metals industry TRENDS & EVENTS

MIRDC

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MIRDC Gets Registered Utility Models

Mercury Retort

Decorticating Machine

The Metals Industry Research and Development Center (MIRDC) recently received Registration Certificates from the Bureau of Patents of the Intellectual Property Philippines (IPP) to two utility models, namely:

1) Portable Retort for Separation and Recovery of Mercury From Amalgam (under Registration No. 2-2007-000337)

2) Decorticating Machine for Separating Coco Coir, Peat and Dust from Coconut Husk (under Registration No. 2-2007-000361)

The portable mercury retort is used to separate gold and recover mercury from the processed amalgam.

Study shows that the fraying ecosystem is polluted with more than 1 kg of mercury for every kg of gold produced. Exposure to high level of mercury may cause poisoning and health hazards. Hence, the MIRDC prototyped portable mercury retorts to reduce the indiscriminate disposal of mercury in the environment by gold processors. This also supports the DOST's high priority flagship program Integrated Program on Cleaner Production Technologies. It ensures efficiency, safe and environmental-friendly gold recovery process. Also, the developed mercury retort is cheaper than imported brands. Small-to-large scale panners from gold mining localities in Luzon and Mindanao stand to benefit from this equipment.

The tailor-made mercury retort comprises a channel-type base, a glass cooling jar mounted on said base with a holding rail being provided on the opposite sides thereof, a stainless steel cooling jar head mounted on the glass cooling jar, equipped with relief valve to dissipate any pressure build-up therein, a heat-resistant glass collecting vessel submerged within the glass cooling jar with the top end of the heat-resistant glass collecting vessel being connected to said stainless steel cooling jar head, a stainless steel evaporator head connected to the other end of the condenser tube, and a stainless steel evaporator mounted to the evaporator head.

Another utility model that the Center had successfully registered with

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inside

From the Executive Director.....

The third quarter of 2008 saw the introduction of the Coco Coir Technology that utilizes coconut husks for the production of geotextile to prevent soil erosion or landslide. This technology makes use of the unwanted coconut husks that will generate additional income to the coconut farmers. The direct beneficiaries of this technology will be the millions of farmers producing unwanted wastes of coconut husks, since this will be an additional income to them. The Philippines have 324.1 M coconut trees planted in 3.1 million hectares of land spread in 69 provinces.

The setting up of this technology at the Aurora Quezon and Sanchez Mira, Tuguegarao, Cagayan provinces by MIRDC has received a good feedback from the people of these provinces and they are looking forward to more technologies transferred by the Center and other Department of Science and Technology (DOST) agencies. The metalworking industries will be able to commercialize this technology from MIRDC as more and more provinces adapt the technology in their respective areas. Also, the coco coir processing equipment were showcased in the previous National Science and Technology Week/Asean Science Technology Week (NSTW/ASTW) Exhibit at the World Trade Center Metro Manila in the early July where some of the representatives from the ASEAN member countries also got interested in this technology. Now, the efforts of our research and development personnel have bore its fruit, they are now reaping the harvest.

MIRDC also joined in celebrating the Philippine Civil Service anniversary in September, where the management recognized and awarded the excellent performance of employees. It is very important for us to recognize and give award to the outstanding employees. Included in the celebration were the presentation of utility models, the research and development projects which were registered and patented.

A very promising project being undertaken jointly by the Center, Industrial Technology Development Institute (ITDI), Department of Science and Technology (DOST) and Department of Energy (DOE) through Philippine National Oil Corporation (PNOC) is the Pilot Production and Testing of Biodiesel from jathropa curcas having to develop Jathropa oil extraction processing technology. Biodiesel being considered an equal replacement of petro-diesel (with 5% less efficiency). Our goal is to improve and develop locally the design of Jathropa oil equipment by reverse engineering in cooperation with local fabricators using the imported oil expeller as benchmark. This technology will increase energy self-sufficiency while addressing environmental challenges.

Finally, the Center is currently conducting the nationwide survey on machine shop sector which contain among others the industry, market and technical profile of the Philippine Machining Sector providing linkages and partnership, in the government planning and formulation of business plan and policies relevant in doing business. These metalworking companies will also be showcased in the Metal Products Directory embodying the nature of the firm, location and contact numbers.

The Center will always be committed to the partnership with the metals and engineering industry for its development and progress. God bless you and more power.

Rolando T. Viloria, CEO III
Executive Director

Erratum: *We apologize having a printing error in our previous issue on page 2. The message from the executive director shall conclude as follows:*

Credits are also due to all the members of the metals and engineering (M&E) sector who have celebrated and shared with us their aspirations that through the years has enabled the Center to continue to exist and serve the industry.

metals industry TRENDS & EVENTS

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MIRDC Updates Machine Shops Survey

The Center is updating its industry survey on the Philippine Machining Sector. The conduct of the survey started in April 2008 and still ongoing. Survey questionnaires were sent to about 3,000 identified machine shops nationwide, however, about 500 were returned (RTS).

The low turnover of survey questionnaires, only 14 percent as shown in the Table below, urged the MIRDC's Information Technology and Promotion Section to conduct field surveys within various cities and municipalities in Metro Manila. To date, there are 253 respondents to the said survey. Likewise, MIRDC regional extension officers are being tapped to follow up survey questionnaires in their respective areas.

