Development of Biolog Extrusion Machine (Model II)

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Abstract

Basically the bio-log extrusion machine is a mechanical contraption that operates on the principle of lever to move the mechanisms forward and backward wherein rotary motion of spur gear is converted into linear one through the rack gear to complete the cycle and the work required. Its basic function is compression since as the lever assembly is rotated clockwise manually the rack gear with attached ram at the tip moves forward thus reducing the volume in the case, hence any soft material inside will be baled. To describe the machine's physical description, the cylindrical case lying horizontally on collapsible frame assembly is look like a hotdog. Thus, the end product will follow the shape of the machine like a punching bag. Said machine made of steel and cast iron in the form of casted product, plates and bars are machined, fabricated and joined by fasteners, hinges and welding.

I. Introduction

Coco coir, or fibers from coconut husks, can be a source of income for communities in the country's coconut-rich areas, according to the Foundation for a Sustainable Society (FSSI). However, the FSSI warned against the long term strategy of exporting raw coco fibers, but instead suggested the export of high-value products with coconut fibers. Exporting raw coco fibers from other countries will give them much boost on employment instead of local communities in our country will be benefitted in making coco fiber/pit by-products and then exported it in other countries as a finished product. The government is also bullish on the coco coir industry, approving the Philippine Coco Coir Development Plan 2011-2016. The government projects $6.5 million in exports of coco-fibers to China and other countries in the next five years. The coconut husk, for instance, is thrown away more than 99 percent of the time. It is considered farm waste—but when we think about it, there are actually so many things we could do with the coconut husk. As the saying goes, there is money and job opportunity in coconut husk waste. Farmers can make money by using its by-product – coco peat and coco coir. The government is encouraging coconut farmers to earn more by bringing their husks to plants that will process them into byproducts. The Philippines has 3 million hectares of coconut plantations in 68 provinces and 1,195 municipalities throughout the country, producing approximately 15 billion nuts a year. Some 6.6 billion husks are burned to cook copra; but some 8.4 billion husks are thrown away as farm wastes. Coconut-producing Aurora province for example recently installed three processing plants to convert husks. The coco fiber is made into twine which is woven into coco net used in erosion control. Southern Luzon, Bicol, Visayas, and Mindanao have 18 coco coir producers registered with the Philippine Coconut Authority (PCA) (Tempo, November 15, 2012). Coco coir or fiber extracted from the husk is a raw material for making high-value export products such as bed mattresses, mats, car seats, ropes and twines, grow poles for plant liners, wattles for orchids, pots, and geotextiles. Coco fiber is used by the Pasig River Rehabilitation Commission for erosion control in Estero de Paco in Manila, in slope rehabilitation in a Tagaytay subdivision, on the San Roque Dam embankment in San Manuel, Pangasinan, at Cherry Hills now Peace Village in Antipolo City, at bio-engineered slopes in the Subic-Clark expressway, and on Ambassador Point at Halsema Road in the Cordilleras. The Philippines exports the biodegradable and environment-friendly coir baled fiber to China, Taiwan, United States, Korea, Japan, and Europe. The processing of coconut husks into coco coir and coco peat is an income-earner for farmers and their families in the coconut-producing regions of the country. All they need are government and private sector's support and assistance (Tempo, November 15, 2012).

In support to Philippine Coco Coir Development Plan 2011-2016 and to Sustainable Engineering for Environmental Conservation the MIRDC will continue to develop project for the caring of environment in doing so, the development of improved biolog extrusion machine (Model II) using coconut fiber is hereby implemented.

Review of Literature

THE Philippine Coconut Authority (PCA) has set aside P160 million next year to purchase equipment that will boost the government's bid to develop the coco-coir industry. PCA administrator said a team from the agency went to Kerala, India to look for equipment that will be add value to coco coir fiber. The purchase of additional equipment for processing

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coco coir is part of the government's push for non-traditional coconut products which include coconut water and virgin coconut oil. Despite the huge potential of coco coir and coco peat, the Philippine Coco Coir Exporters Association (Philcoir) noted that the country could not take full advantage of opportunities due to low buying, high cost of transportation, limited market awareness and the lack of matured technology.The lack of financing support and program and policy support as well as inadequate research and development are also exacerbating the problems confronting players in the coco coir industry. During the National Coco Coir Summit held in April 2011, stakeholders sought exemptions from value-added tax (VAT) imposed on local sales, exemption from duties and VAT on the importation of machinery and equipment and income tax holiday for new investments and ventures.The PCA, an attached agency of the Department of Agriculture (DA), estimates that the country produces some 12 billion coconuts annually.

