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DESIGN AND CONSTRUCTION OF AN ARTISAN BRIQUETTING MACHINE FOR THE PRODUCTION OF BIOMASS BRIQUETTES

Abstract— The objective of the project is to design and build a functional briquetting machine capable of producing biomass briquettes using recycled organic materials. This is where the initiative to create a machine capable of producing handmade briquettes was born, since in Honduras there is no other way to produce them than manually and with machines, which complicates the process a lot. A quantitative methodology with an experimental study was used due to the design of the prototype and the calculations involved.

The handmade briquetting machine is composed of 2 main materials, such as carbonized steel with a wall thickness of 16 and a 2x2 inches, the second material is stainless steel for non-food use with a ¼ inch wait, as a compaction tool a scissor jack was used with a maximum compression height of 37.5 cm and a capacity of 1.5 ton. The prototype was designed to be placed on a table, that is why its horizontal bases are 40 cm, the briquetting machine has height bases of 80 cm, the width between the height bases is 60 cm, it has reinforcements at the base of 25 cm and finally a height gain of 10 cm which allows the Jack of scissors to reach a maximum compression height of 47. 5 cm, the stainless steel molds are used to place the raw material, the first mold is 10 x 25 cm and the second is 10 x 15 cm, the holding and drainage drawer has a measure of 30 x 30 cm with a 5 cm high flange, in the center is the molds holding, with a square measure of 20 x 20 cm has the same height as the flange, in the center of this there is a circle of 11 cm in diameter to place the molds.

Keywords—c: compaction, artisanal briquettes, prototype, compression, mold, carbonized steel, stainless steel.

I. INTRODUCTION

The manufacture of the prototype of a briquetting machine becomes one of the solutions to mitigate the problem, so it will be designed for domestic use due to the components to be used, since they are easily accessible materials and its manufacturing process is very simple, so its use will be manual.

Briquetting is an efficient biomass conversion alternative, in which agricultural residues are compacted to obtain a dense and durable fuel. Briquettes can be produced with or without binders in a variety of shapes, such as square and cylindrical, by compacting feedstocks that can be used for a variety of applications [1]. this process is a good alternative to make briquettes in an efficient way.

The specifications of the briquetting machines developed are based on the ability to minimize the operating space in which it seeks to eliminate the handling of the raw material, in which the efficiency of the machine is a very important parameter to improve. [2], briquetters seek to improve a production process.

In contemporary times, population growth has placed an enormous burden on fuelwood and is forcing the growing population to engage in deforestation. Of the vast energy resources, non-renewable fossil energy continues to dominate the consumption of fuelwood [3].

Some types of briquetters contain the whole process inside them, such as a biomass feeder which ensures the flow of the raw material, then they have a compacting piston and then pass through conveyor belts already from the final briquette. [4].

The screw is the part of the compression machine that will deteriorate after use. From the experiment on the length of the screw to emulate the deterioration. Even if the screw deteriorated, the machine is still usable. [5]. Therefore, this way is an alternative way to make a briquette machine, but it is not handmade. This mechanism is often noted for its high efficiency in the production of briquettes. [6].

The most common mechanism for briquette production in Asia is the die and punch type. [7]. This mechanism is mostly used for the production of briquettes in an industrial environment.

Some important parameters related to the dimensions used for the adjustment of the machine, which include the pressing pressure, the compression process, this is where you can determine if the compressibility of the materials is adequate, all depending on the design. [8]. It can be seen that the selection of

dimensions is an important part of the design to avoid compression failure.

One of the most worrying problems for households is the volatility of LP gas prices, which is linked to climate change as another problem in which they are forced to look for new fuels for powering machine [9]. In which briquettes are a solution for the feeding of artisanal stoves.

This study is based on the design and construction of an artisanal briquetting machine that allows the manufacture of artisanal briquettes in the country since there is no machine in the country that facilitates the manufacture of briquettes. In which much consideration is given to the back of the design based on studies that provide good information to the research. [10].

The research aims to manufacture and design a prototype of a handmade briquetting machine using different materials with the purpose of manufacturing biomass briquettes, thus opening the way for the manufacture of handmade briquettes in the country.

II. METODOLOGY

A. *Approach and variable*

The approach to be used is quantitative, since this is due to the design of the briquetting machine, in which variables such as pressures and resistances of the materials used for the manufacture of the artisanal briquetting machine are involved.

The independent variables are the construction materials, design parameters, stages of the construction process.

B. *Techniques and instruments*

- Welding machine: machine used to weld the briquetting machine.
- Cutting machine: instrument used to cut precisely the materials to be used.
- Grinder: used to polish the cut ends and thus devastate the weld.
- Spatula: used to apply putty.
- Sandpaper: used to clean and detail the putty imperfections.
- Paint gun: used to paint the entire prototype.
- Drill: used to drill and screw the mold into the base of the briquetting machine.

