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AUTOMATIC SCREW PRESS BRIQUETTE MAKING MACHINE

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Abstract: **The study presents a detailed design study of the new briquetting machine. Briquetting of the carbonized agricultural residues represents one of the possible solutions to the local energy shortages in many developing countries.Briquetting of the carbonized agricultural residues represents one of the possible solutions to the local energy shortages in many developing countries. It constitutes a positive solution to the problem of increasing rates of desertification in many areas worldwide. The production cost was found to be lower due to the lower binder requirement for the new machine, which is lower by about 65%. The initial moisture content of the feed stock required for this machine is lower by about 30 % compared to the best alternative, which results in shorter drying time for the fuel briquettes produced. The quality of the produced briquettes was found to be better and of lower smoke generation when burned due to the lower binder content. The local Sudanese briquetting experience was overviewed, studying all the alternative available options and the market potential.**

Keywords: **Agro Waste, Biomass, Briquetting, Binders, Compact biomass briquetting machine, cost analysis, Molasses, productivity improvement, Rural Development.**

I. INTRODUCTION

Biomass briquetting is the densification of loose biomass material to produce compact solid composites of different sizes with the application of pressure. Briquetting of residues takes place with the application of pressure, heat and binding agent on the loose materials to produce the briquettes. Two different types of densification technologies are currently in use. The first, called pyrolizing technology relies on partial pyrolysis of biomass, which is mixed with binder and then made into briquettes by casting and pressing. The second technology is direct extrusion type, where the biomass is dried and directly compacted with high heat and pressure. Setting up the briquette production unit raw material should be locally available.

The raw materials for biomass briquetting can be:

• Agricultural residues (husks, cob, stalks, leaves, stems, shells, sticks)

• Invasive plants

• Waste from bio-product industries like sawmills, plywood industries, furniture factories.

Due to the present world's energy crisis and its related environmental issues as well as increasing trend of fossil fuel prices, renewable energy source is an essential matter. Biomass briquettes are a renewable source of energy and they avoid adding fossil carbon to the atmosphere. They are made from agricultural waste and are a replacement for fossil fuels, and can be used to heat boilers in manufacturing plants, and also have applications in developing countries. Therefore, in this paper we provide a compact biomass briquetting machine which combines three functions including crushing, mixing and briquetting in a single unit. By eliminating individual machines such as crushing, mixing and briquetting machine, the great savings in space and efficiency can be realized while maintaining an output quality with low cost.This paper is organized as follows: In the first section, we describe overview of briquetting process. In the second section, we describe the design and development of a compact briquetting machine. Finally, we provide a comparison of the result of production between the new system (a compact machine) and the existing system.

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The screw conveyor will transport Saw dust (initial moisture 30-40%) into roller screener, after screening the optimal size saw dust material will be transport to saw dust dryer via conveyor. The Hot wind stove produce the hot air flue gas (150-200℃),those hot air will mix together with the saw dust material ,the moisture will be evaporation in the dying cyclone pipe . After drying saw dust moisture at 10% will be out at the bottom of the cyclone, the off gas will be out through the chimney.

II. WORKING

This machine is mainly used to produce hexagonal or square shape briquette. Briquetting is a process that biomass is compressed under high pressure and high temperature. High pressure briquetting uses a power-driven press to raise the pressure of dry, powdered biomass to about 1500 bar (150 MPa). The machine uses a large screw to grind the biomass into briquettes that are of uniform composition. This compression heats the biomass to a temperature of about 120°C, which melts the lignin in the woody material.. The lignin content that occurs naturally in biomass is liberated under high pressure and temperature.