This industry study updates the previous study conducted in 1993. The survey was approved and duly recognized by the National Statistical Coordination Board (NSCB). This study will greatly benefit the metal-working sector as it presents its general profile and highlights its performances for the period 2005-2007 including the production and technical capabilities, among others. Most importantly, this will also provide policy-makers, policy implementers and the members of the industry with the primary data for policy study and recommendation in terms of facilities upgrading, personnel development and investment incentives.

Aimed at getting a factual overview of the machining industry, the MIRDC enjoins local machine shop owners to get involved in this undertaking.

Preliminary Report

REGION	PROVINCES	No.of Shops	RESP*
I	Ilocos Norte/Sur, Pangasinan, La Union	116	2
II	Batanes, Isabela,Nueva Vizcaya, Quirino	69	4
III	Pampanga, Tarlac, Nueva Ecija, Zambales, Bataan Bulacan, Aurora	331	9
IV	Batangas, Cavite, Rizal, Occidental Mindoro, Laguna, Quezon, Marinduque, Palawan	364	36
V	Albay, Camarines Norte/Sur, Catanduanes	84	7
VI	Aklan, Antique, Capiz, Guimaras, Iloilo, Negros Occ.	152	8
VII	Bohol, Cebu, Negros Oriental, Siquijor	135	9
VIII	Biliran, Eastern/Northern Samar, Samar, S. Leyte/Leyte	37	3
IX	Zamboanga Del Sur/Norte	48	2
X	Bukidnon, Camiguin, Misamis Occ./Oriental	109	5
XI	Compostela Valley, Davao	202	8
CAR	Cordillera Autonomous Region (Abra, Apayao)	29	1
XII	Sultan Kudarat, Lanao del Norte, Cotabato, Sarangani	81	5
CARAGA	Agusan del Norte/Sur, Surigao del Sur/Norte	37	1
ARMM	Lanao del Sur, Maguindanao, Sulu, Tawitawi, Shariff Kab.	5	0
SUB-TOTAL		**1799**	**100**

NCR	No.of Shops	RESP*
Kalookan City	99	9
Las Piñas	17	10
Makati	17	5
Malabon	29	0
Mandaluyong	41	9
Manila	55	11
Marikina	25	15
Muntinlupa	23	4
Navotas	29	0
Parañaque	41	22
Pasay	15	7
Pasig	36	4
Pateros	1	1
Quezon City	114	20
San Juan	3	0
Taguig	25	10
Valenzuela	104	26
	674	**153**

TOTAL	2473	253

As of September 30, 2008
*RESP- respondents

Gov't to Consolidate Iron Resources for Steel Industry

The government is finding a way to consolidate its iron resources aimed to support an integrated steel sector that's hoped to become a springboard for Philippine industrialization.

The Department of Environment and Natural Resources-Mines and Geosciences Bureau (DENR-MGB) has commissioned a geology team to identify potentially huge iron deposits all over the country in order to meet required iron requirement of the Philippines' largest steel-maker-exporter Global Steel Corp. (GSC).

DENR is planning for some level of consolidation of iron resources even if these are splintered all over the place as part of a long-term goal toward steel manufacturing integration.

"If we want to go into integrated steel manufacturing, we should consolidate our iron resources," said MGB Director Horacio C. Ramos in an interview.

GSC, run by Global Ispat Holdings Ltd. Of India, one of world's pioneers in steel production, wrote a letter to the government, requesting for an assurance of supply of iron especially as the company is set to carry out a major expansion program.

GSC officials are apparently hopeful that there could be a more systematic, faster way of sourcing iron supply in the country since the government, in the first place, has been claiming that the Philippines is one of the world's most richly-endowed in mineral resources.

Consolidation of mineral resources are obviously easier in India because of the nature of resource ownership.

"Iron ore mines in India are operated by the government, but in the country, these are operated by the private sector (which is why GSC expects the Philippines to have the same system).

"We already assigned geologists to research through and visit all potential deposits. We do have iron resources, but the company just want to be ensured of a source of iron," he said.

Ramos said the government really needs to collectively produce some mineral resources if it has to encourage value-adding in the sector.

The country's potential iron resources are in Zamboanga, Mindoro, Surigao, and Samar. A consortium of Indian companies including Coromandal Mineral Export Private Ltd. also earlier visited an iron prospect in Obra de Ilog, Mindoro Occidental which presently has a contractor, the Agusan Petroleum and Mineral Corp. The prospect is said to have a very high grade iron deposit with a grade of 66.32 percent iron.

Source: Manila Bulletin, 08 September 2008

RP can be Major Global Jewelry Exporter

The Philippines has the potential to become a global player and get a bigger slice from the $154-billion fine jewelry world market.

Filipino jewelry designers had frequently won top prizes in international competitions. Gold, silver, copper, pearl and semi-precious stones are abundant here. And the country has a reservoir of easily trainable manpower, especially women.

