

Lecture 5

Biomass Briquetting – A Value Adding Technology for Agro Residues

Introduction

Biomass plays a major part in fulfilling the energy needs of the developing countries. According to the world's energy topics, it is widely accepted that fossil fuel shortage, fuel increasing price, global warming including other environmental problems are critical issues. Therefore, biomass energy has been attracting attention as an energy source since zero net carbon dioxide accumulation in the atmosphere from biomass production and utilization can be achieved. The carbon dioxide released during combustion process is compensated by the carbon dioxide consumption in photosynthesis. Among several kinds of biomass, agro residues have become one of most promising choices. They are available as a free or almost free, indigenous and abundant energy source. But it is generally difficult to handle them because of its bulky nature, low combustion characteristics and copious liberation of smoke. The direct burning of these agro residues in domestic and industrial applications is inefficient and associated with wide scale air pollution. In order to achieve more efficient usage of agro residues, it is essential to densify them to compact pieces of definite shape and high thermal value. Briquetting is one of the several compaction technologies in the category of densification. The process of briquetting consists of applying pressure to a mass of particles with or without a binder and converting it into a compact product of high bulk density, low moisture content, uniform size and shape and good burning characteristics. Briquettes can be produced with the density of 1.2 to 1.4 g/cm³ from loose agro residues with a bulk density of 0.1 to 0.2 g/cm³.

Raw materials for briquetting

Almost all agro residues can be briquetted. Agro residues such as saw dust, rice husk, tapioca waste, groundnut shell, cotton stalks, pigeon pea stalks, soybean stalks, coir pith, mustard stalks, sugar cane bagasse, wood chips, tamarind pod, castor husk, coffee husk, dried tapioca stick, coconut shell powder are the commonly used raw materials for briquetting in India. All these residues can be briquetted individually and in combination with or without

using binders. The factors that mainly influence on the selection of raw materials are moisture content, ash content, flow characteristics, flow characteristics, particle size and availability in the locality. Moisture content in the range of 10-15% is preferred because high moisture content will pose problems in grinding and more energy is required for drying. The ash content of biomass affects its slagging behaviour together with the operating conditions and mineral composition of ash. Biomass feedstock having up to 4% of ash content is preferred for briquetting. The granular homogeneous materials which can flow easily in conveyers, bunkers and storage silos are suitable for briquetting.

Briquetting Process

The series of steps involved in the briquetting process are

1. Collection of raw materials
2. Preparation of raw materials
3. Compaction
4. Cooling and Storage.

Collection of raw materials

In general, any material that will burn, but is not in a convenient shape, size or form to be readily usable as fuel is a good candidate for briquetting.



Preparation of raw materials

The preparation of raw materials includes drying, size reduction, mixing of raw materials in correct proportion, mixing of raw materials with binder etc.

Drying

The raw materials are available in higher moisture contents than what required for briquetting. Drying can be done in open air (sun), in solar driers, with a heater or with hot air.



Size reduction

The raw material is first reduced in size by shredding, chopping, crushing, breaking, rolling, hammering, milling, grinding, cutting etc. until it reaches a suitably small and uniform size (1 to 10 mm). For some materials which are available in the size range of 1 to 10mm need not be size reduced. Since the size reduction process consumes a good deal of energy, this should be as short as possible.



Raw material mixing

It is desirable to make briquettes of more than one raw material. Mixing will be done in proper proportion in such a way that the product should have good compaction and high calorific value.

