maximum
Mn	0.5 — 0.7
P	0.04 maximum
S	
2. Slag:	0.3 — 1.0
Fe	0.2 — 0.8
Mn	45 — 48
CaO	2 — 3
MgO	38 — 41
SiO_2	8 — 9
Al_2O_3	0.7 — 1.1
3. Top gas:	
CO	
CO_2	36.8
CH_4	4.7
H_2	0.2
N_2	1.5
	56.8

TABLE IV — LOW-SHAFT FURNACE CHARACTERISTICS

1. Dimensions held constant

   Total height from the hearth floor to the top of the stack = 7.40 m

   Maximum height of burden above tuyere level = 4.80 m

2. Dimensions which were modified:

Period	Major Axis, m		Cross Section, Section, m²	Number of Tuyeres m²	Barrel Cross Section, m²	Shaft Cross Section, m²
April 1954	3.00	1.20	3.06	8	3.06	3.06
1954	3.00	1.20	3.06	8	4.40	4.40
1955	3.20	1.40	3.81	10	5.05	5.05
1956-58	3.20	1.40	3.81	10	5.91	5.05
1965	1.40	1.D.	1.56			

namely: Austria, Belgium, France, Greece, Italy, Luxembourg and the Netherlands, and later joined by the Batelle Memorial Institute (USA). The objectives of the association were to construct, at Ougrée, (Liege) Belgium, a law-shaft furnace of sufficient size so that extrapolation to industrial scale may be possible and to study the operational characteristics of this furnace in order to know if the use of a short stack height would allow the economical production of iron utilizing fine ores and fuels of lesser strength than metallurgical coke. Another research objective was to find out if the low-shaft furnace is similar to the blast furnace and if so, whether the low-shaft furnace can be considered as model of the blast furnace in order to take advantage of the experimental facilities available for studying the reduction phenomena in shaft furnaces and notably the effect of oxygen enrichment of the blast.

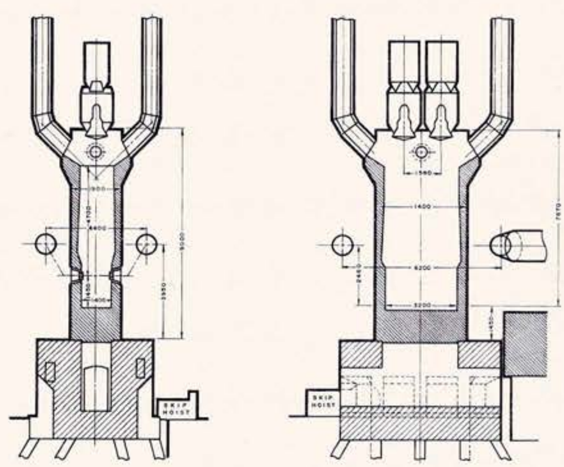
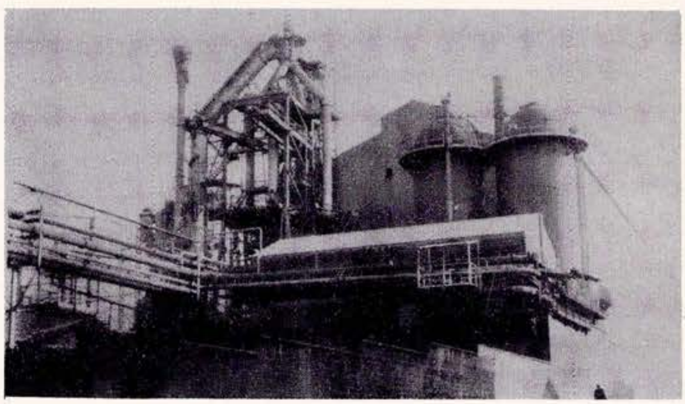


Fig. 3-A vertical cross section of the Ougree low shaft furnace (1958).

An oval cross section was adopted, with major and minor axes of the hearth initially equal to 3.00 m and 1.2 m, respectively, so as to study the behaviour of the burden in such type of furnace. Another major difference of this furnace is that it was equipped for low and high pressure operation.

The furnace had an oval-cylindrical profile and 8 tuyeres initially. It had two charging mechanisms each provided with a small bell and big bell. The furnace characteristics had undergone modifications as seen in the following table. Figure 3-A shows the profile of the furnace after its modification in 1958 and Figure 3-B shows a picture of the plant in 1948.



A view of the Ougree Low-Shaft Furnace Plant in 1958.

The furnace was served by two cowper stoves which could pre-heat the blast to 800°C. The refractories of the stoves were changed in 1962 thus increasing the hot blast heating capacity to 1100°C.

The furnace and auxiliaries were well-equipped for experimental and research purposes. It has facilities for oxygen enrichment of the blast; steam, oil and gas

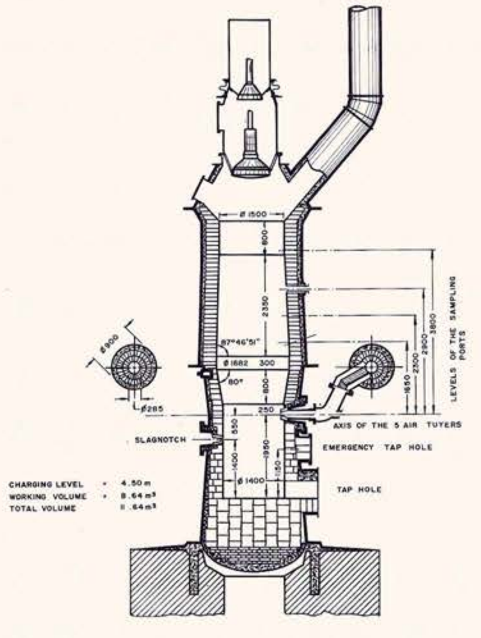


Fig. 4- Cross section of the Ougree experimental blast furnace in 1965.

injection at the tuyeres; continuous top gas analyzer and recorder; vertical and horizontal probes for measuring temperature and taking samples of gas and burden materials at different levels in the furnace shaft.

In 1965, the oval furnace was reconstructed into a smaller furnace of circular cross section with essentially the same height as the oval furnace. One charging mechanism was retained. Figure 4 shows the profile of this furnace in 1965.

Operational Results

The furnace operates in continuous campaigns of 4 to 5 months. Two campaigns are conducted each year in between the winter and summer vacations. During each campaign two or more test periods are performed. As of December, 1969, 182 tests have already been done. After each test period, complete material and energy balances are made. A preliminary report is published after each test. The complete reports and evaluations are published yearly by the "Centre National de Recherches Metallurgiques" (CNRM) which is managing the technical activities of the AIRBO.

From 1953 to 1958 the tests were geared principally to the production of iron from raw materials not usable in blast furnaces. Since 1958 the tests were geared principally to the use of the low-shaft furnace as an experimental blast furnace.

For each test period the effect of a particular variable or combination of variables are studied while the other variables are either eliminated or maintained constant.

The variables can be one or a combination of any of the following:

I BURDEN
- 1. granulometry
- 2. type of ore
- 3. sintered ores
  - 1) reducibility
  - 2) quality
    - a. acid sinter
    - b. basic sinter
    - c. self-fluxing sinter
- 4. pellets
  - 1) reducibility
  - 2) swelling characteristics
  - 3) quality
    - a. acid pellets
    - b. basic pellets
    - c. self-fluxing pellets
- 5. flux
  - 1) limestone
  - 2) basic slag
- 6. extruded briquettes of composite ore and fuel

II. FUEL
- 1. granulometry
- 2. coal
- 3. semi-coke
- 4. metallurgical coke
- 5. coke briquettes from non-coking coal

III. CHARGING METHOD
- 1. separate or bed charging
- 2. mixed or batch charging

IV BLAST
- 1. temperature
- 2. oxygen enrichment
- 3. fuel oil injection
- 4. steam injection
- 5. coke oven gas injection
- 6. natural gas injection
- 7. reformed gas

V PRESSURE

VI BLAST BLOWING RATE

Tables V and VI give the results of several test periods which show the effects of the types of fuel, burden, granulometry of the charge and pressure. The analyses and granulometry of fuels and burden are shown in the same tables.

Based on the test results obtained the first 5 years of operation, it was concluded that the low-shaft furnace was not an economical solution to treat the ore fines directly. For an efficient operation of

TABLE V — OPERATING CHARACTERISTICS OF THE OUGREÉ LOW-SHAFT FURNACE DURING TESTS PERIODS 4, 13 AND 25

A. RAW MATERIAL CHARACTERISTICS

Components (Dry basis)	Iron Ores				
	I	II	III	IV	Pebbles
H_2O (combined),%	7.13	5.60	4.19	6.89	—
Fe (total),%	28.37	34.50	31.48	33.15	—
Mn,%	0.27	0.33	0.30	0.34	—
P,%	0.570	0.698	0.654	0.68	—
S,%	0.137			0.08	—
$SioO_2$,%	17.11	7.41	7.60	7.40	73.50
Al_2O_3,%	5.63	4.25	3.10	4.13	4.29
CaO,%	8.44	15.08	17.17	14.86	8.54
MgO,%	1.76	1.79	1.60	1.13	—
Ignitionless,%	6.65	15.30	18.73	14.94	—
Moisture content,%		11.70	9.30	10.8	
Size range, mm	5-20	5-20	5-35	4-30	
Fines: —10 + 5mm,%	35	27.1	19.8	24.78	
— 5mm,%	35	10.5	8.2	4.5	

Components (Dry basis)	Coke	Semi-Coke I	Semi-Coke II	Coal
Volatile Matter,%	2.2	10.8	9.70	40.40
Ash	12.5	10.3	11.95	6.35
S (total),%	1.0	0.84	0.93	0.85
Moisture content	15.0	12.5	15.8	6.14
Size range, mm	5-20	5-20	5-25	30-50
Fines: —10 + 55mm,%			8.52	2.59
—5mm,%	5.5	8.9	9.25	5.07

Test Periods			
B. RAW MATERIAL CONSUMPTION:		Operational Results	
Ore 1, kg/t pig iron	746.5	—	—
Ore II, kg/t pig iron	3567.8	—	—
Ore III, kg/t pig iron	—	3658	—
Ore IV, kg/t pig iron	—	—	3790
Pebbles, kg/t pig iron	—	—	36
Coke, kg/t pig iron	1673	—	—
Semi-coke I, kg/t pig iron	—	1853	—
Semi-coke II, kg/t pig iron	—	—	98
Coal, kg/t pig iron	—	—	3111
Air blast, SCM/t pig iron	3280	3090	5230

Test Periods	4	13	25
C. OPERATIONAL DATA:			
Blast temperature, °C	662	767	753
Blast pressure, mm Hg	233	173	193
Oxygen in the blast,%	21	28	21
Pig iron production, t/day	33.7	36.1	20.7
Slag yield, kg/t.p.i.	980	1072	1010
Top gas production, SCM/.p.i.	5960	5160	7995
Top gas temperature, °C	214	125	252
Dust loss, kg/t.pi.i	562		
D. PRODUCT ANALYSES:			
1. Pig Iron, Weight %			
C	3.16	3.61	3.37
Si	0.48	0.23	0.90
Mn	0.31	0.34	0.47
S	0.214	0.114	0.118
P	1.85	1.60	1.74
2. Slag, Weight %			
CaO	43.90	47.49	46.71
SiO_2	30.85	28.33	30.20
Al_2O_3	17.30	15.72	16.00
MgO	4.88	4.63	4.32
Fe	1.20	2.12	1.05
Mn	0.40	0.57	0.30
S	1.71	1.31	1.88
3. Top gas, volume %		38.8	31.76
CO	28.9	9.2	6.27
CO_2	10.2	6.9	8.31
N_2	58	45.1	51.86
Calorific value, kcal/SCM	948	1350	1360

the furnace it was necessary to screen the charged to remove the minus 5 mm from the burden and preferably the minus 10 mm from the fuel. With regard to the type of fuel, as its quality decreased the specific fuel consumption increased accompanied by a corresponding decrease in production.

When the furnace was operated at high pressure, its overall operating characteristics is similar to that of a blast furnace. This was the principal basis for the utilization of the Ougrée low-shaft furnace as an experimental blast furnace.

Numerous test results have shown the similarity of temperature distribution, thermal balance and physico-chemical processes in the blast furnace and the low-shaft furnace operating under high pressure and moderate blowing when both are using the same type of burden (screened to the required sizes). The two main differences between the two are the size range of the burden granulometry and the higher productivity per unit of useful volume of the low-shaft furnace. Under this condition the low-shaft furnace has also the unique advantage of highly increasing its productivity, percentage-wise, by just increasing its driving or blowing rate. At increased blowing rate, the productivity can be increased without increasing the coke rate as long as the chemical reserve zone still exists in the shaft. When this chemical reserve zone has disappeared, the coke rate increases almost linearly with the blowing rate until the thermal reserve zone has disappeared beyond which the coke rate increases almost exponentially.

Prior to the time this condition is attained, the the productivity usually has reached its maximum and then starts falling off. The maximum blowing rate is attained when either the charge or the primary slag in the bosh no longer descends (fluidized).

7. THE GERLAFINGEN LOW-SHAFT FURNACE (1,6)

This low shaft furnace was constructed from a cupola at Gerlafingen, Switzerland, for experimental meltings conducted in 1954 using local ore and coal containing high volatile matter (49%) with oxygen enriched blast. The furnace was 3.76 m from hearth to top with a working height of 2.74 m, hearth diameter of 1.47 m, and equipped with four tuyeres of 38 mm inside diameter each. A typical result obtained is shown below.

TABLE VI — OPERATING CHARACTERISTICS OF THE OUGREE LOW-SHAFT FURNACE DURING TEST PERIODS 43, 47, 52 & 53

A. RAW MATERIALS CHARACTERISTICS

Components (dry basis),%	Iron Ore	Sinter	Coke
H_2O combined	7.0	—	—
Fe(total)	32.3	45.6	—
		9.9	—
Fe^{++}	9.0	35.7	—
		0.4	—
Fe^{+++}	23.3	0.9	—
Mn	0.3	13.5	—
P	0.7	10.6	—
CaO	15.1	0.2	—
SiO_2	8.4	—	0.5
CO_2	13.0	—	0.5
Volatile Matter	—	—	11.8-13.1
Ash	—	—	70-73
Fixed Carbon	—	0.1	13.6-15.1
Moisture,%	9.8		

Screen Analysis, Weight %	Iron Ore	Sinter	Coke
+25 —30mm	0.1		1.2
+20 —25mm	8.3		16.2
+15 —20mm	26.7		16.2
+10 —15mm	33.5		39.0
+ 5 —10mm	26.9		30.7
— 5mm	4.5		6.6

Operational Results

Test Periods	43	47	52	53
B. RAW MATERIAL CONSUMPTION:				
Iron Ore, kg/t.p.i.	3279	3290	—	—
Sinter, kg/t.p.i.	—	—	2132	2114
Coke, kg/t.p.i.	1420	1197	1020	890
C. OPERATIONAL DATA:				
Blast temperature, °C	750	750	800	800
Blast pressure, kg/cm^2	0.199	1.52	0.258	1.48
Stock height, m	3.0	4.0	4.3	4.4
Production, t.p.i./day	30.0	32.9	39.6	42.7
Slag yield, kg/t.p.i.	1050	1056	770	780
Top gas temperature, °C	48	60	230	158
Top pressure, kg/cm^2	—	1.42	—	1.37
Dust loss, kg/t.p.i.	24	8	14	9
Indirect reduction	48%	53.5%	52%	59%
D. PRODUCT ANALYSES:				
Pig Iron: C,%	3.55	3.79	3.25	3.45
Si,%	0.58	0.57	1.26	0.89
S,%	0.075	0.029	0.050	0.041
Slag: $CaO/SioO_2$	1.35	1.46	1.02	1.08
S,%	1.35	1.02	1.30	1.19
Top gas: CO_2/Co	0.36	0.42	0.32	0.46
H_2,%	2.9	2.9	1.8	1.7

HEAT TREATMENT OF TOOL AND HIGH TENSILE MACHINERY STEELS

By STIG R. SAMUELSSON
Stockholm, Sweden

The process of using heat in order to change the physical properties in steels used for tools and machinery parts is Heat Treatment. Long ago it was considered a mysterious process. However, what actually is happening in the steel when we are carrying out our heat treatment is no mystery at all.

An excellent insurance against premature failure of a tool is by selecting a good material for it and by doing the heat treatment correctly. It is, however, very common that tools or machine parts fail too early and this is often due to poor selection of steel grades and qualities and wrongly carried out heat treatment.

Two pieces of steel from different steelmakers may have the same analysis but the quality may not be the same. The quality depends much on the structure of the steel, the quantity and composition of the inclusions and the distribution, shapes and sizes of the carbides, etc.

The people selected to do the heat treatment may not be doing it correctly and this may be due to lack of suitable equipment and/or know-how. To make a tool hard is quite simple but to give the tool the most suitable hardness to serve the purpose is often difficult.

To obtain the best properties in correctly selected steel requires ordinary heat treatment equipment — at least the furnace should be provided with temperature control. However, how often does it not happen that the heat treatment is done in a dark, dirty corner in the factory building or even directly under the sky? A crude coke furnace is used in some cases and the temperature measurement is done in a visual guess work. The quenching water is often times covered by a layer of oil and the quenching oil mixed with rain water.

A factory owner may have spent thousands of dollars on good high production machinery, but for equipment for heat treatment only a few dollars are spent in the equipment which is to give the necessary properties of the steel in the tool which the expensive machinery has to support. For factories making complicated tools and not having sufficient heat treatment facilities, it usually pays off to have the tools heat treated by a commercial heat treatment shop or by a neighboring factory which have good furnaces.

STEEL

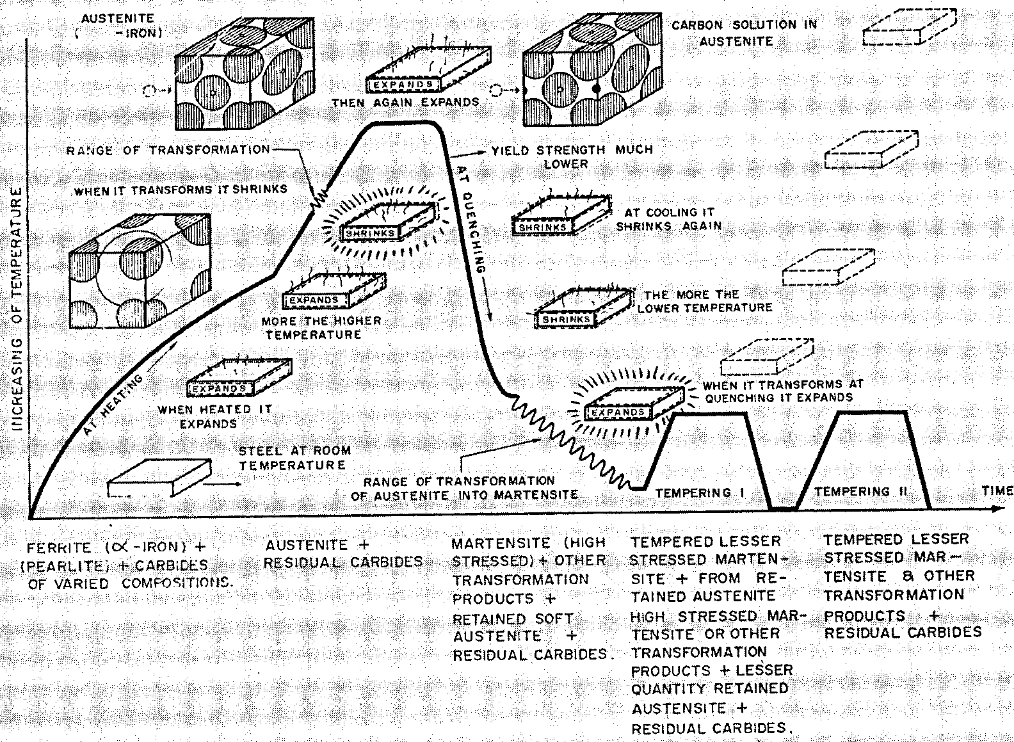
Steels are alloys of iron (ferrite) and other elements in which carbon is the most important. The other important elements are manganese, chromium, molybdenum, tungsten, vanadium, nickel, cobalt, etc.

Looking at a fractured steel surface we can see that it is made up of a large number of crystals. By looking in a microscope, we can also see various steel constituents such as carbides and inclusions, etc.. By X-ray defraction, the crystals have been found to be built up of a huge number of elements called atoms situated in a regular pattern. However, some failure in the pattern called dislocations exist.

The iron crystals change the pattern of the atoms at some temperatures making it possible for foreign atoms to migrate between the iron atoms (solid solution). This is the reason why we can change the properties of the steels by heating. Let's have a look at what is happening in a piece of steel when heated up.

Heated up, the steel becomes hot. Hot steel expands and do so for each degree of temperature rise. If we measure a piece say 100 × 100 × 25 mm at room temperature, we will find that at 400 degrees C the size is 100.44 mm lengthwise and about the same crosswise. The thickness is about 25.11 mm. If we heat in such a way that we get a uniform temperature we also get differences in the degree of expansions. This creates what is known as *thermal stresses*. The bigger the temperature differences the bigger the stresses.

Up to about 720 degrees C, the crystal has its atoms arranged as a cube with one atom in the center. When the temperature rises above this, the atoms rearrange somewhat. The atoms inside the



GENERAL OUTLINE OF PROCESSES & STRUCTURES OF TOOL STEEL DURING HEAT TREATMENT

cube come out and we will find one atom on every surface of the cube. This opens up the spaces between the corner atoms giving greater possibility for foreign atoms to migrate between the iron atoms. When this rearrangement (transformation) happens the steel contracts a little and when this change is ready, the steel expands again.

Looking at the physical properties such as the ultimate or tensile strength and yield strength, we will find that they have changed considerably. At room temperature an annealed tool steel usually has a tensile strength of around 60 to 80 kg. per sq. mm. (40 to 50 tons per sq. in.) and a yield strength of less than 50 kg. per sq. mm. (30 tons per sq. in.). At the transformation temperature, the yield strength is lesser than 15 kg. per sq. mm. (10 tons per sq. in.) and thereby much weaker.

In addition to thermal stresses, we also have *residual (build-in) stresses* from previous machining or forming. If the rate of heating is fast the thermal stresses and the build-in stresses become so high that they exceed the lowered yield strength. These stresses release by deforming the tool (bend or shape distortion) and the change will remain; after that, the heat treatment is completed.

HARDENING OF TOOLS

The hardening of tools consists of three (3) operations, namely:

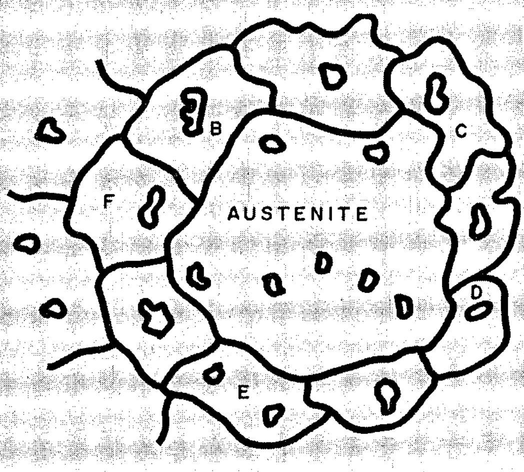
a) Heating
b) Quenching
c) Tempering

Heating

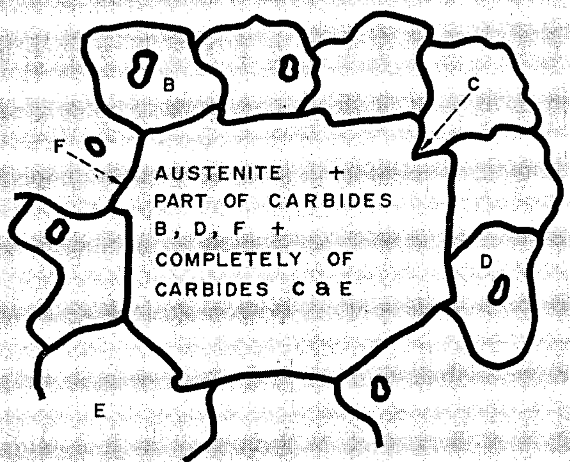
The heating may be done in several ways: in muffle furnaces with controlled atmosphere or vacuum or without by packing the tools in a box with a gaseous emitted packing medium as charcoal, cast iron chips or coke to avoid chemical changes of the heated tool surface. The furnaces may be heated electrically or by oil or gas. Beside muffle furnaces, heating in fused salts (salt baths) is common. These salt baths may be electrically heated (externally with low and medium temperature salts or internally with medium and high temperature salts or by oil or gas heated with medium temperature salts.)

When heating up a steel, care should be taken in order to prevent rapid and uneven heating. This is best done by doing the heating in steps, i.e. preheating in a furnace at lower temperature (450 to 700 degrees C) and thereafter transfering the tool to ano-

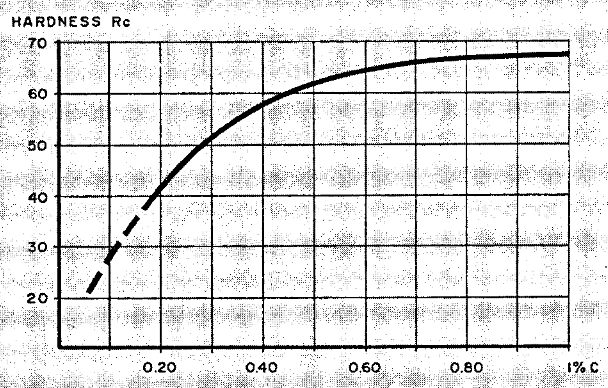
xerox



GRAINS OF AUSTENITE AND CARBIDES BEFORE SOAKING.



GRAINS OF AUSTENITE AND FEWER UNDISSOLVED CARBIDES AFTER SOAKING.



MAXIMUM HARDNESS OBTAINED IN STEEL AS A FUNCTION OF ITS CARBON CONTENT WITH 100% MARTENSITE.

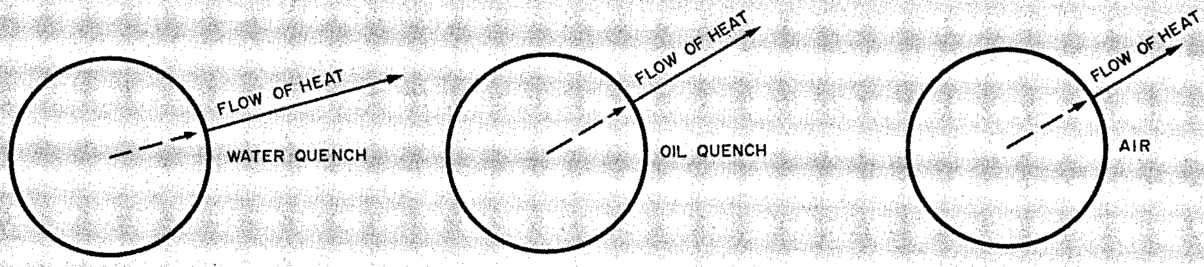
other furnace up at the selected hardening temperature or by increasing the temperature of the furnace used for the preheating. When heating up at a lower temperature the rate of heating is much slower which gives the heat enough time to conduct into the center of the workpiece or to big sections giving only small thermal stresses.

The time it takes to reach the hardening temperature especially of a packed tool is difficult to give. This is due to factors unknwon to the estimator such as the size and type of furnace and very important is its condition. It also heavily depends upon the kind and quantity of packing medium used. A practical way to find out when a tool packed in a box has reached the hardening temperature is to lift the cover with a *hoke,* clear the packing medium from part of the tool surface and notice the color on the tool. If it is darker than the furnace next to the box, it has a lower temperature. If the color is the same, both tool and furnace have the same temperature. When packing a tool, put always the face of the tool down.

When the steel has reached the temperature for the transformation, the specific mixture of ferrite and cementite (ferro carbide) called pearlite transform into austenite (the structure seen in red hot steel) and free ferrite or carbides starts to go into solution. These dissolved carbides alloy or change the composition of the austenite and the composition of it will not become the same as the composition of the steel until all ferrite or carbides are completely dissolved in the austenite.

To dissolve carbides in the austenite takes some time. The carbide atoms have to migrate some distances in the steel. We must, therefore, give them some time for this (we soak the steel for a while). This soaking time and temperature vary for the different grades of steel. Compare lumps of sugar in a cup of tea. Small lumps dissolve easier than big ones and a soft easy melting one faster than a harder grade of lumps.

After completing the soaking time at their right temperature, we quench the steel. The austenite transforms during quenching into a new structure called martensite. The hardeness of the martensite depends mostly on the amount of carbon dissolved in the austenite. In most cases, we do not dissolve all the carbides in to the austenite. This is due to the fact that their hardness is greater than the martensite. We get hereby a hard, strong martensite as a matrix in which still harder small carbides are embedded.



WITH WATER QUENCHING, THE HEAT FLOW FROM THE SURFACE TO THE WATER IS MUCH GREATER THAN THE FLOW OF THE HEAT FROM THE CORE TO THE SURFACE. THIS CREATES BIG TEMPERATURE DIFFERENCES.

WITH OIL QUENCHING, THE FLOW OF HEAT IS LESS FROM THE SURFACE TO OIL THAN WITH WATER BUT STILL GREATER THAN FROM THE CORE TO THE SURFACE.

THE HEAT FLOW WITH COOLING IN AIR IS ABOUT THE SAME FROM THE CORE AS IT IS FROM THE SURFACE TO THE AIR

Quenching

During the quenching operation, we immersed the correct heated and soaked tool in a liquid (oil, water or fused salt) or by cooling in air or forced gases. This is the operation which — if fast enough — produces the hard new structure called martensite. With quenching, temperature differences arise between the surface and core. These differences cause high internal stresses in the steel. If the quenching is too drastic, quenching cracks easily develop. The rate of cooling at the surface layer depends on the ability of the quenching medium to remove heat from the steel while the core is cooled by diffusion of heat (thermal conductivity) from the core out to the surface. The rate of cooling of the core is governed by the thermal conductivity and the size of the piece to be quenched. Thin walled or small tools quench faster than big one and water quench faster than oil or air.

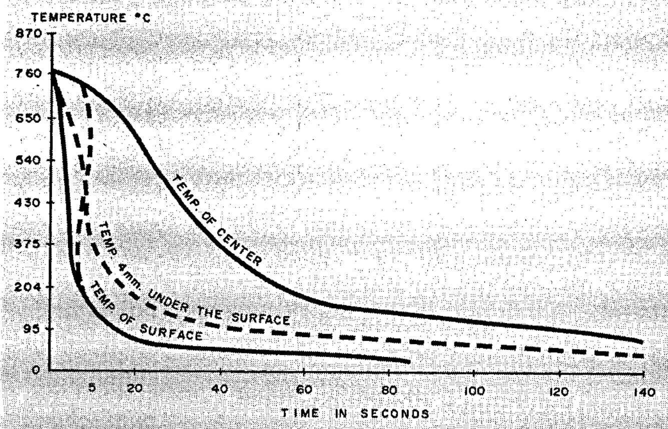
At the quenching, another big stress arises called *transformation stress.* This stress is due to the differences in volume of the products transformed from the austenite. The martensite has the greatest volume of all the transformation products. As the surfaces and thin parts always cool faster, they also transform and harden first and become rigid. After some time underneath the layer, the core transforms and expands, creating heavy tension on the rigid surface of the layer. If the quenching is too drastic, delaying of tools in the quencing media or quenching in oil containing water and long delaying of time between quenching and tempering easily create stresses high enough to crack the tools.

Common Failures to Low Hardness After Quenching

If the hardness after quenching is lower than the hardness indicated in steel catalogues from steel makers, $\pm$ 2 to 3 Rockwell C hardness, the following failures are common:

1. Too low temperature
2. Too short time
3. Too high temperature
4. Too long time
5. Decarburization
6. Too slow quenching speed
7. Wrong identification

1. The furnace may have a lower temperature than the one indicated by the temperature measuring instrument.
2. The steel part has been taken out for quenching too soon so that it may not have reached the temperature or that it has been given a very short time for sufficient carbide solution in the austenite.
3. & 4. Very high temperature as well as too long a time at the temperature gives a lot of soft retained austenite. It may also give large grains which impart poor toughness to the steel.
5. In furnaces, without protecting gas, there is hot air. This hot air contains tbout 21 per cent oxygen (O_2). This oxygen oxidizes the carbon faster than it does the iron (ferrite). This higher rate of oxidation of carbon gives the steel surface a lower hardness as well as lesser wear resistance.
6. Too slow quenching speed produces softer, high temperature transformation products (pearlite, bainite, etc.) than the wanted harder martensite.
7. In workshops with poor stock organization mixing up of steel often happens. Remember that each steel has its own hardening temperature and rate of cooling to become successfully treated. The heat treater must know what grade of steel he has to work on in order to give the tool the best properties.



COOLING CURVES WHICH SHOW THE TEMPERATURE AT SEVERAL POSITION OF A 2 INCH CYLINDER QUENCHED IN WATER, FROM P. PAYSON "THE METALLURGY OF TOOL STEEL."

Commont Causes of Cracking of Tools in Heat Treatment:

1. The quenching has been done too drastically or on too low temperature.
2. The steel has been delayed in the quenching medium.
3. Tempering has not been done immediately after quenching that the tool has cooled down to about 40 to 80 degrees C.
4. The quenching media has not been cleaned (the oil may contain water).
5. Poor selection of steel grade for a specific design.

1. With drastic quenching, big differences of temperature arise between different parts of the steel. These differences create big stresses due to differences in contraction and expansion during the transformation of austenite into martensite or other transformation products:
   To minimize stresses,
   a) Water hardening steel primarily in water and transfer the tool for final quenching in oil.
   b) Oil hardening the steel primarily in oil and finally quench in oil.
   c) Oil and air hardening steels can be quenched in fused salt at 200 to 550 degrees C (depending on the grade). Quenching at these temperatures with the delay of time, permits the temperature to become equal in the steel before transformation. This allows the steel to harden and expand equally.
2. Delaying the steel in the quenching process causes complete cooling of the core followed by expansion which causes stresses on the earlier hardened and unflexible surface.
3. Delaying the tempering operation may provide possibility for further transformation of the core followed by expansion which causes stresses on the earlier hardened steel and not on the flexible surface.
4. The quenching oil may contain, for example, some water which changes the quenching characteristics of the oil. Water causes the oil to quench slowly at the initial stage and rapidly at the final stage. This causes not only cracks but also a softer steel due to transformation of the austenite into softer higher temperature transformation products.
5. It happens now and then that intricately designed tools are made from a poorly selected steel grade. A steel requiring drastic quenching is chosen. To be safe in such cases, an air hardening steel should be selected, i.e. ASSAB XW-10, or XW-5. Remember that the ideal shape for heat treatment is one in which all parts of any section or surface receive and give back the same amount of heat at the same time. Such a shape of course does not exist, but the designers should remember it and work towards it.

Tempering

Tempering is the last operation in heat treatment but not the least important one. The principal reason for tempering is to reduce the internal stresses developed during quenching and to achieve a proper balance between hardness and toughness. Tempering operation means re-heating of the quench hardened steel to a certain chosen time and temperature. The choice of time and temperature depends on the required compromise between "toughness" and "hardness". It is very important to immediately temper the tool after it has cooled down to about 40 degree C. Not done, the risk for cracking is great. The cracking of many tools during heat treatment is due to the very simple fact that tempering is not started until several hours after quenching, when the tool is completely cold. The tool should be removed from the quenching bath when it is hot enough to cause the adherent oil to smoke a little. From this temperature, allow the tool to cool down in air to about 40 degrees C.

SELECTION OF STEEL GRADE

In tool steel, we have two important properties which act in opposition to each other. They are:

1. Hardness and wear resistance.
2. Toughness (the ability to absorb energy by plastic deformation).

When the wear resistance is increased the toughness is usually decreased. We have, therefore, to make a compromise between these properties. This can be done through the selection of an inherently tougher steel grade or by heat treating the selected grade to a lower hardness or by doing both.

