International Journal of Latest Engineering Research and Applications (IJLERA) ISSN: 2455-7137

Volume – 03, Issue – 05, May 2018, PP – 61-66

# Design and Fabrication of Briquetting Machine for Solid Waste

Manjunath K S[1], Omprakash M[2], Niranjan Pangeni[3], Biradar Hanumant[4]
[1](Assistant professor, Mechanical Engineering, Bangalore Technological Institute, Bangalore , India-35 )
[2,3,4](UG Students, Mechanical Engineering, Bangalore Technological Institute, Bangalore , India-35)

**Abstract:** Fossil fuels are the major source for energy. The excess use of these fuels will lead to serious environmental issues like global warming and air pollution. Since the fossil fuels are getting depleted day by day, it is the high time to convert biomass wastes such as sawdust, coir pitch, coffee husk, rice husk etc., to useful biomass briquettes which will be the substitute for some of the fossil fuels. This paper focuses on the design and fabrication of briquetting machine which convert the agricultural and forest waste into source of fuel. It also focuses on the production of biomass briquettes using raw materials mainly sawdust and dry leaves with binding agents like coffee husk and wheat flour. Also study is carried out to investigate the calorific values of the briquettes using bomb calorimeter. The results indicated that the briquettes made from sawdust, dry leaves and very small amount of wheat flour (binding agent) are compact, dry and have greater calorific value when compared to the briquettes made from sawdust, dry leaves and coffee husk (binding agent) are not strongly bonded and possesses slightly lower calorific value.

**Keywords***:* Biomass, Briquette, Husk, Sieve.

## 1. INTRODUCTION

Biomass briquettes are a bio fuel substitute to coal and charcoal. Biomass briquettes are made from agricultural and forestry waste. The low density biomass(agricultural and forestry waste) is converted into high density biomass briquettes with the help of a briquetting machine that uses binder or binder less technique, without using any type of chemical so it is 100% natural. The replacement of these non renewable resources with biological waste would lower the overall pollution of world. Here we have taken initiative to turn waste biomass into a source of energy. And also to reduce the volume of shredded waste and hence decrease the cost of waste management Compared to fossil fuels, the briquettes produce low net total green house gas emission, because the materials used are already a part of the carbon cycle. Hence these briquettes are good replacement for fossil fuel such as oil or coal. In addition to the cost savings associated with reducing the volume of waste compressed briquettes can also be used as a fuel for starting fires or as insulating materials.

## 2. METHODOLOGIES

The project is done in 2 phases,

1. Designing
2. Fabrication

Here we are using Saw dust, Coffee husk, Dry leaves and Rice husk etc. as raw materials .These raw materials are gathered and are added to the hopper in required ratio to get the compact briquette. After filling the raw materials the top portion of hopper is closed this is because due to high speed of the blade the raw material may move out. These raw materials are grinded by the blade, which is driven by the motor. Here the regulator is used to regulate the speed of the blade so that the grinding operation can be controlled. That is by using high speed rotation the raw materials are finely grinded and so on for the medium speed. These grinded raw materials are allowed to pass through the sieve plate, which is placed in between the blade and motor (sieve size 5 mm).

After complete grinding of the raw materials in the hopper the motor is switched off. These grinded raw materials are stored at the bottom and then carried out to press where it gets converted in the form of slurry by mixing with water and binder. After pressing, it becomes compacted and removed water is collected below. Thus compacted briquette is obtained. The following processes are shown in Fig. 1.

  

*International Journal of Latest Engineering Research and Applications (IJLERA) ISSN: 2455-7137*

*Volume – 03, Issue – 05, May 2018, PP – 61-66*

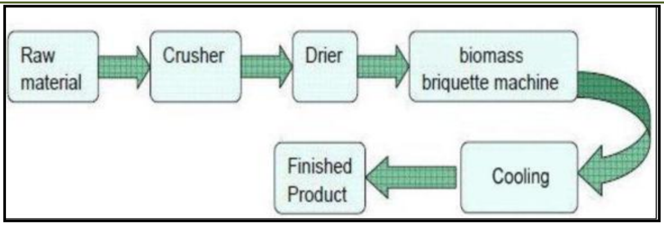


Fig. 1 production processes flow chart

## 3. SELECTION OF COMPONENT

The different components used are listed below:

- Hoper
- Motor
- Grinder Blades
- Stand
- Sieve Box
- Sieve Plate
- Blade
- Sprocket and Bearing
- Mixing Blades
- Pushing Plate
- Chain to drive the sprocket
- Cylinder
- Piston

### 3.1 Design and model

The model and design of the briquetting machine as shown in Fig. 2.

