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FABRICATION AND APPLICATON OF BRIQUETTE MAKING MACHINE

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Abstract: Briquette making machine is designed to make burnable bio waste into desirable size logs by using appreciable reins as binder. These logs can further be used as fuel. Bio waste involves dry leaves; saw dust, rice husk and even some household waste. Usually, bio wastes are dumped in large landfills where they are decomposed. During the decomposition these waste release many gases like CARBON MONO OXIDE (CO), which are hazardous to the environment and human. But burning them will affect the nature much as they undergo complete combustion releasing CARBON DI OXIDE (CO2), which is less poisonous compared to carbon mono oxide. It is even easy to handle and low cost.

Keywords - **CARBON MONO OXIDE (CO), CARBON DI OXIDE (CO2).**

I. INTRODUCTION

Briquette making machine is a concept to make the bio waste to be compressed for useful fire logs. Actually, bio degradable waste is left in landfills gets decomposed and produces the methane gas (toxic level is 20 times more than carbon-di-oxide) harmful to human nature. In contrast, when they are burnt, they only give off the carbon. Hence by compressing this waste into briquettes helps in reducing cutting of tree for fire logs. These briquettes can be used as fire logs and even for different purpose.

1.1 Background

As the population of the world continues to grow, the demand for energy is becoming critical challenge. Global energy consumption has about doubled in the last three decades of the past century.

In 2004, about 77.8% of the primary energy consumption was from fossil fuels (32.8% oil, 21.1% natural gas, and 24.1% coal), 5.4% from nuclear fuels and 16.5% from renewable resources, of which the main one was hydro (5.5%) whereas the remaining 11% consisted of non-commercial biomasses such as wood, hay, and other types of fodder. With improvements in energy efficiency it is expected that global energy demand doubles by 2050.

This is the consequence of global population growth, global economic growth, continued urbanisation, as well as the resulting increased demand on mobility and other energy dependent services. Sustainable energy production and supply are tactical objectives for developed as well as developing countries. The energy sector plays a crucial role in attaining the United Nations Millennium Development Goals (Short, 2002), and the viability of modern economics is based in part on the capacity of countries to ensure their energy supplies. Renewable energy technologies are safe sources of energy that have a much lower environmental impact than conventional energy technologies. Shell International predicts that renewable energy will supply 60% of the world's energy by 2060.

1.2 ProblemStatement

Solid waste management is one of the major problems. This is not only found in the urban areas but also at the rural areas. The major waste generated at the rural areas is agricultural waste or residue (crop by-product). Despite this level of waste generation fuel for heating, cooking and other purposes is a huge problem; hence the rural folks rely on wood fuel and charcoal. The realisation that deforestation and wood fuel shortages are likely to become serious problems has turned attention to other types of biomass fuel. Agricultural residues are, in principle, one of the major sources. They arise in large volumes and in the rural areas which are often subject to some of the worst pressures of wood shortage. The use of briquetting for conversion of agricultural residues is comparatively recent, however, and has only been taken up in developing countries in the last few years. Main agricultural residues that are produced are paddy chaff, coconut dregs, hay, groundnut skin, husk and press cake, palm nut shell, maize cob and cotton stem. There is also bio waste as wood dust. This wood dust is produced in big scale. Beside the problem of transportation, storage and operation, open burning of this bio waste with traditional style without control can cause critical air pollution.

1.3 Objectives

- The main objective of this project is fabrication of briquette making machine.
- To prepare the briquettes for different raw materials like saw dust, dry leaves, etc…
- To determine the calorific value of these briquettes.

II. LITERATURE REVIEW

2.1 Research work

2.1.1 Design And Fabrication Of Biomass Extruder of 50 Mm Diameter Briquette Size

- **Author:** Muhammad SN, Muhammad AA, Abdul N and Anjum M
- **Publication:** 2016

Agricultural residues are producing0in large amount but they are used inefficiently that pollute the environment. 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. To overcome these problems the biomass materials is compressed as 1000 kg/m3 and can increase its density and durability. In this study a machine was designed to densify grinded biomass materials at optimum level of density to obtain more than 90% durability.