"The industry has all the elements needed for success," said Evelyn Singson, former president of the Management Association of the Philippines. Her family, she said, has been in the jewelry business for generations and she wears finely crafted jewelry made by her own brother in their backyard. Singson was a speaker during the 4th National Jewelry Forum called by the Confederation of Philippine Jewellers held recently at Makati City.

Ten years after the Jewelry Reform Act (RA 8502) was enacted into law to coax the players from the underground economy to the mainstream of Philippine industries, that great potential has not materialized. The industry's performance last year was impressive, $264 million in export revenues, reported Export Development Council executive director Senen Perlada. But the figures were somewhat tweaked for these included gold bullions exported by the mines and gold wires used as raw materials by the electronics industry. The real figures of gold-based articles of jewelry made in Meycauayan, Bulacan, Metro Manila and elsewhere were valued at only $45 million.

That export figure was peanuts compared to jewelry exports of Thailand last year which topped $3 billion. And Thailand was behind China, India and Hong Kong that are

E-waste decomposes through catalysis

Electronic products manufacturer Panasonic has developed a recycling technology that enables the recovery of metals form plastic-coated wires and plastics used in electric and electronic equipment without causing hazardous side-effects. Using the catalytic properties of titanium oxide, the innovative technology facilitates recovery of inorganic substances such as metals by transforming organic substances such as plastics into harmless gases.

Panasonic is successfully using the new technology at the Matsushita Eco Technology Center (METEC) to recover copper from degaussing coils covered with vinyl chloride tape found in cathode ray tube televisions. In addition, mixed plastic waste destined for incineration or landfill is being converted into non-toxic gases at METEC. The method not only offers a 'zero waste' solution but also helps reduce carbon dioxide emissions as little external energy is required in the gasification process.

Around 80% by weight of all collected home appliances are sorted into metallic and plastic fractions. The remaining 20% is currently regarded as non-recyclable waste, including rubber, mixed glass and mixed plastic waste which is difficult to sort further owing to its complexity. Although some mixed plastic waste can be used as fuel, wastes containing certain chemicals- such as vinyl chloride- need to be treated in a high-temperature incinerator to avoid dioxin emissions.

The new recycling method combines Kusatsu Electric's non-incineration plastic disposal technology (using titanium oxide) and the high-grade materials recovery technology utilized by Panasonic to recycle obsolete home appliances. The method revolves around unique mixing and carrier systems that allow plastics to contact the catalyst efficiently for gasification, leaving the valuable metals. As the catalytic reaction of titanium oxide generates heat to promote gasification, an additional heating source is not required in the process. The method uses cooling water to maintain the temperature (500ºC) for an optimal catalytic reaction. The heated water from the process can be used for other purposes. Hydrogen chloride produced during the gasification process of vinyl chloride is neutralized using lime.

Source: Recycling International, April 2008, p. 23

Axsun upgrades plastics analyzer

Axsun Technologies, a manufacturer of micro-optoelectronic spectrometers, has developed a new sample interface for the Anavo Analyzer which it describes as 'the fastest hand-held NIR spectrometer on the market'.

Based on the Axsun's advanced MEMS-based spectrometer, the rugged analyzer is designed for material identification applications ranging from plastics compounding and recycling to inspection of incoming raw materials. The new, flexible sampling interface is said to enable the Anavo to measure materials in a wider range of form factors as well as non-contact measurements, thereby providing the user with greater flexibility.

At the heart of the Anavo is Axun's micro-optical platform which combines tunable laser technology with wavelength and power calibration. On-board material libraries and analysis software provide instantaneous material identification in the harshest industrial environments, it is claimed. An intuitive user interface and easy-to-read LCD screen are incorporated to simplify operation for both technical and non-technical users.

Source: Recycling International, April 2008, p. 27

now considered neck to neck with the United States, Italy and other western nations as top suppliers of expensive jewelry worldwide.

Singson, a professional manager connected with 30 companies, suggested to the jewelers that for their industry to become one of the Philippines' top exports, players must believe and share in a single goal.

Without gold of their own and with most of their gemstones imported from neighboring countries, Thailand has built fine jewelry to be its fifth largest export, she said.

She further suggested that new technology to allow for economies of scale must be adopted. The different groups should organize themselves for specialization and quality standardization. But all these require a strong leadership and intelligent planning.

Source: Manila Bulletin, 08 September 2008

Flexible sorting with Varisort Compact

German manufacturer S+S Separation and Sorting Technology has unveiled the modular Varisort Compact sorting system for use with loose bulk materials. According to the manufacturer, the system is flexible and easily adapts to different sorting jobs such as in the recycling of electronic waste.

Different sensor technologies-inductive, optical and near-infrared can be combined in the Varisort Compact. The material to be examined is introduced by way of adapted vibration chutes that give homogeneous material distribution over the complete width of high-speed conveyor belt. At the end of the belt, the material is classified by the corresponding sensors. Upon evaluation of the relevant information, high-speed valves are activated with a corresponding item delay to blow out the material. By way of precisely-controlled blasts of compressed air, the particles to be separated are deflected from their original fall parabola into a separate duct.

Compared to conventional belt sorting systems, the Varisort Compact is of compact design such that it requires little space while offering the user greater mobility. Use of high-resolution sensors and state-of-the-art signal evaluation technologies provide a high detection accuracy and analysis of up to 500 000 parts per second.