The DA noted that collecting merely one half or 6 billion coconut husks and processing these into coco geotextiles and organic fertilizers would yield at least $225 million in export receipts annually. DA said geotextiles or "cocomats" serve as erosion control material that are laid on mountain slopes, river banks and dam embankments. Coconut fibers are also transformed into twine or yarn, while fine coco fibers are used in making beds or mattresses. Coconut peat or dust is used as organic fertilizer, soil conditioner, or animal beddings. For every kilo of coconut husk, 30 percent or 300 grams of fiber or coir can be extracted, and the rest is coco peat or dust.Agriculture Secretary Proceso J. Alcala noted that China is "one big untapped export market. Other potential buyers of geo-textiles and coco peat organic fertilizer and soil conditioner are Hong Kong, Korea, Japan, Singapore, Taiwan, Canada, and the United States. Alcala said China alone imports 200,000 metric tons (MT) of coco fiber annually, driven by its increasing demand for mattresses. In 2010, the PCA noted that the Philippines exported less than 5,000 MT of coconut coir worth roughly $6.5 million. Sri Lanka is the leading exporter, at more than 150,000 MT.

The coconut industry is expected to get a further boost once it capitalizes on its potential to be a top exporter of cocopeat, a fibrous substance made from coconut husks.The Philippine Center for Postharvest Development and Mechanization (PhilMech) said that given the proper postharvest technology, the Philippines could easily make export-grade cocopeat and become its biggest supplier worldwide with the sheer size of lands devoted to coconut trees.PhilMech is mandated to conduct research on the ways farm waste could be put to good use. The agency said it had developed a two-step drying system with its partners in order to produce quality cocopeat. The Philippines has more coconut land than India and Sri Lanka combined but these two countries are way ahead when it comes to cocopeat exports. Cocopeat, a by-product of the coconut husk, is popular worldwide primarily as a growing medium for crops using hydroponics. It is primarily used in organic agriculture.Based on government data, India has one million hectares of coconut lands, while Sri Lanka has a coconut area only the size of the Bicol region. Meanwhile, the Philippines has 3.56 million hectares planted to coconut. Last year, the Philippines exported only 5,000 metric tons (MT) of cocopeat, compared to India's 400,000MT and Sri Lanka's 82,000MT. A research paper from the Philippine Center for Postharvest Development and Mechanization showed that if only 30 percent of discarded coconut husks are processed into cocopeat, the Philippines can easily beat India and Sri Lanka and become the top cocopeat exporter. Indonesia's coconut production is higher than the Philippines' but the former is not a top cocopeat exporter. The Philippines produced 15.2 billion nuts in 2011 while Indonesia produced 16.3 billion. Also, the Philippines still leads in overall coconut exports and product development compared to Indonesia, Sri Lanka and India. In his latest State-of-the-Nation Address (SONA), President Benigno Aquino 3rd boasted that the country's cocowater exports are increasing, and he committed to allocate funds for the development of the coconut industry. This boast is not empty since in the first four months of the year, cocowater exports increased by almost 200 percent to almost 6 million liters compared to the same period last year.In 2011, the Philippines exported $1.957 billion in coconut products, with coconut oil accounting for $1.40 billion, 20.30 percent higher than the $1.627 billion in 2010.While coconut oil exports increased in volume by 146 percent to 79,864 metric tons in the first six months of the year, other coconut products, like cocowater, registered hefty shipment gains abroad.But that does not mean that the Philippine coconut industry still leads in all fronts compared to its competitors.

Coir fiber logs are biodegradable logs or biologs (decomposed ground coconut husks pulp) which are tightly packed in tubular netting. They are 100% natural materials, excellent planting medium additives which add fertility to the soil after biodegradation, high tensile strength, high water absorbency, eco-friendly, and wildlife safe.

Coco coir biologs can be made in variety of lengths and densities to suit different applications. As the logs can absorb large amount of water, the logs can be used to slow down the velocity of storm water run-off, thus stabilizing slopes. They are great for shorelines/river embankment stabilization and forest slope rehabilitation.