2.1.2 Design and Fabrication of low cost Briquetting machine and Estimation of Calorific values of Biomass Briquettes.

- **Author:** Kishan B S, Kiran Kumar, Santhosh T J, U.G.
- **Publication:** July 2016

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 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.

2.1.3 Low Cost, Portable Briquetting Machine – Rural Use

- **Author:** Kishan B S, Kiran kumar, Santosh J J, Charan raj.
- **Publication:** July 2016

There has been a recent push to replace the burning of fossil fuels with biomass. The replacement of these non-renewable resources with biological waste would lower the overall pollution of the world. The waste biomass like dry leaves, sawdust, rice husk, coffee husk etc...Are gathered and compressed into briquettes, these briquettes can also be transported and used as fuel to generate heat. It is high time to take initiative to turn Biomass into a source of energy.

2.1.4 Evaluation of different binding materials in forming biomass briquettes with saw dust

- **Author:** Daham Shyamalee , A.D.U.S. Amarasinghe , N.S. Senanayaka
- **Publication:** March 2015

Biomass briquettes are often used as an energy source for cooking purpose and in some industries like bricks and bakery. The briquettes are produced by densification of waste biomass using various processes. The samples with cow dung as binding agent failed with mould detaching and minimum required binder percentage for other two binders for successful forming were found to be 30%. Density of briquettes with 30% binder of wheat flour and paper pulp was found to be 373.7 kg/m3 and 289.8 kg/m3 respectively.

2.1.5 Biomass Briquette Production: A Propagation of NonConvention Technology and Future of Pollution Free Thermal Energy Sources

- **Author:** Manoj Kumar Sharma, Gohil Priyank, Nikita Sharma
- **Publication:** 2015

Biomass briquettes are a biofuel substitute to coal and charcoal. Briquettes are mostly used in the developing world where cooking fuels are not as easily available. Briquettes are used to heat industrial boilers in order to produce electricity from steam. The briquettes are con-fired with coal in order to create the heat supplied to the boiler. People have been using biomass briquettes since before recorded history. Biomass briquettes are made from agriculture waste and are a replacement for fossils fuels such as oil or coal, and can be used to heat boiler in manufacturing plants. Biomass briquettes are a renewable source of energy and avoid adding fossils carbon to the atmosphere.

III. BRIQUETTING PROCESS

Briquetting is the densification of loose biomass material. Fuel briquettes emerged as a significant business enterprise in the 20th century. In the 1950s, several economic methods were developed to make briquettes without a binder where multitude of factories throughout the world produced literally tens of millions of tons of usable and economic material that met the household and industrial energy needs. During the two World Wars, households in many European countries made their own briquettes from soaked waste paper and other combustible domestic waste using simple lever-operated presses.Today's industrial briquetting machines, although much larger and more complex, operate on the same principle. According to Food and Agriculture Organization (FAO) (1990), briquetting could be categorized into five main types depending on the types of equipment used; piston presses, screw presses, roller press, pelletizing, manual presses and low pressure briquetting. Densified biomass is acquiring importance because of the growing domestic and industrial applications for heating, Combined Heat and Power (CHP) and electricity generation in many countries. In countries such as Austria, Denmark, the Netherlands and Sweden, it is becoming a major industry with pellets traded internationally. In Austria, the production of pellets in 2002 was 150,000 tons but with the rapid expansion of small-scale pellets heating systems, it was expected to reach 0.9 Mt/year by 2010 (Hood, 2010). In Europe this potential has been estimated at around 200 Mt/year and is increasing continuously because advances in technology allow the densification of biomass to be more competitive, driven by high demand.There has been briquetting projects in many African countries such as Zimbabwe, Tanzania, Uganda, Kenya, Sudan, Rwanda, Niger, Gambia, Ethiopia and Senegal, though not all of these are still functional. The raw materials most commonly briquetted in Africa are coffee husks and groundnut shells while sawdust and cotton stalks are also used to a limited extent (Hood, 2010). The history of residue briquetting in Africa is largely one of single projects in various countries which have usually not been successful (FAO, 1990).