C. *Integrating image of the manufacturing process*

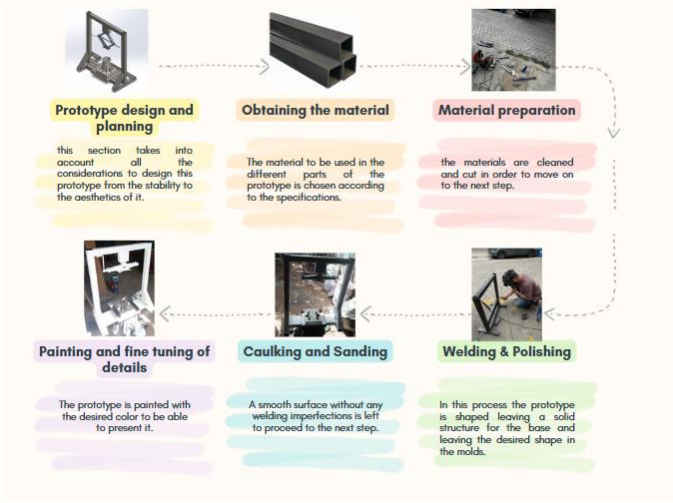


Fig. 1 Manufacturing process

- Prototype design and planning

Due to the need to manufacture a prototype that meets certain requirements and taking into account research which tells us about hydraulic briquetting [11], in which research was also taken into consideration but which mentioned a less complex process to use, such as manual intervention. [12]. In which the SolidWorks program was used to design the prototype.

- Obtaining the material

Taking into account many of the options for selecting the manufacturing material in some of the investigations, some of the materials used based on accessibility can be observed [13]. Materials such as carbonized steel and stainless steel were used in this design.

- Material preparation

For this section, the carbonized steel was cleaned and then underwent a cutting process, as well as the stainless steel.

- Soldering and polishing

The welding of the prototype base, the molds and the polishing of the details of the weld seams were carried out. In which two types of welding processes were used [14].

- Caulking and sanding

The base was caulked and then sanded to remove weld imperfections.

- Painting and fine tuning of details

In this process we proceeded to paint after letting the putty rest for 1 day to obtain better painting results.

III. Analysis and Results

This section will show the processes carried out to manufacture the handmade briquetting machine together with its measurements, rendered designs and the final result of the prototype.

a) Material and Specifications

Carbonized steel:

- Square Tube 2x2 in.
- Plate number 16
- Tensile strength: 250-400 MPa

Stainless steel:

- Sheet thickness of ¼ in.
- Non-food use
- Tensile strength: 350-650 Mpa

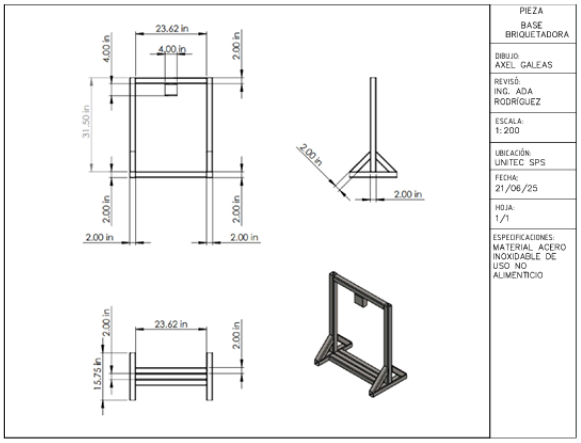
Scissor Jack

- 1.5-ton capacity
- Maximum height measurement 37.5 cm
- Maximum width measurement 41.5 cm

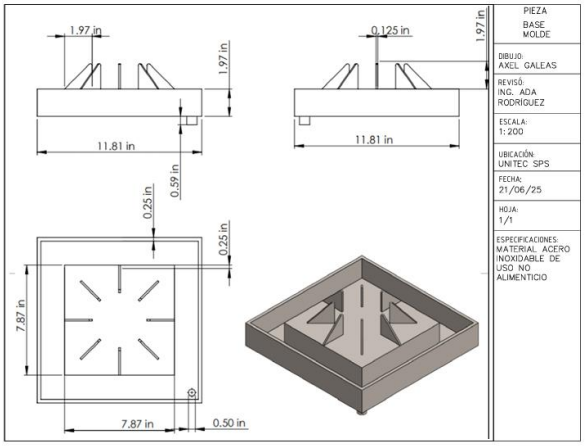
b) Plan of artisan briquetting machine

In this section all the parts that are part of the design of the handmade briquetting machine will be placed.

