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Biomass Briquette Production: A Propagation of Non-Convention Technology and Future of Pollution Free Thermal Energy Sources

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Abstract: *Biomass briquettes are a biofuel substitute to coal and charcoal. Briquettes are mostly used in the developing world where cooking fuels are not as easily available. Briquettes are used to heat industrial boilers in order to produce electricity from steam. The briquettes are con-fired with coal in order to create the heat supplied to the boiler. People have been using biomass briquettes since before recorded history. Biomass briquettes are made from agriculture waste and are a replacement for fossils fuels such as oil or coal, and can be used to heat boiler in manufacturing plants. Biomass briquettes are a renewable source of energy and avoid adding fossils carbon to the atmosphere. The extrusion production technology of briquettes is the process of extrusion screw wastes (straw, sunflower husks, buckwheat, etc.) or finely shredded wood waste (sawdust) under high pressure. There is a tremendous scope to bring down the waste of convention energy sources to a considerable level through the development, propagation of non-convention briquettes technology i.e. briquettes machine , briquettes plant, biomass briquettes plant for production of agro residue briquettes to meet thermal energy requirement . Therefore this substitute energy medium is given national priority as appears to be the only permanent solution into restriction of the national laws and avoid pollutions.*

Key words: *Biofuel, Briquettes Machine, Briquettes Plant, Calorific Value, Incentives*

I. INTRODUCTION

The legacy foundation has developed a set of technique to produce biomass briquettes through artisanal production in rural villages that can be used for heating and cooking. These techniques were recently pioneered by vicuna national park in eastern democratic republic of Congo, following the massive destruction of the mountain gorilla habitat for charcoal. The economics of two countries i.e. India and China are rapidly increasing due to cheap ways of harnessing electricity and emitting large amounts of carbon dioxide. The Kyoto protocol attempted to regulate the emissions of the three different worlds, but there were disagreements to which country should be penalized for emissions based on its previous and future emissions. The United States has been the largest emitter but china has recently become the largest per capita. The United States had emitted a rigorous amount of carbon dioxide during its development and the developing nations argue that they should not be forced to meet the requirements. At the lower end, the undeveloped nations believe that they have little responsibility for what has been done to the carbon dioxide levels.

The major use of biomass briquettes in India is industrial applications usually to produce steam. A lot of conversions of boilers from FO to biomass briquettes have happened over the past decade. A vast majority of those projects are registered under CDM under Kyoto protocol, which allows for users to get carbon credits the use of biomass briquettes is strongly encouraged by issuing carbon credits. One carbon credit is equal to one free ton of carbon dioxide to be emitted into the atmosphere. India has started to replace charcoal with biomass briquettes in regards to boiler fuel, especially in the southern parts of the country because the biomass briquettes can created domestically, depending on the availability of land. Therefore, constantly rising fuel prices will be less influential in an economy if sources of fuel can be easily produced domestically. Lehar Fuel Tech Pvt. Ltd is approved by Indian renewable energy development agency (IREDA), is one of the largest briquetting machine manufactures in India.

Fig. 1 Different types of Briquettes

II. ADVANTAGES OF USING BRIQUETTES COMPARED TO OTHER SOLID FUELS

- Briquettes are cheaper than coal.
- Oil, coal or lignite, once used, cannot be replaced.
- There is no sulfur in briquettes, thus does not pollutes the environment.
- Biomass briquettes have a higher practical thermal value.
- Briquettes have much lower ash content (2-10% as compared to 20-40% in coal).
- Combustion is more uniform compared to coal
- Briquettes are usually produced near the consumption centers and supplies do not depend on erratic transport from long distances.
- Briquettes give much higher boiler efficiency because of low moisture and higher density.

III. ADVANTAGES OF SETTING UP BRIQUETTES PLANT PROJECT

- High sulfur content of oil and coal, when burnt, pollutes the environment.
- There is no fly ash when burning briquettes.
- Briquettes have consistent quality, have high burning efficiency, and are ideally sized for complete combustion.
- Combustion is more uniform compared to coal and boiler response to changes in steam requirement is faster due to higher quantity of volatile matter in briquettes.
- Compared to fire wood or loose biomass, briquettes give much higher boiler efficiency because of low moisture and higher density.
- Briquettes, are easy to store, pack and hygienic to handle.

IV. BRIQUETTES CAN REPLACE FOLLOWING CONVENTIONAL FUELS

- Diesel
- Kerosene
- Furnace oil
- Lignite
- Coal
- Firewood

Calorific Value:

One of the most important characteristics of a fuel is its calorific value, that is the amount of energy per kg it gives off when burnt. The calorific value can thus be used to calculate the competitiveness of a processed fuel in a given market situation. There is a range of other factors, such as ease of handling, burning characteristics etc., which also influence the market value, but calorific value is probably the most important factor and should be recognized when selecting the raw material input.