IV. BRIQUTTE MAKING MACHINE

4.1 Materials and Methods

For the purpose of this study, mild steel was used for the construction of the machine. Mild steel plates and rods were bought from a local mild steel market. The machine was fabricated using electric arc welding machine.

CONCEPTUAL MODEL OF THE DESIRED MACHINE

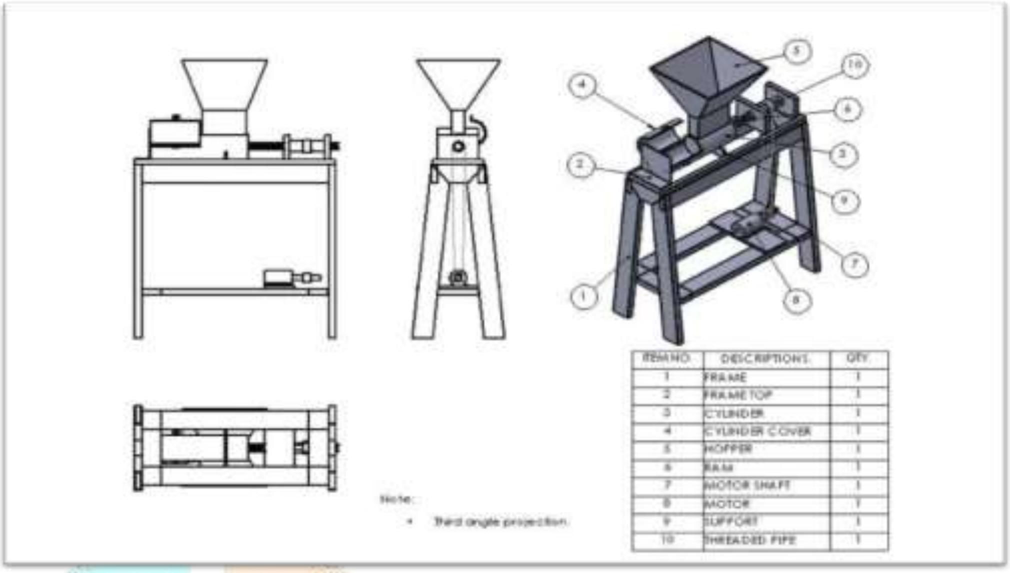

Figure No. 4.1: Design of complete machine.

Conceptual design one operated with the aid of an electric motor. The compaction of biomass material was as a result of pressing the material against a die at high pressure.

Main Components of the Machine

- Hopper
- Cylinder
- Frame top
- Frame

4.2 Material Selection

Property	Value
Ultimate strength	400MPa
Yield strength (σy)	Tensional - 250MPa Shear - 145MPa
Modulus of elasticity (E)	200GPa
Modulus of rigidity	77.2GPa
Density (ρ)	7860kg/m3
Coefficient of thermal expansion	11.7GPa

4.2.1 Conceptual design of hopper

This hopper helps in store of mixed raw material and it helps in the supply of raw material while ramming process .This hopper is attached to the cylinder of the machine parts, the material used is mild steel sheet metal and thickness is 3mm, they have been cut according to the given dimensions and then cut sheet metal are joined by arc welding.