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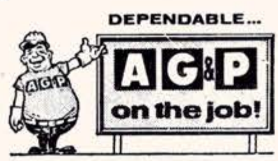


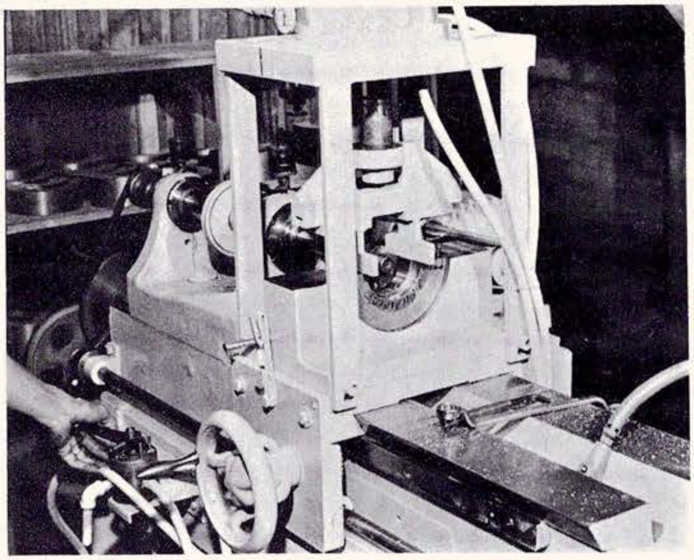
INCREASING THE PRODUCTIVITY OF MACHINE SHOP EQUIPMENT

By LEONARDO B. SANTIAGO

In the metalworking industry, those engaged in the machineshop type of operations are the ones which are usually equipped with general purpose machine tools which provide the necessary flexibility to meet orders for a wide variety of items in small lot sizes. The productivity of these general purpose ma chines are usually dependent upon the operators' skills and efforts such that in most cases, the output is far from satisfactory and the resulting cost per unit more often than not shoots up. Quality of workmanship of the finished products is seldom consistent. In cases where workmanship and dimensional specifications are tight, it becomes necessary to conduct a thorough inspection if it is desired that only those that are within specifications are shipped out. Even with this, defective products manage to slip past the inspectors because of human factors involved.

With the present high cost of labor, materials, utilities, fuels, lubricants and supplies, the productivity profile of a firm can be a factor to determine whether it can remain in operation profitably and compete favorably in the market or fold up altogether. An improvement in the firm's productivity can do a lot towards assuring its survival in today's highly unstable economic situation. There are actually several means by which production can be increased but the choice must be justified in terms of additional capital outlay, suitability to existing market situation as well as projected requirements, and availability of local technicians to operate and maintain the new set-up. Equally important is that the reliability and quality of the product must not be sacrificed by the increase in output. For example, the use of NC (numerically controlled) machines can invariably increase production, but this option is hardly justified at present because of the high initial cost involved. Facilities for programming, and tooling and maintaining NC machines are hardly available in the country.

At Philparts Manufacturing Co., Inc. where majority of the equipment for the manufacture of engine bearings and pistons are general purpose machines, the need for improving productivity shortly after commercial operation was felt. Having to compete with articles produced by the more advanced manufacturers of Europe, Japan and U.S.A. and faced with a fragmented local market which cannot justify the use of high production machines, the plant must have sufficient flexibility to produce small lot orders at cost that must be equal, if not lower, than the imported counterparts. After considering all aspects of operations and the company's financial capability, it was decided to work out the productivity problem in small steps involving already existing machines. As conceived and executed, modifications of machine tools were based on careful studies of the production flowsheet for each type of operation. This insured that the modification or improvement would be the most relevant to the process, reasonable in cost and give immediate result. At the beginning most of the improve-



Pneumatic clamping of half-bearing shells results in increased production and consistent dimensional accuracy.

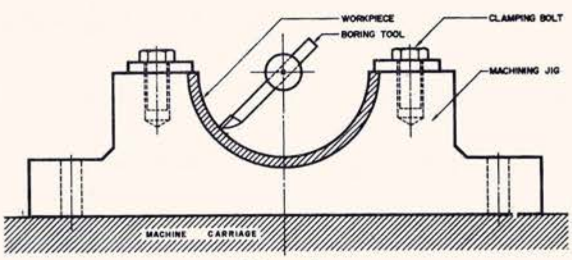


Figure 1

FINISH BORE MACHINING OF HALF SHELL BEARING INSERT WITH BOLTED CLAMPS

Work Loading and Clamping .... 2 minutes
Machining Time (1-1/2" long Workpiece)..... 1 minute
Work Unclamping and Unloading .... 2 minutes
Total Time .... 5 minutes per piece

Note: Accuracy of finish dependent upon torque applied on clamping bolt.

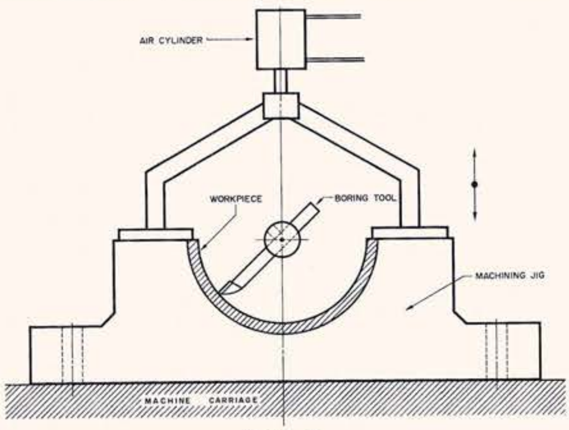


Figure 2

FINISH BORE MACHINING OF HALF SHELL BEARING INSERT USING AIR CYLINDER CLAMP

Work Loading and Clamping .... 30 seconds
Machining Time (1-1/2" long Workpiece)..... 1 minute
Work Unclamping and Unloading .... 30 seconds
Total Time .... 2 minutes

Note: Constant clamping force achieved by means of pressure regulator.

ments were made in the area of work-holding or work-positioning. Later on tool or work-feeding modifications were carried out using electro-pneumatic-hydraulic circuitries. The Low Cost Automation Course conducted by the University of the Philippines Institute for Small Scale Industries provided us with the necessary background to carry out circuit designs for this purpose. Although most of the components needed for the modification works will be imported, cost of the improvements is still justified considering the increase in the output of the modified general purpose machines and the price of an equivalent special purpose machine for the same application. Also worth mentioning is the fact that the flexibility of operations were not affected since we made it a point to stress ease of set-up andchange-over one job to another in our modifications. Some illustrative cases of the work done at Philparts are given in detail below.

a) Figure 1 shows the set-up for the finish machining of the bores of half shell bearing inserts in a simple boring machine with the boring tool in the machine spindle and the workpiece clamped in a jig (the work holding jig was quite costly) fixed to the traversing carriage. The clamping of the workpiece is effected by bolts which are tightened after loading the bearing shell. In this set-up the non-productive time used for loading, clamping and unloading the workpiece during a work cycle is about 400 precent of the actual machining or productive time. Furthermore, the final dimension of the part is affected by the variation in the clamping pressure resulting from uneven torquing of the bolts. With the tight tolerance required of the part (+ or − 0.00025") the reject rate during this operation was high.

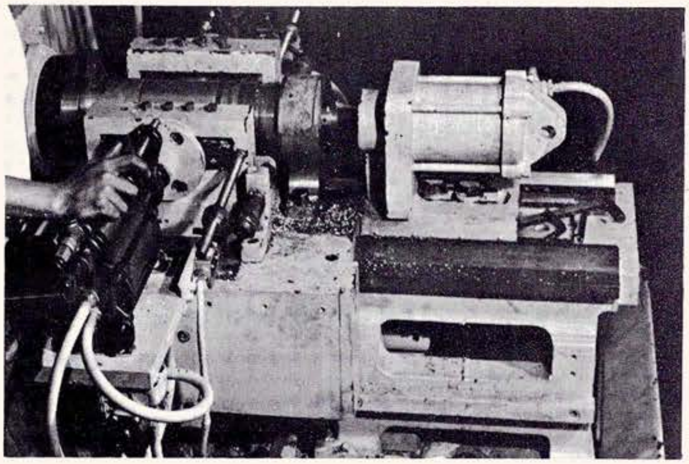
Fig. 2 shows improved set-up. The clamping of the workpiece is now affected by means of an tir cylinder making possible the drastic reduction in the non-productive time of the work cycle. A pressure regulator in the system assures a constant clamping force from piece to piece resulting in more consistent dimensional accuracy for the finished parts. To economize on the jig preparation, a master jig was installed on the traversing carriage, the bore of which was designed to accommodate the outside diameter of the biggest bearing shell that the machine can handle. When using the machine for smaller size bearings, the operation consists simply of preparing the required sleeve material, the outside diameter of which corresponds to the bore diameter of the master jig. A significant saving in jig material was realized and the jig preparation time was also considerably shortened.

b) In the manufacture of piston pins at Philparts, the final operation is superfinishing. This operation levels down the ridges remaining on the surface of the pins after centerless grinding, thus eliminating the high initial rate of wear of the part that will result if the ridges are to be levelled off in service. For this purpose, a superfinishing attachment was acquired instead of a special machine since the volume of work is not big enough. The attachment was used in conjunction with an often idle old cylindrical grinder. Work was held between centers of the grinder through a mandrel (see Fig. 3). The problem here was that the pins being centerless ground, its outside surface is not always true with the bore so much so that when the work is held between centers with a mandrel through the bore, any error between the two surfaces will be reflected on the outside surface, making it difficult to perform the superfinishing operation effectively. A secondary boring operation necessary after finish centerless grinding to true the bore with respect to the outside surface. The productivity of this operation was therefore very low and the cost of the pins exceedingly high.

-Working along the centerless idea, Philparts came out with a set-up consisting of two hardened steel rolls with adjustable centers capable of taking various workpiece diameters. The rolls are mounted on bearing brackets that are fixed to the bed of the grinding machine with one of the rolls engaged to the grinder spindle to serve as the driving roll with the other roll as the idler. With this simple arrangement (see Fig. 4), an increase in productivity was realized and the operation became a lot easier for the operator who now simply dropped the workpiece between the rolls instead of mounting it on the mandrel. Being more rigidly supported on its entire length a much better and more consistent surface finish was obtained.

The cost of this particular modification work was roughly ₱16,000.00 in 1968 including the book value of the old cylindrical grinder. The centerless superfinishing machine was quoted in the same year at about $26,700.00 or mare than ₱100,000.00 at that time. While it may be true that the present set-up is not as sophisticated as the factory made centerless machine, the big difference in cost plus the fact that we were able to realize our productivity objective are more than enough to justify the work.

c) With conventional engine lathes, the ring grooves of pistons are usually machined one at a time with manual feeding of the grooving tool. This practice is acceptable for job lot sizes of orders since it is quite flexible and the tooling is very simple. On medium size production runs, however, especially in highly competitive items, this operation alone can adversely affect the production cost resulting to orders lost to foreign-made counterparts.



Piston ring grooves are done simultaneously in modified turret lathe with hydro-pneumatic tool feeding and electrical controls.

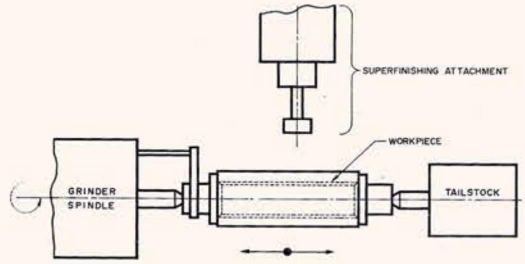


Figure 3

SUPERFINISHING WITH WORKPIECE HELD ON MANDREL BETWEEN CENTERS

Average Production Per 8-Hour Shift A Day (2-1/2" diam. x 5-1/2" long piston pins)--9 to 12 pieces

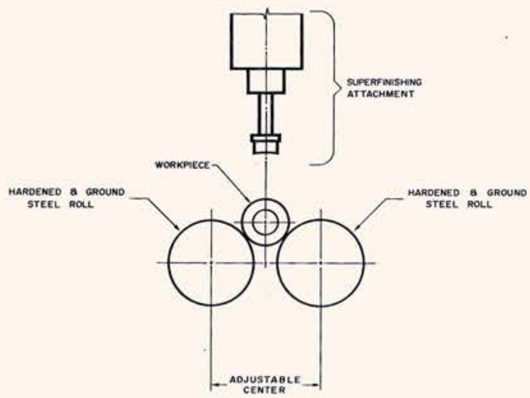


Figure 4

CENTERLESS SUPERFINISHING

(Using the Same Attachment of Fig. 3)

Average production per 8-hour shift per day (2-1/2"diam. x 5-1/2" long piston pins)-36 to 42 pieces

Other improvements: Better surface finish and less operator effort.

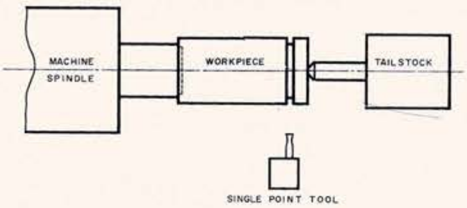


Figure 5

PISTON RING GROOVE MACHINING USING CONVENTIONAL LATHE WITH SINGLE POINT TOOL

Piston Diameter	4 - 3/4"
Material	Aluminum Alloy
No. of ring grooves per piston	5
Average floor to floor time per piston	32 to 36 minutes

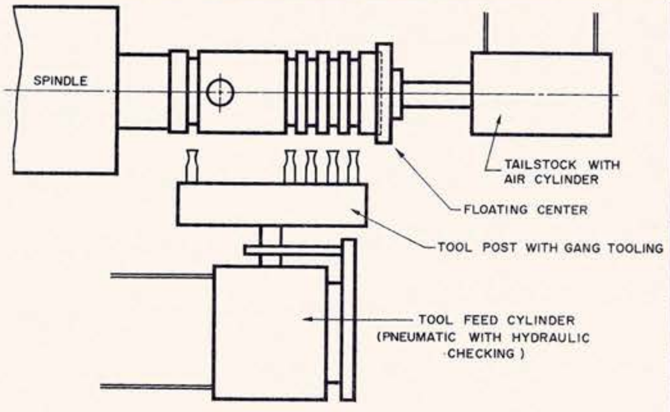


Figure 6

PISTON RING GROOVE MACHINING USING GANG TOOLING ON MODIFIED TURRET LATHE

Piston diameter	4 - 3/4"
Material	Aluminum Alloy
No. of ring grooves per piston	5
Average floor to floor time per piston	4 to 6 minutes

Buying a special piston ring grooving machine at about US \$8,000.00 was out of the question for us. Furthermore, the cost of the available special machines was generally too high for the local market. A lot of idle capacity will occur in the event one of these machines will be acquired considering the present demand and that projected for the next five years. Evaluating the already existing machines and their utilization, an old turret lathe with enough power to serve the purpose was found to be seldom used. Subsequent studies showed that the estimated cost of modifying the machine for ring groove machining operation was justified and we took this course of action.

The modified machine was provided with automatic circuitry based on hydro-pneumatic fool feed elements and electrical controls. Instead of the usual single tool, multiple tooling makes possible the simultaneous machining of all grooves in a piston. Total cost of the whole job was about ₱15,000.00 (present peso value). Fig. 5 and 6 show the old and the modified set-up, respectively.

In practically all machine shop operations there are plenty of possibilities that can be explored to improve productivity. Although the addition of components or the modification of functions will invariably mean additional costs, this can be offset by the increase in the productivity profile granting that the correct approach was adopted. For one thing, modified machines that are designed to be self-regulating will requere less skilled operators for routine production. Thus, the efforts of the skilled manpower of the plant can be channeled to more creative jobs where their skills can be fully used. Secondly, with its lower cost, the modification will mean that the limited means available will not be tied to capital investments. And with an increase in productivity, the product will not only be lower in price but delivery will also be faster. In addition, with an improvement in workmanship quality, the end product will be more competitive.

Unfortunately, favorable results do not always come that easy. There will always be the usual skeptics in the shop who will judge it downright as "it cannot be done" even before a project is started, and take every opportunity to thwart the scheme. Furthermore, there will be the understandable fear among the workers that if a machine's output is increased or if it is made automatic, labor will be displaced. Components needed for the modification also posed a problem since they are not available locally and must be ordered from overseas supplier.

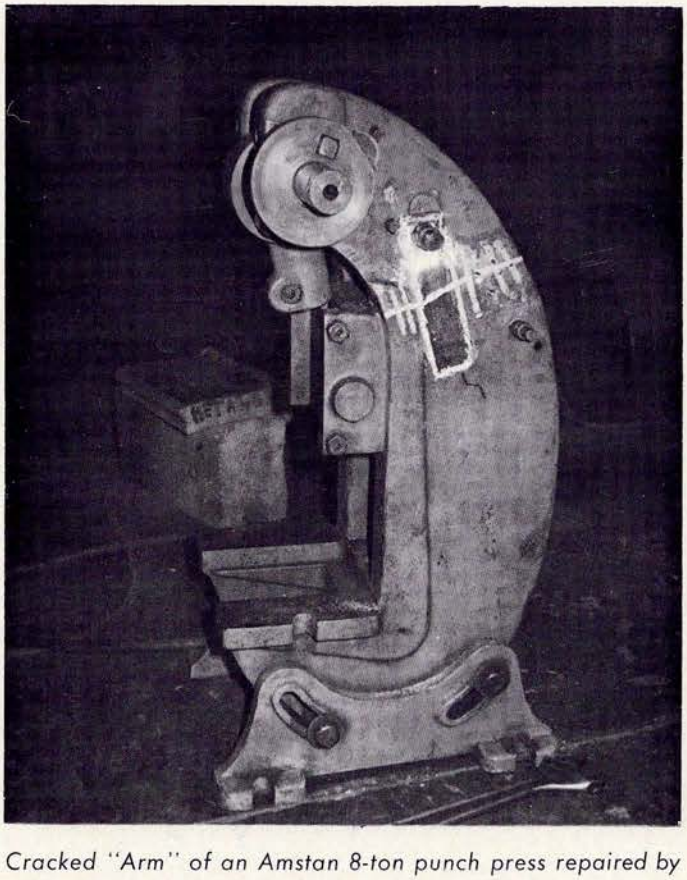
By and large, however, the obstacles to shop productivity improvement by modifying existing machines are generally not too formidable to overcome. On the human side, experience shows that if the shop personnel get themselves involved at the start of the project, preferably from the planning stage, they will be more receptive to the proposed changes and in most cases, will offer suggestions of value to the scheme. As regards components, enough allowance should be made for obtaining these items from foreign sources although for the imaginative and resourceful, suitable substitutes can usually be found in surplus stores, second hand dealers, etc.. It is a matter of determination to accomplish the supposed objectives. Philparts is of the belief that whatever efforts they make in improving the productivity of the shop can go a long way in achieving industrialization and at the same time making it possible for their products to be more competitive.

METALOCK (PHILIPPINES), INC.

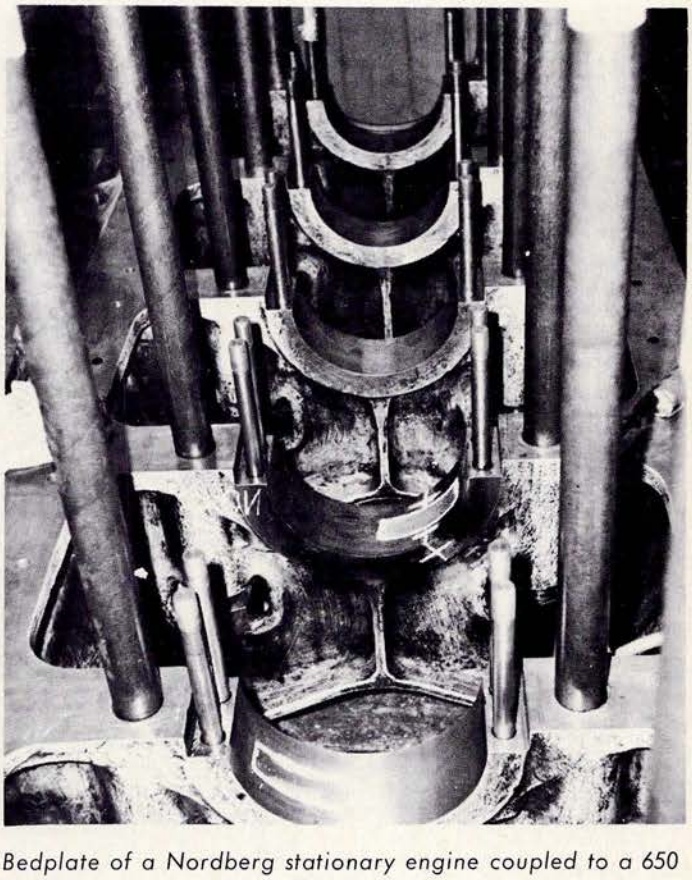
The Metalock process is a precise engineering method of making cold repairs to cracked or fractured machine parts or pressure vessels made of cast or forged metals such as iron, steel, aluminum or brass. Each repair is a separate and distinct engineering problem and repairs are carried out only by specially trained engineers and service men licensed by the Metalock International Association. Jobs carried out are guaranteed against leakage, extension of cracks, breakage of Metalocks and breakage of the parent metal within the repaired area, the length of the guarantee varying with the type of equipment and use.

The Metalock process was first developed during the 1930's in the oil fields of Texas where the open flame of welding presented hazardous problems. The Metalock method, being completely cold, eliminated danger in this connection. After the second World War, the process was introduced in Europe which was littered with wartorn machinery and where replacements were impossible.

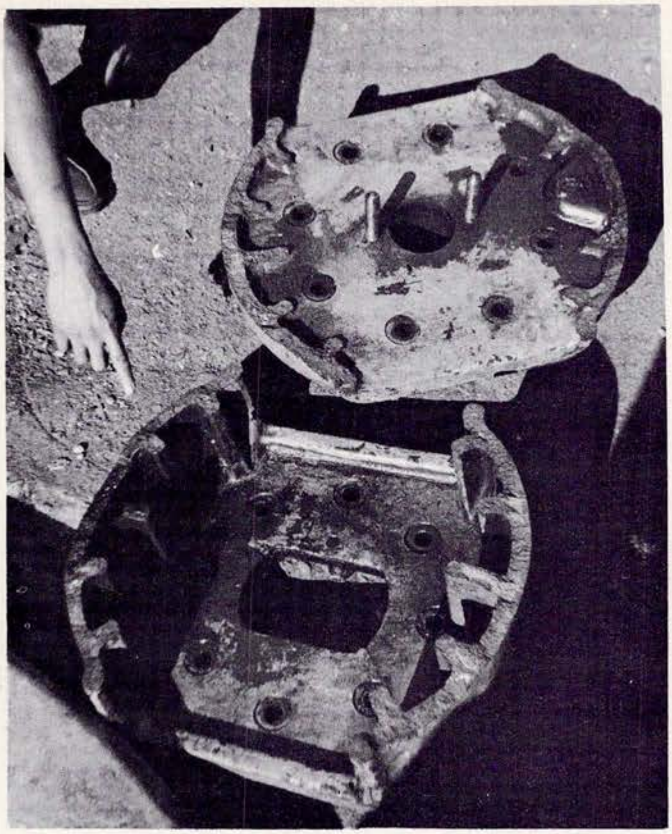
In 1953, the Metalock International Association was formed by fourteen companies which had started to apply the process. The main objectives of the association were to govern World-Wide territorial boundaries as far as the members were concerned, to carry



Cracked "Arm" of an Amstan 8-ton punch press repaired by Metalock.

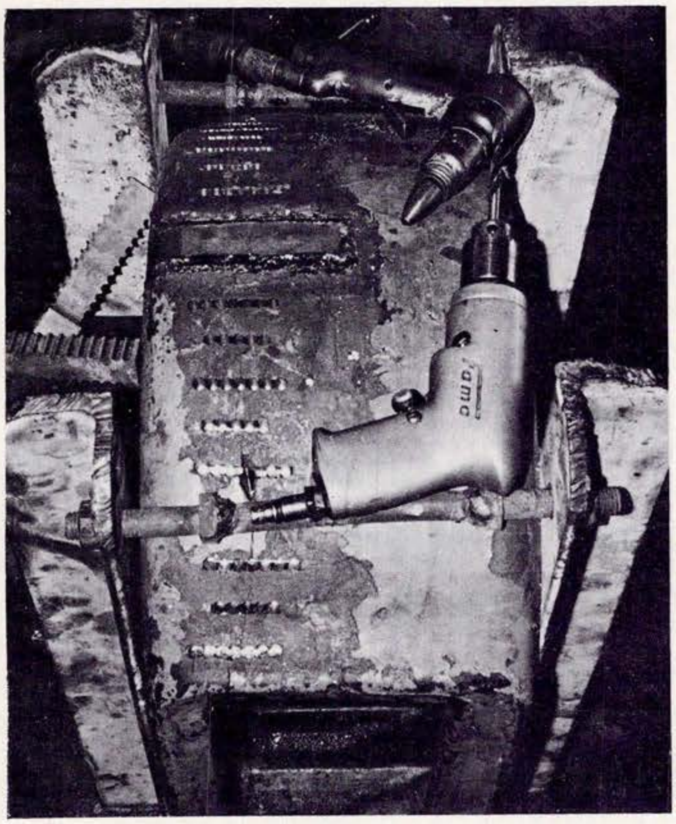


Bedplate of a Nordberg stationary engine coupled to a 650 KW alternator.



A fractured compressor casing.

Clamping the casing to ensure accurate placement of keys and laces.



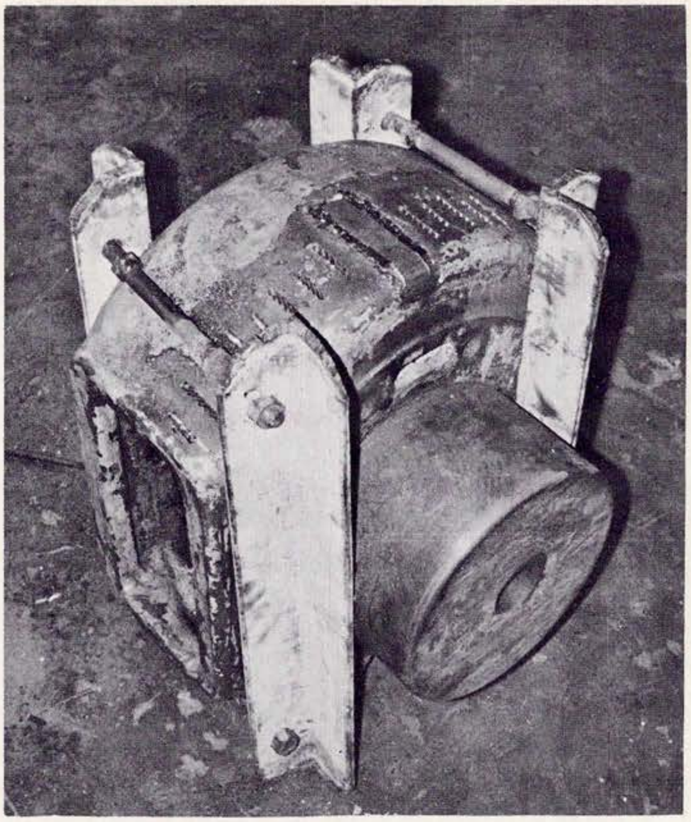
out intensive research in the development of the technique, and to provide a platform for the exchange of ideas and know-how ensuing from the experiences encountered by member companies in the course of rendering service. Since its formation, the association has maintained headquarters in Trafalgar Square, London.

From its small beginning in 1953, the association now has some 70 full member companies and is represented in almost every country in the world.

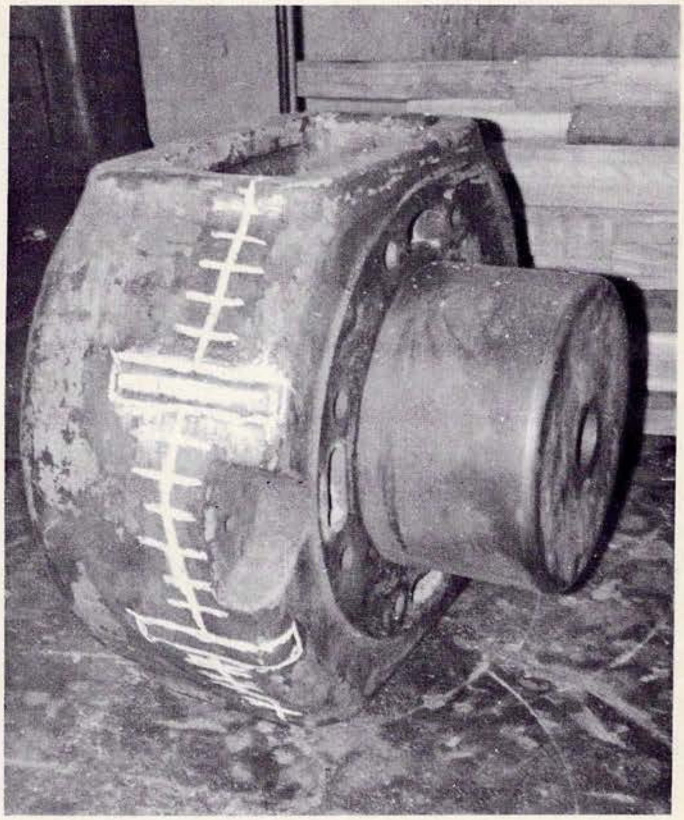
Metalock was first introduced in the Philippines in 1961 and the incorporation of Metalock (Philippines), Inc. took place in March 23, 1961. From that date on to September, 1966, Metalock administration was handled by one of the oldest trading companies in the country. On October 1966, the new Swedish management took over.

The company has its offices and workshop at the CMS Building at Pasong Tamo Extension, Makati, Rizal. Its Cebu branch was opened in May, 1967 and a new branch office in Davao will be opened in the near future, to be able to give service to all sections of the shipping and other industries. The Manila office deal mainly with the repair of ocean-going vessels, general industrial machinery and mining equipment. In Cebu, the bulk of the business is among the inter-island shipping companies. During the off-season of the sugar centrals both Metalock offices concentrate on big and urgent repairs on sugar machineries.

Metalock is not a substitute for welding because it is based on a different principle. Specially-prepared Metalock keys are cold-worked into apertures prepared at right angles to the fissure and, like Metalock keys take the form of circular sections joined by parallel sections. These alloyed keys have a known shear strength enabling the Metalock engineer to determine how much material should be implanted to restore the original strength of the repaired part. After the Metalock keys have been inserted in the pre-



A masterlock is imbedded between two stay bolts.



The repared compressor.

pared apertures, Metalace studs of similar material are used for sealing the crack against leakage. Holes are drilled and tapped and Metalace studs are inserted tangent to each other along the line of fracture.

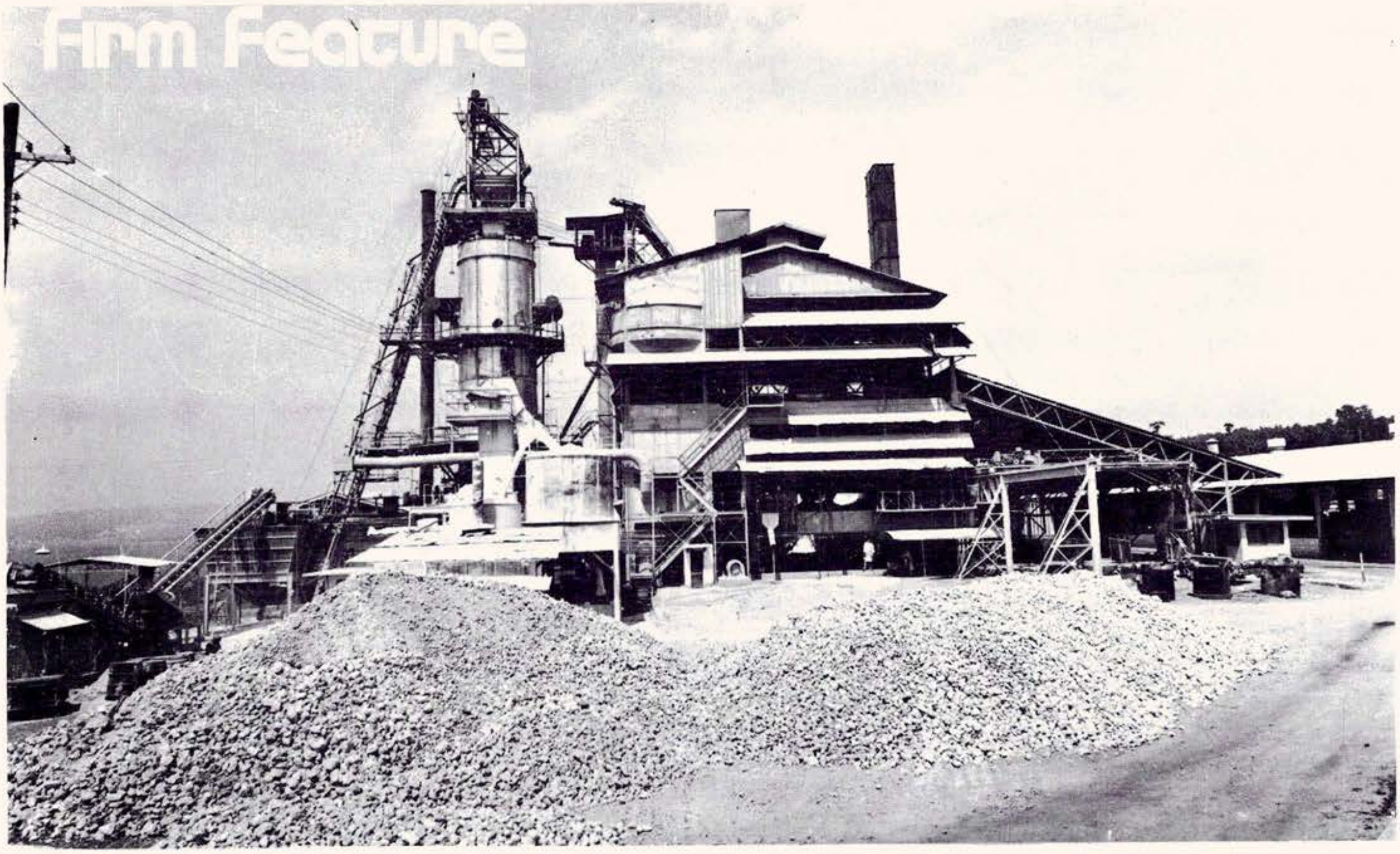
In areas of great stress concentration or in sections subject to overloading, the Masterlock is used. This is a block of high-strength alloyed steel and is held in place by dowels cold worked into matching half holes between the parent metal and the masterlock. The size and shape of the masterlock vary with the physical design and strength requirements involved in each repair job.

SOME ADVANTAGES OF THE METALOCK COLD REPAIR PROCESS:

1. Dampens compression stresses and spreads tensile strains.
2. Distortion and consequent re-machining are eliminated.
3. Provides relief of inherent internal stresses at the region where metal failure occured.
4. Could withstand temperature applications of up to 800°F.
5. Requires a minimum of dismantling.
6. Provides a water-tight joint.
7. Could be carried out on plant site or vessel.

Metalock being a service company, personnel are available for repair calls 24 hours a day, to the advantage of companies whose plants have to operate continuously or to the shipping industry where schedules are strictly adhered to.

Repairs begin within 4 to 6 hours after survey, conducted regardless of the feasibility of repair. Customers usually send semi-detailed descriptions and drawings to the damaged part for the evaluation by Metalock engineers. The extent of the damage determines whether it is economically justifiable to send the damaged piece to the nearest Metalock Office for further analysis and possible repair or to send an Engineer and his team to the site for first hand inspection.



Profile of carbide plant in Iligan City. The cylindrical structure at left is the lime kiln. The main building at right house the furnace (with stack) and packing division. Foreground show limestone stockpile.

MARIA CRISTINA

Maria Cristina Chemical Industries, Inc. (MCCI) was founded in July, 1952 by the family of Judge Guillermo B. Guevara, to answer the country's need for calcium carbide. The MCCI Carbide Plant started operations on November 29, 1954 with a 4,500-KW submerged open-hearth electric-arc rotating ELKEM furnace and lime kiln as main facilities. It is located on a promotory overlooking Iligan Bay at Iligan City, to avail of the cheap power generated from Maria Cristina Falls and and the abundance of limestone and charcoal in the area, the essential raw materials for the production of calcium carbide.

In 1956, Union Carbide Corporation of New York was invited to participate in MCCI, primarily to avail of the expertise of Union Carbide, the world pioneer in carbide and ferroalloy manufacture, as well as their management know-how which the fledgling company badly needed. In December, 1970, the Filipino group bought out the equity and interest of Union Carbide, resulting in the complete Filipinization of the company.

Since its establishment, the plant has undergone modifications and expansion and has now attained a degree of complete integration, while at the same time increasing production capacity on its products.

From the original 4,500 KW capacity, the plant now has a 13,000-KW furnace which not only makes calcium carbide

Charcoal is an ingredient in both calcium carbide and ferro alloy manufacture.

CHEMICAL INDUSTRIES, INC.

but is, on occasion, converted to ferroalloy manufacture. As auxiliary equipment, it has a lime kiln, charcoal briquetting plant, lime hydrating plant and a limestone crushing and screening plant at its own quarry.

The officers of MCCI are: Guillermo B. Guevara, Chairman of the Board, Ricardo P. Guevara, President, Jose Ll. Fabre, Secretary and Rosario G. Dimayuga, Treasurer.