Source: Recycling International, May 2008, p.25

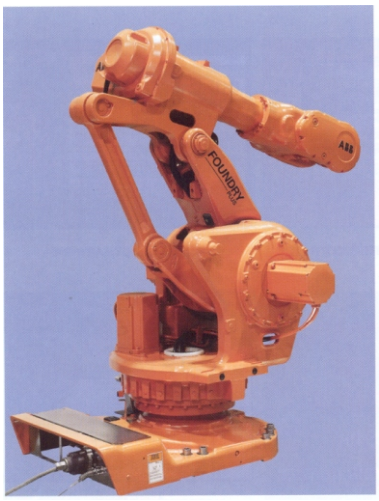
IRB 6600 optimized pre-machining robot

ABB has launched the IRB 6660, the first robot in the market that is dedicated to pre-machining applications in the foundry industry, making it ideal for high performance applications.

This new robot is designed for high-performance applications where robot stability is a key factor for success. The superior stiffness and robustness of the IRB 6660 allows for high productivity in challenging application. It is now possible to achieve a higher removal rate than before, which gives a shorter cycle time and higher productivity.

The greater accuracy of the IRB 6660 also makes for consistent and better part quality, even during high and fluctuating process forces. The relatively heavy robot structure reduces both high and low frequency vibrations. This is especially important for machining applications, with the best combination being a heavy robot with a light spindle.

Source: Metal Casting Technologies, vol. 54 no. 2, June 2008, p.58



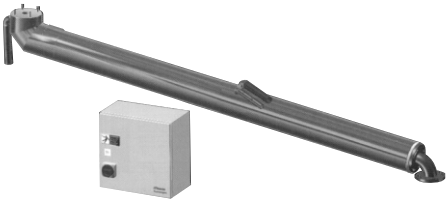
Induction heated melt transfer pipes

iTherm's heated Melt Transfer Pipes transfer molten materials between processing stations with proven energy savings. The Melt Transfer Pipe system operates at intermittent or continuous temperatures of up to 700ºC [1300ºF]. Very high power density heating technology enables the increase of the molten material temperature not attainable with traditional heating methods. Temperature control is contained in the power supply that can interface and communicate with existing process machinery. The flanged pipe system consists of a non-cooled coil, thermal insulation and is protected with an external sheath to withstand harsh industrial operating conditions. Corrosion resistant melt channel coating are available.

ITherm's heating system is different than any existing traditional pipe heating system. High frequency current passes through a coil and induces current to flow in the pipe body. These currents generate heat in the pipe body and either maintain the molten material temperature or increase the melt temperature while flowing through the pipe. The coil carrying the current remains at a lower temperature than the pipe. A closed loop feedback system precisely modulates the power. Melt temperature feedback or power control can be automatically tuned according to the melt flow rate.

The need of super heating a large amount of material in a furnace can be eliminated by heating a small amount of melt as it flows through the heated pipe. Efficiency of up to 95% can be obtained.

Source: Metal Casting Technologies, vol. 54 no. 2, June 2008, p.58



MIRDC Joins Civil Service Commission (CSC) in Celebrating 108th Philippine Civil Service Anniversary

Along with the different government agencies, the MIRDC joins the Civil Service Commission (CSC) in celebrating the 108th Philippine Civil Service anniversary this month of September. This year's theme is "Republic Service - Kabalikat ng Bayan sa Panahon ng Paghamon."

The Center had a simple celebration with guest speaker Atty. Jennifer L. Timbol, Director II, CSC Field Office - Department of Science and Technology (DOST) Cluster. Highlighting the celebration is the awarding of outstanding employees who were recognized by the Center for rendering outstanding work performance. It also underscores the outstanding contributions of some personnel in the making of utility models portable retort and decorticating machine which were granted a Registration Certificate from the Intellectual Property Philippines (IPP). On behalf of executive director Engr. Rolando T. Viloria, deputy executive director Engr. Arthur Lucas D. Cruz together with OIC deputy executive director Dr. Agustin M. Fudolig as well as the Center's management staff and employees congratulate all the exemplars! Also, in their inspirational messages, top execs urged everyone to work in unity in reaching the goals of the Center!

MIRDC Gets Registered... from p1

IPP is the decorticating machine that is used to separate coco coir, peat, and dust from coconut husk. To date, large proportions of coconut husks contribute to unwanted farm waste. But aside from using them as fuel, coconut husks are utilized for conversion into coir and coir products such as mats, floor covering and geotextiles through the use of decorticating machine. Hence, decorticating will be a big business opportunity for farmers, coco processors and/or workers in the coconut industry.

The prototyped decorticating machine for separating coco coir, peat and dust from coconut husk generally has a rectangular body comprises of a plurality of horizontal grate bars mounted in the bottom portion of the rectangular main frame; a plurality of descending length counter blades protruding and attached onto the front portion of the main frame; a pair of bearings that are provided and opposedly disposed within the side end portion of the main frame; a driveshaft connected to a decorticating rotor and securely connected to the bearings; a plurality of attached blades extending outwardly from the circumference of the decorticating rotor; a diametrically larger pulley securely connected at one end of the driveshaft; a diametrically smaller sheave connected at the end shaft of an engine; a hemispherical cover with a hopper and a discharge chute. The rotor blades of the decorticating machine are made of Chromium-molybdenum alloy material arranged in the decorticating rotor 94 mm apart, six sets radially and eight sets axially with a five-degree helix angle blade positions.