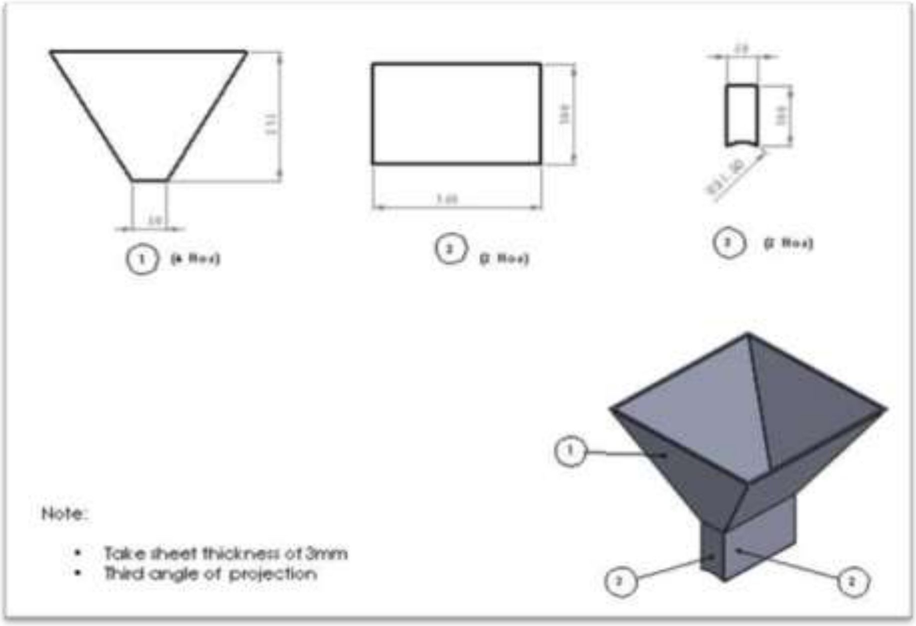

Figure No 4.2: Design of hopper

4.2.2 Conceptual design of cylinder

This cylinder is the major part of this machine, because it guides the piston for the ramming perpose and then it gives the shape of brequettes in what shape we requied. This cylinder is placed under the hopper .

The material used for cylinder is mild steel, sheet metal of thickness of 5mm and this cylinder shape is done with the help of bending process, then it is welded. Where some area of cylinder is cutted because to supply of raw material to the cylinder from hopper, where as other side it is to remove the briquettes.

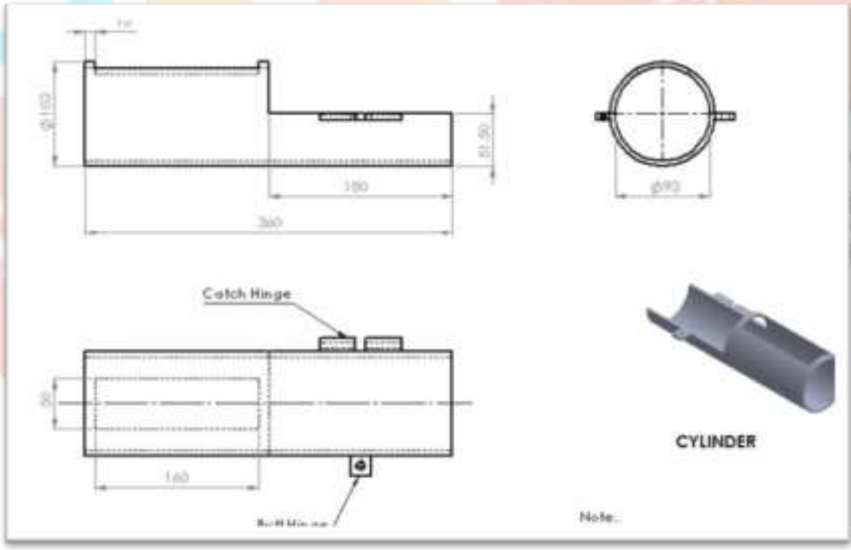

Figure No 4.3: Design of cylinder

4.2.3 Conceptual design of frame top

This frame is placed below the cylinder, in this frame three rectangular plates are placed, one plate is placed at the one end of the frame, where the ramming process will takes place.

while other two plates with hole at centre with a hole diameter of 40mm, is placed at the other end of frame with a gap of 20mm from the end and this two plates is placed with a distance of 170mm from the end of the frame and welded, this holes will guide the screw rod to push the piston.

This plate are made of mild steel with a thickness of 5mm, while of other two plates are made of mild steel with a thickness of 20mm.Then the size of frame is 20×20mm.