Compaction

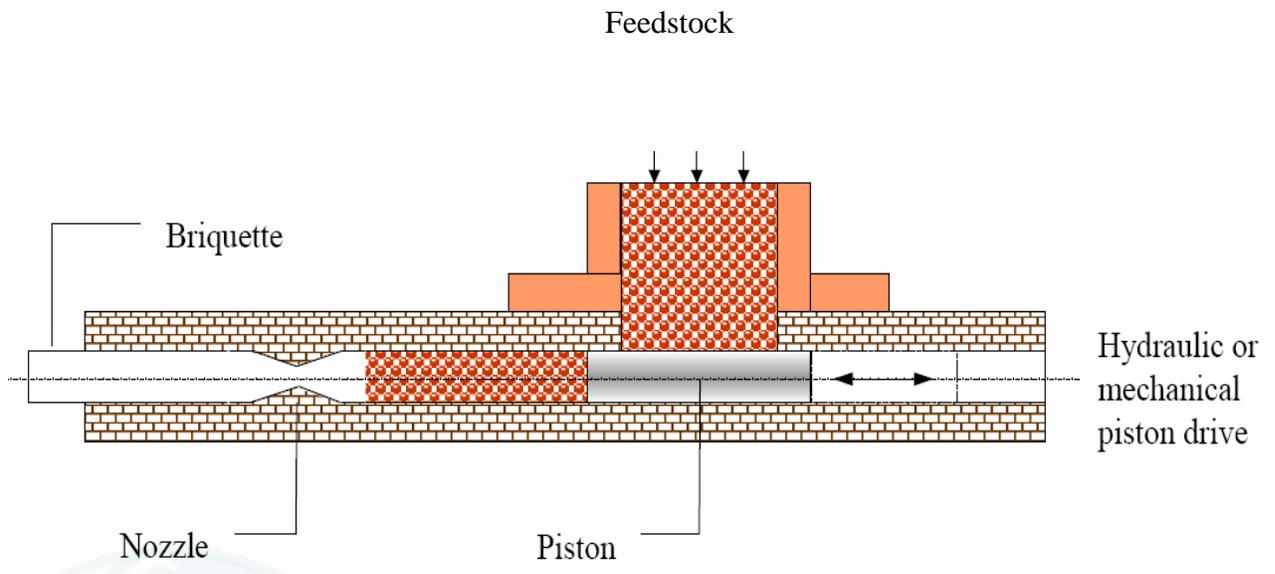
Compaction process takes place inside the briquetting machine. The process depends on the briquetting technology adopted.

Briquetting Technologies

Briquetting technologies used in the briquetting of the agro residues are divided into three categories. They are (i) high pressure or high compaction technology, (ii) Medium pressure technology and (iii) low pressure technology. In high pressure briquetting machines, the pressure reaches the value of 100 MPa. This type is suitable for the residues of high lignin content. At this high pressure the temperature rises to about 200 - 250° C, which is sufficient to fuse the lignin content of the residue, which acts as a binder and so, no need of any additional binding material. In medium pressure type of machines, the pressure developed will be in the range of 5 MPa and 100MPa which results in lower heat generation. This type of machines requires additional heating to melt the lignin content of the agro residues which eliminates the use of an additional binder material. The third type of machine called the low pressure machines works at a pressure less than 5 MPa and room temperature. This type of machines requires addition of binding materials. This type of machines is applicable for the carbonized materials due to the lack of the lignin material.

The high pressure compaction technology for briquetting of agro residues can be differentiated in to two types (i) hydraulic piston press type and (ii) screw press type. Among these two technologies hydraulic piston press type was predominantly used to produce briquettes in India, particularly in TamilNadu all the briquette producing firms' uses hydraulic piston press technology for briquetting. Mostly cylindrical shaped briquettes with 30 mm to 90 mm diameter were produced. All the commercial firms involved in briquette making produces 60 mm and 90 mm diameter briquettes.

A scheme of a hydraulic piston press briquetting technology



Cooling and Storage of briquettes

Briquettes extruding out of the machines are hot with temperatures exceeding 100°C. They have to be cooled and stored in dry place.



Uses for Briquettes

The most frequent applications for this type of fuel are of both a domestic and industrial nature; from fireplaces or stoves to boilers generating hot water and steam. Tea industries, wine distilleries, textile industries, and farms are the major sectors using briquettes. Briquettes are also used in gasification process for electricity production.

Advantages of agro residual briquettes:

- ✓ The process increase the net calorific value of material per unit volume
- ✓ End product is easy to transport and store
- ✓ The fuel produced is uniform in size and quality
- ✓ Helps solve the problem of residue disposal
- ✓ Helps to reduce deforestation by providing a substitute for fuel wood.
- ✓ The process reduce/eliminates the possibility of spontaneous combustion waste
- ✓ The process reduces biodegradation of residues

Necessary requirements to start a briquette production unit

1. Land requirement:

Land area of minimum 1 acre is required for starting a briquette production unit to store the raw materials for briquetting and produced briquettes.

2. Raw materials:

Continuous availability of raw materials is a major factor for profitable briquette production.

3. Drying facility to dry raw materials:

The raw materials which are commonly available are with higher moisture content. So, any of the drying technologies such as solar driers/ heater/ hot air generator system is required to bring down the moisture content to an desirable level for briquetting.

4. Shredding machine:

A shredding machine with minimum of 5 hp motor is required to powder the agro residues for briquetting.

5. Briquetting machine:

A high pressure hydraulic piston press type briquetting machine powered by minimum of 50 hp motor is required to produce binderless briquettes from agro residues.