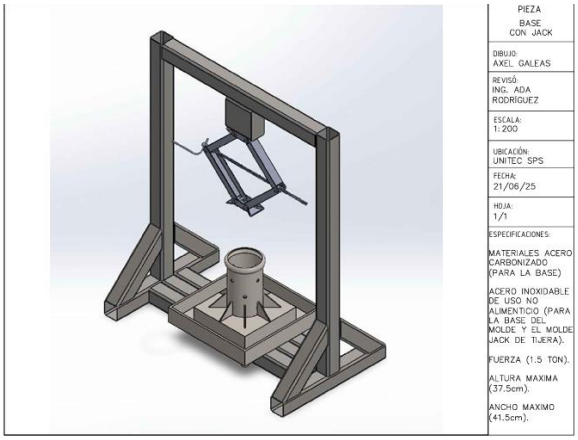
Plan 1 Briquetting Base



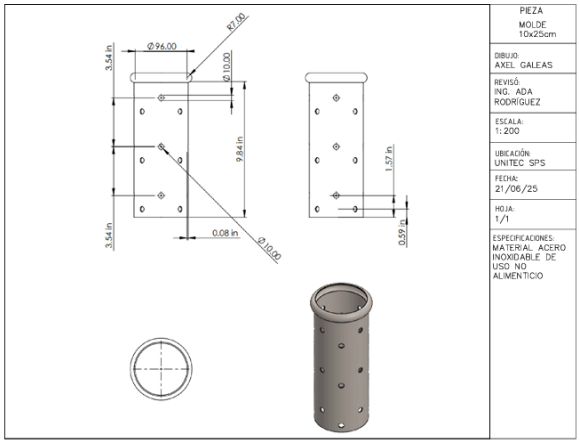
Plan 2 Mold base piece



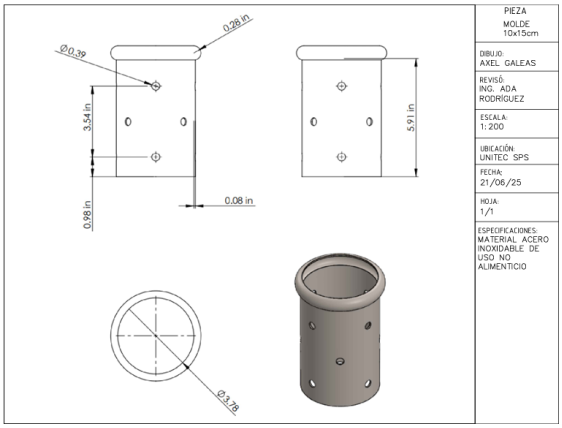
Plan 3 Base piece with scissor jack



Plan 4 Pieces 10x25 cm mold



Plan 5 Piece mold 10x15 cm



c) Measurements and Dimensions

The measures are given to reduce costs and take advantage of most of the materials, in which a basic mathematical analysis using formulas such as the Pythagorean theorem to determine hypotenuses could be highlighted. [15], this prototype is designed to be mounted on a table, which must meet certain size requirements according to the measurements given in this section.

- The horizontal bases (Main)

The bases are of a size of 40 cm both

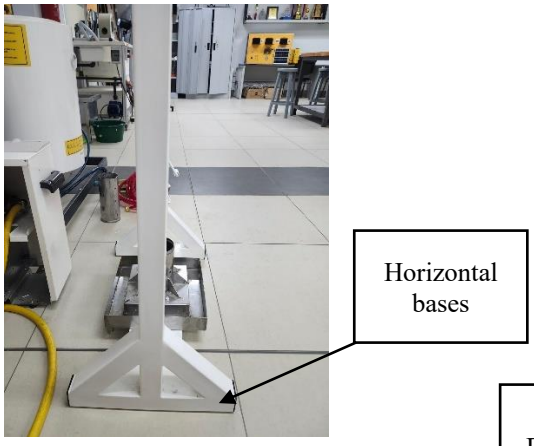


Fig. 2 Horizontal Bases (Main)

- The vertical bases (prototype height)

The bases are 80 cm in size.

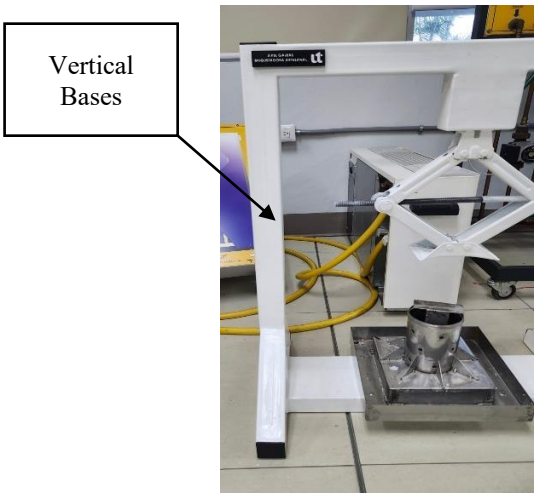


Fig. 3 Vertical bases (Prototype height)

- The width between both bases

The bases are 60 cm each.