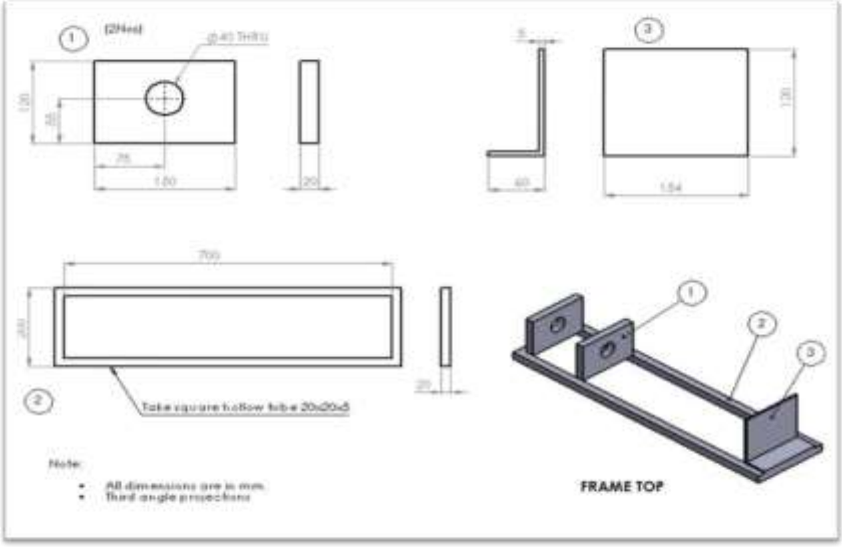

Figure No. 4.4: Design of frame top

4.2.4 Conceptual design of frame

This frame is made up of mild steel sheet in rectangular tube form, which is cut according to the given dimension and then they are welded to join the parts, the thickness of the sheet is 25mm.This frame is placed below the frame top, this frame is used to place the motor and to drive the pulley, which is connected to the screw rod, the pulley of rod and pulley of motor is connected with the help of belt.

