BIOMASS CHARCOAL BRIQUETTING TECHNOLOGY

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Introduction

The use of conventional energy like oil, coal and electricity has increased enormously in the last 25 years in ASEAN economies. India is the world’s sixth largest energy consumer, consuming about 3 per cent of the world’s total energy per year. However, biomass based energy meets a major fraction of the energy demand in rural areas of most developing countries, including India. India produces nearly 350 million tonnes of agricultural wastes per year (Naidu, 1999). The major residues are rice husk, coffee husk, coir pith, sugarcane bagasse, sugar cane trash, jute sticks, silk cotton pods, groundnut shells, mustard stalks and cotton stalks. Apart from the problems of transportation, storage, and handling, the direct burning of loose biomass in conventional grates is associated with very low thermal efficiency and widespread air pollution.

These wastes can provide a renewable source of energy when converted into high-density fuel briquettes with addition of any binder. Biomass charcoal briquetting technology is cost effective, environmentally friendly and can reduces our nation’s dependence on foreign oil, improve our air quality, and support rural economies (income generation). At the same time, the forest would also be saved.

I. What is Briquetting?

Briquetting is the process of converting low bulk density biomass into high density and energy concentrated fuel briquettes.

II. Materials required for biomass briquetting

1. Agricultural or forest wastes
2. Charcoal kiln or drum
3. Briquetting machine (15kg/hr)
4. Binding materials (eg. starch or cassava flour)
III. Flow chart

Biomass collection

Drying

Carbonization

Char powder

Binding solution

Briquetting

Drying & Packing

Marketing

IV. Procedure

1. Biomass collection
Different type of agricultural and industrial wastes such as cotton stalk, sugarcane trash, plant leaves (Eucalyptus, *Casuarina*, coconut leaves), rice husk, sugarcane bagasse, groundnut shells, coir pith, silk cotton pod and mustard stalk dried in sunlight and can be used.

2. Charcoal kiln fabrication
The large size-charring kiln or drum is a portable cylindrical structure with the top cut out to place the chimney. The drum size is about 100 cm height and 150 cm width made out by 16 gauge iron sheets. In the lower side two fire ports with a door (12” height x 20” width) is provided for
firing. Above the firing portion a round shaped iron perforated sheet with holes is fixed. The bottom side of the drum is closed with iron sheets and 4 legs.

3. Carbonization

The collected biomass should be tightly packed into cylindrical metal drum. The drum will accommodate 100 kg dry biomass. After loading the biomass into the kiln, the top of the kiln has to be closed with metal lid with conical chimney. Little amount of biomass can be used in the firing portion to ignite in the kiln and the fire portion lids are to be closed tightly to start the pyrolysis process. Due to the absence of air the heat spreads over the biomass through inner holes.

**Char yield:** After the process, biomass gets fully carbonized within 1-2 hrs (depending upon the biomass). After that water is sprinkled over the charcoal kiln and resultant powder is used for briquetting. The carbonization process produces @ 40-45% char powder from original biomass. The char yield varies from one biomass to another.

**Example**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Biomass</th>
<th>Time period</th>
<th>Char (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><em>Casuarina</em> leaf litter</td>
<td>1hr 30 min.</td>
<td>42 to 45</td>
</tr>
<tr>
<td>2.</td>
<td><em>Eucalyptus leaves</em></td>
<td>1½ –hrs</td>
<td>38 to 40</td>
</tr>
<tr>
<td>3.</td>
<td>Coconut leaves</td>
<td>1hr</td>
<td>32 to 35</td>
</tr>
<tr>
<td>4.</td>
<td><em>Prosaphis</em> stem</td>
<td>45-1hr</td>
<td>34 to 35</td>
</tr>
</tbody>
</table>
**Advantages of the kiln**

a) Higher char yield & lesser time of operation  
b) Cost effective  
c) Easy to operate and maintain  
d) Easily viewable during carbonization  
e) Saves extra biomass

4. **Binder preparations and mixing**
The binder material is used for strengthening the briquettes. The carbonized char powder is mixed with different binders (100kg of char+5kg of starch) such as commercial starch, rice powder, boiled rice water (rice starch) and other cost effective materials. Binder is mixed with water and boiled for 20 minutes. After boiling, the liquid solution is poured into char powder and mixed to ensure that every particle of carbonized charcoal material is coated with binder. It enhances charcoal adhesion and produce identical briquettes.