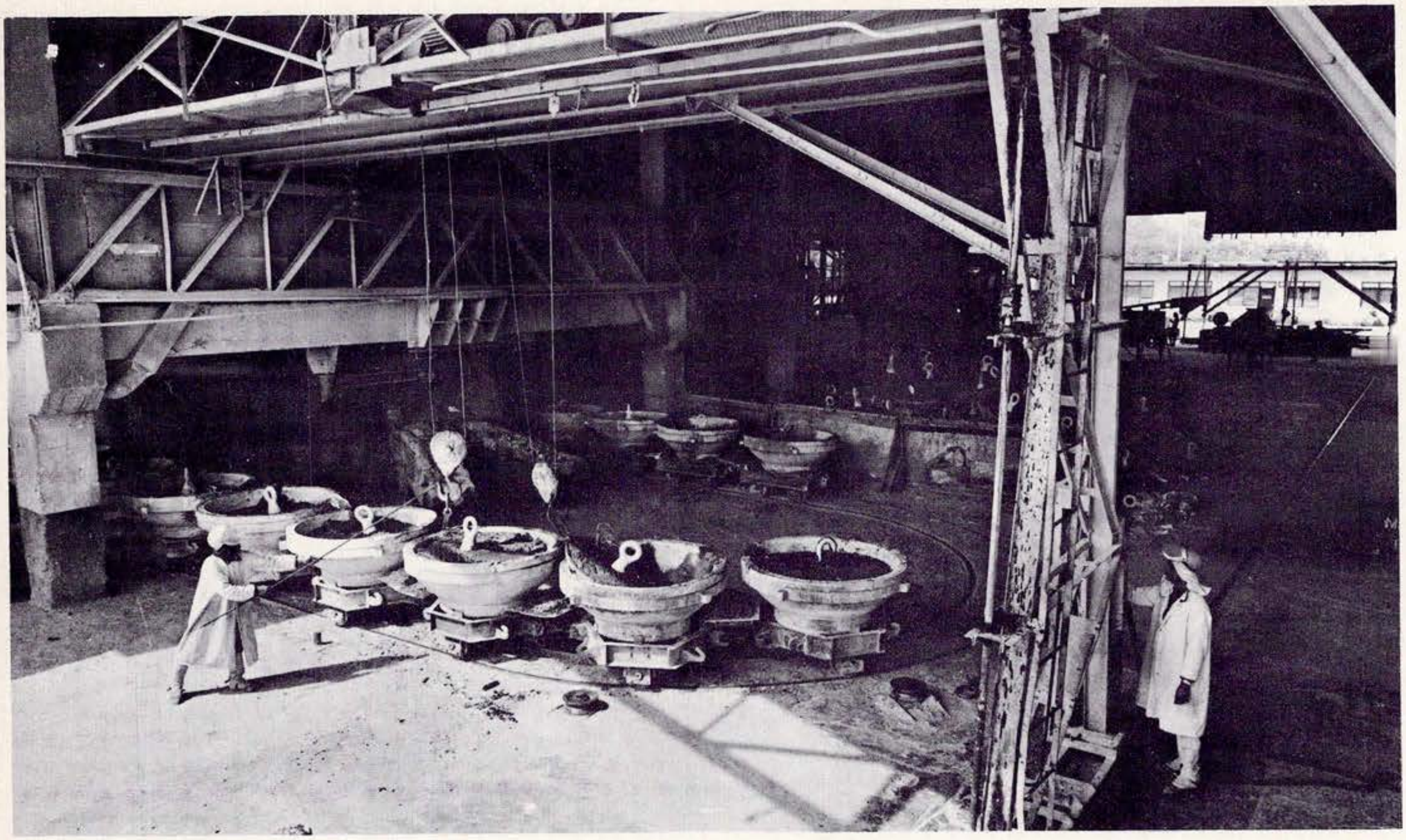
The Plant has a total manpower of 300 working in continuous shifts.

Raw Materials

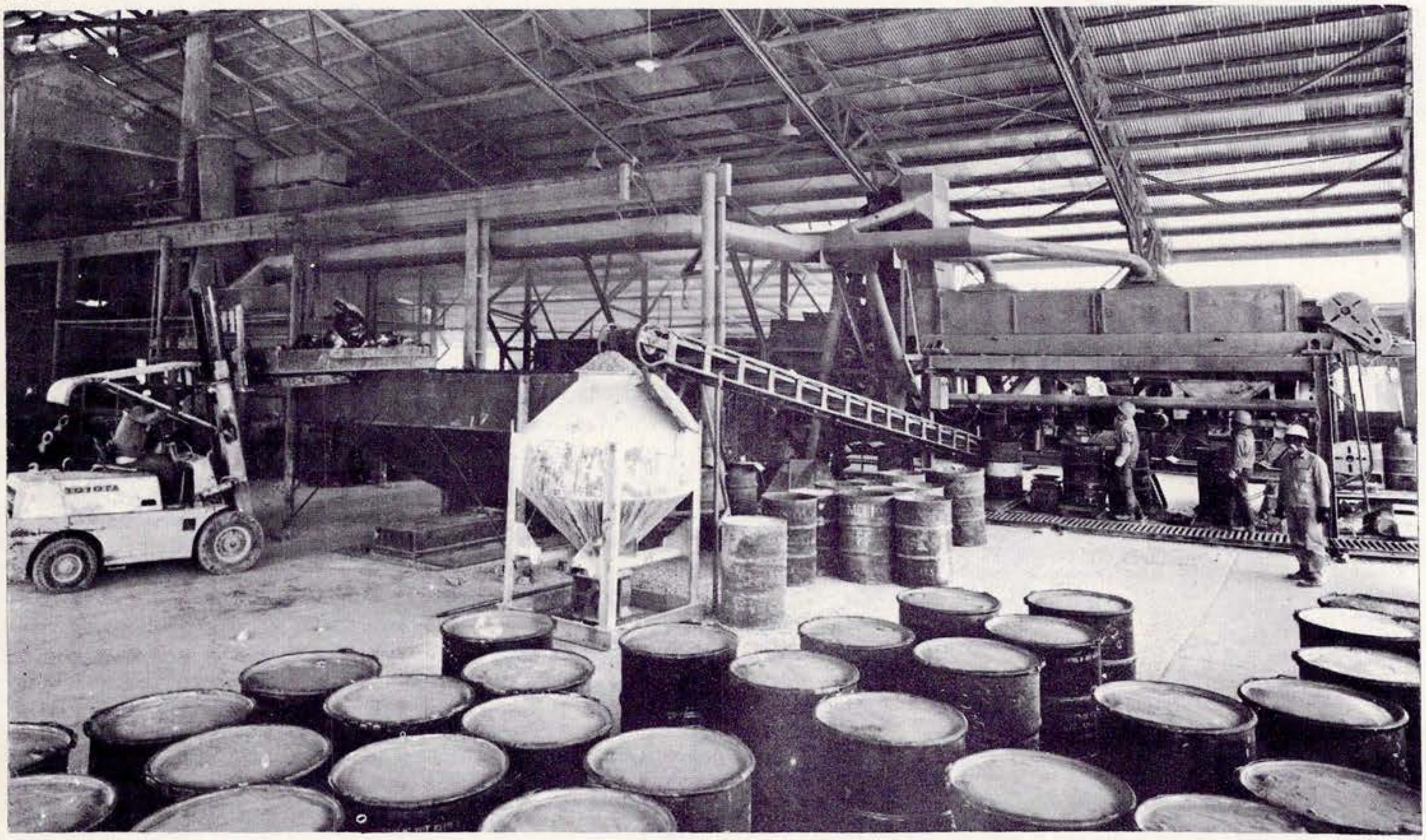
All raw materials for the entire product line are indigenous. Charcoal is secured from the Iligan Bay area, Leyte, Samar, Bohol, Agusan, Surigao, Zamboanga del Sur, Palawan and Davao. Coal is obtained from Malangas; limestone from quarries in Iligan City; Silica quartz from Tagkawayan, Quezon and manganese ore from Leyte, Masbate, Lanao del Sur, Rizal, Zamboanga del Sur and Samar.

Products

MCCI produces calcium carbide, ferrosilicon, ferromanganese, silicomanganese, industrial acetylene, lime hydrate, quicklime and charcoal briquettes. It supplies all the carbide requirements of the country including that of its sister company, Mabuhay Vinyl Corporation. Other carbide consumers are the Acetylene Black Plant of Union Carbide Philippines, the oxyacetylene compressors all over the country, as well as the



Liquid carbide tapped from the furnace has solidified around the "mushroom" and lifted by the crane to the cooling deck seen at the back.



The cooled and solidified calcium carbide is passed through primary and secondary crushers before being screened into various commercial sizes.

small repair shops. MCCI serves the requirements for ferroalloys of the steel mills and foundries. A limited amount of exports are also made from time to time.

CALCIUM CARBIDE

Calcium Carbide is a basic chemical for the generation of acetylene by the addition of water. Acetylene in turn, a gas, is primarily used as fuel, for welding and cutting of steel and for lighting purposes. It is also a raw material in chemical industry such as in the manufacture of polyvinyl chloride.

Raw materials for the manufacture of calcium carbide are lime and charcoal or other carbonaceous materials like coal or coke.

Limestone which is essentially calcium carbonate is crushed, washed and sized at the quarries before being transported to the plant. It is washed and sized again at the plant before being fed to the lime kiln. It is calcined in a vertical shaft lime kiln at more than 900°C. The kiln is capable of producing 120 tons of lime per 24 hours of operation, using bunker oil as fuel. Limestone of about 2″ × 5″ size is fed at the top and discharged as lime at the discharging doors located at the bottom of the kiln.

During calcination, CO_2 is driven off leaving behind calcium oxide also known as quicklime which is half the weight of the original limestone.

$$CaCO3 \rightarrow CO2 + CaO$$

MCCI recently has marketed lime hydrate or calcium hydroxide to those in the sugar industries which is made from quicklime by adding water in controlled amounts.

Calcium oxide is reduced in the ELKEM electric arc furnace having three electrodes of baked carbon paste, each of which is 95 cm. in diameter. Charcoal, as reductant and lime react at 2,000°C producing calcium carbide in molten form and gaseous CO as byproduct.

$$CaO + 3\,C \rightarrow CaC2 + CO$$

Calcium carbide is tapped by opening the tap hole of the furnace with an electrically-charged graphite tapping pencil. The molten product flows into a cast iron chill or pan. Products from the furnace are brought to a nearby cooling deck, after which they are crushed by jaw crushers and carried into the vibrating screen by a bucket elevator. The vibrating screen separates the crushed carbide into five different sizes: lump, egg, nut, quarter and 14 ND. The screened carbide are packed in 250 Kg. and 50 Kg. drums ready for shipment.

FERROALLOYS

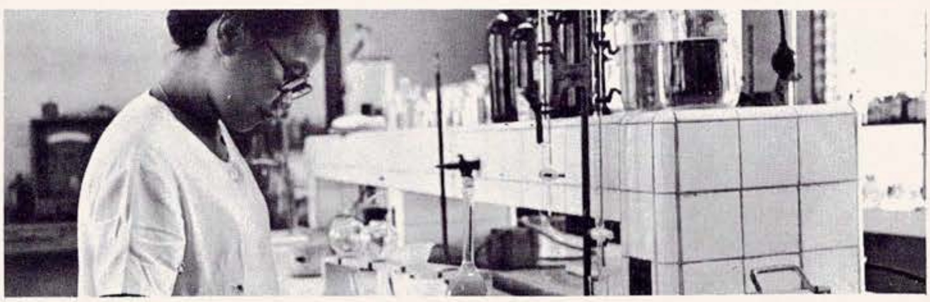
MCCI produces three types of major ferroalloys, namely 75 per cent ferrosilicon, standard (or high carbon) ferromanganese and silicomanganese.

Ferroalloys are needed in the production of steel and other ferrous products. They are added to the molten steel to give the desired qualities, like homogeneity, cleanliness, strength, workability, etc. Sometimes called additive agents, they are used in steel manufacture to control the solidification of the metal in the mold, to facilitate processing from the cast form to the final product, and to impart the desired physical characteristics to the finished product.

Ferroalloys are likened to "salt and pepper" in cooking, pinches of which are required to give steel the quality required.

Ferrosilicon is used principally as a deoxidizer in various types of steel as well as an alloying element. Ordinarily steel contains 0.1% to as much as 0.8% silicon while electrical steels contain as much as 1.0% to 5.0%.

Ferromanganese acts as a deoxidizer by combining with oxygen in molten steel and counteracts the deleterious ef-



Quality control laboratory where all necessary analyses of raw materials and finished products are done.

Shown here is tapping of ferrosilicon, a silvery textured alloy much used in steel refining and in foundries. The white heat indicates the high temperature of the metal.

The solidified ferrosilicon slabs are being stockpiled for cooli ing preparatory to crushing and packing

fect of sulfur by combining with that element as a sulphide. As an alloying element, manganese increases the strength, ductility and hardenability of the steel.

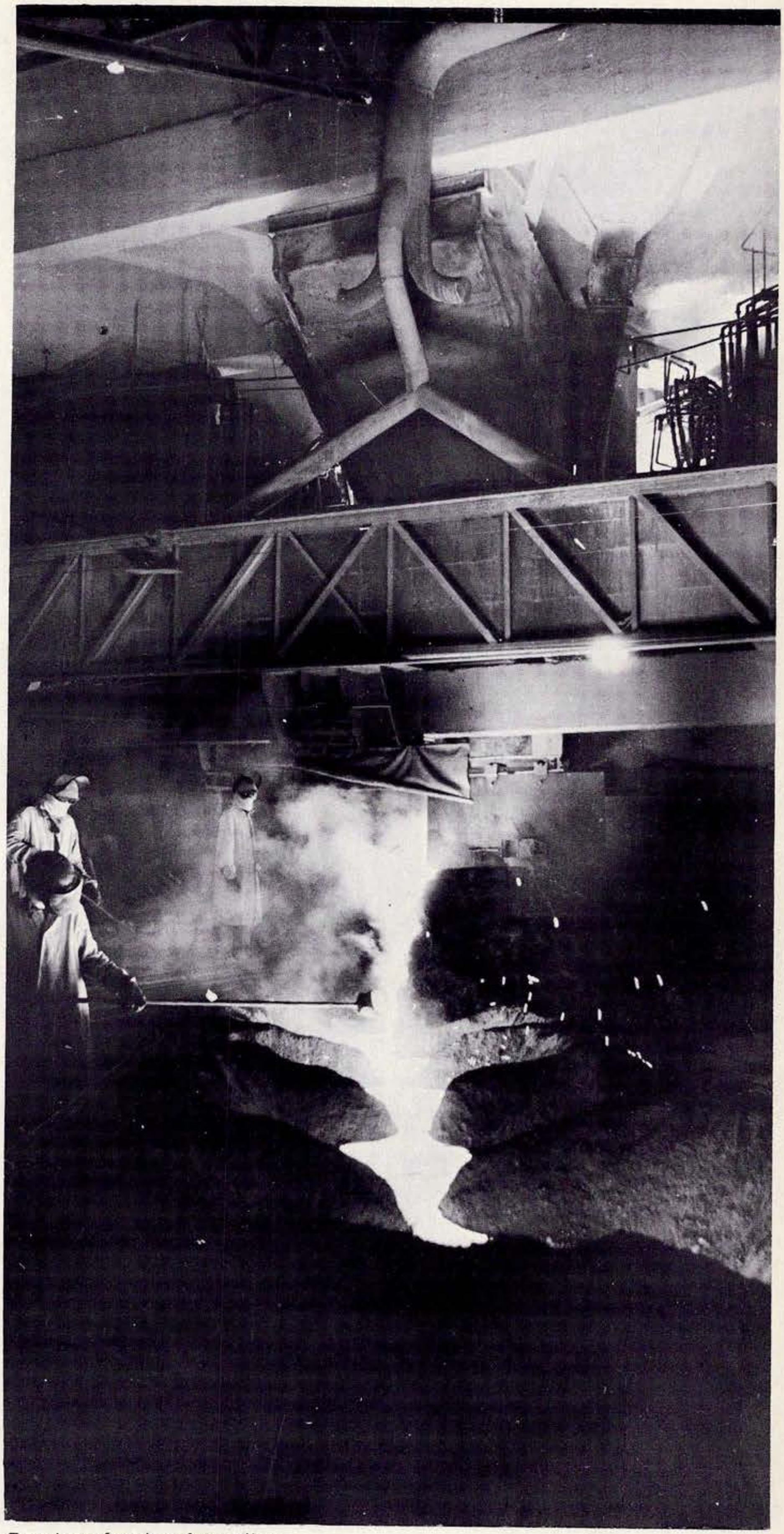
Silicomanganese is used when simultaneous introduction of silicon and manganese are required. It is used widely as a furnace block for improved deoxidation and increased cleanliness.

Ferroalloy Manufacture

The main raw materials in the manufacture of ferrosilicon are quartz and charcoal. Quartz, which is the mineral form of silicon dioxide is reduced to metallic silicon by charcoal in the furnace. This is diluted by adding a small amount of iron in the mix. Ferrosilicon is tapped from the furnace as white-hot molten metal at 2,100°C, which solidifies into a silvery alloy.

The production of ferromanganese starts with manganese ore which must contain a minimum of 42 per cent manganese as manganese oxide. Unlike ferrosilicon which starts with very pure quartz, ferromanganese starts with manganese ore with many and varied impurities. During smelting, part of the manganese oxide is reduced to metallic manganese but a portion remains which is removed together with the impurities as a slag. The furnace is equipped with a slag/metal tap where the heavier metal is separated from the lighter slag through the use of skimmer.

Silicomanganese is essential-



Tapping of molten ferrosilicon

ly the same as ferromanganese only silicomanganese has an acid slag while ferromanganese has a basic slag.

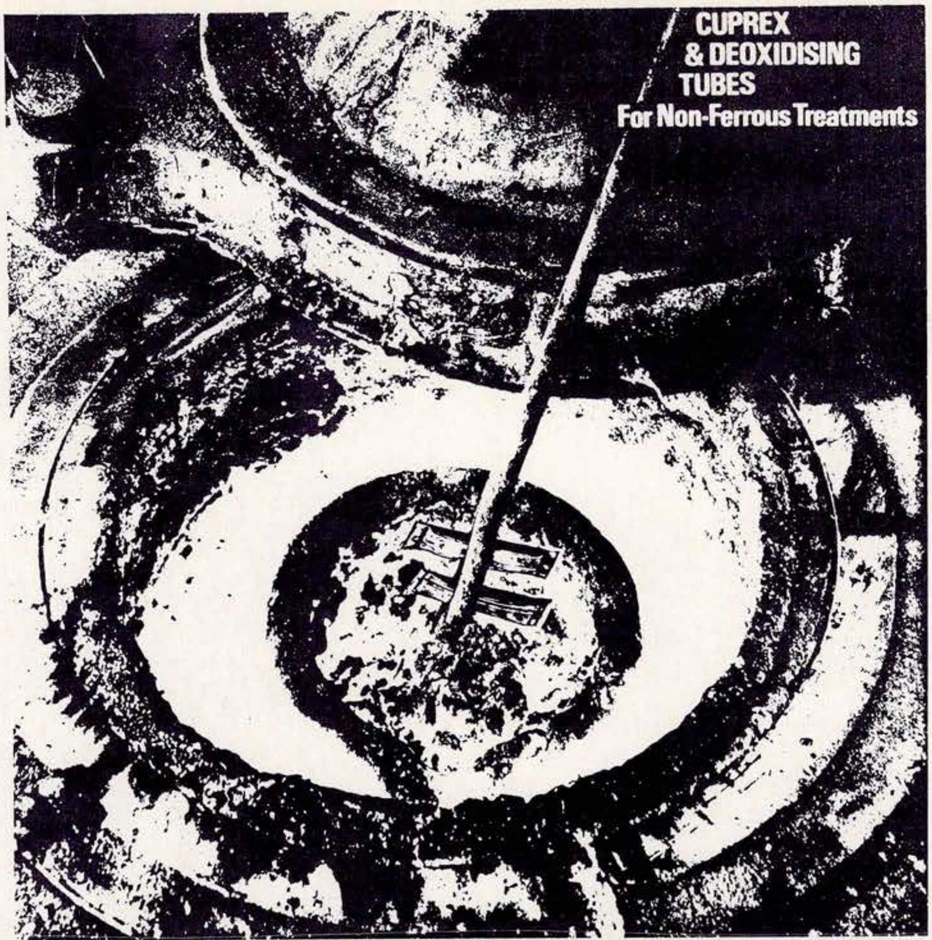
The furnace used in smelting ferroalloys is the same one used in the manufacture of calcium carbide made possible by the similarity in the process known as carbon reduction process.

Expansion Plans

MCCI is presently pursuing an expansion plan which involves the erection of additional furnaces that will facilitate the production of ferrosilicon for export purposes. The initial phase of the project is expected to be completed in 1973 and fully operational in 1974. MCCI has applied for registration with the Board of Investments for 40,000 MT per year measured capacity for ferrosilicon for export as listed in the Third Investment Priorities Plan.

Total financing for the project is approximately ₱42 million of which about \$3.3 million will be needed in foreign exchange. The project in turn is expected to earn \$7.5 million in foreign exchange annually.

Other benefits to the local economy will be to 600 charcoalers who will be permanently employed in supplying the 40,000 MT per year charcoal requirement, to 100 miners required to supply 80,000 tons of quartz aside from 200 regular employees to man the furnaces.



DOMESTIC & FOREIGN EXPORT PRICES

Table 1 CONTINENTAL STEEL EXPORT
Monthly Price Averages June 1971 to Sept. 1971
(In US $ Per Metric Ton)

	June	**July**	**August**	**September**
Billets	82.5	82.5	82	82
Reinforcing rounds[a]	100.4+	96.9+	96.8+	101+
Merchants bars	108.1+	105.8+	106.2+	108+
Joists, channels (Brit)	—	—	—	—
Channels (US)	122.4+	118.5	117.1	—
Joists, channels (Con't.)	—	—	—	—
W.F. (Univ. beams)	132+	127.1+	126.7+	131+
Wire rods	123+	121+	119+	—
Hot rolled strip: 1 in.	119.5+	119.5+	—	—
Tube strip	115.5+	115.2+	115+	115+
Heavy plates[c]	134+	133.2+	130.6+	128.5+
Medium plates[d]	121+	120.2+	119.2+	118+
Universal plates	134+	133.5+	133+	—
Chequer plates	121+	121+	120.2+	118.5+
HR sheets: 16 g. and up	—	—	—	128+
HR coil (dry)	107+	107+	107+	—
CR sheets: 17-20 g.	135.5+	133.1+	133.2+	133+
Galv. coils: 17-20 g.[b]	171*[e]	171*[e]	171*[e]	171*[e]
Bright wire	130	130	131.5	134
Black annealed wire	140.4	141	141	140
Galv. wire: 5-16½ g.	145	145	144.7	144.5
Barbed wire	—	—	—	—
Wire nails	—	—	—	—

Source: Metal Bulletin

+ 2½% exporter's commission incl. * less $5; corrugated extra $2; flat sheets $3.

[a] Usual deformed bar premiums; structural $2, intermediate $3.

[b] 4-ton coil

[c] over 8 mm

[d] 3-8 mm

[e] $25/$30 special allowance, according to spec.

MB's appraisal Continental ECSC mills' basis (net unless stated) FOB export prices, ordinary Thomas Commercial quality. Markets, sizes, quantities, delivery, etc. can affect prices shown.

Table 2
JAPAN MONTHLY AVERAGE DOMESTIC PRICE
(In US $ Per MT unless otherwise indicated)
(June — Sept. 1971)

	June Ave.	July Ave.	Aug. Ave.	Sept. Ave.
Iron & Steel Products				
Round Bar 9 mm	88.04	94.24	96.56	94.79
16-25 mm	84.25	88.48	93.61	90.31
Flat Bar 6 x 50 mm	96.72	95.70	96.69	97.19
Equal Angle 6 x 50 mm	94.22	93.75	96.04	94.83
10 x 90 mm	96.02	95.20	99.33	97.01
Channel 6 x 65 x 125 mm	99.15	101.79	110.42	109.41
H-Shape 9/14 x 250 x 250 mm	131.57	135.07	141.32	137.57
Hot R. Sheet (3 x 6) 1.6 mm	96.02	94.24	96.82	96.56
Cold R. Sheet (3 x 6) 1.2 mm	113.54	112.33	115.25	115.94
Medium Plate 3.2 x 3 x 6	91.63	91.12	96.70	95.10
Plate 6 x 4 x 8	91.26	90.60	96.06	94.51
9 x 4 x 8	91.29	90.34	95.80	94.20
Gas Pipe (Black) 15 A (½ inch) (per Kg.)	0.13	0.13	0.13	0.13
Water Pipe (White) 15 A (½ inch) (per Kg.)	0.21	0.21	0.21	0.21
Galv. Sheet (per sheet)				
(plain) 0.25 (No. 32)	0.59	0.59	0.60	161.11*
(corrugated) 0.25	0.55	0.55	0.55	0.53
Colored Sheet (per sheet)				
(Both side, Plain) 0.27 (No. 31)	0.86	0.86	0.86	226.39*
(One side, Corru) 0.25 (No. 32)	0.65	0.65	0.65	0.65
Wire Rod, 5.5 mm	125.00	125.00	125.00	125.00
Round Nail, 100 mm (4 inches)	144.85	138.89	138.89	135.10
Iron Wire, No. 8	127.75	125.00	124.48	121.46
Annealed Iron Wire, No. 8	125.16	122.40	122.05	120.03
Galv. Iron Wire No. 8	148.52	146.88	146.18	145.73
Barbed Wire No. 14	204.48	204.86	204.86	204.17
Tinplate, 90L (0.257 mm)	275.55	275.56	275.56	276.20
Wire Netting, (20 x 15 mm) one roll	5.32	5.32	5.32	5.28
Welded Steel Netting, (1 sq. meter)				
No. 4 (6 x 150 mm)	0.65	0.65	0.65	0.63
No. 8 (4 x 100 mm)	0.52	0.52	0.52	0.49
Special Steel				
Constructional Carbon Steel (SC) per Kg.	0.14	0.14	0.14	0.13
Stainless Steel				
SUS 24 (18 CR)	—	—	—	—
Sheet (2-6 mm)	0.48	0.44	0.45	0.46
SUS 27 (18-8)	—	—	—	—
Sheet 0.3 mm	1.20	1.04	1.04	1.08

	June Ave.	July Ave.	Aug. Ave.	Sept. Ave.
Non Ferrous Metals				
Electric Copper	1,119.51	1,115.86	1,083.27	1,009.44
Electric Zinc	327.78	337.04	364.33	370.83
Electric Lead	311.81	309.03	309.03	304.65
Tin	3,649.94	3,641.78	3,611.69	3,576.74
Antimony	1,667.93	1,633.68	1,625.00	1,617.50
Nickel	3,631.94	3,631.94	3,631.94	3,631.94
Selenium	24,340.28	24,340.28	22,896.41	20,902.78
Bismuth	14,375.00	14,045.14	12,789.35	12,222.22
Cadmium	5,312.50	5,283.57	4,050.93	3,888.89
Mercury	9,933.71	9,895.83	9,895.83	9,895.83
Aluminum	586.05	581.94	577.60	569.44

Rolled Copper & Brass				
Copper Sheet, 2.0 mm	1,482.32	1,457.18	1,435.18	1,370.83
Copper Tube, 50 x 5 mm	1,589.22	1,566.36	1,539.35	1,465.28
Copper Rod, 25 mm	1,542.09	1,456.48	1,485.72	1,421.76
Copper Wire, 0.9 mm	1,506.73	1,483.41	1,455.63	1,395.37
Brass Sheet, 2.0 mm	1,152.78	1,126.93	1,091.43	1,044.45
Brass Tube, 50 x 5 mm	1,306.40	1,258.49	1,255.79	1,193.06
Brass Rod, 25 mm	969.28	966.44	947.15	892.59
Brass Wire, 6 mm	1,169.19	1,145.83	1,114.97	1,065.74
Rolled Aluminum				
Sheet (99%), 1.0 mm (400 x 1,200)	805.56	805.56	805.56	798.61
Circle, 1.0 mm	881.94	881.94	881.94	881.94
Steel Scraps				
Special for Electric Furnace	35.55	35.17	33.82	29.06
Pig Iron Scrap	61.46	61.46	61.46	59.03
Copper Scrap				
No. 1 Copper Wire (Berry)	1,043.81	1,058.68	995.54	888.47
No. 2 Copper Wire (Birch)	985.42	986.98	955.32	854.17

* per Metric Ton

Source: Japan Metal Bulletin

Table 3
Domestic Retail Prices of Selected Steel Products
Source: Bureau of Commerce
June to September 1971

	June	July	August	September
Galvanized Iron Roofing Sheet, per Sheet				
Local Gauge No. 26 — Apo & River Brand				
32" x 6' Corrugated	10.50	10.44	10.20	10.20
7' "	12.25	12.18	11.90	11.90
8' "	14.00	13.92	13.60	13.60
9' "	15.75	15.66	15.30	15.30
10' "	17.50	17.40	17.00	17.00
36" x 8' Plain	14.00	13.92	13.60	13.60
Gauge No. 31 — Apo & River Brand				
32" x 6' Corrugated	7.50	7.50	7.50	7.50
7' "	8.75	8.75	8.75	8.75
8' "	10.00	10.00	10.00	10.00
9' "	11.25	11.25	11.25	11.25
10' "	12.00	12.00	12.50	12.50
36" x 8' Plain	10.00	10.00	10.00	10.00
Aluminum Sheet, per Sheet				
Gauge No.				
.019 x 36" x 8'	22.00	22.00	22.00	22.00
.024 x 36" x 8'	27.00	27.30	27.30	27.30
Square Bars				
3/8" x 3/8" x 20'	4.50	4.50	4.50	4.50
1/2" x 1/2" x 20'	8.40	8.40	8.40	8.40
5/8" x 5/8" x 20'	13.70	13.70	13.70	13.70
1" x 1" x 20'	40.00	40.00	40.00	40.00
Round Bars				
1/4" x 20'	2.50	2.50	2.00	2.00
1/2" x 20'	4.50	4.50	4.50	4.50
5/8" x 20'	9.00	9.00	9.00	9.00
3/4" x 20'	16.36	16.36	16.36	16.36
1" x 20'	29.10	29.10	29.10	29.10

Flat Bars				
1/8" x 1/2" x 20'	3.00	3.00	3.00	3.00
3/16" x 1/2" x 20'	5.00	5.00	5.00	5.00
1/14" x 1/2" x 20'	7.50	7.50	7.50	7.50
Angle Bars				
1/8" x 1" x 20'	9.00	9.00	9.00	9.00
3/4" x 1" x 20'	10.00	10.00	10.00	10.00
1/4" x 1" x 20"	18.00	18.00	18.00	18.00
3/8" x 3" x 20'	80.00	80.00	80.00	80.00
Galvanized Iron Pipe				
1/2" x 20'	12.00	12.00	12.00	12.00
3/4" x 20'	17.00	17.00	17.00	17.00
1" x 20'	23.00	23.00	23.00	23.00
1 1/2" x 20'	38.00	38.00	38.00	38.00
2" x 20'	48.00	48.00	48.00	48.00
Black Iron Pipe, a piece				
1/2" x 20'	10.00	10.00	10.00	10.00
1" x 20'	19.00	19.00	19.00	19.00
1 1/2" x 20'	32.00	32.00	32.00	32.00
2" x 20'	41.00	41.00	41.00	41.00
Barbed Wire, per roll, local				
70 lbs.	65.00	64.60	63.00	63.00
60 lbs.	60.00	60.00	60.00	60.00
35 lbs.	33.00	33.00	33.00	33.00
Machine bolts, with nuts, per kilo				
All sizes	2.50	2.50	2.50	2.50
Common Wire Nails, per kilo				
1" — 1 1/2"	1.80	1.80	1.80	1.80
2" — 2 1/2"	1.70	1.70	1.70	1.70
3" — up	1.60	1.60	1.60	1.60

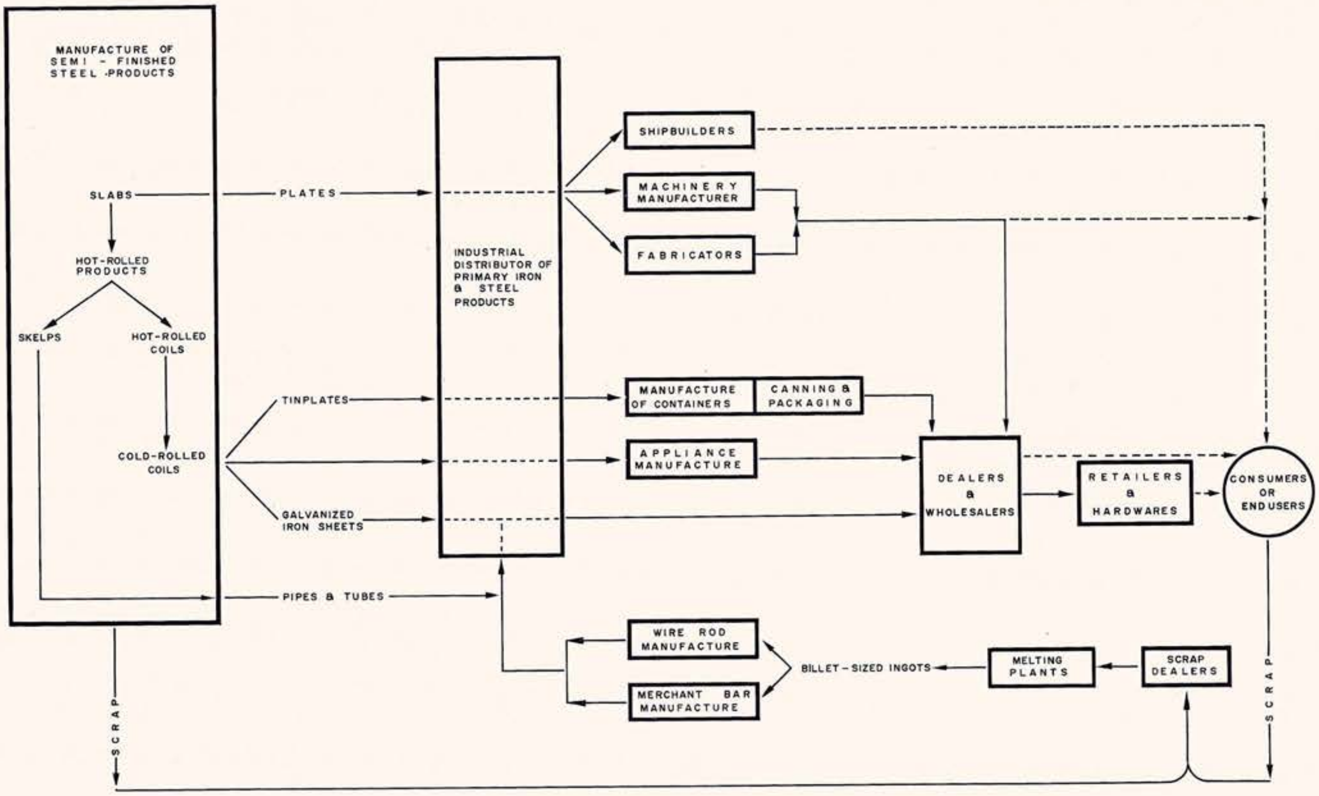
THE DISTRIBUTION SYSTEM OF IRON & STEEL PRODUCTS

One of the most important policy decisions facing any manufacturer is that of determining the channel of distribution he will use in marketing his products. For metal products such as plates, tinplates, GI Sheets, pipes and tubes, bars, and rods, the decision to sell direct or to employ an industrial distributor is a major factor to insure the smooth flow of these goods from manufacturers to end users.

In the marketing of the local iron and steel products, there is a strong tendency for the manufacturers and the industrial users to deal through an industrial distributor. These distributors get orders from industrial users, pass them on to the manufacturers for production schedule, and arrange transportation facilities for customers depending on their contracts. Sometimes transportation expenses are already included in the price list. To serve their customers most effectively, industrial distributors opt to concentrate on areas having a large number of industrial establishments like the Greater Manila area. They also render financial assistance to the manufacturer by allowing them to pay for goods on account basis, reduce his credit losses (because his accounts are few and of better quality) and handle complaints. In return, manufacturers send company bulletins or newsletters to their distributors' salesmen as a means of keeping them up-to-date on the products and to serve as an aid in some "selling points." Some manufacturers assist in the marketing program through industrial advertising wherein the name of the distributor is included in the promotional campaign.

