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Transformation of Biomass into Alternate Fuels by Briquetting Technology

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Abstract—*Today most of our energy demands are being fulfilled by the fossil fuels but with increasing population and rapid industrialization, these resources are depleting at an uncontrollable and alarming rate. This has resulted in a significant reduction of their reserves. It is, therefore, imperative to shift our policy and start using renewable energy resources to avert the inevitable energy crisis on this blue planet which we humans call our home. One of the predominant energy sources is biomass. The world today is focusing its attention on various technologies for the purpose of using biomass as an efficient fuel. Briquetting is one of the simplest and inexpensive technologies which can be used to convert this biomass into effective and efficient fuel which if burned in loose form can be a source of air pollution and will have very low thermal efficiency. Biomass briquettes can not only be used as a substitute for domestic fuels like charcoal and wood in third world countries but it can also be used as a source of thermal energy in industrial boilers to generate electricity. This review is focused on briquetting technology and its importance in alleviating the rapid depletion of fossil fuels and for generation of sustainable energy.*

1. INTRODUCTION

The world today is moving towards diversification of the energy sources due to extreme stress on the conventional resources which has resulted in their fast depletion. In this context, briquettes can be used as an alternate or can be mixed with solid fuels like wood, coal, charcoal etc. These fuels not only find their use in domestic application and small scale industries like brick kilns but can also be used for power generation in industrial boilers. Biomass is an important energy source that contributes to 14% of world energy supply (IMC- Economic Research and Training Centre, 2014). Briquetting is the compaction of loose biomass by application of pressure at elevated temperatures which reduces the volatile matter and densifies the mass to increase the volumetric calorific value. It also eases the storage and transportation of the fuel produced. In other words, briquetting is used to convert otherwise unusable loose material (like plastic, used paper etc.) into fuels. Due to the elevated temperatures carbonization occurs to a certain degree which is the cause of increase in calorific value of the material. In India a large quantity of agricultural waste is produced every year. This waste is either left unused or it is burned in loose form which causes air pollution and loss of thermal energy due to huge smoke and uncontrolled combustion. These agricultural byproducts such as rice husks, bagasse, saw dust and other wood residues are used as a raw material for production of briquettes. Weeds can also be converted into briquettes. Conversion of weeds into briquettes will serve two purposes one is the production of non-conventional fuel and other is the de-weeding of water bodies. The proliferation of weeds in Dal lake has caused pollution and severely impaired many recreational activities. Attempts have been made by J&K government to restore the pristine glory of Dal lake by launching massive de-weeding drives to remove the weeds but these efforts have not resulted in complete eradication of this problem. The weeds are piled up on the banks of the lake and then transferred to a dumping site where it is left to rot, causing pollution and bad odor. This situation can be avoided by briquetting and using these weeds as fuel, which will reduce the monetary burden on the government.

2. BRIQUETTING TECHNOLOGY

The Briquettes are produced by extrusion technology. On the basis of compaction, briquetting is of following types: high pressure, medium pressure with heating and finally low pressure with a binder. Under high pressure the particles of the material come together in a confined volume and are deformed, forming the briquettes. The strength of such briquettes is due to the van der waal's forces and interlocking. For raw materials which do not deform, certain additives (called Binders) are required which keep the briquette together. Under medium pressure and high temperatures the material pressed becomes soft and the natural constituents like lignin, hemicelluloses, starch, fat, proteins and sugar act as natural binders for the briquette. When cooled these bridges become hard which results in strong and durable briquettes. These extrusion processes are carried out in presses. The different types of briquetting presses used are: Piston press, screw press, roller press, pelletizing, manual press and low pressure briquetting. Out of these, Piston press and screw press (High pressure and Binder less) are most commonly used as the cost of the briquette is low as compared to other

technologies. In India, most of the briquetting units use reciprocating type press (Piston press) where the biomass is pressed in a die by a reciprocating ram at a very high pressure. The product is completely solid.