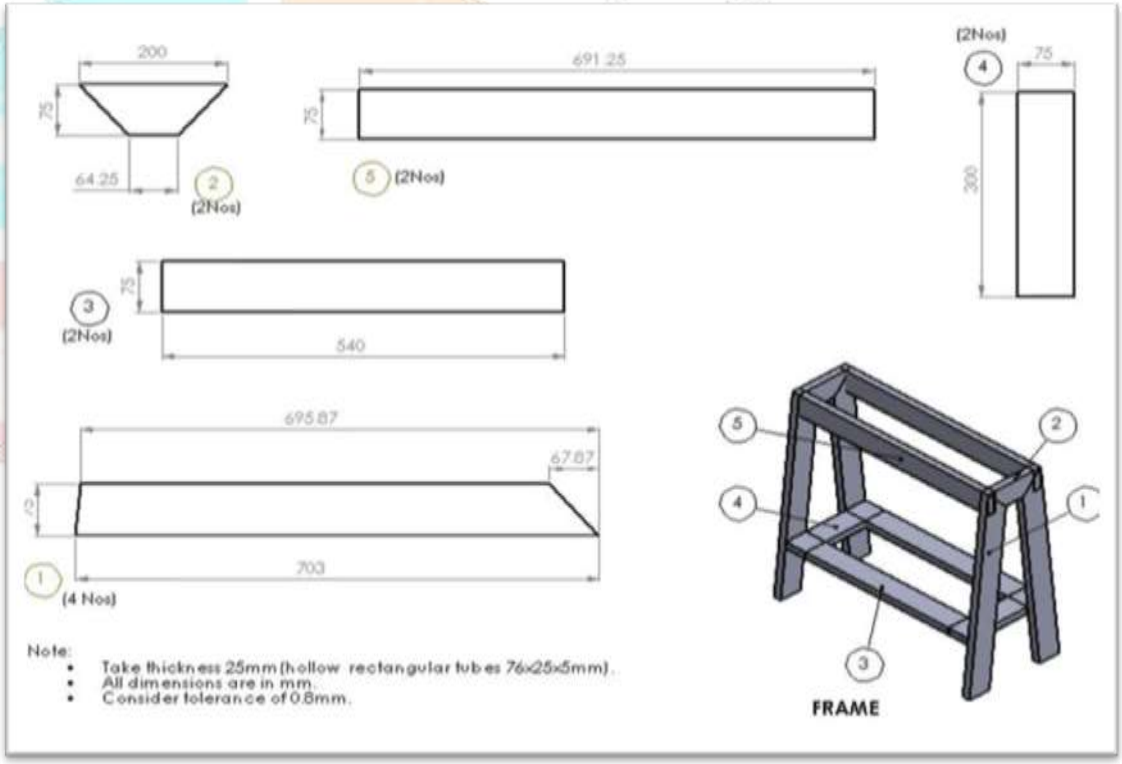

Figure No. 4.5: Design of frame

Working of the machine

- The raw material is crushed into small fragments using crusher or even by hands if possible.
- The crushed raw material is then mixed with required amount of reins to ensure the proper binding of material.
- The mixture is later fed into the mission through the hopper .
- The machine is switched on.
- The motor switch is turned to left of the operater, the piston moves forward applying compression force on the mixture forming a log.
- Later, switch is moved to the right to move piston backwards.
- The log is then removed later.

V. RESULTS AND DISCUSSION

5.1. Testing and Results:

By taking the briquette manufactured by our machine the calorific values have been determined and are compared as follows.

Formulae for water equivalent of calorimeter:

$$\mathbf{W = (H \times M) / T \times (C_t + C_f)} \qquad ....(1)$$

Formulae for Calorific value of fuel sample

$$\mathbf{CV = T \times W - (C_t + C_f)} \qquad ....(2)$$

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 = 6464 Cal/gm,

W - Water equivalent of the Calorimeter in Cal / deg,

CV - Calorific value of Fuel Sample,

C_f - Calorific value of Fuse wire = 2.33 Cal /cm,

C_t- Calorific value of the Thread wire = 2.1 Cal / cm

Initial temperature in ^{0}C

Final temperature in ^{0}C

Temperature difference in ^{0}C

LF - Length of the Fuse wire = 6 cm

LT - Length of the Thread = 10 cm

CF - Heat liberated by the Fuse wire in Cal = 2.33 × LF.

= 2.33× 6

= 13.98 Cal

CT - Heat liberated by Thread in Cal = 2.1 × LT

= 2.1 × 10

= 21Cal

W = ((6464×1)/33.75)(13.98+21)

W=6699.97 Cal / deg

5.1.1 Calculation of Saw dust

With Starch as binder (90% of saw dust, 6% of wheat flour and 4 % water)

Initial temperature = 29.3^0C

Final temperature = 30.02^0C

Temperature difference = 0.72^0C

CV (with starch) = $T \times W - (C_t + C_f)$

$= 0.72 \times 6699.97 - (21 + 13.8)$

= 4789.17 Kcal / kg

5.1.2. Rice husk calculation

With Starch as binder (85% of Rice husk, 9% of wheat flour and 6% water)

Initial temperature = 27.62 ^{0}C

Final temperature = 28.12 ^{0}C

Temperature difference = 0.48 ^{0}C

CV (with starch) = $T \times W - (C_t + C_f)$

$= 0.5 \times 6699.97 - (21 + 13.8)$

= 3315.18 Kcal / kg

5.1.3. Neem leaf calculations

With Starch as binder (85% of Neem leaf, 9% of wheat flour and 6 % water)