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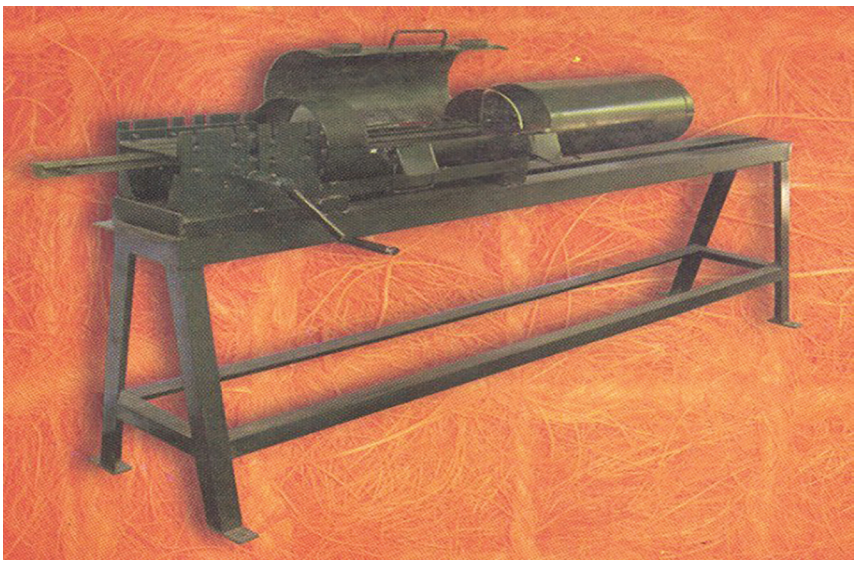

Figure 1. Previous Machine Developed by MIRDC for Coco Coir Biologs (2009) Prototyped Model

It also provides bedding where the seedlings and/or cuttings are inserted into logs with sediment. As the coconut fiber logs biodegrade, the plants develop a well-established root system in the shoreline sediment to retain the soil in place. Moreover, the logs are useful in catch basin protection, keeping unwanted pollutants from entering into sewer systems.

For maximum utilization of coco coir, the MIRDC developed a manual machine for coco coir biologs that compresses coco fibers while encapsulating it in a geotextile net, the so-called coir fiber biologs. The machine measures 1470 mm x 540 mm x 960 mm (L x W x H) and capable of producing 30 units of coco fiber biologs per day even by a novice operator. The manufacturing cost of the machine is approximately P48,000.00.

The machine for coco coir biologs is a promising technology for coir fiber since the Philippines is among the top coconut-producing countries. With this machine, it will not only generate employment for coco processors but also increase the utilization of coconut coir for commercial purposes.

Application Include:

-Slope Stabilisation for Roadways, highways,pathways and railway embankments

-Coir Bio-logs, rolls for lake & stream stabilisation

-Filtration in swimming pond,reed bed & holding resevoir applications

-Silt barrier, sediment control,spill containment contamination applications

-Lake ,pond, river, irrigation and drainage channel bank stabilisation / edging

Figure 2. Coco coir fiber used in making biologs.

Figure 3. Geotextile nets used in making biologs.

Figure 4. The machine completed with the project team.

Figure 5. Collapsible Frame Model BIOLOG Extrusion Machine.

Figure 6. Biolog product.

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Figure 7.1 & Figure 7.2 Biolog application in river embankments.

Figure 8. Biolog application on Hillside Stabilization.

Figure 9. Biolog application on Highway slope embankment.

Figure 10. Biolog application on Irrigation.

Figure 11. Biolog application on Canal embankment.

-Geo-cells for tree root protection,embankment stabilisation,vegetation containment

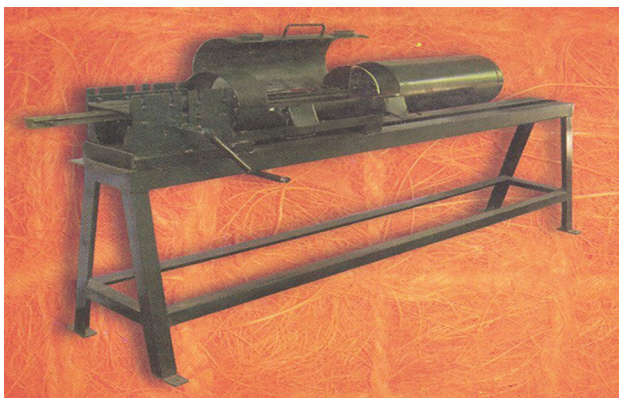
-Slopes with risk of erosion in new development sites,exposed slopes in amenity areas in parks, golf courses etc.