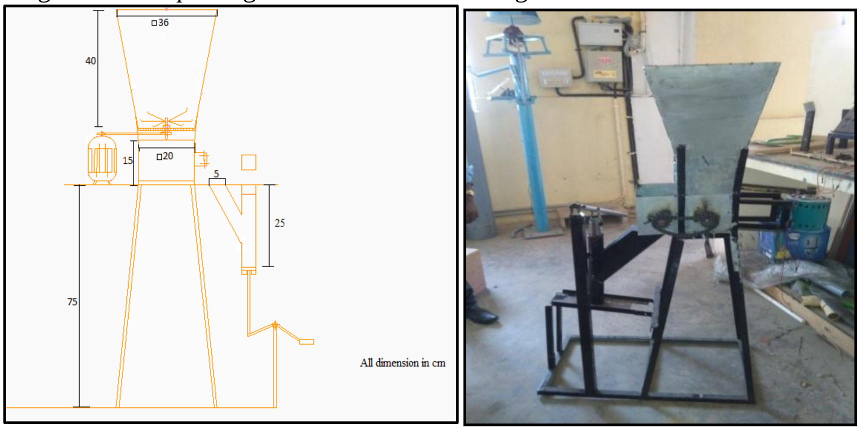


Fig. 2 Design and model of Briquetting Machine

### 3.2 Grinding Unit

This unit consists of a Hopper, Motor, Grinder Blade, Sieve plate. The blade grinder and sieve plate is placed inside the hopper. The motor required to rotate the grinding blades is mounted on the vertical support provided on the square plate as shown in Fig. 3.

Fig. 3 Hopper

  

### 3.3 Motor

Here we have used an AC motor of 250Watts, 230 Volts and 1400 RPM (with no load) is shown Fig. 4. And we have used a regulator to control the speed of the blade which is connected to the motor, as required on the amount of raw material to be grinded inside the hopper. The motor is placed beside the hopper fitted on stand.

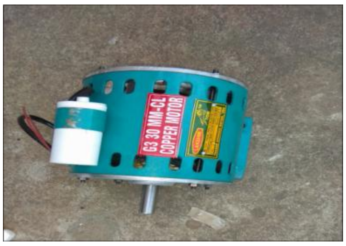


Fig. 4 motor

### 3.4 Stand

This stand will give support to the hopper and provide space for keeping the sieve box which can fitted on guide way. Height of the stand 75cm and width of a stand is 20cm. This member holds the motor and supports all weights of machine, this stand is main base of machine.

### 3.5 Sieve Box

It is a rectangular box (20×20×15) used for carrying the grinded raw material from hopper to the cylinder. The top portion of the box is kept open to fill grinded raw material to the box. And the bottom portion has a small rectangular cut section which is used to fill raw material to the cylinder. It also having mechanism for mixing of crushed raw material which is coming from the hopper and fall inside the sieve box. In sieve box mixing of binder with crushed raw materials and passing to the cylinder directly with the help of connecting pipe which is directly attached to sieve box. The sieve box as shown in Fig. 5.

Fig. 5 sieve box

### 3.6 Sieve Plate

Sieve plate is a rectangular plate as shown in Fig. 6 in which many holes made through which grinded raw material passes and collected in the sieve box. The size of sieve 6mm. This dimension is taken by referring journals, which says that the sieve size between 4mm to 6mm is best suited for good compactness.

Fig. 6 sieve plate

### 3.7 Blade

This acts as a grinding member, and is made up of stainless steel. Based on the power input from regulator the blade rotates at certain RPM and grinds the raw materials, which then passes through the sieve plate as show in Fig. 7.

Fig. 7 blade

  

**3.8 Mixing Blades**

Mixing blades are used to mix crushed raw material and binders for proper compaction in the compressing unit and to increase the density of briquettes. Mixing blades made of stain less steel and it is placed inside the sieve box. This mixing blades are fitted with a sprocket and chain mechanism and the mixing blades are rotated manually. The mixing blades as shown in Fig. 8.