It has also been a common practice among steel manufacturers to employ exclusive distributors which are sometimes owned and operated by them. Under an exclusive dealing, the distributor does not handle the same product line of a competitor in consideration of his supply from a contracted manufacturer. The usual agreement between the two is some sort of a commission based on percentage of sales. The manufacturer can then fix the price of his products so that the distributor can no longer put any mark-ups to increase price. However, in some cases, the distributors are in a position to make mark-ups on the products. Most steel companies in the country employ one exclusive distributor for all their product lines. This is a great advantage because they would be dealing with only one person.

However, some manufacturers particularly of GI Sheets, pipes and tubes, bars and rods also employ direct sale to gain the commission they offer to distributors and to better serve their customers by ensuring faster service and lower prices especially when the customers buy in large quantities. Some customers take the initiative of visiting the manufacturer's factory. Here, they pick up their orders according to their specifications. Some manufacturers, on the other hand, have a list of industrial users who order in carload or larger lots, and whom they could call upon as prospective customers. A small percentage of manufacturers sell direct because of the time involved in calling customers.



A MARKET FLOWCHART FOR IRON & STEEL PRODUCTS

With the limitation to direct selling, the industrial distributor acts as the bridge between manufacturers and industrial users. Because of the mark-up imposed by some distributors of GI Sheets, wire rods, and pipes and tubes, prices of these products are sold at higher prices compared with that purchased in the factory. However, the number of terms offered by the distributor especially the 30-60 day credit makes it very convenient for customers to buy from them.

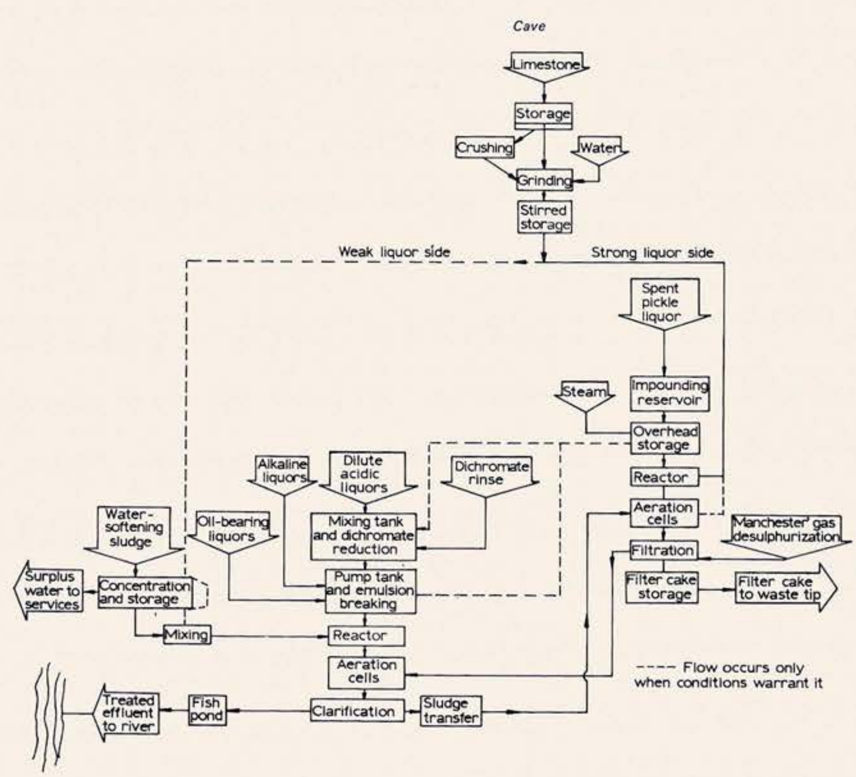
The industrial distributor of plates sells to shipbuilders, manufacturers of machinery and fabricators while tinplates go to manufacturers of containers, crown cups, etc. Domestic production of cold-rolled coils goes to manufacturers of galvanized sheets, tinplates and appliances. Shipbuilders sell direct to customers on orders. Manufacturers of machinery and fabricators of construction materials sell direct through their own salesmen or sales office, or through a dealer or distributor for more aggressive selling. Direct selling is very common because of the amount involved and the need for technical advice. Buying through some distributors has also an added advantage occruing from the conveniences it offers to customers in securing spare parts and accessories. GI Sheets, pipes and tubes, bars, and rods, as well as tin cans are channelled to a wholesaler. These wholesalers purchase goods outright from industrial firms, store them at strategic locations and make them available on short notice to customers. They sell in large quantities and at lower prices than retailers. They are also able to render services to industrial users as well as retailers like extending credit, facilitating transportation and storage costs and aiding buyers because they handle a number of products. The wholesalers remove the gap between manufacturers and consumers by dessiminating information on the product, like the size of the product most often used, price trends, and the availability of supply. From the wholesalers, some of these products pass through a retailer. Commodities like pipes and tubes, GI Sheets, bars and wire products are retailed through hardware stores while canned goods (using tinplate) are sold at supermarkets and other variety stores. Retailers set a certain mark-up on the products.

From the discussion above, the market flow chart of iron and steel products from the manufacturers to industrial users to ultimate consumers can be gleaned. It also traces the marketing costs and margins of each product and the volume of work and number of people involved. This is not the end, however, for from the manufacturers of iron and steel products and from the consumers, a considerable amount of scrap is generated. These scrap, instead of being waste products, are either consumed by the plant itself or sold to scrap dealers who employ persons to collect them from households, industrial users and manufacturers. These, in turn, are sold to melting plants which process scrap into billet-sized ingots. These billets, together with some imported ones, are brought to manufacturers of wire rods and merchant bars for further processing. The finished products are sold to wholesalers, to retailers and finally to consumers.

The channel of distribution of iron and steel products is relatively simple involving only the manufacturer, an industrial distributor and an industrial user, although the end use of these products oftentimes pass through several channels before reaching the ultimate consumers. Any sudden change in the market conditions affects the whole chain of activities. Thus the need for a close cooperation between the manufacturers and the distributors, or wholesalers, or retailers, as the case may be, is imperative. Obviously, the middlemen are more aware of what is happening in the market because they're in close contact with the consumers. They inform manufacturers to schedule production according to the needs of the market. On the other hand, some forms of assistance and incentives must be accorded by manufacturers to distributors to ensure the smooth flow of the products. Any wrong feed-back on both may create problems which will affect not only the manufacturers and distributors but the consumers as well. We can conclude therefore that choosing an appropriate channel to market products is a must but getting the cooperation of everyone even plays a much more important role — for without such cooperation, it would be difficult for them to maximize profits and gain hold of the market.

ENGINEERING & TECHNOLOGICAL DEVELOPMENTS

technical abstracts



Main treatment plant, Ebbww Vale

EFFLUENT DISPOSAL IN AN INTEGRATED WORKS

The liquid effluent problem at an integrated steelworks is in toto inevitably large and complex. Amalgamation of the constituent streams before treatment at one main plant raises more difficulties than it it solves; in contrast, segregation and selected mixing can bring economies in processing the liqours. The principle is illustrated by several examples. The Ebbw Vale works of the Tinplate Group gives rise to an effluent problem of unique intensity. An explanation is given, and the measures now being taken to meet the demands of the local river authority are described. The reasons for the choice of the "carbonate" process are mentioned, and important aspects of the specification of this plant are stressed. Reference is made to the special effluent problems associated with the large-scale chemical and electrochemical treatment of steel strip, unexpected side effects, and anomalies in consent conditions. Finally, the paper speculates on the possibility of making effluent treatment economically viable, having in view the recovery of water, nickel, and chromium as the main examples. **Journal of the Iron and Steel Institute March 1971.**

CIRCULAR GRATE: NEW TOOL FOR PELLETIZING IRON ORE

By taking iron ore on a 22-minute merry-go-round trip this new kiln turns out high-quality oxide pellets —at capital and operating cost that are lower than those incurred in conventional pelletizing plants.

Called, "Unipellet", it combines the know-how and experience that McKee gained while developing three earlier processes: the vertical-shaft furnace in 1946, the horizontal straight grate in 1952 and the grate-kiln system in 1956.

The advantages of the new system are:

1. Uniform product quality — due primarily to the versatility of the air-draft system and

to the discharge method.

2. Lower fuel and power consumption — because of more efficient heat transfer across a shallower ore bed, special water seals, reduced radiation losses, and use of cold fans and minimum ductwork.
3. Lower maintenance
4. Lower capital costs
5. Adaptability to metallization

E/MJ, June 1970

USE OF PRE-REDUCED IRON PELLETS FOR STEELMAKING IN ELECTRIC FURNACES

A trial was carried out on a 5-ton arc furnace using prereduced iron pellets as a partial replacement for scrap in the basket charge and as a continuous feed through the furnace roof. The prereduced material supplied was manufactured in pilot plants and the quality of the product was not as consistent as would be expected from large scale production. Reasonable control of both chemistry was achieved, although with pellets containing appreciable amounts of titanium, the capacity of the slag to retain sulphur was reduced and modifications to the steelmaking practice were necessary. Electrical measurements should increase in energy consumptions as improvements in power factor and voltage fluctuations. There was a significant reduction in the residual content of the steel when the reduced pellets were used. **Journal of the Iron and Steel Institute, June 1970**

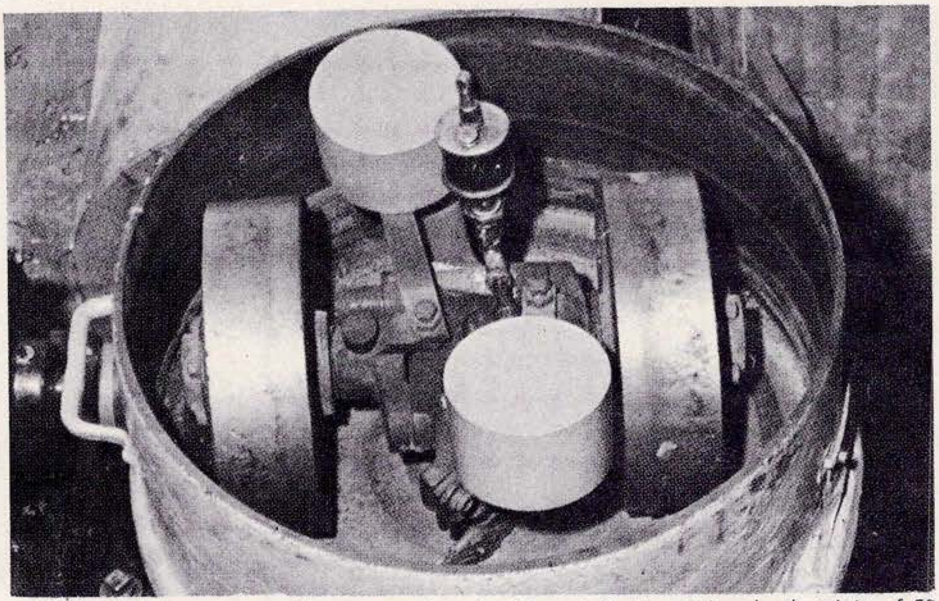
A TWO-ZONE THEORY OF IRON-OXIDE REDUCTION

A two-zone theory of iron-oxide reduction is proposed which is based on microscopic observations at high magnifications of the wustite/iron boundary in partially reduced hematite and magnetite briquettes. From kinetic reduction data, it was determined that the reaction rate is controlled by a phase-boundary reaction process in the primary reaction zone and, at temperatures above 700°C by a solid-state diffusion process through the recrystallized iron layer in the secondary reaction zone.

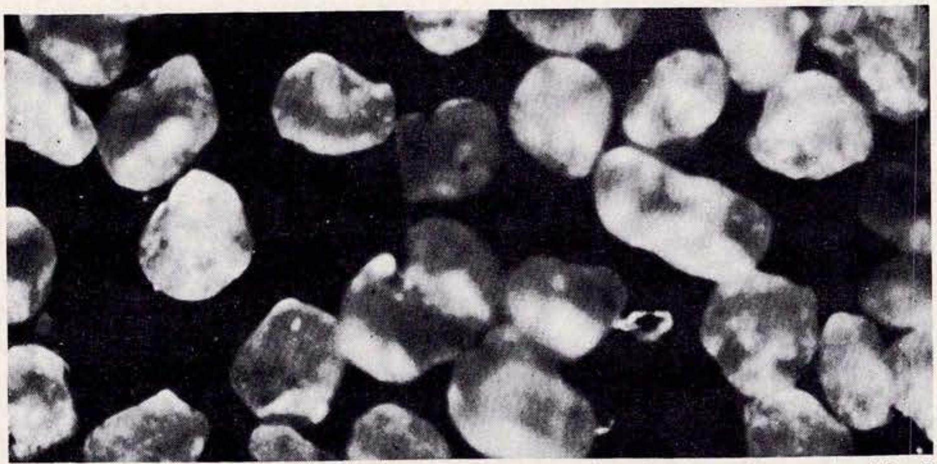
This theory can be used to explain the rate minimum phenomenon often observed during iron-oxide reduction. Furthermore, this explanation suggests the possibility that the presence or absence of the rate minimum is determined by the grain size of the iron-oxide minerals and the presence of certain impurities. **Journal of the Iron and Steel Institute, July 1971**

HOW MULLING TIME AFFECTS SAND PROPERTIES

Mixing time quickly changes the properties of sand. A surprising small amount of clay substance such as three per cent bentonite can be made to develop adequate strength in sand when it is mulled for as long as two hours, although such mulling is impractical. When all of the clay substance has been put to work and all the clay has become effective clay, the sand is completely mulled and mulling efficiency is substantially 100 per cent. At that point, no latent (non-working) clay is present and effective and total clays are identical. Foundrymen should exercise greater attention to the efficiency of sand preparation — particularly to time of mulling and to muller maintenance. **Foundry, July 1971**



Old-style laboratory muller was equipped with weights to attain wheel weight of 50 lb. that it could produce sand with properties equal to those of a sand made in a plant mixer.



Photomicrograph shows silica sand with 6% bentonite after it has been mixed for 2 hours.

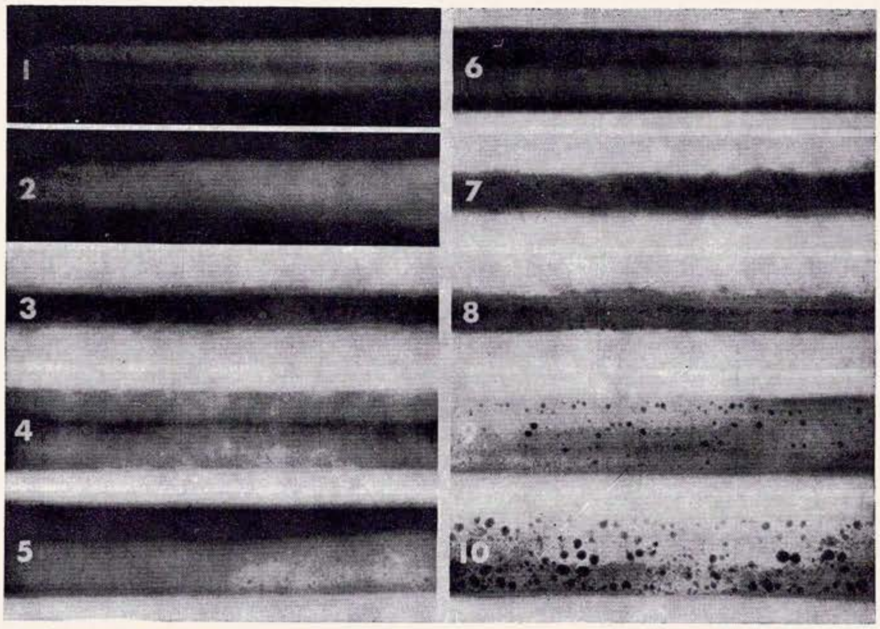
FATIGUE OF ALUMINUM ALLOY WELDED JOINTS

A study of aluminum alloy butt, lap and tee welded joints under axial-stress loading and of butt welds under repeated-bending loading (all of thin-gage plate materials) revealed that their fatigue strengths were affected foremost by the geometric characteristics of the joints. The degree of stress concentration and of symmetry with respect to the load axis both contribute to the following order of decreasing axial-stress fatigue strength for the joints investigated:

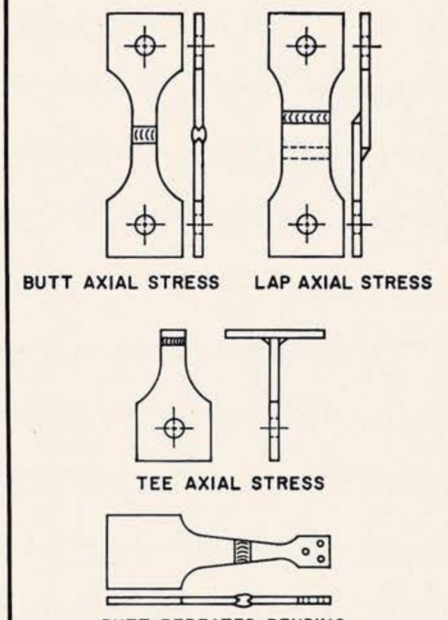
1. Butt, bead on.
2. Butt, bead off.
3. Tee, double fillet.
4. Lap, double fillet.
5. Lap, single fillet.
6. Tee, single fillet.

Only small differences were found between the last three joints, listed, all of which had substantially lower fatigue strengths than the three joints rated above them. The base metal and filler metal alloys apparently had less effect on fatigue strength than the geometric factors.

For any given type joint (butt, lap or tee), the weld size and shape were prime factors afftecting their fatigue strengths (except bead-off butt welds). The highest fatigue strength for bead-on butt joints was obtained from welds with low-profile reinforcements and high tensile strength. Fillet welds with a convex shape produced lower fatigue strengths for both lap and tee joints. Tee joints with fillet welds substantially oversized and with the welds blending smoothly into base metals had the highest fatigue strength for that type joint. **Welding Journal, February 1971**



Radiographic porosity standards for aluminum welds developed and used in the welding laboratories of Kaiser Aluminum and Chemical Corporation.



Fatigue test specimens.

LIQUID ION EXCHANGE RECOVERS COPPER FROM WASTE AND LOW GRADE ORES

The process treats a solution whose concentration is only about one gram of copper per liter. The feed-stream is leach liquor obtained by percolating weak sulfuric acid solution over heaps of waste material containing low-grade copper.

The leach solution or pregnant liquor goes to the extraction stage and is intimately mixed with an organic phase containing an active reagent that preferentially extracts the copper from other metallic ions present. Now rich in copper, the organic phase is passed to a stripping circuit in which it is contacted with a high acid-content solution that strips the loaded organic of its copper content and regenerates the active ingredient for further copper extraction. The copper, now in solution as copper sulfate, passes to an electro-winning operation for production of cathode copper. **EMJ, October 1970**

FRACTURE TOUGHNESS OF PRESSURE STEEL WELDMENTS

It has long been recognized that the use of welding as a fabrication method can pose some complex problems for the design engineer who must consider the heterogeneous nature of the weld. Each of these microstructures has significantly different fracture characteristics and the characteristics of a particular zone or region can influence the behaviour of the weldment as a whole.

The purpose of this investigation was to develop a proper technique for obtaining valid fracture toughness data on the specific regions of a weld composite and to determine to what extent the conditions of heat input and thermal stress relief will be beneficial to the fracture toughness of pressure vessel weldments. The weldments tested were A517-F and A542-Class 3 steel in the form of two inch thick plate welded with the submerged arc process. Three-point slowbend fracture toughness specimen as well as conventional charpy impact and tension test specimens were used in the program

Results showed that valid K_{LC} fracture toughness data were obtained for two inch thick steel weldments over the range of -200 to 0°F. The balance of fracture toughness properties of the as welded A517-F weldments were found to be good. Both the weld deposit and heat-affected zone exhibited toughness levels that were superior to the base metals.

However, for the A542 weldments it was found out that the base metal toughness is high and the weld metal toughness is low with the heat-affected zone falling in the intermediate range. **Welding Journal, August 1970**

HEAT RESISTANT CHAINS ACT AS HEAT EXCHANGERS

Chains cast from heat resistant alloys can serve as a heat transfer medium in kilns. The principle lies behind in the design of the position of chains. The chain is attached to the inside part of the kiln such that the chains hang freely when the attachment point is at the top and become buried in the feed material when it is at the bottom. With each revolution, the chain gathers heat when freely hanging and imparts the heat to the feed when it is buried beneath the material. **Metal Progress, July 1970**

DIRECT-REDUCTION AT HIROHATA

Nippon Steel of Japan has started trial operation at its Hirohata works of a shaft furnace producing direct-reduced iron. The shaft furnace is fed with coal and iron ore pellets, and a reduced gas developed jointly by the company. Texaco is used as the reductant.

Technically, the results are said to be satisfactory but problems of throughput and gas costs are to be expected.

The Hirohata pilot shaft furnace has a volume of 0.67 cubic meters and a capacity of 25 tons per day. A 60-ton electric furnace is being installed which will melt reduced iron and steel scrap. **Metal Bulletin, June 8, 1971**

THE DEVELOPMENT AND PROPERTIES OF A NEW HIGH-CONDUCTIVITY/HIGH STRENGTH COPPER ALLOY

A 99.6 wt percent copper alloy, which when cold worked gives high conductivity, high strength, and high resistance to heat-softening, has been developed by additions of Mg and P, approximately in the same ratio as in Mg_3P_2. Appropriate working and annealing cycles decompose the solid solution to what is believed to be a submicron dispersion of intermetallic compound (s) in a copper matrix. This structure produces significantly higher hardnesses and strengths for a given amount of cold-work than in the absence of the dispersion. Moreover, this dispersion pins dislocations and grain boundaries and thereby retains the strain-hardening to higher temperatures. A wide range of desirable combinations of conductivity, strength, and heat-resistance can thereby be achieved. Details of these, and of the processing to achieve them, are given. **Journal of the Institute of Metals, December 1970**

PRACTICES AND EQUIPMENT FOR HEAT TREATING ALUMINUM ALLOYS

There are two prerequisites for a heat-treattable alloy for age or hardenable precipitation: 1. Solid solubility of major alloying elements should decrease with decreasing temperature. 2. Guinier-Preston (GP) zone solvers should be sufficiently high to be able to form GP zones in a reasonable time.

The degree of strengthening due to precipitation hardening is much greater than that due to solid solution hardening. The 7000 series (Al-Zn-Mg alloys) have the highest mechanical properties because of the high volume fraction and also the size of the precipitates. GP zones are the most effective hardeners because of their small size and large numbers. Generally, it is desired to age to maximum hardeness. Tempers are designated T5, T6 or T8. In certain circumstances, overaging may enhance the stress corrosion resistance; and this temper is designated T7.

Many factors can influence precipitation and resultant properties such as: quench conditions, deformation after quenching, minor addition elements and aging practice.

The article includes discussions on different heat treatment of alloys and the properties, characteristics, and applications of heat-treatable aluminum alloys. **Metal Progress, September 1970**

RECOVERY OF ACID FROM SPENT PICKLE LIQUOR

When pickling with sulphuric acid, the waste pickle liquor is neutralized and the harmless products disposed of satisfactorily. Hydrochloric acid pickling however presents a problem because of high concentration of salt involved. The problem was tackled with the purpose of recovering the hydrochloric acid for reuse in pickling line.

There are three processes for recovering used HCl. The first process was based on the concept of using indirect heating in the pickling baths instead of the current method of sparging live steam into the baths. The second alternative process was based on the addition of concentrated sulphuric acid to the dilute calcium chloride solution to produce a dilute HCl effluent. The third alternative process assumed that the dilute calcium chloride solution would initially be concentrated by evaporation.

Based on these preliminary alternative processes, an economic evaluation was initiated covering whatever laboratory procedures were deemed necessary to corraborate the assumption. **Iron and Steel Engineer, September 1970**

FATIGUE CRACK PROPAGATION THROUGH WELD HEAT-AFFECTED ZONES

Fatigue tests were performed on specimens containing weld heat-affected zones at two orientations to the stress axis. Two heat-affected zones were studied, one in Ducol W30 (a low alloy steel) and the other in mild steel. Under conditions of constant alternating and maximum stress intensity a fatigue crack only propagated at a uniform rate when it was remote from the heat affected zone. A heat affected zone which was harder than either the parent plate or weld metal was found to reduce crack propagation rates by a factor of up to two by restricting the plastic zone size around the crack tip. The changes in crack propagation rate could not be related uniyuely to the conditions of the material immediately adjacent to the crack tip. Furthermore, the shape of the plastic zone was found to influence the direction of the propagation of a fatigue crack which always deviated toward regions of lower flow stress. A crack was never found to follow the interface between the weld metal and the parent metal heat affected zone because the flow stresses were not the same on either side of the interface. There was no difference in crack propagation mechanism between the parent plate and its heat affected zone for the stress conditions imposed. **Metallurgical Transactions, February 1971**

Striations on a mild steel fatigue surface. Magnification, 2700 times.

Striations on a Ducol fatigue surface. Magnification, 2900 times.

DIAGNOSIS OF CAUSES OF DEFECTS IN GRAY IRON CASTINGS

A very high proportion of castings defects are caused by the evolution of gas either from the liquid metal during solidification or from the mould cores or inserts. Such defects constitute areas which are devoid of metal and often than not render a casting scrap. This paper is intended to suggest a simple means of diagnosing blowholes and shrinkage defects and to detail the factors affecting them, together with the necessary courses of action required for their control and elimination. Before any effective action can be taken in the foundry it is imperative that the defect under consideration is accurately diagnosed. After this has been done the correct course of action is generally clear.

When considering blowhole and shrinkage defects, collectively, they may be clearly divided into three main groups; 1. small spherical holes; 2. larger holes; and 3. irregular holes.

The actual form or shape of the hole is an important characteristics when diagnosing a defect. **Foundry Trade Journal, October 29, 1970**

MANAGERIAL CONTROL IN STEELWORKS

A live 24-hour managerial control system in steelworks has been developed. This has improved planning and scheduling, and made possible a new management system characterized by a flatter organizational pyramid within which genuine management authority and expertise is now available on shift as well as on days. Operational management is supported by a communication network which enables the activities of different departments to be better integrated, and their decision-making related continuously to overall works priorities. Plant performance is constantly monitored against plan, and difficulties are quickly pinpointed so that remedial action can be taken. Collective responsibility for results is very evident as its commitment to improve future performance. Results to date have been most encouraging. **Journal of the Iron and Steel Institute, December 1970**

APPLYING VHT HOT BLAST TO CUPOLA MELTING

Usually hot blast cupola means blast temperature of 500 to 800° Fahrenheit. In fact 1000°F usually has been accepted as the optimum temperature limit.

Operating experience with a very high temperature (VHT) hot blast has shown that important benefits can be achieved at blast temperature levels up to 2,000°F. This level has become feasible with the development of the Torrax Super-Blast heater, which is designed to heat air continuously to around 2,000°F with straight line delivery.

The advantages of this temperature are coke reduction, increased production, elimination of oxidation losses, and possibility of reducing silica to silicon.

The theory is also discussed in the article. **Foundry, September, 1970**

NEW ALUMINUM ALLOYS FOR STRESS CORROSION RESISTANCE

Alcoa's 7175-T 36 and MA 15, Harvey's 7075-T 36, Kaiser's 7049-T 73 and an AF/Boeing alloy combine the stress corrosion resistance of 7075-T 73 and the strength of 7075-T 6.

Each of thes alloys has good resistance to stress corrosion cracking as indicated by threshold stress levels of 25,000 to 45,000 psi in the critical short transverse direction.

However 7175-T 36 and 7075-T 73 are only available as die forgings. **Materials Engineering, June 1970**

EFFECT OF ALLOYING ELEMENTS ON THE FORMATION OF AUSTENITE & DISSOLUTION OF CEMENTITE

The effect of alloy elements on the various reactions occuring during austenitization of steel is examined theoretically assuming local equilibrium is established at all phase interfaces. The carbon-activity difference, driving the various reactions, is evaluated from the ternary phase diagrams and is used to calculate the rate of reaction. At sufficiently high alloy additions, the reaction rate will be governed by the diffusion of the alloy element. Numerical calculations are presented for a number of cases where experimental information is available. New experimental information is presented on the rate of cementite dissolution in austenite in three chromium-alloyed steels and on the rate of austenite formation in one chromium-alloy steel. The agreement between theory and experiment is very satisfactory for all the various reactions examined. The result strongly supports the local-equilibrium model and there seems to be indications of interface control. **Journal of the Iron and Steel Institute, January 1971**

FIVE WELDING TECHNIQUES FOR SEAMLESS STEEL TUBING

Selection of a welding process for seamless specialty tubing applications can have a significant effect on the quality of work and the economics of the job. For example, many welding processes are not practical for day-to-day use—those that are practical vary in efficiency and economy with changes in working conditions and tube materials. As a result, the welding processes deemed practical for nearly all tube joint welds are reduced to fire-submerged arc welding, oxyacetylene welding (gas), shielded metal arc welding (TIG or heliarc welding), and gas metal arc welding (MIG or short arc).

All welding processes used to join tubing in the field are versatile. And any process can be used for a variety of tube welding jobs. However, it is important to remember that, in terms of efficiency and economy, there is an optimum welding process for each tubing operation. **Manufacturing Engineering and Management, April 1971**

ARGON-OXYGEN STEEL-MAKING MARKS MAJOR ADVANCE

The AOD (argon-oxygen decarb) process was developed to decarburize a melt, containing a full complement of chromium, to low carbon levels with only a negligible loss of chromium. The production trials were highly successful. In fact it is believed that this is the biggest advance in stainless manufacture since oxygen lancing.

The purpose of the argon is to dilute the CO atmosphere in contact with the melt, thus reducing the partial pressure. This maneuver increases the melt's affinity for Cr without increasing the temperature of the melt. The inert argon also stirs the melt, promoting rapid equilibrium between slag and metal. **Iron and Steel Engineer, June 1970**

GEORGETOWN PELLET PLANT BEGINS OPERATIONS

Commercial production of metallized pellets has begun at Midland-Ross Corporation's new plant in Georgetown, S.C. The facility has a capacity to produce 400,000 tons of metallized pellets a year for the electric furnaces of the adjacent Georgetown Steel Corporation. An identical metallized pellet plant in Hamburg, West Germany, part of a steelmaking complex in which Midland-Ross has a 50 percent interest, will be in operation by late summer. It will increase the company's capacity for production of metallized pellets to 1,200,000 tons annually. **Iron & Steel Engineer, June 1971**

ANISOTROPY AND WELDABILITY

Some otherwise weldable steels are subject to through-thickness tension decohesion cracking under static nonload conditions during or soon after welding. The cracking occurs at temperatures below about

450°F. Geometrical arrangements of individual parts, specified by the designs in corner and tee joints, result in transmission of welding stresses in the through-thickness direction. The cracking is maximized when using welding conditions that result in high levels of internal tensile stress.

These decohesion cracks are associated with highly anisotropic plates having low tensile ductility, low fracture strength, and low impact energy in the through-thickness direction. Unwelded plates, evaluated with smooth-bar tensile specimens, provided elongation at rupture values of from 0.03 to 6.0 per cent. Charpy V-notch energy values from three to 10 ft. lbs. were obtained at ambient temperatures. Ductility values were not improved by heating to commonly used preheat temperatures. **Welding Journal March 1971**

PRACTICAL APPLICATION OF HOPPER AND BIN DESIGN

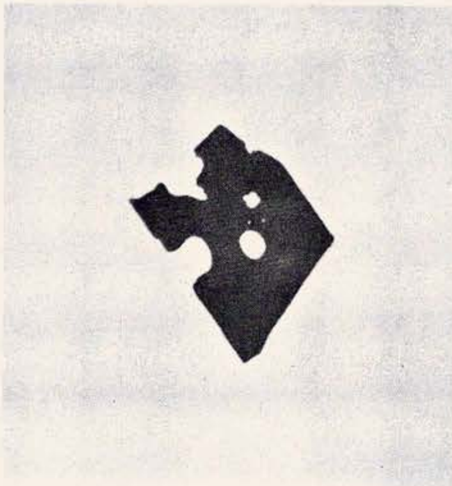
New procedures and techniques are now available for the design of bulk storage bins. These new methods have essentially eliminated guesswork in the gravity flow of bulk solids, and have provided a sound basis for the quantitative analysis of alternate designs of hoppers and bins.

This paper discusses the practical application of the Solid Flow Theory (Jenike and Johanson) and illustrates the required design procedure with a few examples of actual bin operations. **CIM Bulletin, July 1970.**

NEW RUHRKOHLE COKING PROCESS

The new process is claimed to yield perfect coke for blast furnace consumption from coal of only 30 percent coking quality. The process utilizes no binding agents and is claimed to be more sophisticated yet simpler than existing form coke production techniques – yielding strong, abrasion-resistant briquettes, without introducing new chemical substances into the process.

Non-coking coal heated to 700°-800° Centigrate is blended with good quality coking coal fines at a temperature of 450°-500° Centigrade. The mass becomes plastic and binds. The finished form coke briquettes are then subjected to "after coking" by further heating. Tests concluded last year with an experimented blast furnace showed that the "after coking" occurs during the iron making process. **Metal Bulletin, January 12, 1971**



Faceted growth of MnS on a MnS-dendrite.

Beginning of faceted growth of MnS on eutetic MnS.

THE EUTECTIC AND MONOTECTIC FORMATION OF MnS IN STEEL AND CAST IRON

The mechanism of formation of MnS in cast iron has been investigated by a method of directional solidification. The results show that the anchor type of MnS is part of a eutectic structure with austenite. A part of the phase diagram Fe-C-S is calculated and is used to predict the relative amounts of MnS and austenite in the eutectic structure. Types 1 and 11, according to Sim's classification, are interpreted as a result of a monotectic reaction and the effect of various elements on the form of MnS inclusions is interpreted in terms of their effect on the relative stability of liquid and crystallized MnS. **Journal of the Iron and Steel Institute February 1971**

MODERN MILL LAYOUT AND DESIGN FOR ROLLING STRUCTURAL STEEL

Modern combination wide-flange beam and structural mills can be designed for rolling a wide range of product shapes, as well as product sizes, to provide a more economical installation. Convertible equipment has been developed for rolling and processing the complete range of products with a minimum of investment and operating cost, and maximum utilization.

In order to minimize costly storage and warehouse operations while providing short delivery time, these mills must be able to execute minimum rolling lots for direct processing into consumer orders for shipping. New designs, requiring minimum downtime for a section change allow the execution of one hour rolling lots at 90 per cent availability. Rolling cycles for the complete product range can be kept to an extreme minimum.

Continuous high-production finishing lines have been developed for processing very small consumer orders directly for shipping.

High-production jobbing mills of this kind are in many cases the best solution for serving a domestic market with adequate transportation facilities for shipping. **Iron and Steel Engineer, May 1970**

EFFECT OF INCLUSIONS IN STEEL

Colt Industries Crucible Materials Research Center has recently concluded a study of the dependence of inclusions in high-strength and bearing steels on processing variables and engineering properties. Results of the study show that improved cleanliness as a function of melting practice is obtained in the following ascending order: electric furnace air melting, D-H degassing, vacuum arc remelting, electroslag remelting, and vacuum – induction remelting. Tests conducted on AISI 4340 and 300M steels clearly indicated that while other factors such as microsegregation affect properties. Inclusion content is the most important variable influencing critical mechanical properties of steels processed according to specified practices. **Manufacturing Engineering and Management, April 1971**

NICKEL SUBSTITUTES AND ALTERNATES FOR AUSTENITIC STAINLESS STEELS

Manganese, copper and nitrogen have been used in increased levels as nickel substitutes. Copper is an excellent choice since it does enable a substantial reduction in nickel required – to maintain the standard alloy's basic work hardening rate.

Nitrogen is also very potent as a nickel replacement within reason, since nitrogen unlike copper has the tendency to promote higher yield strengths. Bear in mind that the above modifications are restricted by AISI minimum nickel contents in a given 300 grade.