The MIRDC personnel involved in the development of the Portable Retort for Separation and Recovery of Mercury from Amalgam were Engr. Eduardo M. Deang, Jr. and Ms. Maria Gracia M. Peralta; while the Decorticating Machine for Separating Coco Coir, Peat and Dust from Coconut Husk is credited to Engrs. Francisco C. Dime, Jose B. Ferrer, and Jonathan Q. Puerto, all from the Research and Development Division (RDD) of the MIRDC.

Consequently, to acknowledge the outstanding achievements and significant contributions that innovative individuals bring to our industry, the involved personnel receive royalty awards. The awards recognize the creative innovations of the MIRDC's employees, granting the Center an exclusive right throughout the Philippines to make, use, sell or import the utility models.

MIRDC Joins SETUP Expo

The Metals Industry Research and Development Center (MIRDC) joined the "Philippine Business SETUP Expo" from 17-21 September 2008 at the Megatrade Hall of the SM Megamall, Mandaluyong City.

Organized by the Department of Science and Technology (DOST), the expo was held in line with the DOST 50th anniversary celebration event featuring the assisted companies under the Small Enterprise Technology Upgrading Program (SETUP). It aims to promote countrywide technology innovations of the micro, small and medium enterprises (MSMEs) with the DOST intervention to improve their productivity and competitiveness. It also aims to extend DOST's assistance to SETUP beneficiaries to increase their market and promote entrepreneurship.

The event highlights exhibit of the SETUP beneficiaries, public discussions on business and DOST interventions, and seminars on improving productivity and competitiveness. The MIRDC, along with the other DOST Research and Development Institutes (RDIs), was able to present its new technology on coco coir and abaca fiber production that can be tapped by the MSMEs. Such infusion of technologies on science and technology innovations by the RDIs will promote Philippine business to over a hundred DOST-assisted companies.

CEO Jose Concepcion, Jr. delivers a speech during the SETUP Expo opening ceremony

DOST SETUP Expo venue in SM Megamall's Megatrade Hall 2

DOST Secretary Dr. Estrella F. Alabastro together with Assistant Secretary Dr. Carol M. Yorobe and other DOST officials visiting exhibit booths

Prototype Development Cum Testing of Mercury Retort for the Philippine Small Scale Gold-Mining Industry

By:
Maria Gracia M. Peralta and Eduardo M. Deang, Jr.
Metals Industries Research and Development Center-
Department of Science and Technology

ABSTRACT

The Metals Industry Research and Development Center (MIRDC) forged a joint undertaking with the Technology Application and Promotion Institute (TAPI) to design and fabricate an improved prototype mercury retort for recovering mercury after separation of gold from the amalgam. This project is an offshoot of the feedback and comments gathered from the focus group discussions among the local miners in Paracale, Camarines Norte with a composite team of MIRDC and SETUP staff in June 2004. Minor changes in the design of the existing retort were made to suit the needs and conditions of local small-scale gold miners in various regions of the country. A prototype was fabricated based on the requirements of the small-scale gold miners. This was subsequently tested using a working model to ensure that the device performs satisfactorily during service. The prototype unit successfully passed the functional testing and evaluation conducted in MIRDC.

INTRODUCTION

Small-scale mining is considered as an informal sector of the mining industry where miners relies heavily on manual labor and works with simple tools and equipment to extract a broad range of minerals. Gold is the main mineral chosen for mining because it is precious and simple to extract, refine, and transport. It is estimated that more than 100,000 people are directly and indirectly involved in small-scale gold mining in about fifty-three (53) gold mining localities around the country.

Although small-scale gold mining has significant contribution to gold production and rural employment in the Philippines, the gold extraction activities are undertaken by workers with little technical understanding of the long term impacts of their mining activities on health and environment. This has led to severe environmental degradation and pollution of atmosphere, river systems and agricultural sites near the artisanal gold mines. Foremost of these is mercury contamination.

To extract gold, artisanal miners combine mercury with gold-laden ores at several stages of the recovery process. Gold bonds to the mercury and forms a composite known as amalgam, making the gold easier to separate from the gangue sediment. The amalgam is then heated with blow torch in a shallow circular clay pot to burn off the mercury, dissipating mercury vapour in the atmosphere and directly exposing miners and bystanders to this vapour. It is estimated that two to five grams of mercury are released into the environment for every gram of gold produced. Mercury emissions from these activities are derived from poor practices, lack of knowledge about mercury toxicity, and insufficient access to more appropriate techniques. This poorly controlled use of mercury resulted in the following incidents:

› Air mercury concentrations of 42-1664 μg/m^3 were recorded in four different gold commercialization shops in Davao del Norte, with 65% of samples exceeding the World Health Organization (WHO) (1976) industrial exposure limit of 50 μg/m^3. Six percent (6%) of 230 potentially exposed workers sampled in that area showed elevated blood mercury levels, (Department for International Development (DFID) and Department of Energy and Natural Resources (DENR) study);
› Blood mercury levels in Apokon residents revealed blood burdens of up to 20 μg/ml interpreted by the DOH as consistent with excessive, residential and/or occupational exposure. Detoxification of residents with mercury levels greater than 10 μg/ml was proposed and instigated;
› National media coverage of the Department of health (DOH) action in Apokon prompted public and political pressure for the compensation of residents (DOH 1996 survey);
› Several poisoning incidents were reported, the first incident involved 11 injuries and one fatality in Tagum, Davao del Norte, in 1987;
› In 1988, the Mines and Geosciences Bureau (MGB) estimated that some 140 tons of mercury may have been released into the Agusan River catchments during the period 1986-1988;

With the increasing concern on the diffusion of mercury to the environment, government agencies such as the Mines and Geosciences Bureau (MGB) encourage the gold panners to use mercury retort during gold refining for their own protection. A retort traps mercury during blowtorching and prevents it from spreading into the air, thus, reducing the risk of exposure to mercury vapor and, consequently, recovering the trapped mercury for reuse on the succeeding amalgamation.

Although mercury retorts are readily available in the foreign market, the price of such device is prohibitive at $1,000 each. Thus, despite all the benefits the device can offer, small-scale miners still prefer the crude method of blowtorching the amalgam in clay pots allowing mercury vapor to dissipate in air. To make it affordable, the Metals Industry Research and Development Center developed a localized mercury retort. The cost of the retort was reduced by 85%.

In 2000, a composite team of MGB and MIRDC conducted a techno-demo on the proper use of mercury retort to small-scale miners in Bicol. The activity was relatively successful, since a number of gold miners have availed of the device since then. However, during the recent visit in Camarines Norte for the conduct of the feasibility study on the commercial production of mercury retort under the SETUP Program by representatives of the Technology Application and Promotion Institute, MIRDC and a consultant, a number of issues had been raised by miners and most of these were directed to its design and suitability to general requirements of the small-scale miners.

It is in this context that TAPI and MIRDC had decided to undertake a project on the development of a modified mercury retort whose design is in accordance with the set of specification requirements of gold miners in Bicol region as indicated in the Feasibility Study Mid-Term Report submitted by SETUP to TAPI.

The development of a low-cost, highly reliable mercury retort that will satisfy the needs of small-scale gold miners will definitely help mitigate the health and ecological hazards associated with small-scale gold mining. The use of a handy mercury retort will ensure a safe and environment-friendly gold-recovery process. The device will likewise significantly increase profit since the mercury can be recovered and re-used several times.

REVIEW OF LITERATURE

Veiga presented several retorts available to artisanal miners from the crude potato retort and conventional bucket retort to the efficient yet expensive Therm-Ex glass retort. Veiga compared the advantages and disadvantages of the following retorts: kitchen bowl, fish-tin, RYHP, CETEM, Fish-tin retort, Colombian Still, GTZ, and Therm-Ex [Veiga, Marcello M. "Retorts: Many options and many barriers"].

Retorting amalgam in a scooped potato was suggested in a Canadian booklet "Gold Panners Manual" by Garnet Basque. Though it is useful, its sustainability is questionable [Veiga].

The bucket retort is unique in an artisanal mine in China. The ball of amalgam is placed on a pan on top of an electric hot plate, seated in a water-filled bowl and then covered with a metal bucket. The bucket and the water form an air seal, creating a crude but effective retort. When heated mercury evaporates and the mercury vapours condenses on the cover bucket walls and drips into the water -filled bowl. This operation takes an hour and mercury recovery is about 95% [Veiga].

The fish-tin retort used in Papua New Guinea is a modification of the bucket retort. Fish tin can is used instead of bucket and sealing at the bottom of the tin can is accomplished by sand instead of water. Method of heating is by the use of firewood or clay oven used for cooking.

The kitchen bowl retort is an improvement of fish-tin retort. Either an enamelled glazed bowl or stainless steel bowl is used as vessel for amalgam. A transparent kitchen bowl covers the amalgam vessel and either wet or dry sand is used to seal the bottom of the glass bowl. Heating of the amalgam is accomplished by either firewood, kerosene stove, or Bunsen burner. This type of retort is utilized in Sudan, Ecuador, Mozambique and Zimbabwe. In Ecuador, the recorded mercury escaping from the retort using Lumex Mercury Vapor Analyzer apparatus at a distance of 0.1 m from the sand is 50 µg/m3 and 5 µg/m^3 for dry sand and wet sand, respectively. Measurement in Mozambique yields 3 µg/m^3 for 1 m from the bowl and 35 µg/m^3 for 0.1 m from the bowl. The WHO time weighted average guideline for worker exposure is peg at 25 µg/m^3. Processing time ranges between 10 to 30 minutes per batch depending on the heating medium used. Despite the visual control, the glass cover takes 15 minutes to cool down with water being added. Miners prefer the steel cover since it cools down in 5 minutes.