V. KEY FEATURES OF THE BRIQUETTES PLANT PROJECT

- High profitability
- Excellent growth potentiality
- Ready market
- Wide variety and easy availability of agro-waste from various crops

- Short gestation and quick returns
- Employment potentiality
- Conversion of natural resources into hi-tech energy and maintenance of ecological balance.

VI. Raw Materials Used To Briquette with Different Calorific Values

Table no. 1

Groundnut shell	4524 k	3.80
Baggasse	4380 k	1.80
Castor seed Shell	3860 k	8.00
Saw dust briquette	3898 k	8.20
Cotton Stalks / chips	4252 k	3.00
Bamboo dust	4160 k	8.00
Coffee husk	4045 k	5.30
Tobacco waste	2910 k	31.50
Tea waste	4237 k	3.80
Paddy straw	3469 k	15.50
Mustard straw	4200 k	3.40
Mustard shell	4300 k	3.70
Wheat straw	4100 k	8.00
Sunflower stalk	4300 k	4.30
Jute waste	4428 k	3.00
Palm husk	3900 k	4.90
Soya bean husk	4170 k	4.10
Sugarcane	3996 k	5.00
Barks wood	1270 k	4.40
Forestry waste	3000 k	7.00
Coir pitch	4146 k	9.10
Rice husk	3200 k	21.20
Wood chips	4785 k	1.20
Others	3700 k	APX

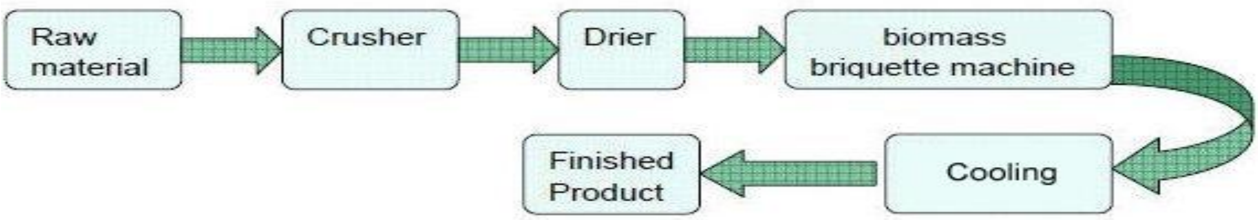
VII. MANUFACTURING PROCESS

This project is called biomass briquetting project and is simply a process of converting agro waste and forestry waste into biomass briquettes/bio coal. The biomass briquetting is the best renewable source of energy for healthy environment and economy. It's a complete eco friendly project.

All materials containing lignite and cellulose are suitable for densification. Successful test have been carried out with variety of materials from saw dust, sander dust, secondary pieces of wood, tree barks and twigs, pine needles, wild grass, coffee husk, sunflower waste, rice husks, groundnut shell, almonds and cotton stalks, sugarcane baggasse, leaves and trash. The above sectors can be briquetted individually or in combination depending on their availability and blending properties. Main concept of this project is to produce the material as a bio-coal, which is made from the wastages. We cannot destroy the wastage totally. But we can use it with the help of briquetting plant and produce the briquettes, which ultimately produce the energy. The use of these cheap fertilizers gives low yield as compared to the modern fertilizer available however the major quantity of press mud goes just as waste. The briquette made from press mud after drying and briquetting have calorific value 4000 Kcal. /Kg Approximately.

We can use such above wastage as an input to the briquetting plant machinery to produce white coal and the non conventional source of energy.

Production Processes:



Production Processes Flow Chart

Screw Press and Piston Press Technologies:

High compaction technology or binder less technology consists of the piston press and the screw press. Most of the units currently installed in India are the reciprocating type where the biomass is pressed in a die by a reciprocating ram at a very high pressure. In a screw extruder press, the biomass is extruded continuously by a screw through a heated taper die. In a piston press the wear of the contact parts e.g., the ram and die is less compared to the wear of the screw and die in a screw extruder press. The power consumption in the former is less than that of the latter. But in terms of briquette quality and production procedure screw press is definitely superior to the piston press technology. The central hole incorporated into the briquettes produced by a screw extruder helps to achieve uniform and efficient combustion and, also, these briquettes can be carbonized.
Table 2 shows a comparison between a screw extruder and a piston press.

Table 2 Comparison of a Screw Extruder and a Piston Press

	Piston press	Screw extruder
Optimum moisture content of raw material	10-15%	8-9%
Wear of contact parts	low in case of ram and die	high in case of screw
Output from the machine	in strokes	continuous
Power consumption	50 kWh/ton	60 kWh/ton
Density of briquette	1-1.2 gm/cm³	1-1.4 gm/cm³
Maintenance	high	low
Combustion performance of briquettes	not so good	very good
Carbonization to charcoal	not possible	makes good charcoal
Suitability in gasifies	not suitable	suitable
Homogeneity of briquettes	non-homogeneous	homogeneous

Parameters of fuel briquettes made by extrusion from sawdust:

Parameter	Value
Briquette density, t/m³	1,0-1,2
Heat content, MJ/kg	19.3-20.5
Ash content, %	0,5-1,5

(MJ = Mega joules. 3.6 MJ equals 1 kWh.)