-Green roof matting/sedum & wildflower coir colls,geocells for vegetation containment

Improvements Made to the Modified Biolog Extrusion Machine (Model II) as Compared to the First Model

1. Use of standard pipe instead of a rolled one just to assure the concentricity of the inside diameter.
2. Revised Frame from bigger to smaller one (compact).
3. Gear Cover was simplified using casted product and serves as guideway in moving the rack gear in reciprocating motion (horizontally) through the rotation of spur gear for easy maintenance and for aesthetic purposes.
4. Second model uses standard latch as compared to fabricated one of the first model.
5. Simplified Handle for the spur gear and cover.
6. Provision of hooks (2 pcs.) which serve as stopper.
7. Simplification of Plug for easy operation and provision of handle.
8. Reduction of gears to the control mechanism of the equipment.

Figure 12. Biolog Extrusion Machine Model II compared to Biolog Extrusion Machine Model I (below).



Thus the final specifications of Coco Fiber Bio-logs Model II are:

Cylinder Length	:	1200 mm
Cylinder Diameter (Outside)	:	214 mm
Ram Diameter	:	198 mm
Length of Rack Gear	:	900 mm
Diameter of Spur Gear	:	40 mm
Number of Teeth of Spur Gear	:	18, Module 2
Length	:	1470 mm
Width	:	540 mm
Height	:	960 mm
Weight	:	95 kgs.
Capacity (for 1 operator only)	:	30 pcs. biologs per day

Summary and Conclusion

To address the concerns and recommendation for improvement of the BIOLOG EXTRUSION MACHINE – MODEL I, the following objectives were addressed:

1. The machine's height, weight and length is ergonomically designed.
2. All parts are designed for the purpose of strength such as the frame and cylindrical drum.
3. It is easy to operate because of its handle's clockwise and counterclockwise rotation.
4. Moving parts are properly located for easy maintenance purposes.

As such, reiteration of the improvements/modifications are the following:

1. Use of standard pipe instead of a rolled one just to assure the concentricity of the inside diameter.
2. Revised Frame from bigger to smaller one (compact).
3. Gear Cover was simplified using casted product and serves as guideway in moving the rack gear in reciprocating motion (horizontally) through the rotation of spur gear for easy maintenance and for aesthetic purposes.
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For future undertaking in modifying this machine, motorized model should be incorporated if possible, but we have to consider the operation costs such as fuel or electricity and see if it is viable and feasible.

Physical properties of Coco-net

Properties		Coconet 400	Coconet 700	Coconet 900
Thickness, mm		10.0 Min.		
Width, m		1.0 Min.		
Length, m		5.0 Min.		
Unit Weight 1g/m^2		400±20	700±35	900±45
Diameter of twine, mm Hand spun		5.0 mm ± 0.50mm		
No. of Twines/m	Crosswise Direction	40 Min.	40 Min.	70 Min.
	Length wise Direction	40 Min.	70 Min.	70 Min.
Material		Woven netting made from high strength 100% coconut fiber twine		
Color		Natural Earth Tone		
Tensile Strength, N/twine		150 Min		
Elongation	(*Machine Direction*), %	26 Min.	34 Min.	42 Min.
	(*Cross Machine Direction*), %	32 Min.	38 Min.	32 Min.
"C" Factor		0.002		
Water Velocity, m/sec		2.7 Min.	3.35 Min.	4.26 Min.
Water absorption, %		163 Min.	146 Min.	132 Min.
Slope Inclination, H:V		≤ 1:1	1:1 to 60	75

"C" Factor – Safety Factor

Standard grades of Coir

Letter Designation	Name of Grade	Description
CH-1	Coir Good	Fiber (bristle) is good for cleaning, with little or no pulp content; color is light to almost dark brown; length is not less than five inches.
CH-1	Coir Fair	Fiber (bristle) is of fair cleaning; fiber are stuck together and considerable pulp are presents; color ranges from dull brown to dark brown or black; length is not less than five inches.
CH-1	Coir Mixed	Mixture of bristle and mattress fibers, generally crumpled and tangled ; of good and fair cleaning, free from coir dust and hard undefibered husk; color range from light brown to dull brown
CH-1	Coir Mattress	Consist mostly of short crumpled fibers with an average length of not less than half an inch; from coir dust and hard undefiberd husk
CH-1	Coir Waste	Consist of coir dust and fiber not fitted in any regular grades of coir, with length of less than two and a half inches long.

Physical Properties of Coco-log

Type of Coco-log/ Fascine	Diameter (mm)	Weight (min.) (Kg/m)
Cocolog 100	100	2.0
Cocolog 200	200	4.5
Cocolog 300	300	10
Cocolog 400	400	20
Cocolog 500	500	30

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