5. **Briquetting machine fabrication**
A meat mincer briquetting mould (Model No.32) and a 1HP electric motor are fitted appropriately to the prototype model briquetting machine. The briquetting machine is divided into two different portions such as lower and upper portions. The lower portion is fitted with a 1HP single-phase electric motor fixed on a platform. The upper portion has the briquetting mould (model no 32, cylindrical type; 10kg/hr) fixed on to a wooden plate placed 1ft. above the lower platform. Both the plates are fitted on an iron angles and covered fully by stainless steel sheets. The motor and the briquetting mould are connected using a wheel and V-belt. In the front side of the briquetting machine, a power indicator and one 5 Amps switch for operation are fitted.
6. Briquetting
The charcoal mixture is made into briquettes either manually or using machines. Pour the mixture directly into the briquetting mould / machine to form uniform-sized cylindrical briquettes.

7. Drying & Packing
Collect the briquettes in a tray, dry them under the sunlight, pack them in plastic bags and seal.

V. Initial investments

1. Charcoal kiln with chimney 1nos - Approx. Rs.12,500/-
   (Size: 150cm width x 100cm height)

2. Briquetting machine 1no - Rs.10,000/-
   (Model: prototype, 1hp motor, 10kg/hr)

   Total initial investment maximum Rs. 22,500/- only.

VI. Cost benefit analysis

a.) Raw materials: Free of cost
   (Casuarina, Eucalyptus, coconut shell & other agricultural biomass)

b.) Transportation: Nil. (The waste has to be carried out where biomass is abundant)

c.) Labor details: Four persons can be involved to produce the briquettes
   (Biomass collection – 2 persons; Carbonization process – 1 person; Briquetting – 1 person)

d.) Expenditure details: Labor charges 4 nos: Rs.400/ (@ Rs.100)-;
   binding material - Rs.12/- (@ Rs.4/kg) ; power – 3 units/day Rs. 12/-
   (1 unit @ Rs.4). Aprox. 60kg briquettes can be produced per day and the total expenditure could be Rs. 424/day.

e.) Sales and income details: Four persons can produce 60kg of biomass briquettes per day from 140-180kg of biomass and each kilogram can sold at taken Rs.8/-. If the unit is operated for 25 days one
can get employment opportunity @ Rs.2500/day. Apart from this she will also get Rs.350/- per month as added income towards sale of briquettes.

<table>
<thead>
<tr>
<th>S. no.</th>
<th>No. of peoples involve d</th>
<th>Briquette s productio n (Kg/day)</th>
<th>Briquettes sales ( per day)</th>
<th>Total income</th>
<th>Total Expen. per day (incl. labour charges)</th>
<th>25 days /person</th>
<th>Extra income 25 days</th>
<th>Total income (person/ month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Four</td>
<td>60</td>
<td>Rs.8/kg (Rs.8 x 60)</td>
<td>Rs.480/-</td>
<td>Rs.424/-</td>
<td>25 @ 100/day</td>
<td>Rs.1400 /4</td>
<td>Rs.2850/(Rs.350+2500)</td>
</tr>
</tbody>
</table>

VII. Who will get benefited

- Un-employed people in rural areas
- Self help groups (SHGs)- men & women’s
- Farmers
- Industries

VIII. Advantages of the technology

1. **Smokeless:** The charcoal briquettes burn without any smoke during ignition and burning.
2. **Low Ash content:** Minimum residual ash is formed (less than 5% of the original weight of the charcoal).
3. **Calorific value:** The calorific value of charcoal briquettes is 6243.58 Kcal/KG compared to 6592.52 Kcal/KG from wood charcoal.
4. **Odourless:** The biomass charcoal briquette contains minimum evaporative substances, thus eliminating the possibility of odour.
5. **Longer burning hours:** Two times longer burning hours compared to wood charcoal.
6. **Sparkless:** These charcoal briquettes will not produce sparks as compared to wood charcoal.
7. **Less crack & better strength:** Less crack & better strength make the charcoal burn for a longer time.