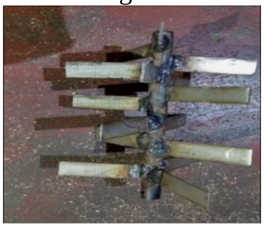

Fig. 8 mixing blades

**3.9 Pushing Plate**

Pushing plate is used to send mixed material from sieve box to connecting pipe, which is connected to from sieve box to cylinder. This is also driven by sprocket and chain mechanism and it rotates inside the sieve box. In each rotation some materials will send to the connection pipe. This is shown in Fig. 9.

Fig. 9 pushing plate

**3.10 Sprockets and Bearings**

Sprockets are used to drive the mixing blades and pushing rods. In this there is two sprockets are used, one sprocket is attached on one end of mixing blades and other one is attached to the pushing plates and also there is four bearings are on either side of mixing blades and pushing plates which will holds and supports the shaft and also make its helps in freely rotation. Sprockets and bearings are as shown in Fig. 10.

Fig. 10 sprocket with bearing

**3.11 Chain to drive the sprocket**

Chain is to use to connect both sprockets of mixing blades and pushing plate, when mixing blades is rotated by manually then automatically pushing plate also rotate with help of a sprocket and chain.

**3.12 Compressing Unit**

The compressing unit mainly consists of a cylinder and a piston. The manually compressor moves the piston inside the cylinder, here manually press system are used how much force is applied that much compression of briquettes take place. The piston and cylinder are machined to the close dimensional tolerance so that the piston moves easily inside the cylinder. The grinded raw materials are input to the cylinder, these materials inside the cylinder are compressed into briquettes upon the application of force applied manually. Thus formed briquettes are taken out by pulling the plate at the bottom of the cylinder. The whole unit is supported by a rigid frame attached to stand.

**3.13 Cylinder**

In the cylinder grinded raw materials are compressed into a briquettes. Its houses the piston at one end and the closing plate at other end. Upon application of force applied by manually through the piston (with closing plate in closed position), the raw material are compressed into briquettes. Cylinder is made up of mild steel with steel coating as shown in Fig. 11. The cylinder having cut portion on side of cylinder for raw material to fall inside the cylinder.

Fig. 11 cylinder

[Dimension of cylinder: Outer diameter = 5 cm, Inner diameter = 4.7 cm,
Length = 25 cm, Material: Mild Steel with coating]

### 3.14 Piston

Piston is a round solid shaft it is used to press the raw material, piston moves inside the cylinder from top to bottom. The one end of piston is connected with handle as shown in Fig. 12. Piston is made of stainless steel.

Fig. 12 piston with handle

## 4. CALCULATIONS

By taking the briquette manufactured by the industry and the briquette manufactured by our machine the calorific value have been calculated and are compared as follows.

Formulae for water equivalent of calorimeter:

$$W = \frac{H \times M}{T} \times (C_T + C_F)$$

Formulae for Calorific value of fuel sample

$C_V = T \times W$ □ $(C_T + C_F)$

**Specification**

T - Final temperature rise of water in degree Celsius
M - Mass of the sample in grams
H - Known calorific value of benzoic acid in Cal/gm =6464Cal/gm
W - Water equivalent of the Calorimeter in Cal/deg
$C_{vs}$ - Calorific value of Fuel Sample
$C_{vf}$ - Calorific value of Fuse wire = 2.33 Cal/cm
$C_{vt}$ - Calorific value of the Thread wire = 2.1 Cal/cm
Calculation
Initial temperature = 28.1 $^{O}$C
Rise in temperature = 28.80 $^{O}$C
Difference in temperature = 0.7 $^{O}$C
$L_F$ - Length of the Fuse wire = 10 cm
$L_T$ - Length of the Thread = 10 cm
CF - Heat liberated by the Fuse wire in Cal = 2.33 × $L_T$.
$C_F$ - Heat liberated by Thread in Cal = 2.1 × $L_T$
Final temperature = 30.02 $^{O}$C
Rise in temperature = 0.72 $^{O}$C

$C_V$ (with binder) = $T \times W - (C_T + C_F)$
$= 0.72 \times 6699.97 - (21 + 13.8)$
$= 4789.17$ Kcal / kg

From the above calculations it is found that the calorific value of Briquette with and without binder are almost nearer, choosing any one of them is suggested.