This type of substitution of course has been implemented by the basic producers. As a general statement, it can be said that this type of nickel savings by a producer results in equivalent alloys with respect to mechanical properties and general corrosion. **Blast Furnace and Steel Plant, October 1970**

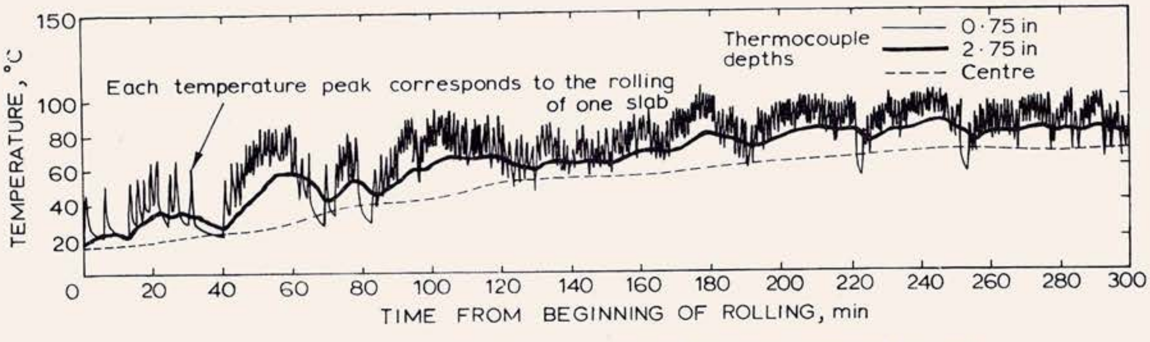
INCREASING WORK-ROLL LIFE BY IMPROVED ROLL-COOLING PRACTICE

Because of the lack of information about the temperature distribution within a work-roll, considerable variation in roll-cooling practice exists in hot strip mills. Using a specially instrumentated work roll, measurements of the roll temperatures have been obtained in a roughing stand of a medium-width strip mill. From these data, the stress cycles experienced by the roll surface have been estimated and these have shown that thermal fatigue can be a major factor in roll wear in the roughing train and also in the early finishing stands. From these considerations, a new form of roll cooler has been developed and has been fitted to the roughing train of a mill for the past year. This change in roll-cooling practice has resulted in a significant increase in roll life throughout the mill, not only in the roughing stands, but also in the finishing stands. Further investigations are planned with a view to improving the cooling of finishing-stand work rolls, and it is hoped that the data gained will enable optimum cooling systems to be designed for any rolling situation. **Journal of the Iron and Steel Institute, January 1971**

HIGH PRESSURE DISCALING FOR BAR MILLS

Surface finish requirements of rolled products make it imperative to have an effective system for the removal of scale that forms during the heating and rolling processes. in the past, efforts have been made to place moisture between the work rolls and the stock; the moisture would vaporize in an explosive manner breaking away the scale. Continued progress brought into being the present day hydraulic pressure spray system.

This system has shown that low volume and high pressure can be used to effectively descale a flat product, while minimizing temperature losses and that it is possible to operate and maintain a system of this type under steel plant conditions. **Iron and Steel Engineer, June 1970**



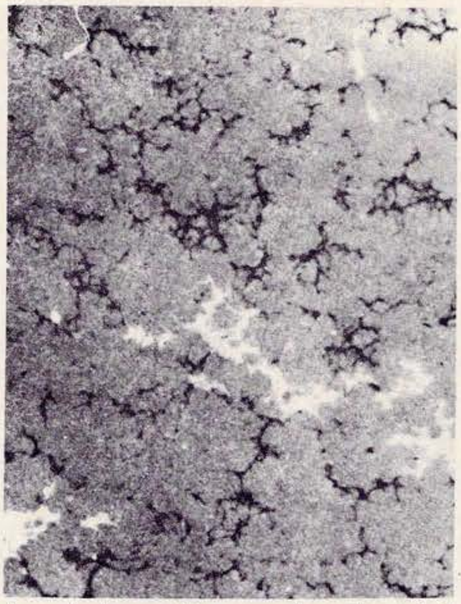
Variation of temperature within the main body of the main body of the roll.

ON THE REMOVAL OF PORES FROM CASTINGS BY SINTERING

The causes, the sizes, and distribution of porosity in castings have been reviewed and quantitatively evaluated for several important modes of alloy solidification. In general, gas exsolution is found to be the most probable cause of porosity in casting which solidify in either a cellular or dendritic fashion. On the other hand, solidification alone may cause porosity creation if the interdendritic liquid metal cannot feed the solidification shrinkage. This effect may be enhanced by gas exsolution.

Removal of porosity by "sintering" after solidification requires that the grain size be of the order, of or smaller than, the pore spacing, that the pores be small (approximately) micron for removal within reasonable times (tens of hours). When gas exsolution is the cause of pore creation, the gas must be diffused out of the sample to permit pore shrinkage. Small ingot sizes (approximately 10 cm.) and rapidly diffusible gases (H_2) are required for pore elimination within reasonable time (tens of hours).

The application of low pressure (approximately 20 atm) during sintering increases the rate, or size (to approximately 10 m) of the pores which can be eliminated within approximately 20 hr. **Metallurgical Transactions, February 1971**



Porosity formed in a sand casting of Al 4.5 pct Cu.

Decanted solid; liquid interface of an aluminum crystal exhibiting cellular growth, showing pores in cell walls after electroplating. Magnification 272 times.

THE QUALITY AND PRODUCTION OF LIME FOR BASIC OXYGEN STEELMAKING

Modern quality specifications for lime used in basic oxygen steelmaking impose stringent limits on impurity content and on certain physical properties. Impurities in lime arise from the limestone used, from contaminants introduced in the lime-burning fuel, from maloperation of the production process, and from failure to provide adequate protection of the product against atmospheric attack subsequent to manufacture. Methods of limiting contamination from all sources are described in the context of an outline of the physical chemistry of lime and lime burning. Lime quality specifications also include particle size distribution and rate of reaction of lime with water, this latter property often being accepted as a measure of the ability of lime to form an early basic slag in steelmaking. An investigation into the factors affecting lime solution rate in steelmaking slag suggests, however, that lime reactivity to water is of doubtful relevance and that lime apparent density is a more significant criterion by which to assess lime suitability. Finally, the characteristics of the kilns currently available to the lime producer are compared, and the factors governing the selection of the type of kiln to produce high quality lime for basic oxygen steelmaking are outlined. **Journal of the Iron and Steel Institute, April 1970**

MATHEMATICAL MODELS FOR OPTIMUM DESIGN OF GRINDING CIRCUITS

Some specific cases of the collection of data from industrial grinding and classifying operations and the development of models from the data so obtained are described. The problems encountered, the efforts involved, and the value of the derived models in improving the plant effeciencies will be discussed and documented where possible **To Canadian Mining and Metallurgical Bulletin, April.**

THERMAL ANALYSIS PREDICTS NODULAR IRON (QUALITY IN MOLTEN STATE

A fast, unique test to predict the quality of nodular cast iron while the molten metal is still in the ladle has been developed at General Motors Research Laboratories. Still in the experimental stage, the method predicts the microstructure of nodular iron from an analysis of cooling curves. The analysis provides a measure of graphite nodularity and percent carbides within two minutes after withdrawing the molten sample. **Iron and Steel Engineer, June 1971**

COD Tests on Aus-Ten 50 Beams at 0°C

Test No.	Notch and Weld	At Initiation COD (in.)	At Initiation Stress (ksi)	Behaviour of Defect
C 26/3	2 in. long × 0.25 in. deep part-through notch at web/flange junction in parent material.			No initiation up to general yield.
E 26/2	2 in. × 0.25 in. cut web/flange junction. A plate 1 in. × 6 in. × 3 in. was then welded onto flange (at 0°C) adjacent to notch. Flange was then re-cooled to 0°C and a cosmetic pass made adjacent to notch with a 10 gauge rod so notch tip wholly in HAZ (V.P.H. 400).	0.005	17 (117 MN/m^2)	Cleavage propagation but arrested in tension flange 2 in. from tips of flange.
F 26/4	Preparation as above, but welds made to specification, i.e. pre-heat to 125°C.			No initiation up to general yield.

THE ANALYSIS OF SOLID-SOLID SEPARATIONS IN CLASSIFIERS

A new simple correlation has been developed to evaluate the performance of classifiers. The new correlation has been tested on existing data from 150 different hydrocyclone classification tests. It is shown that this model provides a meaningful improved method of mathematically describing the classification process. **The Canadian Mining and Metallurgical Bulletin, April 1971.**

RELATIVE USE OF HIGH-STRENGTH STEELS

High-strength steels are defined as those having yield stresses in the range from 50 to 120 ksi. Current specifications for mechanical properties of such steels are critically reviewed with respect to definition of yield stress, tensile strength, ductility and impact strength. The additional important design parameters of toughness and fatigue are considered, and a detailed discussion is given of the crack opening displacement concept as a measure of toughness in structural steels. Finally, the economics of use of high-strength steels are examined. **Journal of the Australian Institute of Metals, June 1971**

PARTICLE METALLURGY TURNS OUT TOP TOOL STEELS

Crucible Materials Group of Colt Industries is commercially producing high-speed tool steels by a new process which, it says, eliminates carbide segragation to produce better tool steels. The new process, called particle metallurgy, was developed by Crusible at its Materials Research Center.

The process involves gas atomization of a molten stream of the desired alloy. When the atomized alloy is cooled, resulting particles are in effect, extremely fine micro-ingots. The particles are then placed in containers and compacted to a 100 percent density by an unusual hot isostatic compression method. Crucible has patented the process, its equipment and applications of the finished steel. Its Syracuse plant manufactures 100,000 lb. of high-speed tool steels a month. **33/The International Journal of Metals Producing, February 1971**

EXTRUSION OF STEEL IN THE TEMPERATURE RANGE BETWEEN 20 AND 700°C

In the last few years there has been an increasing demand to form non-alloy, high-carbon steels and alloy case-hardening and heat-treatable steels by cold extrusion. In particular, the high quality surface finish and greater dimensional accuracy have made cold extrusion appear attractive when compared with forging. A limit has, however, been set to the workability of higher strength steels by the load bearing capacity of the extrusion dies. The strain attainable per operation drops considerably with increasing flow stress of the material, so that finally cold extrusion alone becomes uneconomical due to the number of forming operations necessary. Further limits are set to cold extrusion by the high press loads with fairly large workpieces, by the inadequate ductility (brittleness) of many materials and by structure transformations during cold forming such as for instance in the working of austenitic stainless steels.

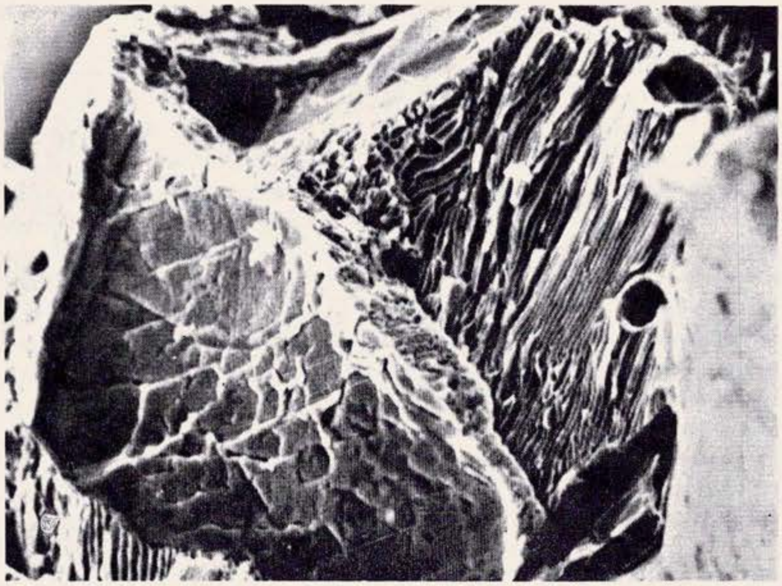
At least some of the drawbacks of cold forming can be avoided without completely losing the advantages, by forming in a temperature range between room temperature and 700°C. Extrusion in this temperature range, which has only been used in industry to a very limited extent, brings a number of problems which are discussed in this article. **Metal Forming, March 1971.**

COLD EXTRUDING STEEL

Cold extrusion has two distinct advantages: (1) It conserves steel-most of the material in the preform ends up in the finished part. (2) It is excellent for mass production applications.

The two major methods are forward extrusion and backward extrusion. Both require a combination of properties to meet extrusion requirements.

Among the more important material properties that must be considered when deciding whether to use cold extrusion are low strength and hardness, high ductility, and high machinability rating. If the part is to be heat treated after forming, these properties must be balanced against the need for proper response to the heat treatment so that hardness, strength, wear resistance, and toughness are developed. **Metal Progress, May 1970**



Fracture surface of graphite flake and pearlite.

VARIABILITY OF LIFE IN DROP FORGING DIES

The life of drop forging dies varies considerably both for a given forging and from one forged shape to another. Depending on the complexity and size of a forging, the average die life may vary from a few hundreds up to about 50,000 pieces.

It has been pointed out that if the causes of such variation were known and could be controlled, it may be possible to increase average die life substantially by optimising forging conditions.

The object of the present paper is to consider the possible causes of die life variation and where possible to estimate the extent of variation which can be attributed to each cause.

Variations in average die life for different forgings are not considered here, since they have been investigated and are reasonably well understood.

The paper is concerned only with those factors which affect the life of dies which fail due to erosive wear. **Metal Forming, February 1971**

DEFORMATION AND FRACTURE OF GREY CAST-IRON STRUCTURE

The effect of varying microstructure on the mechanical properties and fracture behaviour of grey cast iron was studied. It was found that the graphite flakes cleaved under an applied stress and these microcracks initiated fracture within the cast-iron matrix. Annealing the grey cast irons produced ferrite around the graphite flakes which increased the K_{IC} value and produced a transgranular fracture. Increasing the annealing time, increased the amount of ferrite and the grainsize, decreased the K_{IC} value, and the fracture became more intergranular either along the ferrite grain boundaries or along the prior austenite grain boundaries. **Journal of the Iron and Steel Institute, February 1971**

GAS-METAL REACTION IN CO_2 ARC WELDING

Gas-metal reactions in CO_2 welding are complex involving interactions between carbon, oxygen, iron, deoxidants, and alloying elements at the surfaces of, and within, the weld pool and electrode tip. They have been examined in stages by considering reactions firstly for static pools, melt runs and deposited weld beads in pure iron, followed by the more complex conditions involved with 1% silicon iron, a mild steel, and an 18-8 stainless steel. It is found that intense reaction occurs in the region of the arc roots where thermodynamic equilibrium is established thus determining, for example, whether carbon is absorbed or rejected. Reactions within the weld pool and within the droplets forming on the electrode tip are then dependent on transport processes circulating the molten metal through these active zones. The mean effective reaction temperature at the weld-pool surface for the conditions used in the present work was assessed to be about 2300°C and that at the surface of the electrode tip about 100°-200°C higher. The reaction takes place to a greater extent within the transferring droplets than within the weld pool because of the higher surface area to volume ratio, so that the molten metal circulates more rapidly through the active zone in the small droplets. The carbon level attained under a continuous stream of CO_2 is higher than would be attained in a closed system where the CO_2 would be largely converted to CO, so that within the molten metal the absorbed carbon and oxygen attempt to re-react to form CO. A deoxidant, such as silicon, reduces the oxygen level in the molten metal and raises the equilibrium carbon level at which CO starts to form within the molten metal so that porosity is eliminated; but deoxidants are much less effective in arc welding than in other, non-arc, metallurgical processes because of the higher effective reaction temperature. **Journal of the Iron and Steel Institute, April 1971**

COPPER AND COPPER ALLOY STRIP MANUFACTURE BY EXTRUSION PROCESS

Extrusion has been adopted in preference to conventional hot or cold rolling for the production of copper and copper alloy strip by the Furukawa Electric Co., Ltd., Japan, in a plant with an output of ~ 1000 tons per month. The advantages that this change in work practice offers are discussed. The features of the process have been exploited to the full in the extrusion of weldless, defect-free strip of precise dimension and high conductivity for the trans-Pacific Submarine Cable, and attention is therefore focused on this aspect of the company's work. **Journal of the Institute of Metals Vol. 98 August, 1970**

DEEP DRAWING STEEL FROM ARMCO

Field evaluation have confirmed the excellent drawing properties of Armco's I-F steel — a new family of steels. Critical to the material's characteristics. The new steel offers a significant advantage over rimmed and aluminum-killed steels in that it has the nonaging and nonfluting characteristics of aluminum-killed steels. Critical to the materials's performance is the absence of yield point elongation. Carbon and nitrogen, the interstitial elements which cause yield point elongation, are tied-up by alloying. As a result, the basic metallurgical structure is free of interstitial elements. I-F steel has an r_m (relative drawability) value of approximately 2.0. This compares to an r_m value of approximately 1.5 for aluminum-killed steel and 1.2 for rimmed steel. The development is seen as particularly important to galvanized steels. Present galvanized has an r_m value of 1.5, while I-F galvanized has an r_m steel value of 1.30-1.50. Typical yield strengths for I-F steel are in the 22,000 psi range while tensile strength are approximately 48,000 psi. **Manufacturing Engineering and Management, April 1971**

metals NEWS

& RELATED EVENTS

Shown at the contract signing done at Esco's Portland office: Jaime V. Ongpin, EEI President, (seated); standing, from left are Dan Babbit, export manager, Esco International; Steve Clark, field engineer, Esco International; Jesse Baum, EEI foundry consultant; Chuck Haney, vice president, Esco Corporation; and Jack Friedel, technical manager, Esco International.

EEI OBTAINS ESCO LICENSE

Esco Corporation of Portland, Oregon, U.S.A. & Engineering Equipment, Inc., recently finalized a technical assistance and proprietary products agreement.

Under the agreement, EEI's Foundry Division will make castings using the latest techniques, designs and newly discovered alloys of Esco. Resulting benefits for local industries are expected in terms of reduction of dollar requirements for imported castings and significant savings thru the use of longer-life castings.

This latest move is a major step in EEI's program of pioneering development in the local foundry industry thru the acquisition of modern equipment and continuous upgrading of methods used.

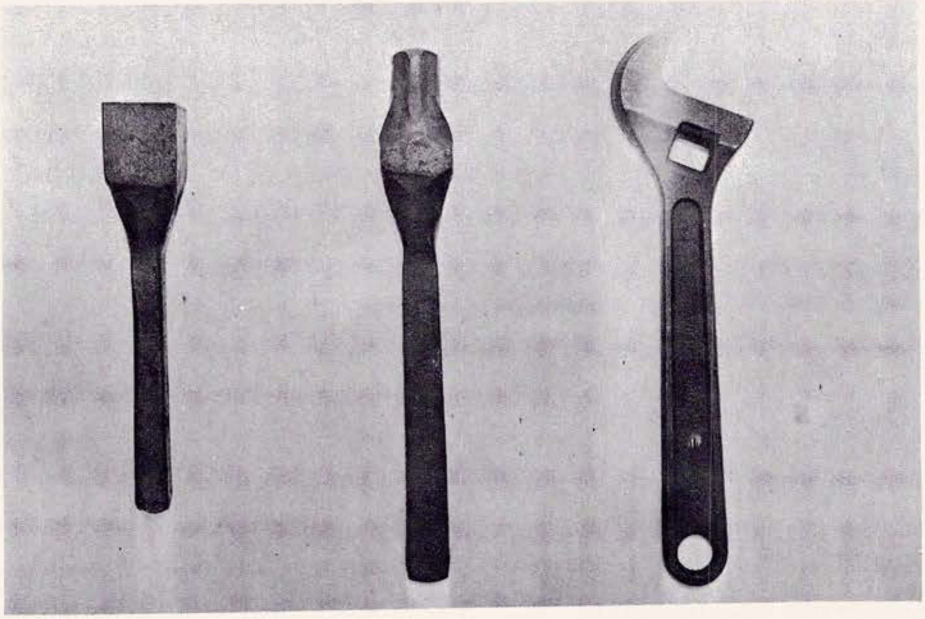
Esco is recognized the world over for the quality of its foundry products and the wide variety (over 100) of the steel alloys it produces. Its logging and rigging equipment, its shovel dippers (the world's largest), digging teeth, crusher jaws, wearable parts for size reduction equipment, nuclear reactor castings have become the standard for the industries which use them. Esco maintains one of the largest and best equipped metallurgical engineering staff of any alloy steel foundry.

PELLET CORPORATION SETS EXPANSION EQUITY HIKE

The Pellet Corporation of the Philippines, a 90 per cent Japanese-owned company, has set a ₱4 million expansions program within the next two years, involving the construction of a fourth furnace and the modernization of its existing pelletizing plant in Camarines Norte..

The company is increasing its authorized capital stock from the present ₱4m to ₱9M to raise funds required for the expansion program.

Pellet's board of directors is composed of the following: Motoi Sakaki, Ryoichi Yamakoshi, Kiyoharu Iga, Harry Campbell and Jesus Avanceña.



Adjustable wrenches. one of the hcnd tools to be produced by Elitool.

GERMAN ASSISTANCE FOR ELITOOL

There are 15 engineers from Elisco Tool manufacturing Corporation who are now undergoing training at Belzer-Werk plant at Wuppertal, West Germany. Berlzer-Werk, one of the oldest hand tool Manufacturers in Germany will be sending three engineering experts to provide additional technical know-how assistance to Elitool. They will be here for not more than a year.

The construction of buildings and facilities at Elitool plant are 60 per cent complete. Their product lines include wrenches (open end, box and adjustable), claw and ball peen hammers, flat and phillips screw divers, pliers (pipe, slip joint, combination, side cutter and long nose) and sugar cane knives.

MMIC KOBE STEEL PACT

The Japanese government recently approved the contract between Kobe Steel Ltd. of Japan and Marinduque Mining and Industrial Corporation for the supply by Kobe to MMIC of a nickel extraction plant with a total value of $64 million. This contract will go down in history in Japanese trade circles.

The nickel extraction plant in the contract is the single largest plant in monetary terms ever to be exported from Japan.

The nickel project which will be set by the MMIC plant in Nonoc Island, Surigao del Sur is being financed by loans from the United States Export and Import Bank, the International Finance Corporation and a consortium of US commercial banks, headed by the Bankers Trust of New York. Technical support to the project will be provided by Japan, the United States and Canada.

PHILACOR BUILDS COMPRESSOR PLANT

Expansion is going on at the Philippine Appliance Corporation plant, Parañaque, Rizal. Construction of a new building that will house the compressor plant, electronics area, production storeroom and warehouse are now underway. The new compressor plant will be capable of producing 250 units of Westinghouse compressors a day, operating on two shifts. Approximately, 50 persons will be required to operate various machinery and equipment.

The compressor plant is expected to be fully operational on May, 1972.

William W. Dunkum, Jr.

Jose F. Singson.

REYNOLDS NOW PRODUCING WIDER AND THINNER FOIL

Reynolds Philippine Corporation recently increased its capability to produce wider and thinner aluminum foil.

According to William W. Dunkum, Jr., vice president and general manager, the company can now turn out foil with a 36-inch finished width and a thickness of .00025 inch (.00635 milimeters).

It would need 4,000 sheets of this thickness to make a stack one inch high. With its new capability, the company can produce foil 20 percent wider and 16 per cent thinner than before.

The company's capability is such that it would take only 40 days to turn out enough foil to circle the globe at the equator (27,000 miles), or 675 miles of foil in a day.

FIRST PHILIPPINE NICKEL EXPORT

A local nickel firm with concessions in Palawan has signed a five-year nickel supply contract with Sumitomo Metal Mining Company of Japan. The first shipments are scheduled to start next year.

According to Edgar Lee Rodrigueza, president of Infanta Mineral and Industrial Corporation, this is the first time that the Philippines is exporting nickel ore. He said his company's nickel deposits in one concession contain 2.2 per cent nickel, similar to that of Caledonia.

The company has plans to set up a nickel processing plant in the future.

HOOVEN PUTTING UP ₱18-M ALUMINUM PLANT

An aluminum sheet and foil plant worth some ₱18 million to be operational next year with a capacity of 12 million pounds is being put up by Hooven Philippines, Inc.

Aluminum ingots needed as raw materials for this rolling mill project will be imported from Australia.

Hooven has just been registered with the Board of Investment for its aluminum sheets and foils manufacturing venture, non-pioneer. It is also registered with the BOI for its extruded aluminum fabrication with a capacity of 10.5 million pounds, non-pioneer. Hooven has been in aluminum fabrication for 16 years.

SEMINAR ON AIR AND WATER POLLUTION IN THE STEEL INDUSTRY

Mr. Jose F. Singson, Industrial Consultant from the Presidential Economic Staff (PES), was the lone Philippine representative in the seminar on Air and Water Pollution Arising in the Iron and Steel Industry held at Leningrad and Cherepovets, USSR from August 23 to 28, 1971. The seminar was organized by the Economic Commission for Europe (ECE) in cooperation with the USSR Ministry for the Iron and Steel Industries and was attended by 244 experts from 29 countries. Among the topics discussed were: modern techniques for the purification of effluents and industrial gases arising in the steel industry and the effects of discharges on natural environment, human health, installations and the design of industrial plants.

GOODYEAR STEEL PIPE EXPANSION PROGRAM BARED

Goodyear Steel, leading manufacturer in the Philippines of galvanized welded iron, black iron and conduit pipes, announced a gigantic expansion program to make the country self-sufficient in all sizes of welded pipes up to 12 inches without the need for importations from Japan and Taiwan.

The machinery which will arrive on January, 1972 will produce from four inches up to 12 inches galvanized and black welded iron pipes with a production capacity of 1,500 tons a month. At present, Goodyear Steel Pipes is producing 1/2 in. to four in. welded galvanized iron and conduit pipes.

Upon completion of machinery installation, Goodyear will become one of the largest pipe manufacturers in Southeast Asia.

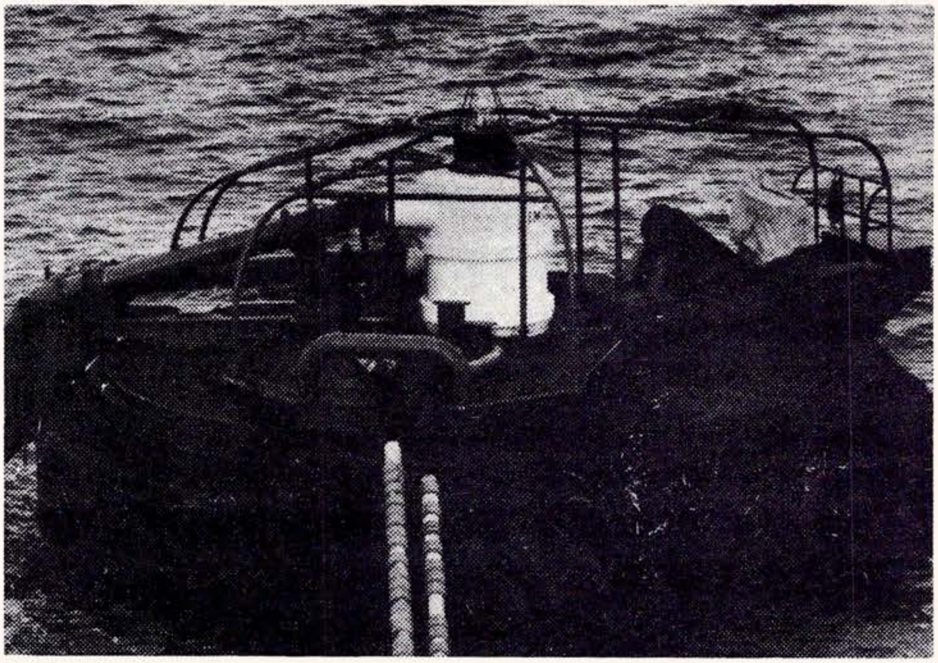
HOCHMETALS PHILIPPINES, INC.

Hochmetals Philippines, Inc., the local subsidiary of South American Consolidated Enterprises S.A., has just completed its first year of operations in the Philippines.

The parent company is one of the leading international mining and trading organizations with a worldwide network of operations which include mining, smelting, ore-buying and exploration as well as industrial production, manufacturing, trading and other commercial activities.

The group operates an integrated copper mining and smelting complex in Chile (Mantos Blancos) which uses a unique and especially developed metallurgical process to produce some 30,000 tons a year of high-conductivity copper ingots conforming to ASTM specifications B5/43. Other representative operations include a sulphur mine and sulphuric acid plant (Aucanquilcha) located at over 20,000 ft. altitude in the Chilean Andes, and a joint venture (with Banque de'l Indochine and the Societe Le Nickel of France) nickel mining and smelting complex (Morro de Niquel) in Brazil which annually produces close to 3000 tons of pure nickel, contained in ferro nickel.

Hochmetals Philippines, Inc. act as exclusive representative for the international group in all its varied fields of activity including investigation of new mining and metallurgical projects in the Philippines which might require services which the group can offer; purchase of Philippines ores and concentrates for export and worldwide marketing through the group's international offices; and supply to local users of metals, alloys, chemicals, machinery of all types, with particular reference to mining equipment such as conveyor systems tailor-made to the customers' requirements.



Anchored one and one-half miles off New Zealand's North Island, bouy above serves as critical transfer point in submarine pipeline from iron sands mines ashore and as mooring facility for large ore carriers operated by Marcona Corporation, USA.

ALLOY WIRE MADE FROM POWDER

Fulmer Institute at Buckingshamshire, England has started the experimental production of wire from alloy powders using novel techniques.

High quality wire has been made from nickel-chromium alloys, precipitation-hardening stainless steels, copper-beryllium alloys for computer memory systems and nickel-titanium for heat recovery alloys. With the existing melting and primary fabricatioñ equipment, metals and alloys can be produced in wire down to 0.0028 inch in diameter, with execptionally high surface finish.

Powders of the constituent metals and compounds are ground in a high energy ball mill and then compacted and hot worked to the final product. A major advantage of the technique compared to conventional ball-milling is that relatively coarse powders may be used as feeds but the final product consist of an intimate, final product consists of an intimate, fine mixture of the components. It is said to be particularly applicable for processing reactive powders.

MARCONA LOADS ORE SLURRY VIA PIPELINE

The world's first offshore shipboard loading of bulk mineral commodities has been successfully completed by Marcona Corporation, an affiliate of Cyprus Mines Corporation and Utah Construction & Mining Co.

The historic shiploading was accomplished with the company's recently introduced slurry handling process, known as Marconaflo. The cargo, consisted of 42,000 tons of iron ore concentrates in slurry form. It was pumped via submarine pipeline aboard the S.S. San Juan Traveler which was moored near the west coast of New Zealand.

The Marconaflo system was introduced in July, 1969 with the first dockside slurry shipment of iron ore from Peru to Portland, Oregon. Marcona has since signed a ten-year, $113 million contract for delivery of 10 million tons of iron ore concentrates by the process from its mines in Peru to the Hirohata Steels Works of Japan's grant Nippon Steel Corporation.

AUSTRALIAN CRUSHING AND SCREENING EQUIPMENT FOR CHRISTMAS ISLAND

The British Phosphate Commissioners recently awarded the contract for the design, supply and installation of crushing and screening equipment for its two plants at Christmas Island, to Humphreys and Glassgow, Ltd. of Sydney, Australia.

The job comprise two dry phosphate rock screening and crushing plants with their conveyors, buildings, dust extractors, sampling equipment and other related facilities. These have been installed and are being commissioned to produce sized grades of phosphate rock required by fertilizer manufacturers in Australia and New Zealand.

One plant is capable of operating at 400 tons per hour, the other at 300 tons per hour.

Compact "Argenta" electrolytic silver recovery unit can be distaff operated. Two new models are shown here.

MINI-ELECTRO REFINERIES BOOST SILVER RECOVERY

Future Systems, Inc. of the United States has succeeded in designing mini-electrolytic refineries called Argenta, for the recovery of silver from a photo-film solution.

Key to the system's success is an advanced and exclusive design based on fluid dynamics, called the boundary layer tripper that overcomes the formation of insoluble silver sulfide. This is done with the use of flexible non-conductive strips or boundary layer trippers, which are attached to a stationary anode. These prevent electrical resistance build-up in the boundary layer by allowing a continuous flow of fresh, silver-rich solution to the systems rotating cathode.

The company cited the following advantages of the refineries: 1) they need little electrical power for plating and less cathode area 2) they effect simple and fast desilvering and reduction of waste solution pollutants and 3) offer the lowest total cost per ounce of recovered silver.

WHY INDIRECT EXTRUDING

The basic difference between the two methods is that since there is no relative motion between the container bore and billet in the indirect method, there is no residual friction. However, in the direct method, the relative movement between the plastic metal in the billet and the container bore creates considerable friction, varying with the length of the billet, type of alloy, temperature differential and other factors.

In the direct method, up to about 30 per cent of the press tonnage is used to merely overcome the friction of the billets against the liner wall. With the indirect method, the die is moved through the container and there is no relative motion between the billet and the container, thus eliminating this friction and making practically all of the press tonnage available for extrusions.

NATIONAL-STANDARD ORDERS PRESS FROM ASEA (UK)

ASEA (Great Britain) Ltd. has recently received an order for a QUINTUS hydrostatic press with auxilliary plant from the National Standard Co. Ltd., the largest overseas subsidiary of National-Standard Co. of Niles, Michigan, U.S.A.

The QUINTUS press will be installed in a new plant at Perth, Scothland which will be manufacturing copper-clad aluminium redraw rods, bushbars and will produce tubes and sections from copper and copper alloys as well as from aluminium and aluminium alloys.

STEEL PRODUCTION BY IISI MEMBER COUNTRIES

The International Iron and Steel Institute, composed of 24 member countries recently announced the decrease of one per cent in steel production, composed with last year's production.

For the first five months of 1971, the cumulative total was 171.68 million metric tons against 174.45 million metric tons for the same period in 1970, or a 1.6 per cent decrease.

The comparative performance in million tons by major groups of countries are shown below:

	1971	1770	% of change
E.C.S.C.	8.61	9.37	–8.2
U.K.	2.21	2.48	–10.9
U.S.A.	11.74	10.50	–11.8
Japan	7.33	7.93	–7.5
Others	5.19	5.16	–.7
Total	35.08	35.44	–1.0

METHODS DEVELOPED FOR PROTECTING SILVER AGAINST TARNISHING

The United States' Silver Institute reports having reviewed 22 effective methods recently developed for protecting silver against tarnishing. Two interesting systems are herein described.

The first system consists in dipping in a methanol solution of 15 per cent tin chloride for five to 30 seconds. This method was developed by Dr. A. Burkhardt in Germany.

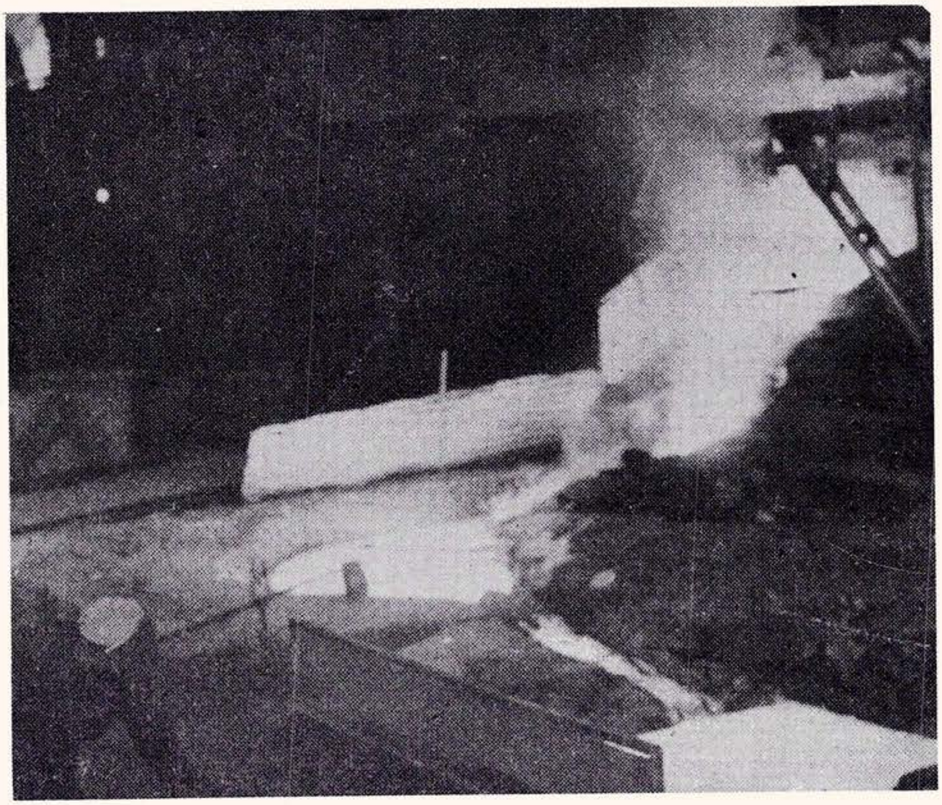
The second procedure is an electrophoretic treatment with alumina, using a water solution of 0.4 per cent aluminum sulfate and 0.2 per cent ammonium oxalate at temperatures of 20 to 30 degrees Centigrade.

The silver part is the cathode and platinum anode is used at four volts and 0.4 amperes per square inch. This method was developed by Drs. R. Fath, G. Ban and F. Hasko of Budapest, Hungary.

SPECIAL ALLOY REDUCES PINHOLES IN CONTINUOUS CASTING OPERATION

Union Carbide's Ferroalloys Division in Alloy, West Virginia, has developed "Calsibar" alloy, a calcium-barium-silicon deoxidizer used to reduce the formation of pores and pinholes in billets or slabs.

