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Design of Briquetting Machine

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ABSTRACT: A developing country like India is reaching out of fuel-starved; it is an effort to provide an affordable firewood alternative to the rural households, agricultural and small industries. In India maximum land cover is by agriculture, where biomass is easily available source of unconventional energy. This paper is explaining the designing and fabrication of biomass briquettes machine application from domestic cooking to industrial boiler. Samples of briquettes from various materials also presented. Also we tried to focus on this social innovation and adapt it to offer remarkably low cost solutions to day-to-day problems of underprivileged people, while protecting the environment.

KEYWORDS: affordable firewood, biomass- unconventional energy, Briquettes machine, etc.

I. INTRODUCTION

Biomass briquettes are made from agricultural waste and are replacements for fossil fuels such as oil or coal. Fossil fuels combustible substance, which is made mainly of carbon, hydrogen, oxygen, nitrogen and varying amount of sulfur. It is primarily used as solid fuel to produce electricity and heat for the combustion. Coal is the largest carbon dioxide emitter per unit area when it comes to electricity generation. So there has been a recent push to replace the burning of fossil fuels with a nonrenewable resource. Biomass briquettes are one of good substitute to coal and charcoal. They are mostly used in the remote areas, where cooking fuels are not as easily available. Economical and eco-friendly Briquettes are easy and clean to handle for conventional cooking fuels, and utilize materials that constitute solid waste.

Biomass energy currently plays a major role in meeting the present energy needs of developing countries. A number of authors (Beyea et al., 1991), have also expressed the view that biomass has the potential to meet the additional energy demands of urban and industrial sectors.

II. METHODOLOGY

- ✓ Now day's we faced problem of disposal agricultural waste, weed, sawdust, recycled shredded paper. So, the idea behind this paper is to transformation of unwanted into wanted. Agricultural waste and sawdust are organic waste which can be easily converted into eco-friendly Briquettes.
- ✓ In market number of machines is available, but our design give consideration to the cost element, so farmer or under privileged people can easily purchase it. Reasonable Income Selling Briquettes making machine₁.
- ✓ Today, indoor air pollution, due to traditional Chula, ranks 10th among preventable risk factors contributing to global burden of disease. Briquettes have main advantages: low smoke fuel it reduces the toxic pollutants and avoid the harm to human health and its availability can be nearly unlimited, the fact that it can be use essentially without damage to the environment.
- ✓ This paper present overview of briquettes making process, we have use complete mechanical based operation for briquettes production where electricity not required. This is not production machine limited to quantity but further scope is given.
- ✓ Content of the paper divided into five groups design calculation for briquetting machine, fabrication of assembly and Procurement of parts, cost summary and Results that includes samples made by machine.

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III. DESIGN

Briquettes are formed in cylindrical logs using high mechanical pressure without the use of chemical or binder. It produces from Agro waste which has high calorific value. This implies conversion of waste into energy. Before putting biomass directly to the machine it should be crushed into particles, and make it dried.

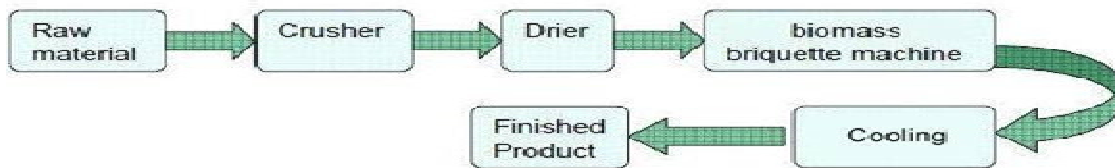


Figure 1 : Overview of Briquetting Process

- The basic working consists of hydraulic jack having capacity of 3tonne. Initially, we have to put the raw material properly into the die. Make sure that the die plate is placed below the die.
- After putting the raw material start the punching action of the machine by operating the hydraulic jack. This will starts the motion of punch in downward direction. Now the punch exerts the force on the raw material and densifies the material. Wait for the 30 sec and then loose the relief valve. This will result in punch to move upward. Assembly of briquetting machine shown in below picture.
- Now lift the die and remove the die plate from the ring. After which fix die in ring properly and again operate the hydraulic jack to remove briquette from die.
- This is how the machine is operated. Die has holes on his periphery are given to remove excess water from the briquette. Also hydraulic jack has arrangement to adjust the height.