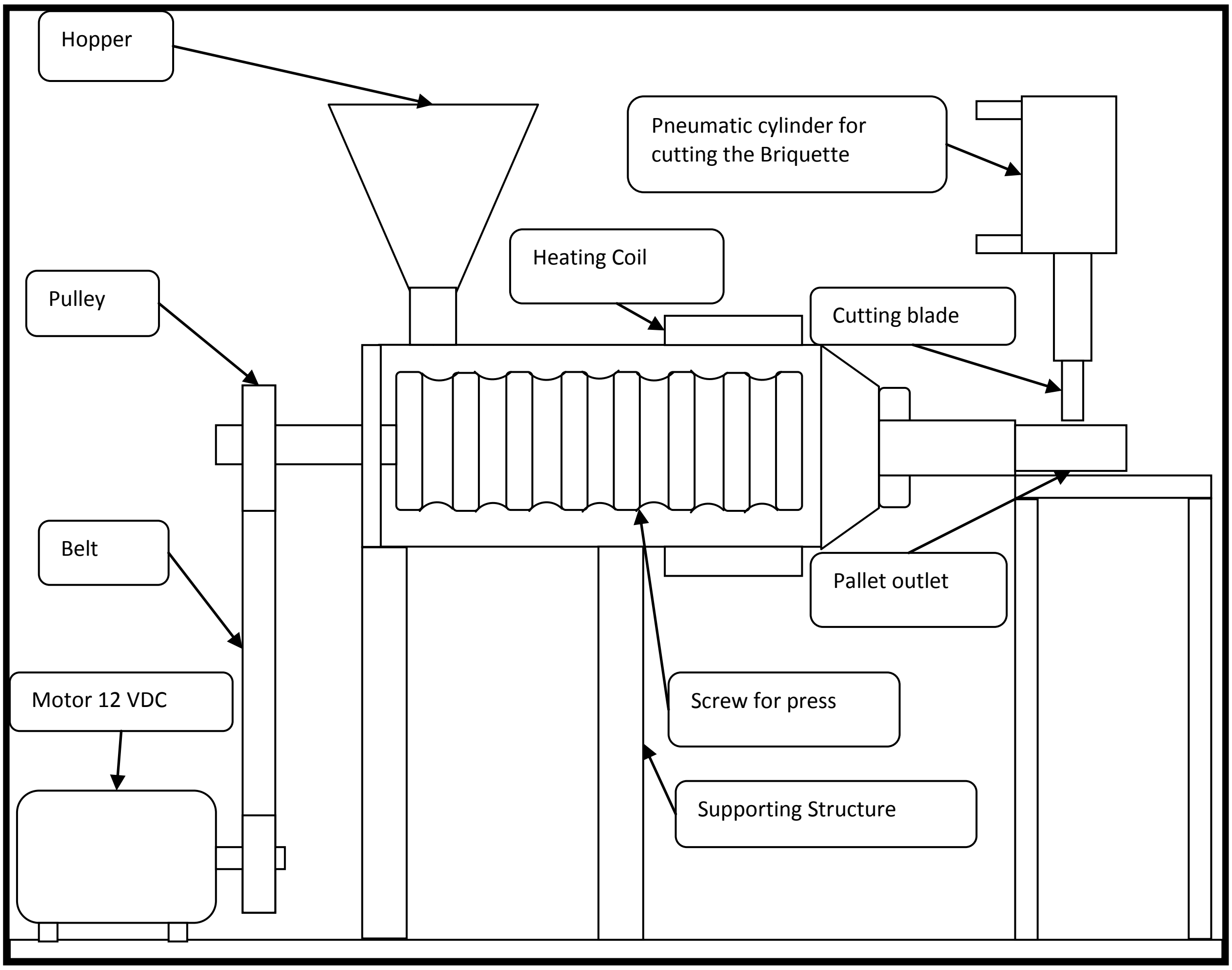

Fig 1: block digram

Lignin serves as the glue in the briquetting process, thus binding, compressing the biomass to form into high density briquettes. The press forces the hot material through a die at a controlled rate. As the pressure decreases, the lignin cools and re-solidifies, binding the biomass powder into uniform, solid briquettes. During this process, no binder need to be used. So the output briquette is a type of clean and green fuel that is ideal for use in furnaces, boilers and open fires.

The density of the briquettes is 1300kg/CBM.

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A. BRIQUETTING TECHNOLOGIES

1. Screw Press and Piston Press Technologies:

High compaction technology or binderless 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 carbonised.