  

## 5. CONCLUSIONS

A large volume of agricultural by products being generated in India and which constitute environmental hazards. Call for effective utilization of those high grade biomass material for solid fuel called briquette. Hence it can be concluded that the waste material like dry leaves, wheat straw, saw dust etc., are feed stocks for the biomass briquette. Generally dry leaves and wheat straw are burnt to reduce waste, which causes several pollution to environment, but if wisely handled these wastes can then could be a better option for briquetting. Hence for an agricultural country like India that produces huge amount of agricultural waste every year, use of these waste as a briquette can be economically viable, sustainable and environment friendly solution. And also as machine concerned, it can be concluded that by using simple mechanism with widely available machine element the machine cost could be lowered and makes fabrication economical and portable.

## 6. REFERENCES

[1]. Oladeji J.T, Fuel Characterization of Briquettes Produced from Corncob and Rice Husk Resides, Pacific Journal of Science and Technology. Vol.11, 2010, Pp 101-106.

[2]. S. H. Sengar , A. G. Mohod , Y. P. Khandetod , S. S.Patil , A. D. Chendake , Performance of Briquetting Machine for Briquette Fuel, International Journal of Energy Engineering, Vol.2, 2012, Pp 28-34.

[3]. P.D.Grover, Agriwaste feed processing for energy conversion, 26-27 April 1996, Proc. International Conference, Bangkok, Pp 177-195.

[4]. Khoa, TranMinh, S.C.Bhattacharya, Amur Ghulam Qambar, Study of agriwaste as a source of energy in Vietnam, International Journal of Energy Engineering, Vol. 21, 1999, Pp 69-75.

[5]. A.K.Tripathi, P.V.R Iyer, T.C Kandpal, Questionnaire based survey of agriwaste briquetting in India, MNES, International Journal of Ambient Energy, New Delhi, Vol. 2, Jan 2000, Pp 31-40.

[6]. Daham Shyamalee , A.D.U.S. Amarasinghe and N.S. Senanayaka, Evaluation of different Binding Materials in Forming Biomass Briquettes with Sawdust, International Journal of Scientific and Research Publications, Vol. 5, Issue 3, March 2015, Pp 250-470.

[7]. N.P.Singh, Agriwaste programme in India an overview Proc. International Conference, 26-27 New Delhi, February 1996, Pp 65-72.

[8]. Maninder, Rupinderjit Singh Kathuria, Sonia Grover, IOSR Journal of Electrical and Electronics Engineering (IOSRJEEE) ISSN: 2278-1676 Vol. 1, Issue 5, July-Aug. 2012, Pp 11-15.

[9]. Jankovic S. Mechanical properties of light compositive biobriquettes, Facta Universitatis Series Working and Living Environmental Protection, Vol. 1, No. 2, 1997, Pp 59-64.

[10]. Obi O. F, Akubuo C. O, Okonkwo W. I., Development of an Appropriate Briquetting Machine for Use in Rural Communities, International Journal of Engineering and Advanced Technology (IJEAT), ISSN: 2249 – 8958, Vol. 2, Issue 4, April 2013, Pp 578-580.

[11]. Nandini Shekhar, Popularization of Biomass Briquettes- A means for Sustainable rural Development, Asian Journal of Management Research, ISSN 2229 – 3795, Vol. 2, Issue 1, 2011, Pp 457-476.

[12]. P.D. Grover & S.K. Mishra, Biomass Briquetting Technology and Practices, FAO Regional Wood Energy Development Programme in Asia, Bangkok, April 1996, Pp 15-43.

[13]. Reuben Shuma, Dariel M. Madyria, Production of loose biomass briquettes from agricultural and forestry residues, International conference on Sustainable Material Processing and Manufacturing (SMPM), 23-25 Jan 2017, Pp 98-106.

[14]. Manoj Kumar Sharma, Gohil Priyank, Nikita Sharma, Biomass Briquette Production: A Propagation of Non-Convention Technology and Future of Pollution Free Thermal Energy Sources, American Journal of Engineering Research (AJER), Vol. 4, Issue 2, Pp 44-50.

[15]. Shreya Shukla, Savita Vyas, Study of Biomass Briquettes, Factors Affecting Its Performance and Technologies Based On Briquettes, IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT), Vol. 9, Issue 11 Ver. II, Nov 2015, Pp 37-44.