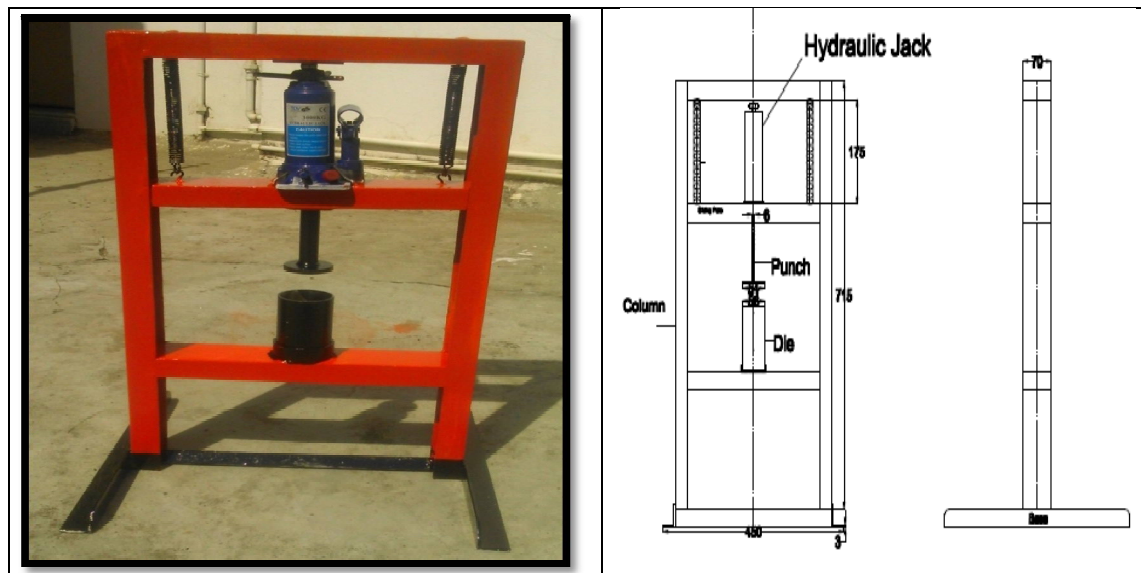


Figure 2 : Assembly Of Machine

IV. DESIGN CALCULATION

3.1FRAME & SLIDER:

Frame is rectangular assembly of c channel which supports all the components of the briquette machine. It supports slider, hydraulic jack, springs, die, punch, punch plate. Frame made of mild steel material. Slider is the sliding member

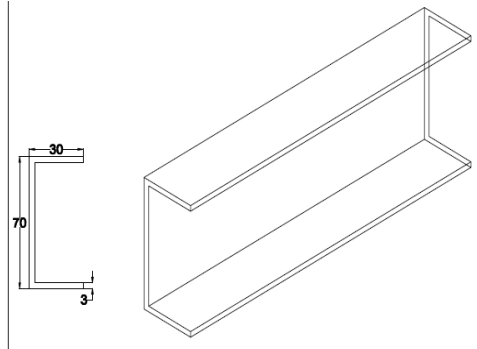
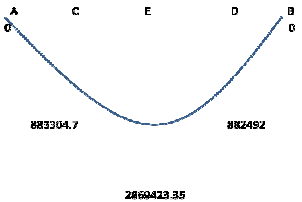
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of the machine which slides up and down with the help of springs attached to it. The up and down motion is created by motion of hydraulic piston of hydraulic jack. Also on the bottom side of the slider punch is fixed.