Professor Raphael Hypolito of University of Sao Paolo devised a home-made RHYP retort. It is used in Indonesia, Zimbabwe, Sudan, Venezuela, and Mozambique. RHYP retorts are made from galvanized steel plumbing material consisting of elbow, double nipple, end plug, and pipe tube with sizes ranging from ¾" to 4". The ideal size to burn 10 to 20 gms. of amalgam is 1 ½". Amalgam is placed on the distilling chamber made from end plug and double nipple connection. This is attached to the condensing tube with a pipe elbow. The distilling chamber may be heated by either charcoal or torch where the mercury evaporates and condenses in the condensing tube. The end of the condensing tube discharges the mercury in a water bucket. Though it is cheap, the RHYP retort has some drawbacks: (a) it leaks if not well set up; (b) zinc from galvanized steel must be burned off for this can be toxic; (c) gold sticks inside the retort; and (d) heating takes longer time. A modified design of RHYP retort was made by Mintek, ITDG (Intermediate Technology Development Group). According to ITDG, most of the mercury is normally trapped in the retort on the first time it is used, and it will be recovered in second and subsequent uses. Measurement in Mozambique using this type of retort yields 2 µg/m^3 for 1 m from the retort and 30 µg/m^3 for 0.1 m from the retort.

A retort that is considered to be of good design was devised by CETEM, Brazil. The CETEM retort has a 3.8 cm O.D. x 7 cm distilling chamber made from AISI 1020 carbon steel. The distilling chamber is screwed on a 3.8 cm O.D. X 6 cm cap attached to a 12.5 cm – 25 cm O.D. X 20 cm long stainless steel air-cooled condensing tube. The retort is heated with Bunsen burner.

The stainless steel GTZ retort of Germany provides a water cooler cup to cool the condensing tube during retorting. There is no water circulation during retorting. The advantage of having stainless steel cooling pipes is that mercury does not stick on the pipe wall when it cools down.

Another good design is the retort developed by Venezuela. The retort uses a replaceable stainless steel cup as crucible. The steel condenser tube is air cooled and mercury is discharged in a water glass.

One comparatively sophisticated retort is the Therm-Ex glass retort manufactured by the Munich-based company Metall-Technic. The crucible is made from heat resistant glass attached to an air cooled stainless steel condenser tube by a threaded ring. The condensed mercury is discharged to another heat resistant collecting glass vessel. The retorting chamber, condenser tube and the collecting vessel comprise of the retorting unit which is made air tight by graphite and rubber gaskets. The collecting vessel is cooled and enclosed by a water-filled glass container.

The Therm-Ex retort is probably the first commercially available glass retort ever produced. It is compact and weighs approximately 1 kg. The Therm-Ex manufacturers contend that in addition to the environmental impact resulting from heating the amalgam in open air, miners lose up to 12% of the gold during the amalgam burning process.

The Therm-Ex glass retort allows miners to observe the entire process of separation of mercury and gold from the amalgam. Other advantages include:

› The retort warm-up time is shorter compared to metallic retorts (7 to 12 minutes);
› Contrary to metallic retorts where the gold becomes darker or browner due to its reaction with iron, in the glass retort there is no colour change; and
› There are less gold losses than in metallic retorts where gold infiltrates into iron surfaces.

Veiga, however, contends that the Therm-Ex retort cannot be used as permanent retort but for demonstration purpose only due to its low capacity (30 grams of amalgam), high cost, breakability, and lack of spare parts (in the mine site). With longer use, the crucible becomes opaque (silicon oxide formation) and seeing the amalgam inside becomes difficult [Veiga, Marcello, "Equipment Specification for the Demonstration Units in Sudan", Global Mercury Project, UNIDO].

It is interesting to note that the arguments of the miners visited by Veiga in different countries for not using retort are the same apprehension by the small scale miners in Camarines Norte, which includes:

› Gold will be lost
› Retorting is not hot enough
› Gold will not be burned well
› Some mercury remains
› Retorting takes too long
› Burning can't be observed
› Glass retorts are too delicate
› Gold becomes brown
› Gold sticks to the retort crucible

SCIENTIFIC BASIS/ FRAMEWORK

Mercury is the main agent used to separate gold from ore concentrate in the amalgamation process. Amalgamation is popular in the small-scale mining areas as it is inexpensive and does not require skilled labour. In this process, miners simply mix ample amount of mercury to separate gold from the gangue component of the ore concentrate. A good rule of thumb is to use about 5 times the amount of mercury as there is gold in the batch. When mercury is brought into contact with clean gold, the gold is wetted and dissolved in the mercury forming an alloy called amalgam. The excess mercury is removed by squeezing it through damp chamois or canvas leaving a hard lump of amalgam.

Owing to its relatively high vapor pressure compared with gold, mercury vaporizes at a much lower temperature and it can be driven off from the amalgam by heat leaving the gold behind. This separation of precious metal from the mercury in the amalgam can be safely done by a simple distillation procedure using a specially designed retort. The boiling point of mercury is 357°C and typically temperatures of 600-700°C are applied to vaporize the contained mercury [http://www.e-goldprospecting.com/html/retorquing.html].