"Calsibar" alloy contains 14 to 17 per cent calcium, 15 to 62 per cent silicon, 14 to 18 per cent barium and seven per cent maximum iron. Effectiveness of "Calsibar" alloy is due to barium which sharply reduces the reactivity of calcium in steel, therefore providing more consistent deoxidation and inclusion control.



"Calsibar" alloy, a calcium-barium-silicon product, is tapped from a giant electric-smelting furnace at Union Carbide's plant in Alloy, West Virginia, USA.

NIPPON'S FORMED COKE PLANT

A plant for the commercial-scale production of formed coke will soon be completed at a site adjacent to Nippon Steel of Japan's Tobata works. The plant, having a capacity of 400,000 metric tons per year of briquettes, will use a continuous formed coke production process developed by Hippon Steel.

The first commercial-scale plant of its type in Japan, the plant will be geared exclusively to the supply of formed coke to Nippon's blast furnaces.

MITSUBISHI SUCCEEDS IN CONVERTING ILMENITE TO RUTILE

Mitsubishi Metal Mining Company, using chlorine gas to eliminate impurities in the ore, has succeeded in increasing the titanium content of ilmentite ore to 95 per cent, the same concentration as that of rutile ore, the primary source of metallic titanium.

This is a timely contribution to the metal industry as the supply of rutile ore is decreasing. The ilmenite production of the United States, Australia and Norway is much greater than rutile ore.

NEW ZIRCONIA NOZZLE SPEEDS SCRAP COPPER RECLAMATION

Engineers at Bell Laboratories, collaborating with the engineers of Nassau Smelting and Refining Company has found a faster way to reclaim scrap copper for re-use in new telephone equipment. A new zirconia-ceramic nozzle was developed and tested for a continuous casting process and has a pouring rate of 20,000 pounds of molten copper per hour.

Zirconia has a melting point of 4,892 degrees Fahrenheit compared to 1,980 degrees Fahrenheit for copper. The nozzle consists of a zirconia-ceramic liner with a 60-degree funnel-shaped entrance shaped to fit a flow control pin and a tapered exit through which the liquid copper flows.

An electric heater is built into the nozzle where it raises the temperature of the liner near that of the molten copper to protect the liner from thermal shock. It continues to operate during production so that copper cannot solidify.

JAPANESE TO ASSIST THAI STEEL MILL PROJECT

Four Japanese steel firms (Nippon Kokan, Nippon Steel Corporation. Kawasaki Steel Corporation and Sumitomo Industries) and four trading firms (Mitsui & Co., Mitsubishi Shoji, Marubeni-Iida and C. Itoh & Co.) have finally agreed with the Government of Thailand to assist in the latter's construction project of a one million ton blast furnace.

Thailand has been earnestly asking assistance from the Japanese firms in the construction of an integrated steel mill including the one million-ton blast furnace. However, the Japanese firms are likely to advice Thailand to begin the construction of a cold rolling mill before erecting the blast furnace.

KIMBERLY ALUMINUM PROJECT AGREED UPON

Two years of negotiation between Sumitomo Chemicals, Showa Denko, American Climax, Anaconda, the Netherlands Aluminum and VAW of West Germany finally ended when all agreed to participate in a joint venture of mining bauxite in Kimberly, West Australia. Operations and production which will be conducted by Kimberly Alumina Co., a 100 per cent subsidiary of American Climax, will start as soon as the venture is approved by the Government of Australia and the other countries concerned.

The alumina plant, after completion, will be the second largest alumina plant in that country, next to Doston Alumina Plant, a joint firm of Comalco and Kaiser.

ADVANCE IN NICKEL DETECTION USES NEUTRON BOMBARDMENT

A new method which can be used to detect nickel and other elements in the earth's crust, and possibly on the ocean floor and the surface of the other planets, has been revealed by the scientists of the U.S. Geological Services, Department of the Interior.

Dr. Frank Senfle, a U.S.G.S. physicist reported results from survey laboratory experiments in which radiation signals given forth by nickel under neutron bombardment can be quickly identified.

The experiment makes use of a radioisotope, Californium 252, which can emit as many neutrons as 2,000,000-volt accelator. Bombardment of these neutrons on atoms causes the emmission of high-energy gamma rays which can readily be interpreted by recently developed solid state detectors.

Laboratory simulation tests showed that nickel concentration as low as one-tenth of one per cent could be detected and that the technique need not be limited to use on land.

ACTIVATED DIFFUSION BONDING DEVELOPED AT GE FOR SUPERALLOYS

A process producing a metal-to-metal bond, called diffusion bonding, was developed by General Electric's Aircraft Engine Group, for joining difficult-to-weld nickel base superalloys, which are now used extensively in advanced high performance aircraft jet engines.

The new process 1) produces defect-free joints with strength approaching base metal properties; 2) combines the ease of brazing with the high joint strength of solid state diffusion bonding; and 3) requires only nominal pressure thus allowing the joining of fragile parts of complex configuration without risk of part deformation. Feasibility studies of the process has been proven in laboratory tests and in the production of engine components.

Activated diffusion bonding process requires the use of a special bonding alloy, but not the melting of the parent metals.

This fabricated jet engine turbine nozzle assembly demonstrates the capability of the activated diffusion bonding process. The three vanes are joined at both the inner and outer bands.

KOBE STEEL DEVELOPS EPOCHAL PRODUCT

In welding high strength steel, welded parts are likely to crack because of hydrogen contained by the moisture in the electrode. Therefore, most low hydrogen-based covered electrode have to be dessicated before they are used, and must be used in a short time – within 30 minutes for electrodes for 70 and 80 kilogram high strength steel.

Kobe Steel Ltd. of Japan has successfully developed moisture-proof low hydrogen-based covered electrodes using water glass to absorb moisture. This new product which will be on the market shortly does not require redessication for about one day after the covers are removed.

SIMPLIFIED SILVER RECOVERY PROCESS ECONOMICAL FOR SMALL OPERATIONS

Valuable quantities of silver are being recovered from film and fixing solutions through two simplified processes developed by Noble Metals, Inc. One system is for small offices, the other for plants recovering silver commercially.

Noble's small batch electrolytic units which were developed by Robert J. Copper and Dr. Carnell, recovers 92 to 96 per cent pure silver.

The Gonzaga University chemistry department worked with Noble Metals to develop its large commercial system which recovers silver from any photographic material in gel suspension including x-rays, photographic negatives and prints, movie film, microfilm, etc.

new arrivals at the MIDC library

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METALS INDUSTRY trends & events

a newsletter published by the Metals Industry Research & Development Center (MIRDC), an attached agency of the Department of Science & Technology

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MIRDC

MIRDC Conquers "No Man's Land"

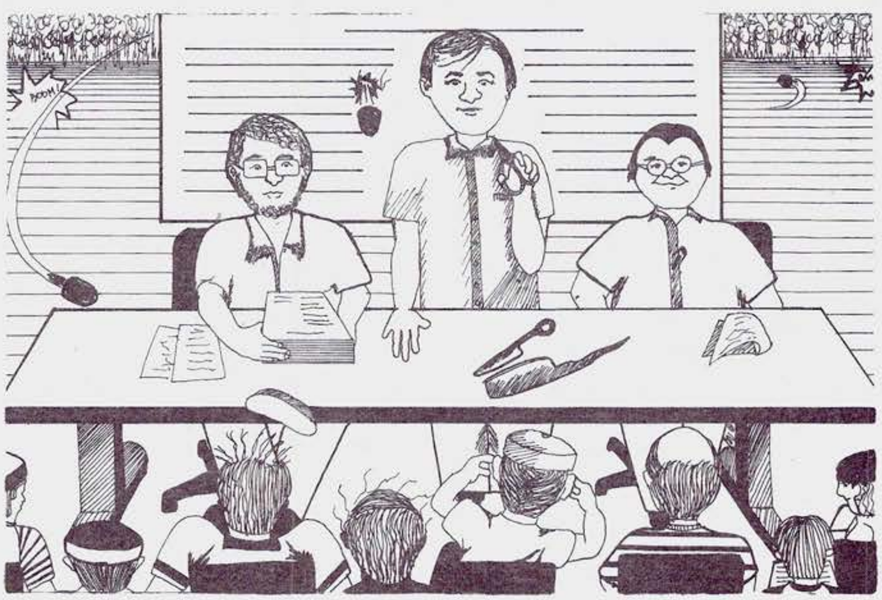
Buluan in Maguindanao, a place that has posed a big challenge to the government's claim of commitment to rural development, recently welcomed a three-man team from the Metals Industry Research and Development Center (MIRDC), an attached agency of the Department of Science and Technology. Because of Buluan's notoriety of being in the warpath of hostile factions, the place seldom receives government attention. Even investors from other provinces hesitate to engage in profitable activities in this area due to fears of being caught in the crossfire.

The MIRDC team assessed the existing smithery industry in the area through plant visits and dialogues with local entrepreneurs and blacksmiths. Their findings showed a prevalent use of antiquated facilities and backward smithery practices. Among the problems that local cutlery shops normally encounter are: **1)** scarcity and high cost of raw materials; **2)** lack of financing/ shortage of working capital; **3)** shortage of skilled labor; and **4)** poor quality of products.

The team recommended that the cutlery operators band themselves into a local association to solve their raw material sourcing problem, and in order to avail of loans from government financing institutions. Thus, they will be able to update their tools and equipment. More blacksmiths should also be trained to increase their number, which now runs to only 21. Related to this, the team trained the local producers on scissors production.

The MIRDC team, composed of Dominador C. Cabatic, Industry Assistance Department Manager, Rolando A. Bongat and blacksmith Noel Datul, visited the place in connection with the Technical Consultancy Module of the USAID-Metals and Engineering Industries Assistance Program.

A second visit by another MIRDC team composed of Roy Sagrado, MIRDC Extension Officer in Cagayan de Oro, Luis Ramel and Noel Datul, brought pruning shears production to the area. Where they used to produce only knives, bolos and plows, now the local blacksmiths are also capable of producing high quality scissors and pruning shears. This is expected to augment the income of the cutlery producers of Buluan. The team likewise recommended the use of proper polishing materials and correct working procedures to



improve product quality, as well as proper heat treatment procedure to ensure adherence to product quality standards.

The Buluan entrepreneurs relayed their request for financial assistance valued at about P1 million to enhance smithery operations in their area. This is presently being worked out through the Technology and Livelihood Resource Center (TLRC).

The people of Buluan expressed both their surprise and appreciation for the first-ever visit by concerned government agencies.

Regional Service Centers: Metalworking Technology Dispersal to the Countryside

The Technical Panel and Review Committee on Metals and Engineering recently proposed the establishment of Regional Service Centers (RSCs) to improve countryside manufacturing capability.

An RSC is envisioned to be a facility or cluster of facilities directed exclusively toward assisting small and medium metalworking firms in improving their production processes. The type of RSC shall be determined by the type of metalworking subsector that regional firms are most prepared to develop. Currently up for consideration are such subsectors as metalcasting, tool and die making, heat treatment, electroplating, welding (fabrication), machining and forging.

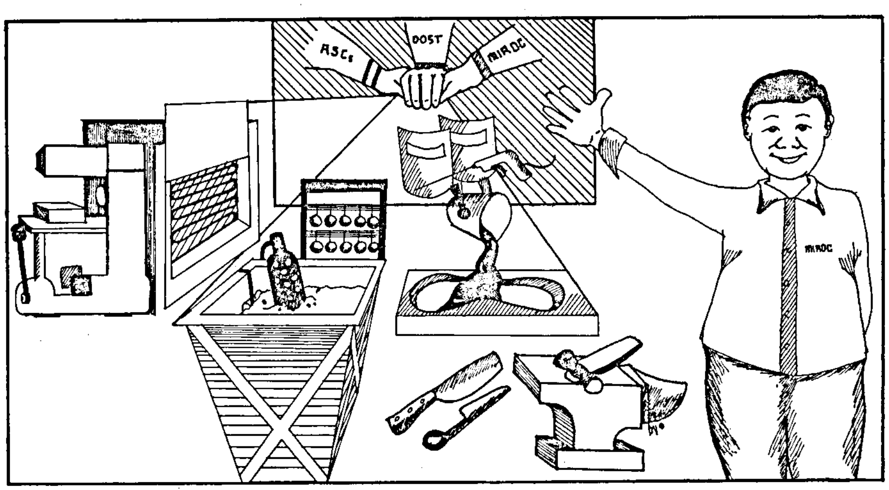
Small and medium scale industries in the regions shall eventually be given such RSC assistance as consultancy for production and process engineering, technical training for craft level skills, facilities sharing for product development, testing and quality control for metal products and processes, and relevant applied research. On a larger frame, RSCs are envisioned to serve as technology incubators where all functions can be directed to nurture potential enterprises until they can productively use particular technologies.

Initially, the government shall support the RSCs in terms of financing and technical capabilities, effectively sustaining its first few years of operation. The RSCs shall be attached to DOST regional offices for administrative requirements, while MIRDC shall provide technical supervision. After they have gained sufficient support and patronage, the control of RSCs shall be turned over to local metalworking associations.

The Plan indicates seven (7) possible sites for RSCs, each with a distinct cluster of facilities requirements. Three of these have already been identified as pilot RSCs, since they have the most progressive metalworking industries: Region VII - Central Visayas (particularly the Cebu metropolis), Region XII - Central Mindanao (Iligan), and Region XI - Southern Mindanao (Davao). The Luzon area's projected needs for a Regional Service Center is expected to be covered by MIRDC. Altogether, these RSCs shall form a nationwide network of institutions promoting technology and productivity for the metalworking industry.

MIRDC Establishes Regional Linkages

Promoting the government's countryside development programs, the Metals Industry Research and Development Center is implementing a line-up of programs extending advisory services to small and medium scale producers whose products



have export and/or import-substitution potentials. MIRDC assists individuals, private firms, cooperatives and communities on raw materials acquisition and on the latest and relevant technologies, including assistance in the opening of new markets.

One of these is the Department of Science and Technology's Grant-in-Aid project called the "Development of Local Capability for Machinery and Parts Manufacture". Under this scheme, an assessment of the capabilities and needs of the metalworking sector in Regions III, VI, VII, X, XI and XII will be done prior to actual program implementation. The program modules shall include skills training, technical consultancy, design and fabrication of prototype models of proposed machineries and parts, machine rebuilding and product development, and establishment of common service facilities.

Another rural expansion project is the Salvapul-Bamur Technical Development Program. This project assists the metalworking entrepreneurs of one economic district in Negros Occidental (Salvador Benedicto-Valladolid-Pulupandan-Bago-Murcia) through manpower training and extension of technical advisory services.

A common service facility will be set up in Tugaya, Lanao del Sur with the assistance of Rep. Ali Dimaporo, to demonstrate the proper technology for brassware casting in order to improve the quality of Maranao brassware. MIRDC will also conduct skills training of brassware artisans and render technical consultancy services.

Technical assistance shall be extended to smithery shops in identified regions through training programs and demonstration of proper procedures to produce local scissors and other cutlery products.

Finally, MIRDC extension offices will be set up in Cebu and Iloilo to better serve the interests of metalworking industries in those regions. These are in addition to the existing extension office established in Cagayan de Oro early in 1989.

Developing Local Capabilities for Machinery and Parts Manufacture

The Department of Science and Technology (DOST) through its attached agency, the Metals Industry Research and Development Center (MIRDC), is implementing a program for the development of the local manufacturing capability for machinery and parts. The program aims to develop and strengthen the machinery and parts manufacturing sector along product lines and production activities in which the Philippines can be more competitive.

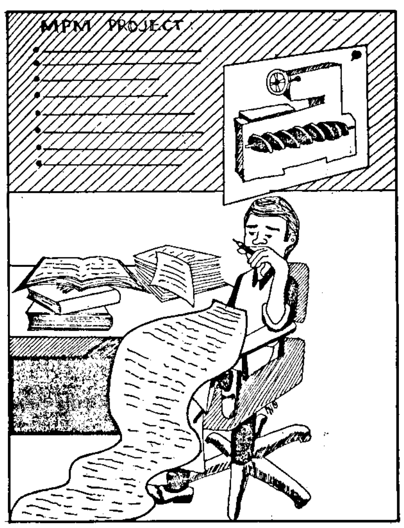
The metalworking subsector expected to benefit directly from the program is composed of about 1,400 machine and fabrication shops. The production activities of these establishments have linkages and growth impact on other productive sectors of the economy. They either supply the input requirements or directly and indirectly consume the products of other industries.

The success of the program will result in the training of skilled craftsmen and technicians capable of producing basic machineries and parts. It will save considerable foreign exchange as well as increase and diversify the country's sources of income. Finally, it will help generate employment.

The project shall be undertaken by MIRDC in cooperation with various industry associations such as the Metalworking Industries Association of the Philippines (MIAP), the Philippine Foundry Society (PFS), the Society of Manufacturing Engineers (SME), and the Agricultural Machinery Manufacturers and Distributors Association (AMMDA), with the assistance of the DOST Regional Offices staff.

The components of the project are as follows:

1. Data gathering/survey of machinery and parts manufac-



turers;
2. Technical consultancy;
3. Design and fabrication of prototype models of proposed machineries and parts;
4. Machine rebuilding and product development;
5. Manpower training in such proposed areas as metalcasting, heat treatment, machine shop, machine rebuilding, metrology and quality control, welding, pressworking (die design); and
6. Establishment of heat treatment facilities in identified regions.

Considering the important position of the machinery and parts manufacturing industry in the country's drive for industrialization, the DOST, through MIRDC, has gone into extensive direct assistance for the development of this sector.

Engineering Manpower Development Program

In conjunction with the UNDP Science and Technology Manpower Development Mission's Philippine visit last October 4-18,1989 to study the government's proposed programs for the development of Science and Technology capability and to identify a project for possible World Bank financing, a committee consisting of representatives from the Metals Industry Research and Development Center, the Department of Education, Culture and Sports, and the Technical Panel for Engineering Education, has conducted an assessment of several schools from Northern Luzon to Mindanao.

The Mission had recommended that the Philippine Manpower Development Program should marshal faculty resources, and that research laboratories be equipped to international standards. Science and higher engineering education should be strengthened by initially improving a limited number of universities chosen on the basis of their development potential and geographical location.

Basically, the assessment team gathered the opinion of school authorities nationwide regarding their willingness to improve engineering courses to make them responsive to the needs of the industry.

Improvement of the engineering curricula involves two components — faculty development and facility development. Depending on the schools' facilities per DECS requirements and their performance in the board examinations, fifteen schools will be selected as resource base for engineering manpower development. Majority of the schools' authorities interviewed were willing to shoulder the salary of qualified faculty members sent for scholarship training. They are also willing to welcome loans for facility improvement provided that they will have a hand in choosing the equipment and the supplier; also, that the loans be available and payable in pesos and not in dollars.

According to Mr. Arthur Lucas C. Cruz, the MIRDC representative to the assessment committee, the whole idea of the program is that engineering courses should address the needs of the industry. The academe has to go beyond the bachelor's degree, going to masteral and doctorate degrees eventually to re-enforce research and development in line with our aim to achieve Newly Industrialized Country (NIC) status by the year 2000.

Metals and Engineering Plan Takes Off

The "**Metals and Engineering Industries National Action Plan** 1990-2000" is the first Action Plan presented to and approved by the Science and Technology Coordinating Council (STCC), the highest S & T governing body consisting of Cabinet Secretaries and representatives from the private sector and the academe. It is the first in a series of accomplishments by the Metals and Engineering Technical Planning and Review Committee (TPRC) in its move to push S & T (specifically metals and engineering) projects that would bring about Philippine industrialization by the year 2000.

To date, the achievements of the Metals and Engineering TPRC are as follows:

A. The establishment of the Design and Engineering Center Foundation, Inc. (DECFI). It was launched last 24 October 1989 and was duly registered with the Securities and Exchange Commission as a private foundation. It has elicited an initial support fund of P1.7 million in checks and pledges from private and government entities; has drawn a total of 38 members from private and government sectors; has set up office at the Metals Industry Research and Development Center (MIRDC) and already has a line-up of five (5) prospective design projects for 1990.

B. The formation of TPRC sub-committees tasked to expedite the packaging of essential components for modernization and to initiate their implementation. These five-member bodies are the Incentives Package Sub-committee led by the Board of Investments; the Manpower Development Sub-committe led by MIRDC; the Financing Package Sub-committe led by metalworking industry leaders; and the Accreditation Sub-committee led by the Bureau of Product Standards.

C. The approval of the Foundry Industry Development Program. Accreditation and modernization/rationalization guidelines are now taking effect. The BOI now processes foundry applicants on the basis of the guidelines; accreditation of foundry shops is scheduled to begin in June 1990.

D. The approval of the Tool and Die Industry Development Program. Accreditation and Standardization Committees are now studying the guidelines for implementation. The Department of Science and Technology is set to grant P630,000 for a comprehensive two-year tool and die making training program for industry and MIRDC personnel; it is to start in April 1990.

E. The approval of development programs for the heat treatment, electroplating and machining industries. Development programs for the forging, pressworking/stamping, and welding/steel fabrication industries are still to be deliberated upon.

F. The establishment of Regional Service Centers was approved in principle.

German Aid for RP Metals Testing

Dr. Gunter Wipplinger, Managing Director of Delta Consult, and Mr. Christian Goerlich, Technical Adviser of TUV-Bayern, were in Manila last March 15-22, 1990 to discuss with the Metals Industry Research and Development Center the details of the technical assistance to be extended by the Federal Republic of Germany to improve metals testing in the country. Both were members of the team which assessed the needs of the local metals industry in 1988.

The bilateral agreement between the governments of the Federal Republic of Germany and the Republic of the Philippines calls for technical cooperation by both countries for the upgrading of MIRDC services in material testing and quality inspection to improve the quality of Philippine metal products. The project will be directly implemented by the Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ) with the assistance of MIRDC.

The German assistance shall have three components: 1. short-term consultancy by German experts in selected fields of material testing for up to 45 man-months; 2. provision of training opportunities (fellowships) in Germany for selected laboratory personnel for up to 36 man-months; and 3. supply of measuring and testing equipment and spare parts to complement the MIRDC laboratory, as well as technical literature, up to a total value of DM 1,200,000.

The Philippine government, on the other hand, shall make the following contributions to the project: **1.** propose suitably qualified candidates for training in the Federal Republic of Germany and ensure the long-term employment of the graduates in their respective specialties at MIRDC; **2.** guarantee the proper assembly, installation, start-up and maintenance of equipment supplied; **3.** make available suitable office premises and communication facilities for the German experts; **4.** exempt the German-supplied items from import duties and other public charges and ensure that they are cleared by customs without delay; **5.** assume the operating and maintenance costs with respect to the project; **6.** ensure that the tasks of the German experts are taken over as soon as possible by Philippine experts; and **7.** afford the German experts any assistance they may require in carrying out the tasks assigned to them.

MIRDC has prepared a list of equipment to be supplied through GTZ assistance, as well as the names of laboratory personnel to be sent for fellowship training in Germany. §§§

PFS PAGE

a summary of news releases from and about the Philippine Foundry Society

PFS Board Names New Director

Kim Sin Ongkauko of Asa Metal Products was appointed Director by the PFS Board to replace Desiderio Agbayani Jr. of Benguet Management Corporation, formerly Director and Information Committee Chairman. Kim will assume the directorial post vacated by Agbayani up to the end of the fiscal year, or June 1990.
Agbayani resigned from the Board due to his pressing commitments.

New Committee Chairman Appointed

Ed Bate of Elasco International was unanimously chosen by the PFS Board to take the place of Leonardo Santiago as Manpower Committee Chairman, after the latter's resignation from the Board last November, 1989.
Ernesto Ang of Grand Engineering was named Information Committee Chairman, in lieu of Desiderio Agbayani Jr.
Messrs. Bate and Ang will take over the unexpired term of Santiago and Agbayani up to June, 1990.

Welcome to New Members

PFS welcomes the following additions to the roster of members whose membership applications were approved by the Board:

Alba Metal Corporation – Benjamin K. Jim – Regular
Kopa Metal Industries, Inc. – Jaime Go – Regular
Quality Metal Mfg., Inc. – Juanito Tan – Regular
Regal Metal Craft – Charles Ang – Regular
New Unity Foundry, Engineering Machine Shop & Hardware – Pilardo Lim – Regular
Cebu Iron Foundry – Alfredo Relucio – Regular
Glori Foundry – James Relucio – Regular
Dr. Felipe P. Calderon – Semirara Coal Corp. – Personal

Uy Sang Foundry and **Negros Metal Corp.** have converted their memberships from Personal to Regular.

PFS Organizes a Foundation

The foundry industry, in its desire to meet the government's efforts halfway, is initiating and instituting a program for the rehabilitation/modernization of the industry to upgrade its products to international standards. The **Philippine Metalcasting Foundation, Inc.** shall hopefully provide a vehicle by which funds can be generated to support all activities envisioned for the industry. The foundation shall support the Philippine Foundry Society in its thrust to fully unite the industry and present a solid front vis-a-vis our government and other international organizations.

The objectives of the Foundation are as follows:

1. To promote the stabilization, rationalization and advancement of the foundry industry;
2. To solicit and accept contributions, donations and/or endowments from the public or the government, either local or foreign, exclusively for the Foundation to augment its finances for the furtherance of its objectives, activities and programs;
3. To administer such contributions, donations and endowments which may be received for the attainment and realization of the aims of the Foundation;
4. To acquire, hold and/or dispose of, by purchase, sale, lease exchange or otherwise, conditionally or absolutely, real estate, properties, or any interest therein for the Foundation; and
5. To perform all and everything necessary and proper for the achievement of the goals of the Foundation.

The Foundation consists of 13 members of the Board of Trustees who are presently the Board of Directors of PFS.

Bacolod/Cebu Meeting and Plant Visit

The PFS Board of Directors and some members of the Society had a Board meeting and plant visits in Bacolod and Cebu cities. The foundries visited were Uy Sang, Victorias Milling, Negros Metal Corporation, R.U. Marketing and V.L. Yap in Bacolod

City, Atlas Consolidated Mining in Toledo City and Cebu Iron Foundry Company in Talisay, Cebu. A total of 25 participants joined this activity.

PFS Prepares for Convention and Annual General Meeting

Preparations are under way for the forthcoming 18th Metalcasters' Convention and Annual General Meeting. This year's convention theme is "**Foundry Modernization — Key to Achieving NIC Status for the Philippines**".

The date of the convention, which was originally scheduled for June 28, 1990, was postponed to July 12, 1990.

The venue is the Manila Midtown Hotel along Pedro Gil corner Adriatico, Ermita, Manila.

In commemoration of this major event, the Society will again come out with the Annual Souvenir Program. For this year, advertising rates are as follows:

Centerfold —	P4,000.00
Inside Full Page —	1,500.00
Inside Half Page —	800.00

Participation fee is P250.00 per head.

For particulars call the PFS Secretariat at 1135 EDSA, Balintawak, Quezon City at telephone numbers 34-75-36 to 39.

PFS Embarks on Project with MIRDC

The Society was contracted by MIRDC to prepare the feasibility studies for setting up common service facilities for foundries in Regions I and XI. Both studies were completed and submitted on time last February 28, 1990.

Technical Consultancy in Regions I and XI

In line with the technical consultancy schedule for metalcasting in Regions I and XI, the following members of the Society rendered consultancy:
Region I — **Loreto P. Matibag** of Metercor and
Danilo Ramillano of P&R Parts
Region XI — **Tomas Merdegia** of Foseco
PFS members who serve as consultants are paid P250.00 per hour with normal consultancy duration of 40 hours.

New Committee Formed

The new *Public Awareness Committee* chaired by Jose Hui was created in order to keep all members abreast with activities and functions of the Society. With this Committee, the PFS has adopted a new policy of inviting members to attend monthly meetings of the Board of Directors. Interested members may call on the Secretariat in advance. Cost of meals is P100.00 per person.

Board Meetings in Other Places

The idea of holding Board meetings outside Metro Manila, like in Davao, Pangasinan, etc., is being considered, to bring the Society close to the other regions. A survey to get the consensus of the members regarding this proposal will be sent out.

New Name for the Society

The PFS Board of Directors is considering changing the name of the Philippine Foundry Society to the **Philippine Metalcasting Association.** This matter shall be brought out during the 18th Metalcasters' Convention and Annual General Meeting on July 12, 1990.

PFS Meets with QIT and Netherlands Mission

Some members of the Society recently met with the QIT group from Canada. This group is willing to transfer their technology to the foundries in the Philippines and teach the foundries to produce ductile iron. They also intend to supply sorel metal on an ex-stock basis. The meeting with the QIT group was arranged by Ed Bate of Elasco International.

The PFS Board and some members also had a meeting with the Netherlands Mission through the arrangements of MIRDC, for the transfer of technology in the production of ductile iron castings. If the results of the mission prove favorable, the Dutch government shall sponsor the training of foundry personnel in Egypt (including air fare).

Foundry Manual Still Available

Interested parties can still get copies of the PFS manual entitled *"Introduction to Basic Foundry Operations - A Compilation"*, from the PFS Secretariat.

The book contains the following major topics:

1) the industry,
2) pattern making,
3) melting,
4) moulding and coremaking,
5) production,
6) metallurgy,
7) quality control, and
8) prospects of the 80s.

The manual is hardbound and priced at P250.00 per copy.

57th World Foundry Congress

The 57th World Foundry Congress will be held in Osaka, Japan from September 23 to 28, 1990, centering around the theme *"Foundry Technology Approaching the 21st Century"*.

Topics such as "The Application of Robotics and Automation to Foundry Technology" and "The Utilization of Computers in Foundry Technology" will be discussed in the technical forum of the Congress. Poster sessions, special lectures and video corners are also planned. Plant visits, a banquet, and ladies' program are also being prepared.

An exhibition near the site is being planned to coincide with the Congress. Exhibits will include castings created with the latest technology. At the same time, press forming, powder metallurgy products and plastic products shall likewise be exhibited.

For interested parties, registration forms for the 57th World Foundry Congress are now available at the PFS Secretariat.

Deadline for submission of registration forms is July 22, 1990.

Small and Medium Enterprises Consultancy Program

The Technical Planning and Review Committee — Metals and Engineering Sector is linking with the DTI Bureau of Small and Medium Business Development's "Small and Medium Enterprises Program" to implement a continuing technical consultancy program for metalworking firms. This is mandated in the Metals and Engineering Industries National Action Plan.

The program calls for pooling on-call consultants on metalworking technologies such as casting, electroplating, forging, tool and die making, heat treatment, welding and machining. Consultants' rates range from P9,000 to P15,000 per program mission to be fixed by NEDA after evaluation of degree of expertise. Travel, lodging and meal expenses comprise the counterpart component of the beneficiaries or DTI regional offices. MIRDC shall assist in identifying beneficiaries in each specific area.

PFS members are invited to enlist in the Consultants' Pool.

For interested members, you may get the Personal Data Sheet forms at the PFS Secretariat, 1135 EDSA, Balintawak, Quezon City, or call telephone numbers 34-75-36 to 39, 361-81-35, or inquire through FAX No. 361-7590. §§§

Metals Industry

CURRENT AWARENESS SERVICE

metals and engineering technology at your fingertips

This reader service allows you a glimpse of the actual contents of newly-arrived technical periodicals and books at the MIRDC library. Indices contain only the major articles; we therefore urge our readers to actually lay their hands on these books and periodicals to experience the thrills of advancing technology.

MODERN CASTING

SEPTEMBER 1989 VOLUME 79 NUMBER 9

Special Report: EPC Patterns & Tooling

2pp **The Function of Tooling in Evaporative Pattern Molding**
The design, construction and function of evaporative pattern casting (EPC) tooling governs the successful molding of polystyrene beads into accurate evaporative patterns

2pp **New Techniques for Making Accurate Foam Patterns**
The quality of evaporative pattern castings can be improved by producing more dimensionally accurate evaporative foam patterns

2pp **Producing Foam Patterns with Ventless Molds**
Recently developed, ventless molding of foam patterns for the production of metal castings represents another refinement of the evaporative pattern casting process

2pp **Foam Producers Aim for Improved Material Control and Developments**
Better understanding of foam pattern shrinkage is the key in achieving net shape castings with the EPC process.

3pp **Heat Treating, Aging System Also Permits Core Sand Removal**
A heat treating and aging system designed for aluminum castings in continuous and batch configurations combines heat treat, quench systems and aging oven with core sand removal capability

3pp **SPC for the Small and Medium Foundry's Sand System: Part 1**
With its emphasis on testing and record keeping, statistical process control is proving to be a valuable tool in producing better castings, reducing costs and preventing problems

5pp **The Metalcasting Process - Part 9 of 12:** Good Pouring Practice Contributes to Quality Castings

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ADVANCED MATERIALS & PROCESSES

NOVEMBER 1989 VOLUME 136 ISSUE 5

FEATURES

Materials Characterization

3pp **Metallography: Entering the 1990s**

8pp **Greater precision for materials analysis**
Materials-analysis technology is meeting the challenges of characterizing advanced materials with better precision and accuracy

Nondestructive Examination

3pp **Nondestructive characterization of materials**

8pp **Evaluating materials for quality**
Formerly reserved for the research laboratory, materials-evaluation technology is now providing quality assurance at the production level

Mechanical Testing

2pp **New challenges**

10pp **New emphasis on automation**
Once regarded as a "necessary evil", hard-core mechanical testing has become essential to improved quality, and increasing automation

INTECH

DECEMBER 1989 VOLUME 36, NUMBER 12

FEATURES: INSTRUMENTATION & APPLICATIONS

ISIJ INTERNATIONAL

VOL. 29 (1989), NO. 10

METALLURGICAL PLANT AND TECHNOLOGY INTERNATIONAL

Volume 12 5/89

23rd Annual Conference of the IISI

METAL FORMING

JANUARY 1990 VOL. 24, NO. 1

CHEMICAL ENGINEERING

JANUARY 1990 VOLUME 97, NO. 1

MACHINE DESIGN
SEPTEMBER 7, 1989 VOLUME 61, NUMBER 18

FEATURES

5pp **60 years of design engineering**
The past 60 years have seen tremendous changes in technology and in the way engineers do their jobs

5pp **Flexible shafts**
Applications keep growing for this simple, yet sophisticated, power-transmission technique

6pp **Avoiding errors in microvolt signals**
Measuring low frequencies and accelerations challenges the ingenuity of engineers

6pp **Expert-system mechanism design**
Engineers may soon use knowledge-based systems to take the guesswork out of mechanism design

TECH BRIEFS

2pp **Optimizing die cast products**
2pp **Flow valves for simple control**
2pp **Flux vector control for AC motors**

MODERN ELECTRONICS
OCTOBER 1989 VOLUME 6, NUMBER 10

FEATURES

7pp **Choosing the Right Computer Power (Part I)**
Guidelines for buying a personal computer

3pp **Car Back-Up Alarm**
Sounds an audible alert to warn pedestrians and other drivers when you move your car in reverse gear

5pp **One-Button Digital Timer**
Accurately controls the time-on interval for rechargeable cells and batteries to prevent damage due to overcharging

2pp **An Infrared Detector**
Gives visible indication of presence of infrared energy that is invisible to the human eye

COLUMNS

7pp **Electronics Handbook**
How to Detect Ultraviolet, Visible Light and Infrared Radiation

4pp **Solid-State Devices**
An ISDN Communications Controller, a Dedicated Motion Controller, a Micro-Power Comparator, and a Ground Fault Interrupter

WELDING & METAL FABRICATION
OCTOBER 1989 Vol. 57 No. 8

3pp **Plasma cutting**
Takes a look at how the use of plasma cutting has accelerated in the last five years, largely due to the increasing number of applications

3pp **Superplastic forming – aluminum**
Describes the process and looks at the advantages

4pp **Structure and properties of GTA welds in aluminum alloys**
Presents the results of a study dealing with the solidification structure, mechanical properties, and susceptibility to solidification cracking of GTA welds in two aluminum alloys (ASTM 1050 and ASTM 5052)

MODERN CASTING
OCTOBER 1989 VOLUME 79 NUMBER 10

Features

2pp **Maintenance: If It Ain't Broke, Keep It from Breaking!**
Preventive maintenance, long an overlooked budget item, is gaining new respectability through profit potential

3pp **SPC for Small to Medium Foundry's Sand System: Part 2**
The purpose of statistical process control (SPC) is not to conduct tests and make charts. It's to gather data and present it in such a way that you will be able to recognize potential problems before they cost you money in poor-quality molds that produce scrap castings

MACHINE DESIGN

OCTOBER 26, 1989 VOLUME 61, NUMBER 21

FEATURES

WELDING REVIEW

NOVEMBER 1989 Vol 8 No 4

AMERICAN MACHINIST

NOVEMBER 1989 Volume 133, Number 11

FEATURES

1p *Casebook:* **Device measures temperature-sensitive steel**

1p *Casebook:* **Pallet system reduces tool change time**

DEPARTMENTS

3pp **Practical Ideas**

DIE CASTING ENGINEER

NOVEMBER/DECEMBER 1989 Volume 33 Number 6

1p **Fire-Resistant Hydraulic Fluids in the '90s**

4pp **Corundum Formation in an Alloy Melting Furnace**

4pp **Compressive Stress Texturing for Die Performance**

1p **Marketing Communications Improves Sales**

AMERICAN MACHINIST

October 1989 Volume 133, Number 10

FEATURES

3pp **Research: Future machines = more electronics**
Impact of control technology on tomorrow's machine tools was a recurring theme throughout recent NMTBA research forum

3pp **Metal Forming: Making steel forgings from powder**
Their use is increasing, especially for drive-train components in cars and trucks. Here's how one producer makes them

1p **Cutting Tools: Drilling to +-0.001 in. with step drills**
Step drills sharpened in the conventional manner cannot hold close tolerances consistently. Try this method.