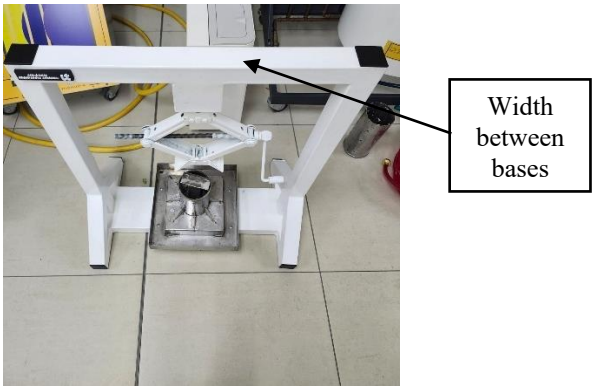


Fig. 4 Width between bases

- Reinforcements placed between the horizontal base and the vertical base

They are 25 cm each

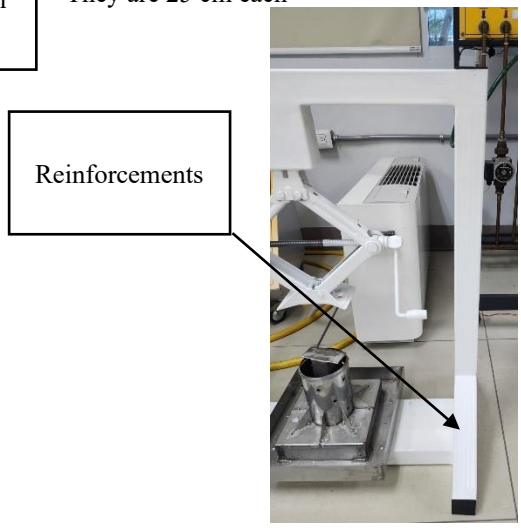


Fig. 5 Reinforcements

- Height gain of the Scissor Jack

The height is 10 cm in order to increase the maximum height of the Scissor Jack, so now its new maximum height would be 47.5 cm.

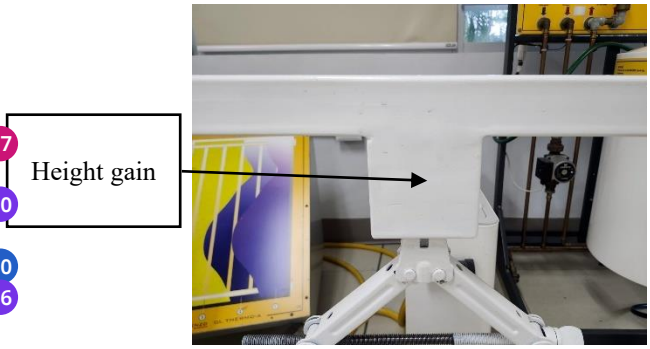


Fig. 6 Height gain of the Scissor Jack

IV. Conclusions

The materials selected for the construction of the handmade briquetting machine were considered to be easily accessible, in the case of steel, a 2 “x 2” pipe size of sheet metal number 16 was used, as for stainless steel, a non-food type with a thickness of 1/4 was used, the scissor jack is 1.5 tons.

The design parameters included material resistance variables in terms of oxidation and compression as these are two data that could affect the prototype, that is why the use of stainless steel in the parts that are in contact with water and ensured that this set of materials resists the compression of the scissor jack. This set of parameters caused the good functioning of the prototype, the dimensions used for the base of the briquetting machine for the height is 80 cm, the horizontal bases is 40 cm, the reinforcements between the base of height with the horizontal base is 25 cm, for the width between the bases of height was used a measure of 60 cm, the stainless steel drawer is composed of two measures, The external measure is 30 cm x 30 cm, the height of the flange is 5 x 5 cm on each side, the internal measure is 20 cm x 20 cm with an internal height of 5 cm, in the center were placed clamping tabs with a diameter of 10 cm, the stainless steel molds have a measure of 10 cm in diameter with heights of 15 cm and 25 cm. Finally, the scissor jack has a maximum compression height of 37 cm with a maximum width of 41.3 cm.

The construction process, which was low cost in comparison to designs with complex devices, involved cutting, welding, caulking, painting and the assembly of parts, and being a handmade version was taken into account when selecting the materials in order to reduce costs.

The prototype is used for data comparison between manually manufactured briquettes versus biomass briquettes manufactured with the artisanal briquetting machine, thus demonstrating the efficiency that the prototype provides.

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