In the retort, the amalgam is placed and enclosed in the evaporator vessel where it is heated using Bunsen burner or oxy-acetylene set-up. The retort should not be filled much over half full of amalgam as room is required for the vaporized mercury [http://www.metalresourcesdirectory.com/browse-mercury_heavy_metal-373-1.html]. To allow the mercury to vaporize more rapidly, it is good practice to make the amalgam into several small balls. The distillation is performed at a very low temperature and heat is applied gradually until the mercury begins to evaporate and the vapour is exhausted into the condensation system of the retort. If heated too rapidly the amalgam may splatter and clog the outlet which could result in the explosion of the retort. In the condensation system, the vapour is cooled rapidly to below the boiling point (357°C) of mercury in the condenser tube. The condenser tube is either air cooled or has a water jacket surrounding it, through which a small quantity of cold water is continuously passed during the operation. Heat is transferred from the vapour to the condensation system and the vapour transform to liquid mercury below 357 °C which flows by gravity in the condenser tube and collected in the collecting vessel of the retort. The mercury produced contains small quantities of gold, silver, and other metals but is usually of sufficient purity to be reused for amalgamation. Mercury losses vary between 0.2 % and 0.4 % for each distillation cycle. These losses are mainly result of uncondensed fumes leaving the condensation system and mercury vapour that permeates into the refinery during retort loading/unloading processes [http://www.e-goldprospecting.com/html/retorquing.html].

Several specifics and precautions were listed by Dr. A. K. Williams in handling mercury [http://webpages.charter.net/kwilliams00/bcftp/docs/mercury.htm]. These include:

› Mercury will form amalgams with almost all metals except iron and aluminum.
› Do not let mercury contact aluminum. Mercury will react rather violently with aluminum. Do not use mercury in an aluminum gold pan or try to store it in an aluminum vessel.
› Never try to distill (retort) Mercury in a glass retort.
› The non-vented type of retort is simply a boiling vessel and a cooling tube from which the mercury drips into a catch vessel. With this type of retort **never** put the exit end under water in a catch vessel. A very slight drop in the temperature of the boiling mercury will create a vacuum sufficient to suck water back through the system right into the boiling mercury at 357 ° C.

METHODOLOGY

Conceptual Framework

The following procedures were followed to come up with a modified design of the MIRDC mercury retort:

1. Review of literature.
2. Review of small scale gold-miners requirements in the Bicol region vis-a-vis information gathered from the literature.
3. Design and fabricate a working model based on the outcome of the review.
4. Conduct experimentation and testing.
5. Documentation.

Requirements of Small-Scale Gold Miners vis-a-vis Information from Literature

The project was initiated with a thorough review of literature and the functional requirements of the retort based on the feedback and comments gathered from the focus group discussions among the local miners in Paracale, Camarines Norte with a composite team of MIRDC and SETUP staff.

The consultant of SETUp reported the following concerns by the small-scale gold miners in the Bicol region on the MIRDC mercury retort together with some of his recommendations:

1. The retort have flat design that cause amalgam to spread in the inner bottom of the heating vessel thus it must be concave in shape for better collection of materials;
2. The retort process was not visible to the operator due to its heating vessel made of metal. It is recommended that the vessel be made of glass to monitor the status of the process of purification;
3. The heating vessel is hard to handle when hot, thus, gold extraction process becomes difficult; and
4. The vessel's capacity is 500 grams which was observed to be very big for the regular amounts of 200 to 300 grams of amalgam processed/needed by small-scale miners for purification.

The flat shape of the MIRDC mercury retort vessel was patterned after the Therm-Ex glass retort provided by the MGB. However, there is wisdom in the recommendation of the SETUP consultant to use concaved bottom of the heating vessel for a more efficient vaporization of mercury and better collection of the processed gold. Furthermore, the concaved shape takes the form of the clay dish being used by the small-scale gold miners.

The "black-box effect" of retorting (i.e., the process is not visible to the operator) has been a common argument of miners for not using retort not only in the Bicol region but also on artisanal gold mines in China, Sudan, Zimbabwe, etc. This made the use of heat resistant glass as an attractive alternative material for the amalgam vessel (e.g. Therm-Ex glass retort). However, survey of literature reveals that the use of glass has some draw backs as reported by Veiga:

› the glass vessel is fragile and replacement will be difficult to secure in the mine area;
› the refractory character of the vessel makes retorting time longer; and
› the glass crucible eventually becomes opaque due to silicon oxide formation which makes the amalgam retorting process difficult to see.

Furthermore, Dr. A.K. Williams had strongly cautioned never to use glass in retorting. Dr. Williams did not elaborate the reason for this but it is logical that this is due to safety aspect. It was already mentioned that if the retort is heated too rapidly the amalgam may splatter and clog the outlet which could result in the explosion of the retort. Metal crucible has a higher resistance to breakage than glass if ever this accident will happen.

It is therefore imperative that the crucible should be made from metal provided the "black-box effect" can be addressed.

Among the metals, a stainless steel material will be the most appropriate alloy to use for the following reasons:

› Mercury forms amalgam to all metals except iron and aluminum;
› Mercury reacts violently with aluminum;
› Retorting in ordinary iron or steel makes the gold brown which reduce its market value; and
› Discoloration of gold is not observed for retorts made from stainless steel alloy.

To be continued on next issue...

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