1p **Forming Composites: Small system shapes long parts**
A novel system, now in the lab, for forming thermoplastic composites limits equipment size regardless of part length

METALS INDUSTRY trends & events, vol. 4 no. 2, March-April 1990
A bi-monthly newsletter of the Metals Industry Research & Development Center, MIRDC Compound, Gen. Santos Ave., Bicutan, Taguig, Metro Manila, Philippines. Tel. Nos. 822-0431 to 35. Printed in-house on 60# bookpaper.

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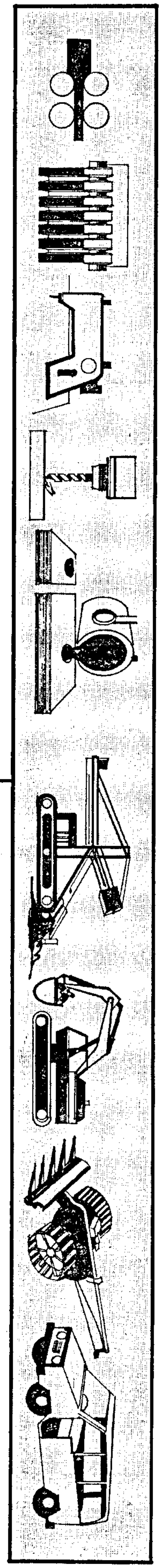


METALS INDUSTRY trends & events

a newsletter published by the Metals Industry Research & Development Center (MIRDC), an attached agency of the Department of Science & Technology

vol. 6 no. 5
Sept. - Oct. 1992

MIRDC

in the news

ABIS NAMED TO DOST USEC POST; VILORIA IS MIRDC ACTING EXECUTIVE DIRECTOR

Outgoing MIRDC Executive Director Dr. Leopoldo V. Abis has been installed as DOST Undersecretary for Regional Operations. He is concurrently the Chairman of the MIRDC Board of Trustees, replacing Dr. Ricardo T. Gloria who has been appointed DOST Acting Secretary.

A graduate of the University of the Philippines (Bachelor of Science in Mechanical Engineering), Dr. Abis finished his master and doctoral degrees in the same field at the Kansas State University where he served as a Ford Foundation Fellow from 1966-1969. He has spent 30 years of his career as researcher, teacher, project leader, project adviser and administrator. He served as a consultant in TEST Consultants, Inc. for 15 years and as Senior Research Engineer at UPIRC for 10 years. He was Executive Director of the National Engineering Center before his stint at MIRDC; and also Officer-In-Charge of the Transport Training Center.

He is a member of various engineering associations such as the Philippine Society of Mechanical Engineers and the American Society of Mechanical Engineers. Presently, he is president of the Regional Center for Energy, Heat and Mass Transfer. He has also written numerous articles and books on engineering and related subjects.

Recently, he has been presented the Productivity Excellence Award by the Asian Productivity Organization Society of the Philippines for his contributions to productivity education and training of workers in the manufacturing sector.

Meanwhile, Engr. Rolando T. Viloria has been appointed Acting Executive Director of the Metals Industry Research and Development Center effective September 24, 1992. This was announced recently by the MIRDC Board of Trustees.

A certified mechanical engineer, Engr. Viloria has been with MIRDC since 1971. He started as an assistant engineer and rose from the ranks to his previous position of Deputy Executive Director for Technical Operations of MIRDC. He has been the recipient of various in-service study and scholarship grants, including professional education and advance training in Tool & Die Making and Construction of Jigs & Fixtures in the Federal Republic of Germany. He has also undertaken training courses in Tool Engineering and Production Management held in Japan and Korea, respectively.

Engr. Viloria has served as speaker/moderator for various seminars, workshops and symposia on metalworking-related subjects. He is an acknowledged expert in tool and die production, and also served as project director of the USAID-sponsored Metals and Engineering Industries Assistance Program. The latter was a highly-successful DTI-DOST project implemented by MIRDC to directly assist small and medium metalworking entrepreneurs in Regions I, IV, V, VI, XI and XII.

Engr. Viloria is concurrently the Focal Point Coordinator for the Philippines in the ongoing UNDP-sponsored introductory project for Computerized Maintenance Management System for ASEAN iron and steel industries; member of the Technical Advisory Committee, Plastics Research and Development Council; and ex-officio director, Philippine Iron and Steel Institute.§

DOST OFFERS ASSISTANCE TO SPRING MANUFACTURERS IN SAPANG PALAY, BULACAN

The Consultancy staff of the Metals Industry Research and Development Center recently visited a group of spring manufacturers in Sapang Palay, San Jose Del Monte, Bulacan to assess the latter's capabilities, needs and problems relative to the spring making industry.

The group located six spring makers who are situated adjacent to each other. Altogether, these shops produce a varied line of springs: bed spring, seat spring, brake drum extension spring, automobile carburetor extension spring, coil spring for heavy duty trucks and motorcycles, clutch plate compression spring, and jackhammer spring.

These manufacturers get their basic raw materials from scrap wire rods bought from junk shops. They voiced out their common problem which is the scarcity of raw materials and the increasing price thereof. Presently, they employ a crude way of heat treating (stress relieving, in particular) their products using a blow torch to heat the product and usually motor oil for quenching. They also use the blow torch for blackening products which require it. Other plating requirements are subcontracted to plating shops in Manila.

The MIRDC staff borrowed samples from the group to be subjected to mechanical and metallographic tests, then plated when necessary. The findings shall be shared with the spring makers and the latter will be consulted if they would like to learn the recommended heat treatment, plating and testing procedures. MIRDC also brought up the idea of setting up common service facilities for plating and heat treatment. One of the spring makers volunteered to gather the entrepreneurs and discuss this proposition and also to avail of the demonstration on heat treatment and plating which MIRDC plans to conduct. §

MORE GTZ EXPERTS CONDUCT TRAINING/CONSULTANCY; EXTENSION OF PROJECT PROPOSED

A series of seminars and consultation workshops will be conducted by experts from the **German Technical Cooperation Agency (GTZ)** through the **Metals Industry Research and Development Center (MIRDC).** These programs which will be held in the last quarter of 1992 shall disseminate current advances in metals testing.

The experts are as follows with their corresponding expertise:

- **Mr. Gerhard Micksch,** Federal Institute for Materials Research and Testing (Berlin)
  Field: Corrosion

- **Dr. Fritz Rauchle,** GTZ
  Field: Chemistry and Corrosion

- **Mr. Heiko Bottger,** Assistant Manager, Material Structure and Strength Section of the Laboratory and Test Technology Department, Allianz-Zentrum fur Technik GmbH
  Field: Failure Analysis

- **Mr. Michael Hahn,** General Manager of the Department of Quality Assurance and Material Technology (TUV Bayern)
  Field: Quality Assurance

- **Mr. Victor Tan,** Consultant, Measurement Standards Center (Singapore Institute of Standards and Industrial Research)
  Field: Temperature Measurement and Calibration

- **Mr. Christopher Lee,** Mitutoyo Co.
  Field: Coordinate Measuring Machine

- **Mr. Chua Sze Wey,** SISIR
  Field: Electrical Measurement and Calibration

- **Mr. Gerhard Winklmaier,** Mechanical Testing Laboratory (TUV)
  Field: Testing of Welds

- **Mrs. Ling-Tan Siew Leng,** SISIR
  Field: Metrology

Messrs. Wey and Tan together with Mrs. Ling-Tan are conducting an **Information Seminar on Measurement and Standards** on *November 3, 1992* at the MIRDC Seminar Room. The seminar aims to present advance techniques and standards used in the fields of electrical, temperature and length measurements to personnel involved in quality control, instrumentation and calibration, and maintenance.

Then, a **seminar on The Role of Failure Analysis on Damage Assessment** will be conducted on *November 10-11, 1992* also at the MIRDC Seminar Room. Resource speakers are Dr. Rauchle, Messrs. Bottger and Micksch. The aim of the program is to provide an insight on failure analysis and the techniques in the system of investigations. Target participants are quality assurance engineers and technicians, personnel from insurance companies, plant engineers and structural engineers.

Apart from these seminars, technology transfer is also to be effected by these experts through consultancy conducted in selected industrial plants on request.

These programs are supplementary to the GTZ-MIRDC Technical Assistance Project for the Upgrading of the MIRDC Testing Laboratory Capability. In effect, the project has increased the availability and range of services for industrial undertakings in the field of materials testing and quality control.

An extension of the project is being proposed by MIRDC to GTZ to complete the upgrading requirements both in terms of facilities and technical expertise. It is highly evident that there are still several types of technical services that are not being made available to existing and prominently emerging needs of the local metals and engineering industries.

With this project extension, the MIRDC Testing Laboratories will have the capability to provide a full range of basic metal testing services comparable to international standards. Basic facilities and expertise deficient in the initial project phase such as in metallography, chemical analysis, failure analysis, mechanical testing and corrosion analysis will be acquired.

Reliability and timeliness of MIRDC testing services will be enhanced as these additional systems are put on line. All of these will redound to the overall benefit of the metalworking industry, as more and more firms recognize the importance of quality as the primary factor for their continued competitiveness in both local and foreign markets. §

INITIAL ACTIVITIES FOR PM PROJECT TAKE SHAPE

MIRDC has taken initial steps in continuance of the **UNDP Preventive Maintenance (PM) Project.** The immediate task of this project is the formation of a distinct preventive maintenance unit to be composed of engineers and technicians who will have the sole responsibility of implementing the project effectively and efficiently. Thus, MIRDC has created a PM core group composed of selected technical personnel from the Plant Engineering and Maintenance Division and the Analysis, Testing and Inspection Department. This group, however, has access to the support and services of the Consultancy, Training, and Marketing Groups. Among the staff's primary activities will be securing historical data, setting up the system, and close monitoring of the project.

The services of former staff members of the PM System who have gained the expertise while still with the project (during UP-NEC implementation period) have been tapped as consultants not only for training of the core group but also for the proper inventory of the equipment transferred to the Center. For the MIRDC core group to effectively transfer the PM system to the industry, the consultants shall be engaged to train this group, i.e. help familiarize the staff with the different PM equipment, deliver lectures on basic maintenance and on each consultant's field of specialization relative to the project, and provide hands-on practical training. It is also one of the requirements of the project that these consultants will help the core group in the setting up of three (3) demonstration centers, two (2) of which will be piloted at the Foundry and Machine Shop of the Center. This will include maintenance audit to establish the base line from which subsequent recommendation and maintenance productivity program can be based. Given the necessary background and skills, the group can now extend the acquired expertise to the industry through training and piloting of one (1) small or medium-scale machine shop.

A list of equipment plus their accessories and other consumables have already been transferred to MIRDC as component of the project. These include thermovision equipment, selectron surface coating equipment, laser alignment system, vibration analyzers and a host of laboratory testing equipment, to name a few.

Before the year ends, testing services will start covering nondestructive testing, failure analysis and condition monitoring. Popular courses will be given twice in the whole duration of the project while the others will be conducted only once. Each training program will run for a maximum of 30 hours or 4 days.

MIRDC gives assurance that a proper maintenance system shall be installed in order to maintain the project equipment.

Meanwhile, Altius Mainteneering Corp.,a private firm engaged in consultancy services on preventive maintenance has been taken in as a technology business incubator at MIRDC. The company is represented by its President, Mr. Ramon S. Publico.

The PM Project is now being implemented by MIRDC through the funding of the United Nations Development Program (UNDP). §

Iron & Steel, Special Steel, Nonferrous Metals, Rolled Copper & Brass, Rolled Aluminum (per kg), Steel & Copper Scrap

Dealer's Price
In Yen per M/T unless otherwise specified
July -September, 1992

Iron & Steel	
Round Bar, 9mm	77,000
16-25mm	67,000
Flat Bar, 6 x 50mm	63,000
Equal Angle, 6 x 50mm	57,500
10 x 90mm	62,500
Channel, 6 x 65 x 125mm	61,500
H-Beam,	
9/14 x 250 x 250mm	60,000
Hot R. Sheet (3 x 6), 1.6mm	66,750
Cold R. Sheet (3 x 6), 1.2mm	83,250
Medium, Plate, 3.2 x 3 x 6	59,000
Plate, 6 x 4 x 8	59,750
9 x 4 x 8	62,750
Gas Pipe (Black),	99
15A (1/2 inch/kg)	
Galv. Sheet	
(Plain), 0.30mm	132,500
(Corrugated), 9.25 /sheet)	489
Colored Sheet	
(One Side, Plain), 0.30mm	173,750
(One Side, Corrugated)	
(0.25 /sheet)	601
Wire Rod, 5.5mm	91,000
Round Nail, 100mm (4")	91,000
Iron Wire, No. 8	82,000
Annealed Iron Wire, No. 8	90,250
Galv. Iron Wire, No. 8	119,750
Barbed Wire, No. 14	157,750
Tinplate, No. 25 (0.23)	198,100
Wirerope - JIS (per 200m)	
1st Grade, Zinc Coated (24 x 6)	
10mm	42,375
20mm	110,000
Special Steel	
Structural Carbon Steel (SC)	83,333
Stainless Steel,	
SUS 430 (18CR)	
Sheet 0.3mm	353,333
SUS 304 (18-8)	
Sheet 0.3mm	440,000
Nonferrous Metals (per kg)	
Electro, Copper	353
Electro, Zinc	204
Electro, Lead	105
Tin	1,025
Antimony	348
Nickel	1,275
Selenium	2,300
Bismuth	1,050
Cadmium	650
Mercury	39,000
Aluminum	186
Rolled Copper & Brass (per kg)	
Copper Sheet, 2.0mm	645
Copper Tube, 50 x 5mm	733
Copper Rod, 25mm	647
Copper Wire, 0.9mm	615
Brass Sheet, 2.0mm	548
Brass Tube, 50 x 5mm	777
Brass Rod, 25mm	355
Brass Wire, 6mm	535
Rolled Aluminum (per kg)	
Sheet (99%),	618
1.0mm (400 x 1,200)	
Circle, 1.0mm	685
Steel Scrap	
Special For Electric Furnace	5,250
Pig Iron Scrap	25,875
Copper Scrap (per kg)	
No. 1 Copper Wire (Berry)	302
No. 2 Copper Wire (Birch)	252

STEEL ITEMS OF BASE SIZE

Excluding shipments to the USA and China
In US$ per M/T, FOB Japan
July — September 1992

Cold Rolled Sheet Coil	470
Hot Rolled Sheet Coil	370
Plate	440
Round Bar	300
Angle	310
Channel	310
H Shape	340
Wire Rod	360
Iron Wire	400
Galvanized Iron Wire	560
Galvanized Iron Sheet	550
Stainless Sheet (SUS 304, 2-6mm)	2,250

Nonferrous Metals

Copper Tube (50 x 5mm)	5,800
Copper Wire (0.9mm)	4,900
Copper Rod (25 mm)	5,200
Copper Sheet (2mm)	5,100
Brass Tube (50 x 5mm)	6,200
Brass Wire (6mm)	4,200
Brass Rod (25mm)	2,800
Brass Sheet (2mm)	4,300
Electrolytic Zinc	1,700
Electrolytic Lead	870
Antimony	2,700
Cadmium	6,000
Bismuth	8,500
Selenium	18,500
Aluminum	1,500
Aluminum Sheet	4,800
Aluminum Circle5,	400

PMAI ELECTS NEW OFFICERS

The Philippine Metalcasting Association, Inc. has elected a new set of officers for 1992-1993. They are as follows:

Kim Sin Ongkauko,	President
Ernesto Ang,	Vice-President
Robert Loo Tian,	Secretary
Jose Hui,	Treasurer
Johnny Tan,	Asst. Treasurer
Antonio Dimaguila,	Int. Auditor

Board of Directors

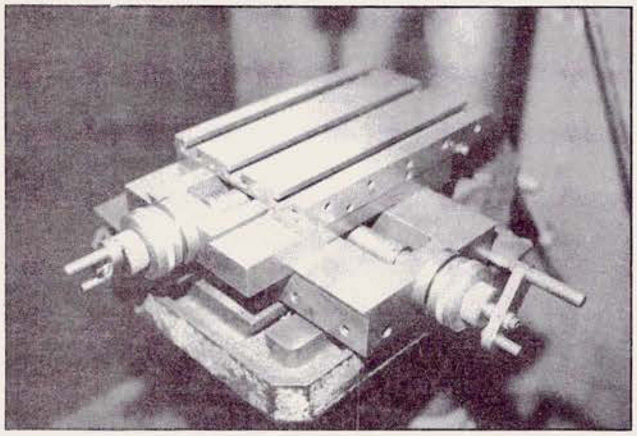
1. Leon Ang
2. Ernesto Ang
3. David Ayroso
4. Kim Sin Ongkauko
5. Romarico Platon
6. Alexander Relucio
7. Antonio Dimaguila
8. Raul Hernandez
9. Jose Hui
10. Selmo Huang
11. Alfredo Sanvictores
12. Jovy Luis
13. Johnny Tan
14. William Ang Tee
15. Robert Loo Tian

For inquiries, contact:

THE PHILIPPINE METALCASTING ASSOCIATION, INC.
1135 EDSA, BALINTAWAK, QUEZON CITY
Tel. Nos.: 34-75-36 to 39; 361-81-35
Fax No.: 361-75-90

FEATURE

MIRDC PROTOTYPES TOOL FOR DRILL PRESS



The Department of Science and Technology (DOST) is now pursuing the development of versatile yet low-priced machine tools to upgrade the capabilities of the local metalworking industry.

A project spearheaded by the **Metals Industry Research and Development Center (MIRDC)** concerns the production of the compound table, commonly known among machine shops as the work positioning table. This is primarily intended to supplement the basic function of a given type of drilling machine, making the latter suitable for a wider range of applications.

Technology

The compound table developed by MIRDC is rectangular in shape and has both longitudinal and lateral movements. Basically, it is designed as an attachment to the floor-bolted drill press. Its primary functions are: a) to clamp the workpiece; and b) to locate the workpiece with reference to the cutter.

The longitudinal and traversal slides are each fitted with graduated dials for reading the location, or the movement of the workpiece mounted on the compound table. (Refer to Table 1 for Product Specifications).

Table 1. Product Specifications

Product Overall Dimension:	**340mm x 320mm x 101mm**
Longitudinal Slide (max. travel):	**100mm**
Traversal Slide (max. travel):	**100mm**
1 revolution of graduated collar:	**2.5mm**
1 division of graduated collar:	**0.1mm**
Clamping surface:	**222mm x 150mm**
No. of T-slots:	**3**
Width:	**13.5mm**
Weight:	**20.0 kgs.**

Market

The principal potential market for the compound table includes *1) small-scale machine shops, and 2) in-house service/ maintenance/repair shops of various manufacturing firms.* There are *1,134* registered small-scale machine shops and *67,147* manufacturing establishments with their own machine shops in the Philippines as of 1991.

To date, there has been no record indicating use of compound table attachments on drill presses. However, it is estimated that there is a substantial demand for the compound table in the abovementioned market involved in low-cost and flexible machining operations, i.e. accurate and fast drilling and basic milling are possible with the use of a compound table properly mounted on a rigid drill press.

FEATURE

The estimated projected potential demand for the compound table is *7,931* units in 1993 and *10,128* in 1998 with an annual growth rate of *5.5% or 439* units.

Requirements

The initial capital outlay for one time investment in order to reprogram the operations of an existing machine shop to manufacture compound tables is about *P500,000.00.* Production shall employ mostly machining operations such as milling, turning, grinding, scraping and assembly. A machine shop with existing milling machine, precision lathe, surface grinder and drill press can be reprogrammed to make use of the technology. Thus, there is no need to acquire new or additional major machine tools for the first five years of operation.

Conclusion

MIRDC continuously strives to come up with prototype equipment which could be fabricated profitably by interested entrepreneurs. This thrust promotes the country's self-sufficiency in industrial requirements and lessens its dependence on imported machineries and machine tools.

new products & processes

NEW HIGH STRENGTH COLD FORGING STEEL

A newly developed multipurpose, low carbon (0.1%) alloy steel is forgeable at room temperature and in the process, develops considerable strength while retaining substantial toughness. It thus precludes heat treatment and can provide considerable cost benefits. Designated BHS-1, it was developed at the University of Pittsburgh and is undergoing commercial development at Bethlehem Steel's bar, rod and wire division.

Although the manganese- molybdenum-niobium steel was designed for either hot forging (under recrystallization controlled conditions) or cold forging, most of the large scale production trials pertained to the latter.

The performance of BHS-1 is attributed to its high rate of work hardening and amenability to austenite conditioning in controlled rolling followed by air cold deformation. In the air cooled condition, the steel has tensile yield strength of 67,000 psi and 65% ductility as measured by reduction of area.

Strength increases substantially without appreciable loss in ductility, following cold reductions of 10-4 % for example, 147,000 psi and 40-50 % with 30-40 % reductions.
— Source: American Machinist, August 1992.

PROTECTIVE GELS

A range of GelTek gels manufactured by Raychem of Swindon is designed to act as an anti-corrosion sealant by sealing the target surface at a microscopic level. The gels act by wetting the surface, thereby leaving no bending site either for water or oxygen molecules without which corrosion cannot occur. The materials have now been introduced in the UK. The gels are based on either silicone materials

new products & processes

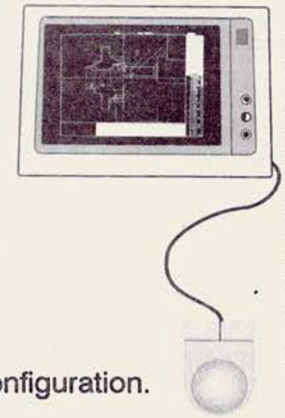
or non-silicone thermoplastic materials and are formed by combining liquid components into a stable semi-solid matrix by molecular crosslinking.

The GelTek gel exhibits both fluid-like and solid-like properties. Being mildly adhesive, the gels are able to stick to the target surface but when removed they leave no residue. GelTek products are supplied ready for use either in tape form or as pre-formed gaskets or blocks. The tape is available in widths of up to 0.5 m, lengths of up to 7.5 mm, and thickness of 0.7-4.0 mm, manufactured to specifications.

Further inquiries can be coursed through:

Scientific Surveys Ltd.
P.O. Box 21, Beaconsfield,
Bucks, HP9 INS, England
Source: Corrosion Prevention and Control, August 1992

TURNING TO CNC MODELING



Improvements in CNC turning equipment were motivated by the need to increase productivity. Although most of their increased value results from making parts faster, some increased capability results from changes in machine configuration.

Four-axis lathes increase productivity by allowing two cutting tools to work at the same time. Both can cut OD while the other cuts an ID. Twice as much material is removed in the same amount of time. Reduction in cycle time per part is between 30% and 40%.

One of the most powerful capabilities of true CNC process modeling is being able to experiment with various types of cutting procedures to reduce cycle time, improve cutting efficiency, consider alternative workholding options and adapt to a changing machining situation.
— Source: Tooling and Production, July 1992.

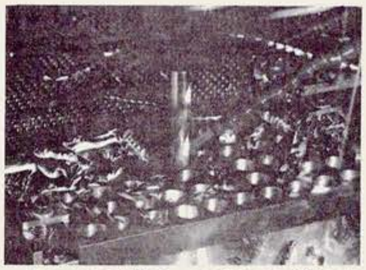
COMBO DRILL DOES IT ALL

Hertel's new BF Drill combines center drilling and chamfering into one tool. The unique geometry of the drill helps achieve much higher penetration rates than standard drills.

The drill point creates a smooth transition from the major cutting edge to the center of the drill which removes stress peaks and allows freer chip flow. More important is that, it eliminates the need for center drilling. The combination drill exhibits increased penetration rates, seven and a half times faster than that of high-speed steel and five times faster than that of standard carbide drills. Penetration rates are increased because of the narrower chip flutes and a 30% thicker web, giving the drill excellent cross section strength and rigidity.

More of the above information can be acquired from Hertel Cutting Technologies Inc., Oak Ridge, TN.
— Source: Tooling and Production, July 1992.

HOLEMAKING GOES HIGH-TECH



To date, drilling and tapping have been getting the attention they deserve, with new developments coming thick and fast. There are new geometries, new coatings and new tool materials - all driven by customer needs for

new products & processes

higher quality, greater productivity, lower cost and longer tool life.

Many drills and taps that used to be considered special are now standard but specials still play a big role in the business.

Kennametal Inc. Latrobe, PA has introduced KC 935, an aluminum oxide coated insert grade, designed to provide longer tool life at higher operating speeds. OSG Tap and Die Inc. at Glendale Heights, IL is about to introduce its HY-Pro EX - DC HT line for tapping cast aluminum. Made of 30% vanadium HSS, the taps are coated by an ion nitriding process to increase surface hardness and wear resistance without losing the toughness of the cutting edge.

— **Source: Tooling and Production, July 1992.**

AUTOMAKERS TO DRIVE HIGH-PERFORMANCE COMPOSITES

General Electric is way ahead in its pursuit to improve metal/plastic composite technology. Their techniques for nickel-plating Lexan polycarbonate resin, a high strength engineering plastic, can improve part quality and reduce production costs for several applications. The first commercial applications will be lightweight, impact resistant PC housings requiring shielding from electromagnetic and radio frequency interference, but the process will also see the use in metal plated auto parts.

The surface structure of a normally chemically inert material is thus changed into a chemically reactive area. The nickel atom chemically bond to the newly formed molecular structure on the polycarbonate resin surface, strengthening the bond. In contrast, traditional plating approached rely on a mechanical bond. The plastic is first chemically etched to create microscopic pits in the surface. The result has a rough surface, which can be a drawback for many applications.

— **Source: Manufacturing Engineering, April 1992.**

THE UTILITY STAINLESS STEEL

The development of 3CR12, a utility ferritic stainless steel, has proved to be a major step forward in the continuing battle against corrosion. Developed by Staffordshire based Cromweld Steels, 3CR12 is the result of improving the metallurgy of muffler grade stainless steel to give better formability and weldability.

With an 11-12% chromium content, high strength combined with excellent corrosion and abrasion resistance are the major features of 3CR12. In a price per ton comparison, 3CR12 falls between mild steel and conventional stainless steels. The corrosion resistance of 3CR12 in an industrial/marine environment is approximately 250 times greater than mild steel. This shows that in life cycle casting, which takes into account maintenance and repairs during the life expectancy of the structure, 3CR12 offers considerable cost savings.

The choice of 3CR12 for the construction of the AVA sports cars chassis achieved the designers objective of a lightweight high strength structure which is combined with a non-stressed GRP body with carbon fiber reinforcement, to make the structure virtually maintenance free.

The use of 3CR12 has been brought about primarily by the introduction of induction heating hobs which work by generating an alternating magnetic flux to excite the molecules in the base of the pan. This principle of operation prohibits the use of aluminum, copper and 1810 and 1808 grades of austenitic stainless steels, all traditional materials for cooking vessels.

— **Source: Stainless Steel, February 1991.**

new products & processes

THIN SILICON OXIDE FILM PREPARED BY SOL GEL PROCESS

Central Glass, in cooperation with Osaka Municipal University, has developed a thin, transparent silicon oxide film by the sol-gel process. The film is highly water repellent and durable. It is difficult to realize both of these properties using the conventional sol-gel process, however an intermediate step is used to produce a thin, porous film of gel. The starting materials are tetroethoxy oxisilant, ethanol, water hydrochloric acid and polyethylene glycol (PEG) which are mixed thoroughly to form a sol solution. A glass substrate which is coated with the solution by dip coating, is calcined at 350 degrees centigrade for 10 minutes to form a thin, porous film of gel by evaporating PEG. It is then coated with fluoroalkyl trialkoxysilane and fired at 600 degrees centigrade to produce the target thin film. The thin film is expected to find applications as a coating for vehicles and building windows.

Interested parties may contact:

Techno Japan
7F Daini Bunsei Bldg.
11-7 Toranomon 1-chome,
Minato-ku, Tokyo 105 Japan

NEW TYPES OF ROOFING TILES

Tokoname Ceramic Technology Center has developed two types of roofing tiles, one having improved water-tightness and the other having a heating element for melting snow. It has been found that rain water penetrates into the back side of the water-tight tiles after bouncing off the tiles and spattering into mushrooms, not by capillary phenomenon. The water-tight tiles contain three layers of linear water repellent guards on the surface with or without one layer of the guard on the back side. No water leak was found under the conditions of 45/100 slope, no wind and 180 mm/hr or less precipitation. The quantity of leaked water is one-third or less that of the conventional tile under the conditions of 25/100 slope. They contain an embedded heating element of 30w at the highest for safety reasons, or they are printed with the heat-generating resin.
— Source: Techno Japan, April 1992.

WATER KNIFE SIMPLIFIES ASBESTOS REMOVAL

Asbestos abatement requires the asbestos material to be wet with a fine spray of water prior to cutting to keep the level of airborne fiber low. Usually, one worker controls a spray wand to wet the material and another cuts it off with a utility knife. Having two workers present in the close quarters of some removal project can be difficult. A recently introduced tool combines both the knife and water sprayer in a single device allowing one worker to both spray and cut. The Aqua Knife contains an eight-point snap-off blade within an ergonomic handle.
— Source: Machine Design, April 1992

SPUTTERING PROCESS COATS INSIDE OF TUBE

Surface Solutions Inc. in Boulder, Colorado has developed a dc magnetron sputtering process for depositing material on the inside surface of tubes and pipes. Conventional planar sputtering processes require a fixed-magnet assembly too large to fit inside small ID tubes. Sputtering equipment used in the new process is relatively simple. Instead of a fixed magnet, the new process generates a magnetic field electrically around a cathode that fits inside the tube to be coated.

The sputter-coating process can be used on tubes from 0.5 to 5 inches in diameter with lengths up to 4 ft. Ferrous and non-ferrous metals, ceramics and glass have all been successfully coated using the process.
— Source: Machine Design, April 1992.

new products & processes

GETTING SMART ABOUT INTELLIGENT HEAT TREATING

The high value of products being produced by heat treaters is motivating them to investigate total quality management (TQM) procedures and the use of computer-based management, documentation, and control systems to optimize processing and provide accurate documentation needed by customers.

The computer-aided heat treatment systems constantly monitor and control the process and the operator is free to perform other duties: More time can be spent properly fixturing the next load or evaluating a project. With the tighter process control afforded by a computer aided design, rework and scrap are reduced. Rework savings have been as high as 98%. With optimized scheduling, the gap time between furnace batches can be shortened by as much as 20 minutes.

The first step in planning a computer-aided heat treating system is to define the objective. The system should also be configured to meet the requirements of heat treating operation.

For an SQC/SPC effort to be successful and long lived, the data collection portion of the system must be part of the mainstream information/paperwork flow, and data collection must be the rule rather than the exception. In addition, a convenient method of organizing data for analysis must be built into the system.
— **Source: Advanced Materials and Processes, July 1992.**

METALS INDUSTRY trends & events

vol. 6 no. 5 • September - October 1992

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METALS INDUSTRY trends & events

a newsletter published by the Metals Industry Research & Development Center (MIRDC), an attached agency of the Department of Science & Technology

Vol. 3 No. 2

MIRDC

news

New Directors For MIRDC

Dr. Leopoldo V. Abis takes his oath of office before DOST Secretary Ceferino L. Follosco, witnessed by MIRDC Assistant Executive Directors Dr. Adolfo Jesus R. Gopez and Atty. Jose G. Bautista Jr. together with outgoing MIRDC Executive Director Constante V. Ventura.

The Board of Trustees of the Metals Industry Research and Development Center (MIRDC), an attached agency of the Department of Science and Technology (DOST), recently announced the assumption into office of Dr. Leopoldo V. Abis as Executive Director and Dr. Adolfo Jesus R. Gopez as Assistant Executive Director for Technical Operations.

Dr. Abis holds Bachelor of Science degrees in Mechanical Engineering and Electrical Engineering from the University of the Philippines. He took his Master of Science degree in Mechanical Engineering at Kansas State University, and was a recipient of a Ford Foundation Fellowship for his doctorate studies on the same subject at Kansas State University.

Prior to his designation as MIRDC Executive Director Dr. Abis has been a UP instructor; graduate assistant and research assistant at Kansas State University; rose to full-fledged professor at UP and served as chairman of the Mechanical Engineering Department from 1970-1972. He has been an Associate Dean of the UP College of Engineering, Executive Director of the National Engineering Center and Officer-in-Charge of the Transport Training Center.

Dr. Abis succeeds Mr. Constante V. Ventura, who retired last July 31, 1989.

Dr. Adolfo Jesus R. Gopez, who assumed office as Assistant Executive Director for Technical Operations last June 16, 1989, was previously the Deputy Director of the Industrial Technology Development Institute (ITDI). He has served as Secretary of the UP College of Engineering, UPERDFI assistant professor of materials science, lecturer in French in technology at the Department of European Languages at the UP College of Arts and Letters, and instructor of Metallurgy and Engineering Sciences at the UP College of Engineering.

Dr. Gopez finished elementary schooling at the Colegio de San Juan de Letran and high school at the Philippine Science High School, both with honors. He graduated magna cum laude from UP with the degree of bachelor of science in Metallurgical Engineering. He took his post graduate studies on Materials Science at the

Institut National Polytechnique de Lorraine in France on a French government scholarship from 1979-1983.

Dr. Gopez is concurrent assistant professor of metallurgy at the Department of Mining and Engineering of the UP College of Engineering, and a lecturer-consultant in materials science at Integrated Micro-Electronics, Inc. He has had a number of articles published by the Philippine Engineering Journal.

Task Force Revolutionizes S & T

The Task Force on Science and Technology which was created by Pres. Aquino last August 11, 1989 was mandated to formulate a Science and Technology Plan that will enable the Philippines to become a newly industrialized country (NIC) by the year 2000.

Thus, S & T will be harnessed to the fullest extent to attain industrial take-off at an economic sustainable growth rate of at least 10% GNP per annum by the year 2000 onwards. S & T is expected to contribute at least 40% toward economic growth during this period.

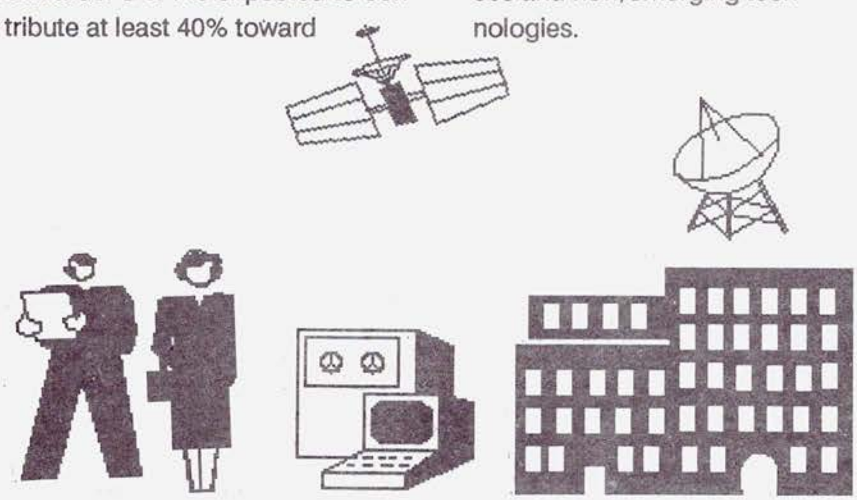
Support structures inherent to the national S & T development plan have to be established. There are three areas of concern:

1. The establishment or upgrading of research laboratories and testing/calibration centers;

2. The establishment of facilities and infrastructure for new products, improvement of processes, and increased productivity and quality. These should be accessible to the private sector; and

3. A network of information linking major universities, research and development institutions and worldwide information sources.

Sectoral technical panels have proposed measures to modernize the S & T infrastructure in the following areas: construction, information technology, energy, electronics, metals and engineering, agriculture and aquaculture, textile, marine fisheries and oceanography, mining and minerals, processed food and feed, forestry and natural resources and new/emerging technologies.