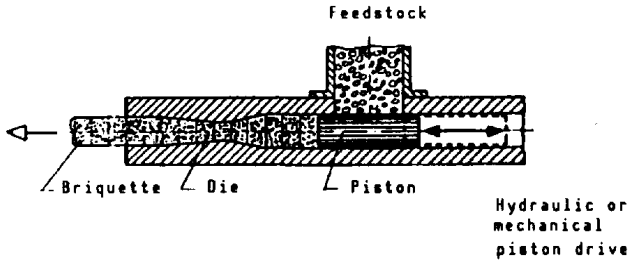

Figure 1: Ram Press.
(Source internet)

In screw extruder press, the biomass is continuously extruded by a screw through a tapered die which is maintained at a high temperature. The briquettes have a concentric hole. The wears of contact parts in piston press e.g. ram and die is less than the wear of the screw and die in screw press and also the power consumption is low as compared to the latter which makes it less costly to operate a piston press than a screw press. The quality of the screw extruded briquettes is far better than the piston extruded briquettes because of two reasons, one is the central hole in screw extruded briquettes helps in uniform and efficient combustion and the other is that the screw extruded briquettes are carbonized by the heated die. The screw extruded briquettes are consistent, compact and do not disintegrate easily, they can be used to produce fuel gases.

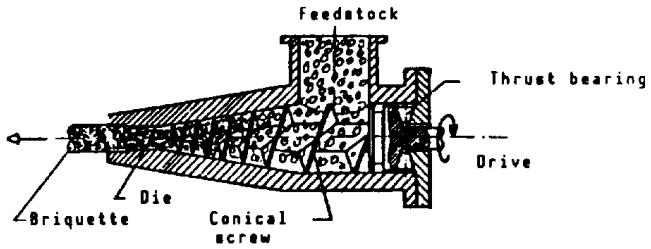

Figure 2: Screw Press.
(Source internet)

3. BRIQUETTED FUEL AND CURRENT SCENARIO

The fuel produced has higher energy content and low moisture content and can be combusted at a controlled rate. The calorific value of briquettes depends on its composition and degree of compaction. Using binders increases the calorific value of briquettes. For most of the biomass briquettes calorific value is above 16 MJ/Kg and for some materials like groundnut shell and coconut husk it is 19 MJ/Kg and 20.8 MJ/Kg respectively (American Journal of Engineering Research, 2015). In comparison, brown coal has a calorific value of about 19.5 MJ/Kg while for completely dry wood it is about 18.5 MJ/Kg (http://www.kominkowe.info/en/wartosc-opalowa). The other characteristics which are usually taken into consideration to measure the quality of the briquettes are compression strength and resistance to humidity. The compressive strength usually is higher than 12 Kgf/mm^{-2} and the resistance to humidity varies with the raw material used and ranges from 7% to 66% (Khobragade C.B., 2015).

The Indian renewable energy development agency (IREDA) is funding many piston press briquetting units. Due to some technical flaws (as briquetting is still a developing field) and a lack of understanding of biomass characteristics these units face many odds. Entrepreneurs are being educated and technical back-up is being provided to improve the briquetting scenario in the country. In India about 67% of the population relies on traditional bio-fuel for energy which comprises of about 32% of the total primary energy (Indian merchants' chamber, 2014). The average firewood consumption per household is approximately 115 kg's per year (Indian merchants' chamber, 2014). Therefore, briquettes can be used as an alternative for such fuels since briquettes have higher practical thermal value, low ash content and steady flame. However, major advantage of briquetted fuel is its application in industry, usually to produce steam for production of electricity. Conversion of boilers from fossil fuels to biomass fuels has been gaining trend over last few years especially in places where the briquettes are created domestically. In India a total of 4,449 MW has been installed under bio-energy both in grid connected and off grid capacities (Indian merchants' chamber, 2014). Most of these projects are registered under Kyoto protocol by which the countries get carbon credits. One carbon credit is equal to one free ton of carbon dioxide to be emitted into the atmosphere.

4. CONCLUSION

Briquetting technology provides a promising alternative to shift our dependence from fossil fuels to various renewable resources of biomass origin. Biomass briquettes on combustion produces very less smoke and can compete with firewood and charcoal on the basis of calorific value. Flexibility of their usage in different appliances can help in making a significant impact on the use of biomass fuels. India has a widespread agricultural economy and hence the scope for biomass conversion to briquettes is immense. Further we can optimize different parameters such as temperature and pressure to produce best briquettes in a cost efficient manner which will help in making this technology popular and widely accepted.

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