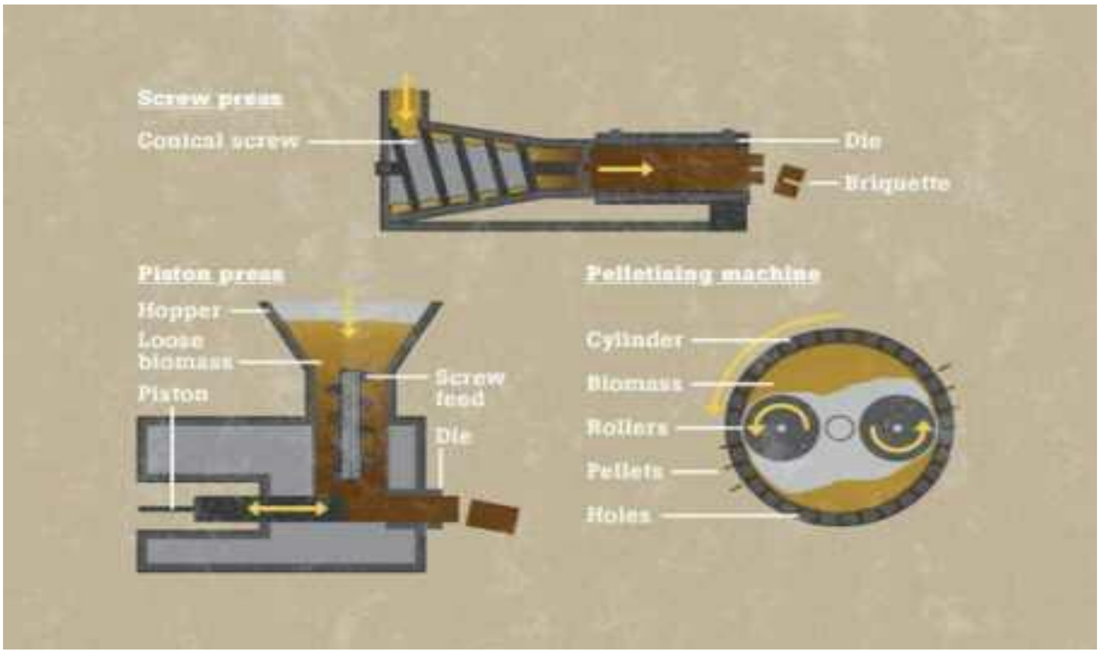

Fig 2: Screw Press and Piston Press Technologies

Table 1: shows a comparison between 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
Carbonisation to charcoal	not possible	makes good charcoal
Suitability in gasifiers	not suitable	suitable
Homogeneity of briquettes	non-homogeneous	homogeneous

B. History:

The biomass briquetting technology has been developed in two distinct directions. Europe and the United States has pursued and perfected the reciprocating ram/piston press while Japan has independently invented and developed the screw press technology. Although both technologies have their merits and demerits, it is universally accepted that the screw pressed briquettes are far superior to the ram pressed solid briquettes in terms of their storability and combustibility. Japanese machines are now being manufactured in Europe under licensing agreement but no information has been reported about the manufacturing of European machines in Japan.

Worldwide, both technologies are being used for briquetting of sawdust and locally available agro-residues. Although the importance of biomass briquettes as substitute fuel for wood, coal and lignite is well recognized, the numerous failures of briquetting machines in almost all developing countries have inhibited their extensive exploitation.

C. Results and Discussion:

The machine prototype was manufactured locally by a standard workshop in Khartoum industrial area, and transported to *Al-Gazeera* area in central Sudan for actual field testing. All the testing measurements were conducted at the field and at the Energy Research Centre (ERC) main laboratories at *Suba*, south of Khartoum. The machine general performance was found to be very good when working at the right slurry composition. The slurry moisture content was reduced gradually to find the minimum possible moisture content for continuous operation of the briquetting machine. The lowest value was found to be 30% moisture content, above which the machine started to stop frequently due to the die blockage by the relatively dry slurry.

Samples were taken for different slurry moisture content values, and the mass of each patch produced within a certain interval of time was measured on dry bases, measurements were usually taken after two days of sun drying of the specimens on open drying trays. The best production rate was found is 198 kg/h when the initial feed stock moisture content was adjusted to 35 %, lower moisture contents resulted in lower production rates due to the machine's frequent blockages, while higher moisture contents resulted in lower production rate after drying due to the initial higher water content. This production rate is about eight times the production rate of the double acting hydraulic press described earlier. This production rate could have been improved slightly if the slurry handling system was mechanized, but this was thought to complicate the system and increase the manufacturing cost.

Samples were taken from all the production patches at the different moisture and binder compositions and subjected to the drop test suggested by Pryor [4], in which a certain number of specimens were dropped from a height of two meters on a hard concrete floor. The results of the test showed that all the specimens of binder content higher than 3 % passed the test, however specimens of binder content lower than 2.5% were found to be very brittle and were very difficult to handle and transport.

III. CONCLUSION

Average savings in the electrical energy consumption due to pre-heating were 23.5% at heater and 10.8% at motor respectively. The average total energy savingwas about 10.2%. The lowest electrical energy consumption for rice-husk was 0.172 and 0.150kWh/kg of briquettes produced, without and with pre-heating respectively.The biomass stove developed for die-heating was found to perform satisfactorily,and requires periodical fuel loading and ash scraping. A low pressure briquetting machine was designed and the prototype was manufactured locally in Sudan. The briquetting system used is based on a power screw concept, and is suitable for the briquetting of the carbonized agricultural waste for household fuel production. The system showed a very good production rate when compared with the previous local systems. The production rate of the new system was found to be 198 kg/hr, which is eight times the production rate of the previous local machine. The binder content required by the new system was lower than the previous system by 65% which means a big reduction in the total production cost, and better quality due to the lower smoke generation. The initial moisture content of the slurry required for the new system was reduced to 35% instead of 50% required by the previous system, this resulted in lower drying time of the produced briquettes.

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