For metals and engineering the sectoral panel has proposed the: a) establishment of metal quality testing and control centers, preferably in regions outside Metro Manila; b) strengthening the Metals Industry Research and Development Center; c) upgrading the facilities of technical training institutions; and d) creation of a Design and Engineering Center to generate expertise to serve the metals industry.

DTI/BPS After Producers of Substandard Rebars, GI Sheets

Trade and Industry Secretary Jose Concepcion Jr. has ordered the Bureau of Product Standards and concerned DTI personnel to inspect warehouses and trade inventories for non-compliance with mandatory product standards of rebars and galvanized iron sheets. He likewise advised the public to watch out for, and report, unscrupulous traders who market undersized or substandard housing materials.

Although reports of monitoring teams reveal stable supply and prices of the two products, Concepcion wants to make sure that the prices are not being maintained at the expense of product quality and size.

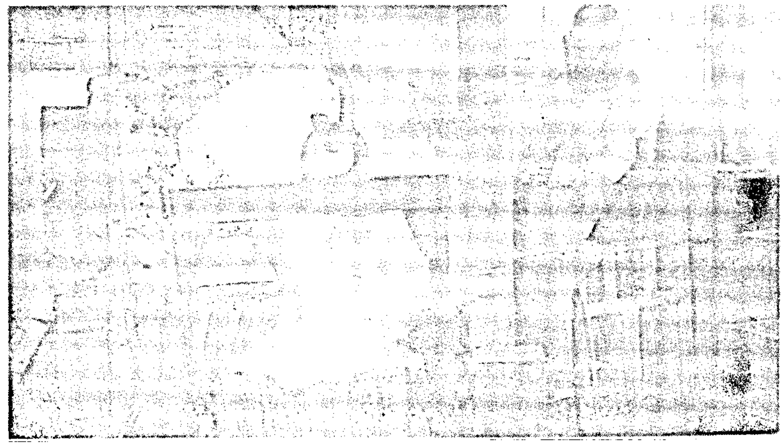
Concepcion said that manufacturers are authorized to use the Product Standards or PS seal on their products only after compliance with standards agreed upon by the private sector and government representatives to ensure consumer protection and safety. The license for the use of the PS seal is withdrawn from those who fail to meet the set standards. Other penalties for violators include a fine of up to P150,000, preventive suspension, censure, withdrawal of goods from the market, and cancellation of other DTI licenses.

In a related development, GI sheet manufacturers announced that Metro Manila sales outlets which require gauge 31 GI sheets (distributed mainly in the provinces) may now order the said commodity.

Foundry Industry Included in FRG Loan Program

The Department of Trade and Industry has proposed the inclusion of the foundry industry in the $15 million industry modernization loan program extended by the Federal Republic of Germany to the Philippines. This was announced by BOI Governor Melito S. Salazar Jr. during the induction of newly-elected officers of the Philippine Foundry Society during the recently concluded 17th Metalcasters' Convention.

A West German fact-finding mission has visited the country to evaluate which local industries need to be supported with the above-mentioned loan. The loan shall be used to supplement World Bank funds for industrial restructuring.



Salazar suggested that the industry take full advantage of domestic and export market prospects by using the loan to update existing facilities, improve operating efficiencies, raise product quality and cost-competitiveness through cost reduction, waste reduction, labor training and application of improved production technologies, and to generate employment and earn foreign exchange.

Salazar cited various government programs to upgrade technology including involvement of MIRDC in technical cooperation with foreign firms and industry associations, development of training programs, support mechanisms for bulk or cooperative purchasing of raw materials, and packaging of long-term financial facilities for rehabilitation.

CAST International Conferences

The China Association for Science and Technology (CAST) announces through the Philippine Embassy in Beijing that the 23 international conferences on science and technology will push through as planned. They will be held in China on the second half of 1989.

The conferences include:
September 5-8 — Beijing International Workshop in High TC Super Conductivity

September 5-8 — Beijing International Workshop in High TC Super Conductivity

September 12-15 — International Conference on Agricultural Engineering

September 18-20 — '89 Beijing Symposium of International Councils for Computer Communication

November 5-10 — 5th Pacific Conference on Automotive Engineering

German Assistance for RP Metal Testing

The Federal Republic of Germany and the Republic of the Philippines recently finalized an agreement covering P35 million in technical assistance for upgrading the latter's materials testing and quality control capabilities. The assistance program's main beneficiary shall be the Materials Testing Laboratory of the Metals Industry Research and Development Center (MIRDC), an attached agency of the Department of Science and Technology.

The program covers the services of German experts/advisers, counterpart training in testing methods, and supply of measuring and testing equipment including spare parts to complement the existing laboratory facilities.

The program shall be directly implemented by the Deutsche Gesselschaft fur Technische Zusammenarbeit (GTZ), an FRG technical assistance arm, in cooperation with MIRDC.

PCIERD Proposes Projects for MIRDC

The Philippine Council for Industry and Energy Research and Development (PCIERD) has proposed two projects seeking Soviet assistance in upgrading the capability of local machine building and upgrading of design and fabrication capability of the metalworking sector. MIRDC has been tapped as the counterpart agency for these projects.

The projects hope to acquire new and advanced techniques and necessary equipment for building up machine building capability and metalworking designs and fabrication. These techniques shall be disseminated to the local metalworking industry, which shall likewise be provided with cheap and locally fabricated machines and equipment. Consultancy and shop floor demonstrations shall be made part of the projects.

The projects involve 3 components: technical training of local personnel in the USSR; machine and equipment acquisition; and expert consultancy/demonstration services by the newly trained personnel backed by Russian experts.

It is hoped that such projects shall keep local industry abreast with trends and developments in the metalworking sector and make it competitive with such industries in other countries.

House Bill on Science and Technology

Congressman Eduardo P. Pilapil has filed House Bill No. 19969, known as the act declaring 1990-2000 as the science and technology decade, providing mechanisms therefor and for other purposes. The bill recognizes the vital role of science and technology in national economic development.

The bill creates a joint executive-legislative Science and Technology Development Commission mandated to:
1) formulate a comprehensive 10-year science and technology development plan for the country;
2) update the Science and Technology Code of the Philippines; and
3) allocate at least 1% of the GNP to fund research and development and draw the central direction for programs designed to accelerate the development of science and technology in the country.

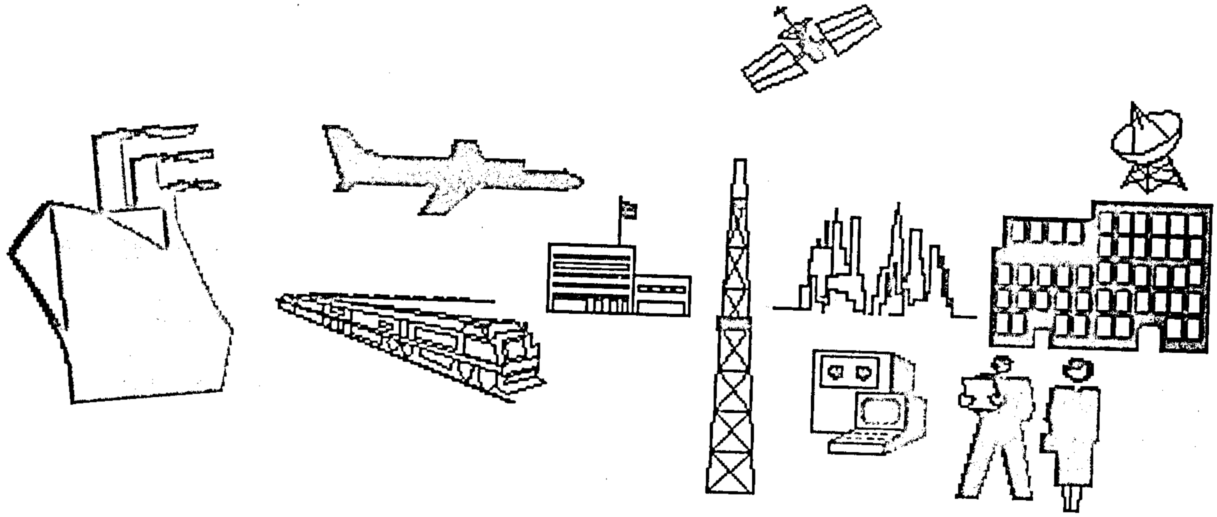
The Commission shall have a Secretariat headed by an Executive Director to be appointed by the President. The Executive Director, in coordination with experts and personnel from other government agencies and offices, shall direct the Secretariat in the formulation of guidelines, policies, rules and regulations geared toward achieving this national policy.

MIRDC Sets Up Regional Offices

MIRDC is establishing regional offices starting September 1989 in Region X (Cagayan de Oro City) and Region VII (Cebu City). The extension offices shall be within the premises of the existing offices of the Department of Science and Technology in the two regions.

The regional offices shall undertake information dissemination and promotion of MIRDC services, the conduct of training seminars/workshops in various shopfloor techniques as needed by the regions, facilitation of assistance to small and medium scale metals industries, and the undertaking of regular assessment visits to small and cottage metals enterprises to ascertain their needs in the areas of skills training, direct consultancy and product research and development (prototyping).

Designated as officers in charge of the two offices are Roy C. Sagrado for Region X and Elenita P. San Juan for Region VII.¶



Task Force Finalizes S & T National Action Plan

Covers Decade from 1990 to 2000

The urgency of promoting Philippine industrialization by the year 2000 has compelled the Metals and Engineering Technical Panel of the Presidential Task Force on Science & Technology to come up with a detailed national action plan designed to meet industry requirements. Composed of industry captains, government leaders and members of the academe, the Task Force epitomizes the core of the National Action Plan, which calls for linkages between the industry, academe and government.

Metals and Engineering Industry, 1990–2000. Foremost among the plans is the establishment of a Design and Engineering Center. It shall be a non-stock, non-profit private service foundation composed of experts from industry, government and the academe. It aims to gain expertise in designing whole industrial plants, and shall serve as training ground for future design engineers.

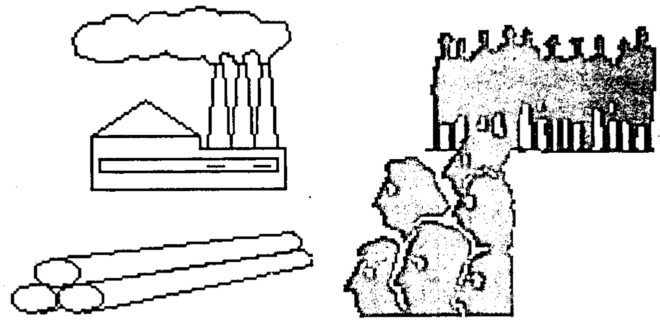
The Task Force has suggested the next line of action to consist of industry rationalization through the accreditation of various firms involved in foundry, tool and die making, heat treatment, welding, forging and stamping, electroplating and machine shop operation for the provision of incentive packages. These shall be in the form of fiscal incentives as well as marketing and technical assistance. Product standards shall have to be formulated to complement the project, together with public awareness campaigns.

Inherent to industry modernization is a sound manpower development program. To be spearheaded by the Metals Industry Research & Development Center (MIRDC), crafts, secondary and tertiary level skills will be developed in consonance with the needs of industry; specialty courses will be explored, higher level skills will be developed, and the National Engineering Center utilized for design and CAD/CAM (computer-aided design/computer-aided manufacture) courses.

Two essential components of the action plan consist of trainor development and institution building. The first is foreseen to enhance development of a strong corps of competent instructors from crafts to PhD level, while the latter shall involve establishment and upgrading of facilities within engineering institutions.

The program calls for a financial package of P1.84 billion to be implemented in the following modules: P300 million for industry modernization, P40 million for technology utilization, P500 million for loan programs and P1 billion for sectoral loan packages.

USAID-MEIAP Project Update



The USAID-funded Metals and Engineering Industries Assistance Program, drawn up by the Department of Trade and Industry's Small and Medium Enterprise Development Project Office (DTI/SMED) has been started by the Metalworking Industries Association of the Philippines (MIAP), the Philippine Foundry Society (PFS) and the Metals Industry Research and Development Center (MIRDC).

Experts from MIAP, PFS and MIRDC have actively joined hands to implement the overall program involving technical consultancy, skills training and conduct of study tours.

An update on the project activities follows.

JULY:
Three assessment teams made up of seven members each (4 from MIAP/PFS, 2 from MIRDC, 1 from DTI/SMED) conducted plant visits and dialogues with metalworking firms in Regions I, IV, V, VI and XII. The teams looked into specific needs and problems of each of the said regions. As a result of the enthusiastic response of local entrepreneurs toward the dialogues, technical experts have been named to provide consultancy covering metal casting, electroplating, smithery and equipment manufacture. To date, only Region V has undergone active consultancy in smithery.

The assessment program also resulted in a restructuring of the project's program priorities, and the following changes have been incorporated:

First, brassware making which was previously given top priority has been scrapped due to time constraint in sourcing out an American expert in this field, as well as MIRDC's insufficient capability to handle this module;

Second, seminars on skills training shall be held at the MIRDC plant in Bicutan, Taguig, Metro Manila instead of in the regions to ensure availability of qualified resource speakers from MIAP, PFS and MIRDC. Demonstration workshops, the sites of which are difficult to obtain in the regions, shall likewise be held in-plant at MIRDC;

Third, there shall only be one feasibility study for each of the six regions instead of the original 12 proposed studies for common service facilities due to time constraints. USAID has committed funds for this project; and

Fourth, constraints in processing/procurement steps involved in providing metal testing equipment for educational institutions in each of the regions has resulted in the scrapping of the program for commodities/institution upgrading.

August:
The following seminars were successfully carried out in Bicutan, Taguig, Metro Manila, participated in by managers, shop supervisors, technicians, and engineers:
Region I – Smithery, 13 participants; Machine shop practice, 12 participants; Heat treatment, 18 participants
Region VI – Heat treatment, 19 participants ;Electroplating, 21 participants;Machine shop practice, 18 participants
Region XII – Metal casting, 20 participants

The program will continue on a staggered basis for participants coming in from the six regions, and shall last until November 1989.

September:
Local study missions consisting of entrepreneurs from the regions shall visit modern metalworking shops around Metro Manila. They shall observe leading edges in metals and engineering technology, specifically in metal casting, heat treatment, electroplating, smithery and equipment manufacture.

THE IDEAL ENGINEER

Eugene Raudsepp
President
Princeton Creative Research Inc.
Princeton, N.J.
(an SME technical paper)

The major complaint that managers have about engineers is that they tend to get sidetracked into pursuing what interests them most, without regard to the needs of the organization. A corollary complaint is that many engineers apply their personal standards when attacking a job, seemingly not realizing that their efforts are just one part of a complex business that must meet cost and market requirements. Also, some engineers - especially the younger ones - approach their jobs with unrealistically high expectations in terms of work challenge and career progress. They confront management, rather than work with it. They want quick promotions, greater responsibilities and major changes in procedure. When these are not forthcoming as quickly as they desire, they get impatient and look elsewhere for satisfaction. As one manager put it, "Many engineers expect special treatment and work privileges, without having to prove that they are worth it."

What does management look for in an engineer? The ideal engineer is practical and realistic. He readily aligns his personal attitudes and goals with those of the organization. He not only considers the immediate impact of the problem he tackles, but he assures their long-range implications for department operations and company fortunes. Other general engineer characteristics considered important by managers include:

Learning the organizational system and policies quickly

Grasping what is to be done on the job, and how it is to be done without having to be told

Finding out what management's expectations are and what problems the company faces

Making the accomplishment of the company's purposes his overriding concern

Maintaining a positive attitude toward the company's policies and operations

Not being unduly concerned about promotions, salary increases, or changes in the system to suit personal preferences

Characteristics of the Ideal Engineer

Balanced aptitudes: Management is seeking the proper balance between technical aptitudes and personal qualities, particularly traits which enable the engineer to get along with others. To be outstanding, engineers have to overcome real handicaps in interpersonal relationships.

Enthusiasm: The ideal engineer has a drive that prevents him from thinking about his work in terms of either a romantic adventure or a paid job; instead he sees it as an opportunity for a lifetime career. Thus, he continuously improves his ability to analyze, synthesize and develop insight into his field.

Initiative: The ideal engineer is a self-starter. He can execute a project independently. He suggests new programs when appropriate. He has a sure sense that tells him when the time for such suggestion is right. He realizes that if such opportunities are allowed to escape, he is less valuable to his company and less likely to progress in his career.

Acceptance of routine work: Routine work is considered to be subprofessional and is universally disliked by engineers. Yet, the effective engineer does not balk at occasional routine work. He is able to carry it out efficiently and accurately.

Creativity: The effective engineer can think up varied and sometimes radically new approaches to problems. He comes up with novel solutions. But creativity is not simply a matter of coming up with new ideas. It includes developing imaginative ways of selling new ideas and showing how ideas developed for one use can be applied to another..

Good Communication: The effective engineer can communicate difficult ideas and thoughts clearly and concisely. He knows how to report results orally and in writing. He keeps supervisors and management informed about his work progress. He knows how to sell his ideas to his supervisors and how to get support from associates in implementing them.

Adaptability: The effective engineer is flexible in his thinking, work performance and personality. This enables him to keep up with technological progress and to grow professionally. He uses slack periods for study and replenishment of his technical know-how.

What Managers Expect of Engineers

Good grasp of technical fundamentals

Up-to-date knowledge of pertinent fields

Ability to solve complex technical problems

Good judgment and objectivity in approaching problems

Capability to choose the most efficient methods and the latest developments in the solution of technical problems

Ability to device new or improved methods, materials and equipment

Capacity for adapting available methods and equipment to meet new requirements

Ability to plan and organize work so that exact requirements and specifications of a project are known before work is begun

Sufficient flexibility to anticipate and make provisions for meeting unforeseen difficulties and for checking the accuracy of data and methods used

Willingness to work under pressure and to produce outstanding results under adverse circumstances

Promptness in completing assignments

Capacity for completing assignments rapidly without compromising standards of quality

Ability to change methods and work schedules to meet deadlines, without reducing the value of results

Willingness to sustain productivity without supervisory prodding

Readiness to put in long hours if necessary

Ability to give as well as to follow instructions ¶

vital statistics

Apparent demand for metalworking products dipped in 1985, but subsequent demand has taken commendable leaps to reflect the current optimistic attitudes toward industrialization. Despite the trend, however, the figures are still below the 1983 high of $3,234,000.

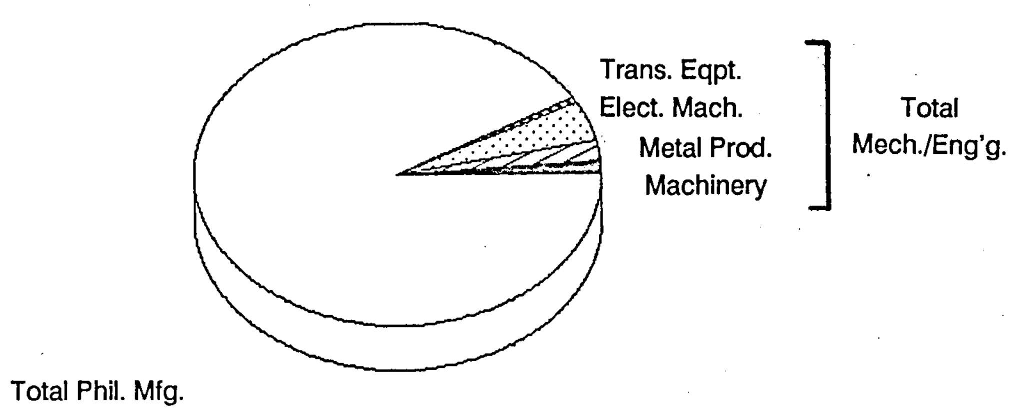
On the last chart shown, metal products manufacturers lead the pack in terms of number of establishments and total manpower count. However, plants producing electrical machinery are noted to be equally labor-intensive, and these figures may grow with the projected science and technology plan to achieve newly-industrialized country (NIC) status by year 2000.

METAL PRICES
(as of July 1989)

Mild Steel Scrap 1020	P4.00/kg
Mild Steel Scrap 4140	6.50/kg
Stainless Steel Scrap HF	29.00/kg
Pig Iron Scrap	5.91/kg
Cast Iron Scrap	4.30/kg
Copper Scrap	75.00/kg
Tin Ingot	295.00/kg
Lead Ingot	27.00/kg
Zinc Ingot	57.00/kg
Aluminum Scrap	45.50/kg
Brass Scrap	40.90/kg
Bronze Scrap	36.36/kg

GROSS VALUE ADDED IN MECHANICAL & ENGINEERING INDUSTRIES
(in million pesos, at current prices)

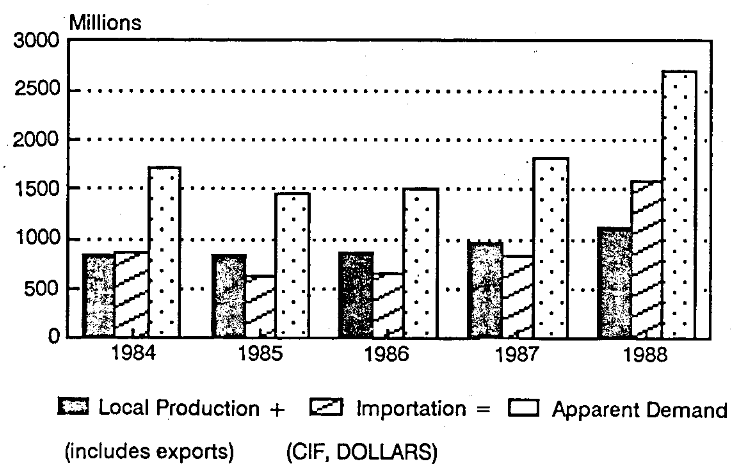
Industry Group/Year	1984	1985	1986	1987	1988
Metal Products	2,768	3,638	3,678	4,105	4,680
Machinery except Electrical	1,916	2,333	2,518	2,792	3,532
Electrical Machinery	6,405	6,097	7,567	8,614	10,095
Transport Equipment	462	647	690	857	1,414
Total (Mech./Eng'g)	11,551	12,715	14,453	16,365	19,721
Total (Phil. Mfg.)	137,251	150,523	154,719	174,000	



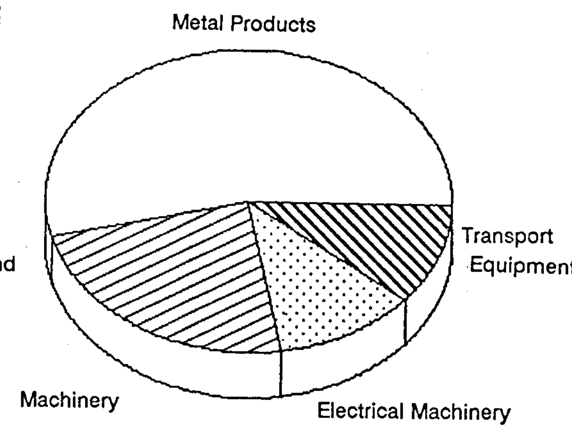
METALWORKING PRODUCTS
APPARENT TOTAL DEMAND
1984-1988
(in million dollars, at current prices)

	1984	1985	1986	1987	1988
Gross Value Added	692	679	708	795	915
Gross Value of Output	1,227	1,204	1,258	1,412	1,623
Local Production*, CIF	846	832	868	974	1,120
Importation, CIF	874	621	644	837	1,581
Apparent Demand (C & D)	1,720	1,453	1,512	1,811	2,701

Note: Local production figures are derived from NEDA Value Added Data and Deflated by mark-up and taxes.



ESTABLISHMENTS

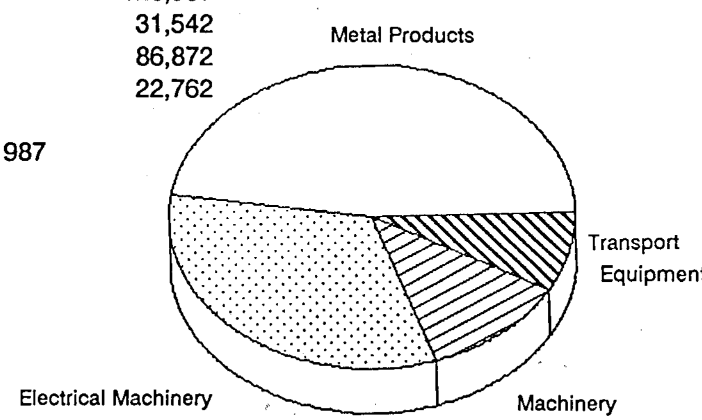


EMPLOYMENT/NUMBER OF ESTABLISHMENTS IN THE METALWORKING SECTOR, 1987

Industry	Number of Establishments	Number of Employment
Metal Products	1,427	126,307
Machinery except Electrical	622	31,542
Electrical Machinery	302	86,872
Transport Equipment	287	22,762

Source: NCSO Annual Survey of Establishments, 1987

EMPLOYMENT



trade opportunities

Foreign companies are sourcing for the products listed below. Interested exporters are invited to send a presentation of their company and detailed offers directly to the buyers concerned.

Since importers and agents receive a large number of business offers, suppliers are well advised to include all vital information in their first business communication. Please describe your **product** *as fully and technically as possible, enclosing catalogues and/or photographs.* **Samples** *are always of interest, particularly when promotional material is lacking.*

Give **prices** *in convertible currencies. Suggest the best possible price at the onset in order to win the interest of buyers.*

FIRM NAME/ADDRESS	DESIRED PRODUCTS
Mr. Gilles Cormier SOUCY INC. 5355 St. Rock Drummondville, Quebec J2B 6V4 Canada	*Automotive products andspare parts*
Dean Gabrielson Owner SURPLUS MACHINE TOOL P.O. Box 65641 St. Paul, Mn 55165 USA Phone: (612) 227-8088	*Shears, brakes, forklifts, mills, saws and drills*
Jeff Hawkins Trade Representative STRONG AUTO-INDUSTRIAL TRUCK CENTER 129 A Street Linton, IN 47441 USA Phone: (812) 847-4494	*Auto spare parts, truck suspensions, ball/roller bearings, truck brake shoes & accessories, gear boxes, transmissions and universal joints*
K. KITAMURA Manager A PACIFIC DELIVERY SERVICE Akashi P.O. Box 63 Akashi, Hyogo 673 Japan Telex: 5628940 ANGELS J Phone: 078-911-0303-5 FAX : 078-911-0306	*Cooking wares: aluminum cooking pots*
B.K. IMPORT ENTERPRISES 26 Okoya Street Lagos, Nigeria	*Sewing machines, generators*
Mr. Bozon SPRAGUE FIL-MAB 1 Rue Fontaine de Mie 37540 St. Cyr Loire France Telex: 750503 Phone: 47518901 FAX : 47515851	*Transformers: standard, pulse, adaptors & power line*
Mr. Scott Campbell Sales Manager SITEC CANADA 142 Islington Avenue Toronto, Ontario Canada M8V 3B6	*Steel, aluminum sheets & bars*
Mr. Patric Silva General Manager MEGASCOPE INTERNATIONAL 32 Turtle Creek Blvd. Brampton, Ontario Canada L6W 3T9	*Automotive products*
KEJRIWAL ENTERPRISE 312 World Trade Center Barakhamon Lane New Delhi Telex: 031-66308 KEJE IN Phone: 331-5029	*Agricultural machineries*
Mr. Frank Amons Chairman ARMONS IMPORT, B.V. P.O. Box 9522 Ikeja Lagos, Nigeria 15 Ikeja Industrial Estate Nigeria	*Motor spare parts*
Mr. J. Y. Bissieres S.A. Q.M. STOKVIS Z1 St. Jory BP 3, 31150 Fenovillet France Telex: 531706 Phone: 61702566 FAX : 65226726	*Home appliances and all types of household and garden equipment*
CIA TECHNO INDUSTRIAL S.A. Alberto Llona 901 (Maipu) Santiago, Chile Telex: 240079 CTI CL	*Parts of electrical household appliances*
Andres Munoz V. Fidel Oteiza 1952 of F Santiago, Chile Telex: 441658 ACERO CK	*Steel roofing & prefabricated sheds*
Herman Gleixner S. Huerfanos 1161 of 612 Santiago, Chile Telex: 240552 GLEIX CK	*Aluminum extruded shapes*
Carlos Cabrera T. Tercera Avenida 1228 (Cisterna) Santiago, Chile	*Seamless pipes*
PROINTEL LTDA. Puenta 632 Santiago, Chile	*Hardware and tools*

CURRENT AWARENESS SERVICE

(abstracts of books and periodicals)

The summaries of topics described here comprise the latest information culled from technical journals here and abroad. Interested readers who may wish to avail of copies of any of the articles can go to the MIRDC Library, MIRDC Compound, Gen. Santos Ave., Bicutan, Taguig, Metro Manila, or write to The Librarian, MIRDC, P.O. Box 1440 MCPO Makati, Metro Manila 1299. Copying services are available for a minimal fee.

What's ahead in automotive materials. 1p.
Brief insight is given on the kind of materials that most likely would replace conventional materials used in the automotive industry. Ford Motor Co. has come up with a more sophisticated technology using plastic bodies and engines containing titanium ceramic and other exotic materials on cars and trucks. The article highlights the concept of the Low Investment Vehicle (LIV) assembled from a fiber-reinforced composite. Advantages derived from its use offer lower tooling costs, greater design, versatility, simplified assembly, significant weight reduction and reduced corrosion. *Modern Casting, January, 1989.*

Refractories designed to take stress. 4pp.
Discusses induction furnaces currently used in thinner refractory linings. This laboratory tool has remarkably undergone growth in popularity because of its being clean and quiet, nonpolluting, versatile and having an unchanged effect on the metallurgy of the melt. Elaborates on two new families of refractories which are designed to accommodate stress and achieve high strength. Their characteristics/applications as well as advantages derived are given. *Modern Casting, January 1989.*

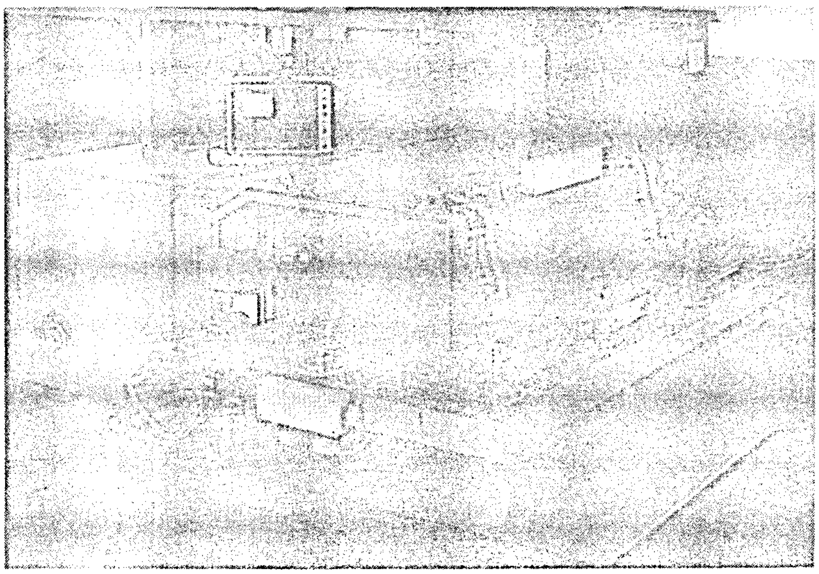
Casting design: a critical concern. 4pp.
Elaborates on the casting processes and considers effective casting application and design as primary tools in manufacturing productivity. Develops and encourages use of the "system-wide design thinking", a conceptual framework which considers the requirements of both casting designers and users as well as casting producers. It further gives the four essential physical characteristics that affect the castability and performance of a given alloy. *Modern Casting, January 1989.*

Evaluating side risers and necks. 1p.
Discusses side risers from the viewpoint of the foundryman. Advantages derived from the process are given, like minimizing cleaning room costs, improving yield and quality with the use of a round neckdown sleeve or breaker core (said to reduce the contact area of the riser). However, evaluation and comparison of the trade-off yield and foundry productivity must be considered when making the final choice. *Modern Casting, December 1988.*

Geometric dimensioning and tolerancing: advantages for steel foundries and their customers. 3pp.
Discusses geometric dimensioning and tolerancing as an alternative to engineering drawing, replacing the traditional coordinate dimensioning. Terminology is more specific and tolerances are expressed in terms of categories such as position, form, profile and orientation. Favorable application in producing a more cost-effective steel casting is discussed. *Modern Casting, January 1989.*

Successful melting with coke-less cupola. 3pp.
Focuses on the concept of replacing coke as a fuel for melting cast iron in a cupola. Compares the advantages derived from the use of the present method over that of the conventional one. Result of usage shows it can be an effective alternative to coke-fired cupola melting and electric furnace melting as the low sulfur base is very easy to produce. Expected range is 0.01%. *Modern Casting, December 1988.*

Computer (CNC) and sensor-controlled grinding center automates cleaning and fettling. 1p.
MAN-Roland Druckmaschinen AG and Edward Bautz Gmbh have developed a four-axis CNC and sensor-controlled raw casting grinding center which, when equipped with automatic casting loading and pallet storage, makes a considerable contribution to the automation of cleaning and fettling shops. The grinding center can deflash castings along their contours, cut off gating systems and feeders or grind off the feeder residues for subsequent operations. *Casting Plant & Technology, April 1988.*



Raw casting grinding center with 4-axis CNC and sensor control (ROBOMAT 2.3, MAN-Roland Druckmaschinen AG and Eduard Bautz GmbH system)

New method of fatigue detection. 1p.
Hocking NDT Ltd. has developed a new approach to in-service inspection with the introduction of Weld Scan, an inspection package for the detection of fatigue cracks in all areas of welded-steel structures and process plants. The system consists of a newly-developed probe of appropriate size. The package is designed to provide cost and time savings of up to 80% on routine work. *Corrosion Prevention & Control, December 1988.*

Advancements in forging technology. 7pp.
Discusses technical innovations in the forging industry. Specific areas focus on the improvement of overall efficiency of the industry, including computer-aided engineering, energy conservation through improved forging methods, and lower cost forging materials. The three basic areas where computers can be applied in the forging industry are discussed. *Advanced Materials and Processes, June 1988.*

Influence of slag during cupola melting, particularly in hot blast cupolas. 5pp.
Presents improvements in the melting process showing the influence of slags on iron as well as interrelationships between iron and slags. Shows metallurgical advantages derived from Si carriers over that of FeSi. Also emphasizes that these materials should come in contact with each other in order to form an active slag above the actual melting zone. Operation with a pressure siphon enables achievement of good reactions between iron, slag and coke. *Casting Plant & Technology, April 1988.*

Systematic planning of investments in molding plants allowing for technical and organizational developments. 6pp.
Presents actual evaluation of a jobbing foundry wherein requirement profiles are established. Molding tests are carried out showing substantial differences between test and operational machines. Economics of alternative plant concepts are investigated. *Casting Plant & Technology, April 1988.*

An instrument for fast and simple measurement of the degree of compaction of production sand molds. 3pp.
The well-known mold hardness and mold strength testers used to determine the degree of compaction in production molds have been superseded by the mold compaction tester. Compared to the first two, the latter guarantees certainty in measuring conditions. Tests have indicated that the operation is simple, fast and safe. *Casting Plant & Technology, April 1988.*

Mini mills and applicable technology. 6pp.
Discusses present status of mini mills in industrialized countries. Comparative annual production capacities in tons for each country is given. The two major types of mini mills are presented with a brief description of the steelmaking processes used. New techniques in EAF (electric arc furnace) steelmaking are given as well as the problems and challenges that affect the industry's market conditions. *Metallurgia International, March 1989.*

Environmental regulations and treatment for salt baths. 5pp.
Covers the disposal of salt baths containing cyanide and barium salts and the rinses or quenching waters resulting from those operations. Hazardous wastes criteria are given. The pretreatment standards applicable to the electroplating industry are illustrated. *Journal of Heat Treating, v.6 no. 2 1988.*

Cutting PM parts with CBN inserts. 1p.
A newly-developed BNX4 grade of CBN (cubic boron nitride) which can be used effectively in machining PM parts, yielding acceptable tool life 15 times that of coated carbides, has been introduced by Sumitomo Electric Industries (Japan). Important features given are excellent wear resistance and good retention of edge sharpness in machining iron base PM and cast iron. *American Machinist, February 1989.*

Eliminating disposal of wastewater. 2pp.
Compares four waste fluid treatment systems including the advantages and disadvantages of each. Looks at the possibility of recycling and reusing fluids as a means of reducing the amount requiring disposal. *Die Casting Engineer, May-June 1989.*

Cars of the future. 2pp.
Demonstrates a prototype vehicle that previews future designs. Complex technologies were developed by numerous companies with the basic purpose of making glass meet not only design needs but also government standards for roadability. *Automation, March 1989.*

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