Fig.2 Reciprocating Type Machine

Following Industries Can Make Maximum Use Of Briquettes:

- Ceramic and Refractory Industry
- Solvent Extraction Plant
- Chemical Units
- Dyeing Plants
- Milk Plants

- Food Processing Industries
- Vegetable Plants
- Spinning Mill
- Lamination Industries
- Leather Industries
- Brick Making Units
- Other Industries having Thermal Applications
- Gasifies system in Thermal
- Textile Units

VIII. ECONOMICAL THAN OTHER FUELS

It is more economical than other fuels because it contains low moisture, low ash high density. It is very easy for handling, transporting storage. It is cheaper than heavy furnace oil, steam coal fire wood etc.

IX. TYPICAL COST ANALYSIS

A typical cost analysis with materials which are available in dry form and do not therefore require drying but do need grinding prior to briquetting is given below. The potential types of biomass under this category are rice husk, coffee husk and groundnut shells.

The below given analysis is based on a screw press costing Rs.9.0 lac. Plants with less than two machines are not recommended. However, plants with more machines will definitely have better profitability and advantages of scale of operation can be derived.

Basis:
Two machines each 750 kg/hr
Production capacity = 1.5 T/hr (20 hrs/day operation)

Operating days per year	300	
Operating hours per year	6000	
Capacity utilization	85%	
Raw material	8000	TPY
Moisture losses	350	TPY
Briquettes produced	7650	TPY
Briquettes consumed (Dryer)	600	TPY
Saleable production	7050	TPY
Infrastructural facilities		
Power	1 5 0	kW
Land area	3000	m²
Operational shed area	240	m²
Briquetting storage (covered area)	250	m²
Investments	**In Rs.(lac)**	
Installed cost of plant & machinery (based on 9.0 lac for each machine)	52.0 3.0	
Land	4.2	
Building	59.2	
Total investment	7.5	
Working capital		
Cost of production	**In (Rs./tonne)**	
Power	136.70	
Manpower	67.50	
Water	8.00	
Maintenance (including consumables)	76.70	
Administrative overheads	43.00	

Depreciation (Plant 10% Building 5%)	74.10	
Subtotal	406.00	
Financial cost	91.50	
Cost of production	497.50 = Rs. 500/- per tonne	
Overall cost of production per year	Rs. 38.25 lac	
Profitability		
Basis:		
Cost of raw material	Rs. 500/- per tonne	
Net sale price of briquettes	Rs. 1450/- per tonne	
		In Rs.(lac)
Total sales	(1450 x 7050)	102.22
Production cost	(500 x 7650)	38.25
Raw material	(500 x 8000)	40.00
Gross profit before taxes		23.97
Pay-back period		**2.5 years**

X. INCENTIVES BY THE GOVERNMENT

The Government of India has announced series of incentives for promoting this project for installing such plants to the entire printers engaged in developing alternative energy source.

The major incentives are:

- **100% Depreciation:** The total value of plant and machinery is allowed to be depreciated in the first year.
- **Excise Exemption:** The solid fuel briquettes are completely exempted from Excise duty. The Government is also considering exemption in the case of plant and machinery.
- **Sales Tax Exemption:** The various states like Madhya Pradesh, Maharashtra, Rajasthan, Thailand, Delhi & Pondicherry have exempted solid fuels briquettes from sales tax. Other states are also considering the same and many states and offering sales tax exemption in backward area.
- **No Licenses:** The whole industry of non conventional energy sources has been exempted for obtaining any license.
- Income tax Exemption for first five years.
- The Central and State Government give subsidies.
- Low rate of interest from Government financial institutions.

XI. FUTURE SCOPE OF WORK

Our main task is to stop and minimize the carbon emission as far as possible while producing briquettes by blending with some other material in order to save the environment from toxic Sulphur pollutants.

XII. CONCLUSIONS

Thus briquettes can be used in any appliances meant for burning wood or coal. However, certain changes in operating parameters especially the distribution of primary and secondary air will have to be incorporated into the conversion. One should first understand the specific characteristics of briquetted biomass before taking steps to make changes in appliances. With a view to improving the briquetting scene in India, the Indian Renewable Energy Development Agency (IREDA) - a finance granting agency has financed many briquetting projects, all of which are using piston presses for briquetting purposes. But the fact remains that these are not being used efficiently because of their technical flaws and also due to a lack of understanding of biomass characteristics. Holding meetings with entrepreneurs at different levels, providing technical back-up cells and educating entrepreneurs have to some extent helped some plants to achieve profitability and holds out hope of reviving the briquetting sector.

India is the only country where the briquetting sector is growing gradually in spite of some failures. As a result of a few successes and IREDA's promotional efforts, a number of entrepreneurs are confidently investing in biomass briquetting. These entrepreneurs are also making strenuous efforts to improve both the production process and the technology.

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