Initial temperature =28.84^0C

Final temperature = 29.38^0C

Temperature difference = $.54^0$C

CV (with starch) = $T \times W - (C_t + C_f)$

$= 0.54 \times 6699.97 - (21 + 13.8)$

= 3583.17 Kcal / kg

5.2 Graphical representation of calorific value

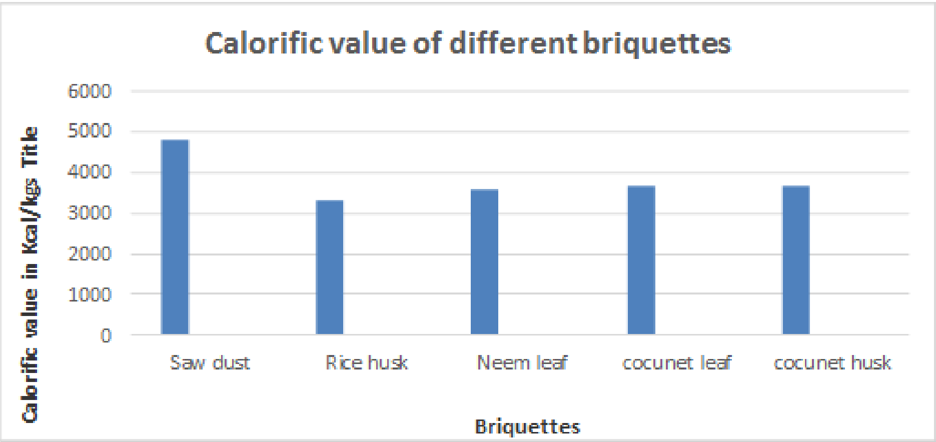

Figure No.5.1: graphical representation of CV

VI. APPLICATION AND ADVANTAGES

6.1 Application of Biomass Briquettes:

Biomass Briquette are widely used for any type of thermal application like steam generation in boilers, in furnace & foundries (It can be used for metal heating & melting where melting point is less than 1000d/cel.), for heating purpose (Residential &Commercial Heating for winter, heating in Cold areas and Hotels, Canteens, Cafeterias and house hold kitchen appliances etc), drying process and in gasification plant replacing conventional solid fuels like Coal and Firewood and liquid fuels like Diesel, Kerosene, Furnace Oil (FO), etc.

It's a high quality asset towards economical, ecological, & advanced environmental company policy Briquetted fuel can be used by the industrial, commercial and household sectors. It is ideally suited for use in the following areas:

- Boilers: (sugar mills, paper mills, chemical plants, Cement, food processingunits, oil extraction units etc.) using fuel for steam generation and heating.
- Forges and Foundries: For metal heating and melting.
- Brick kilns and Ceramic Units: For firing of furnaces.
- Residential Heating: For winter heating in cold areas and in restaurants, canteens etc…
- Gasification: The gas can be used to generate power, and eventually replace coal based producer gas systems.
- Agriculture: Heating Green houses, Nurseries and Chicken coops.

6.2Advantages:

Briquettes produced from briquetting of biomass are fairly good substitute for coal, lignite, Firewood and offer numerous advantages

- This is one of the alternative methods to save the consumption and dependency on fuel wood.
- Densities fuels are easy to handle, transport and store.
- They are uniform in size and quality.
- The process helps to solve the residual disposal problem.
- The process assists the reduction of fuel wood and deforestation.
- It provides additional income to farmers and creates jobs.
- Briquettes are cheaper than coal, oil or lignite once used cannot be replaced.
- There is no sulphur in briquettes.
- There is no fly ash when burning briquettes.
- Briquettes have a consistent quality, have high burning efficiency, and are ideally sized for complete combustion.
- Since briquettes can be domestically made from plants and animal wastes, they are consequently less expensive to produce, and thereby sold at lower prices.
- Compacting biomass waste into briquettes reduces the volume by 10 times, making it much easier to store and transport than loose biomass waste
- The compression process allows the briquettes to burn for a lot longer than if it was loose in its original condition.

CONCLUSION

- A manual biomass briquetting machine is suitable for the production of biomass briquettes on a small scale, was designed and constructed and used in the production of biomass briquette using biomass raw material.
- Briquette with higher durability was produced using the constructed briquetting machine.
- It is absorbed that if binder ratio is increased then the hardness of the briquette increases.Thus resulting in slow burning of briquette.

FUTURE ENHANCEMENT

The machine fabricated requires some human effort for compressing the raw material. The requirement of human effort can be eliminated by using a less capacity motor to actuate the telescopic jack gradually for compressing the feed stock. This increases the compression pressure which helps in obtaining the good quality briquettes. And also this high pressure causes raw material to bind stiffly and this may also lead to elimination of using binder.

By some minor changes in the compressing unit, the cylinder piston arrangement and inverted position of jack will allow the operator to apply maximum pressure as much as possible. And by using this mechanism fabrication cost can be reduced. Any type of feed stock can be used apart from the saw dust, coffee husk, dry leaves and other biological and non-biological waste can be compacted toreduce waste management cost and facilitates the easy transportation of the same.

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