<p>DESIGN OF C CHANNEL:</p> 	<p>Moment about Y axis: $Y = A_1 Y_1 - A_2 Y_2 / A_1 - A_2$ $A_1 = 30 \times 70$ $A_2 = (70 - 6) \times (30 - 3)$ $= 1728 \text{ mm}^2$ $Y_1 = 30 \times 2 = 15$ $Y_2 = (30 - 3) / 2 = 13.5 \text{ mm}$ $Y = (2100 \times 15) - (1728 \times 13.5) / 2100 - 1728 = 21.96 \text{ mm}$</p>	<p>Moment of inertia (I) $= I_{xx1} - I_{xx2}$ $= (IG1 + A1h1^2) - (IG2 - A2h2^2)$ $= 70 \times \{30^3/12 + (2100 \times (21.96 - 15)^2)\} - 64 \times \{273^3/12 + (1728 \times (21.96 - 132))\}$ $I = 259227.36 - 228651.7248$ $I = 30.5756 \times 10^3 \text{ mm}^4$</p>
<p>DESIGN OF SLIDING PLATE</p>  <p>Figure 4</p> <p>Compressive stress at E- $M_E \times Y_E / I = 2.86 \times 10^6 \times 81.96 \times 30 / 30.57 \times 10^3$ $= 230.75 \times 10^3 \text{ N/mm}^2$</p>	<p>Maximum allowable stress- $= 390 / 1.5 = 260 \times 10^3 \text{ N/mm}^2$ Hence, Max. Allowable stress > max. Compressive stress in beam. Moment of inertia = $dt^3/12$ $= 700 / 12 \times t^3$ $= 58.33 t^3$ Using bending formula, $M/I = \text{bending stress}/Y$ $230.75 \times 10^3 / 58.33 \times t^3 = \text{bending stress}/Y$</p>	<p>For 25c8, $S_{yt} = 390 \text{ N/mm}^2$ Allowable bending stress, $S_{yt}/f.o.s = 390 / 1.1$ $= 354 \text{ N/mm}^2$ $3955.94 / t^3 = 354 / t$ Thickness of plate = 3mm Hence, Plate with thickness 3mm is selected for safe design.</p>
<p>DESIGN OF BASE PLATE $L = 390 \text{ mm}$ & width = 30mm load acting on base plate = (3000kg of jack) + (spring of 20gm) + (sliding plate 2.5kg) + (ring 20gm) + (punch 400 gm) + (die 150 gm) $= 29450.5 \text{ N}$ Taking moment about A, $229.45 \times 390 \times 195 = R_B \times 390$ $R_B = 5742.75 \text{ KN}$ $R_A = (29.45 \times 390) - 9568.65$ $R_A = 5742.75 \text{ KN}$</p>	<p>Using bending formula, $M/I = \text{bending stress}/Y$ $139.83 \times 10^3 / 58.33 \times t^3 = \text{bending stress}/Y$ For 25c8, $S_{yt} = 390 \text{ N/mm}^2$ Allowable bending stress, $s_{yt}/f.o.s = 390 / 3$ $= 130 \text{ N/mm}^2$ $2397.22 / t^3 = 130 / t$ Thickness of plate = 3mm Hence, Plate with thickness 3mm is selected for safe design.</p>	

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<p>Calculation for punching force $F = P \times t \times \text{shear strength}$ $P = \text{perimeter, } t = \text{thickness}$ Circular perimeter Shear strength = 85N/mm² $F = \pi \times 54 \times 2 \times 85$ $= 2939.8 \text{Kg}$ $= 2.93 \text{ton}$ Punch is the part used for the pressing operation. It is made up of mild steel. Punch pressurizes the raw material present in the die. It densifies the raw material</p>		$L_m = (2t/8) \times (E/f \times t) \times 0.5$ $L_m = \text{length of punch}$ $t = \text{thickness}$ $F = \text{shear force}$ $E = \text{Modulus of elasticity} = 200 \times 10^3 \text{ N/mm}^2$ $L_m = (2 \times 3/8) \times (200 \times 10^3 / 250 \times 3) \times 0.5$ $L_m = 100 \text{mm}$ For safe design we take 104mm
	<p>Design of Die : From book 'Metal Forming Process' by G.P.Nagpal $t = 25 \text{mm}$, When $P = 75 \text{ to } 250 \text{mm}$ $P = \text{Blanking Perimeter}$ $P = \pi D$ $= \pi \times 62$ $= 195 \text{mm}$ So, Required thickness of die block is 25mm</p>	

V. MATERIAL PURCHASE

 <p style="text-align: center;">Figure 6 Hydraulic jack is 3000 kg capacity</p>	<p>Calculations Total shear stress = $1.204 \times 8 \times 65 \times 5.6 / \pi \times 2.25^2$ $= 120.72 \text{N/mm}^2$ Deflection in spring, Deflection = $(8 \times c^3 \times W \times n / G \times d)$ $= (8 \times 5.6^3 \times 65 \times 51 / 80 \times 10^3 \times 2.25)$ $= 26$ Stiffness in the spring $K = W / \text{deflection}$ $= 65 / 26$ $= 2.5 \text{ N/mm}$</p>	 <p style="text-align: center;">Figure 7</p> <p>Return springs are attached to the ram of the jack which provide the automatic return after bending operation</p>
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VI. COST ANALYSIS AND RESULT

THE TOTAL RAW MATERIAL COST AS PER THE INDIVIDUAL MATERIALS AND THEIR CORRESPONDING RATES PER KG IS AS FOLLOWS, TOTAL RAW MATERIAL COST = Rs 500/-

Table 1: Purchase Cost

SR. NO.	NAME OF THE PART	QUANTITY	COST (Rs)
01	C CHANNEL	01	900
02	HYDRAULIC JACK	01	1500
03	SPRINGS	02	150
04	PUNCH	01	250
05	DIE	01	250
06	PLATE, SUPPORT, HOOKS	01,03,04	300
09	MISCELLANEOUS COSTS	01	600
10	COLOUR	01	400
	TOTAL		4400

Table 2 : Machining Cost

OPERATION	RATE Rs /HR	TOTAL TIME HRS	TOTAL COST Rs/-
LATHE	90	2	180
CUTTING	105	1	105
DRILLING	50	1	50
WELDING	180	4	720
TOTAL			1055

TOTAL COST = Raw Material Cost +Machine Cost + Miscellaneous Cost + Cost of Purchased Parts Hence the total cost of machine = **Rs6500/-**approx.

Results: Briquette produced from our machine is of following specification- (Sawdust sample)

Ingredients: Sawdust (60%), Corn starch (10%), Water (30%).

Height: 55mm, Diameter: 55mm, Weight: 40 gm.



Figure 8 : BRIQUETTE OF SAW DUST



Figure 9 :Briquette of Saw dust & Wheat flour



Figure 10: Briquette of Saw dust and Corn Starch

From this we found that the sample has become as per our need. As we stated earlier that height of the briquette should be half of the die height. So it is exactly half.

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VII. FUTURE EXPANSION

For increasing the performance of briquetting machine, operation time can be modify (shown prototype) by using following methods,

1. Increasing the number of dies.
2. Increasing the height of the machine.
3. Using the electric motor, Using plastic.

VIII. CONCLUSION

The study on the development of a biomass briquetting machine is of great importance to poor and developing rural areas as it addresses the issues surrounding the efficient utilization of abundant quantities of agricultural wastes and residues which provide an enormous untapped fuel resource.

The proposed machine is technically feasible and economically viable. The main purpose of paper is to save our environment by overcoming pollution. Also helps the farmers to utilize their agriculture wastage materials properly.

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