FABRICATION OF FUEL BRIQUETTING PRESS AND ANALYSIS OF FUEL BRIQUETTE

A DISSERTATION SUBMITTED IN THE PARTIAL FULFILMENT

FOR

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BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

BY

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CERTIFICATE

This is to certify that the project entitled " FABRICATION OF FUEL BRIQUETTING PRESS AND ANALYSIS OF FUEL BRIQUETTE" is being submitted by MOHAMMAD ABDUL BARI , AMMAR TAHOOR ZAFAR and ADNAN RASHEED bearing Roll Nos: 1604-11-736-024, 1604-11-736-062 and 1604-11-736-001 respectively in partial fulfillment for the award of the degree of Bachelor of Engineering in Mechanical Engineering to the " OSMANIA UNIVERSITY " is a record of bonafide work carried out by under my guidance and supervision. The results in this project report have not been submitted to any other University or Institute for the award of any Degree or Diploma.

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DECLARATION

This is to certify that the work reported in the present thesis titled "FABRICATION OF FUEL BRIQUETTING PRESS AND ANALYSIS OF FUEL BRIQUETTE" is a record of work done by us in the Department of Mechanical Engineering, Muffakham Jah College of Engineering and Technology. No part of the thesis is copied from Books/journals/internet and wherever the portion is taken, the same has been duly referred in the text. The report is based on the project work done entirely by us and not copied from any other source.

MOHAMMAD ABDUL BARI
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ABSTRACT

Energy consumption in the rural sector of India, particularly in the form of petroleum-based fuels, has increased manifold during the last 40 years or so. Fast depleting stocks of fossil fuels and steep increases in their prices may lead to an energy crisis in the not-too-distant future. Such a crisis will have a serious effect on all economic and domestic activity, particularly in the vast rural areas.

Women of the rural India have always suffered from lung diseases and several other problems by using traditional fuels for cooking. Wood, coal, kerosene, cow dung etc., which when burnt, give off smoke and other harmful gases, which in the long run, not only damage the health of rural women, but also significantly contribute to the air pollution and influence climate change. So there is a pressing need to develop an alternate cooking fuel, which not only minimizes the above listed problems but is also economically feasible to rural India.

One of the solutions for this is the Biomass Briquette fuel, which can be made from any kind of organic waste, which is easily available everywhere. The organic waste can be made into briquettes by mixing it with a thick solution of paper pulp. This mixture is then poured into a briquetting press to remove water and make them into solid pieces. These briquettes can be dried and used as an alternative cooking fuel.

Briquetting of waste materials to produce cooking fuel reduces solid waste to be disposed of, reduces air pollution, reduces carbon foot print, empowers the poor and establishes a model “people-friendly-eco-friendly” technology.

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Nomenclature:

mm	millimeter
cm	centimeter
mc	moisture content
Kg	kilogram
OC	degree centigrade
Kw	kilo watt
Psi	pound per square inch

CHAPTER 1

Introduction

Biomass Briquetting is the process of converting low bulk density agro waste into high density fuel. These are good replacements for conventional cooking fuels, Economical and eco-friendly and utilize materials that constitute solid waste.

India is reaching out to fuel-starved rural/urban communities and individuals to transfer the simple skills for making fuel briquettes from agricultural, municipal, industrial and domestic waste to people in remote areas to meet their cooking fuel needs and for livelihood support from selling the briquettes. This project is a rare example of how simple, innovative technologies and techniques can offer remarkably effective Solutions to critical, day-to-day problems of underprivileged people, while protecting The environment.

A manual Briquetting Machine, single person operated can produce about 5 to 6 to 8 Kg of briquettes per day/per shift. A family of 4 persons requires about 0.5 to 0.75 kg of briquettes daily to meet their cooking needs. A day's operation of briquetting machine can produce more than a week's fuel requirement easily. It also helps in Solid Waste Management by reducing the volume to be sent to land-fills, where it is presently burnt or buried without proper care.

Almost 70% of Afghans live below the poverty line of $30 a month, with very little economic stabilization programs in sight to reduce the effects of war and increase The purchasing power of Afghans and bring their life a sense of normality. With the briquette project, Afghans 4 Tomorrow.(A4T) aims to directly address the issue of poverty by providing a simple and sustainable business opportunity to the most disadvantaged populations of Afghanistan; one that will not only serve as an ongoing source of income to help people satisfy their basic needs, but also introduce & produce alternative environment friendly burning fuel to heat homes and cook food.

1.1 Materials used in the fuel briquette making:

The fuel briquettes are made out of loose raw materials like rice husk, saw dust, coir pitch, groundnut-shell, coffee husk, sugar cane which are abundantly available, into a compressed form to increase its specific weight, thus increasing the fuel efficiency (Combustion Efficiency) as compared to its loose condition without using any Binders.

The materials that we are using are saw dust and rice husk with binding material (paper) . As they are mostly available in cities which can be properly used in making briquettes .

Fig1. Material used in the fuel briquette making

-Fuel Briquettes are used to replace conventional fuels like coal, firewood in heating.

-Briquettes do not emit smoke with sulfur or phosphorus and also fly ash. Hence no need of pollution controls equipment .

1.2 Material of briquetting machine

Mild Steel is used in designing the machine we thought that Mild Steel would be a better material because it is readily available , they can be easily made into machines. We have chosen Mild Steel as it is extremely durable ,easily weldable and is available in many shapes and sizes,

Mild steel is ductile and can be easily machined. Generation of heat is less than that of steel machining. So, the tool can have better life and you can do more machining. Cost factor is of prime importance as other steel are more costly than Mild steel.

Mild steel, a grade of steel that does not harden when heated and chilled with cold water, so further machining can be easy. .They have longer life and can sustain higher stresses.

1.3 Introduction To Tools And Equipment

The various tools and equipment involved in this project are,

M I X I N G T O O L S
CREO PARAMETRIC
ANSYS WORKBENCH
LATHE MACHINE
GRINDING MACHINE
WELDING MACHING
DRILLING MACHINE

1.3.1 Mixing Tools

1.3.1.1 Wooden Mallet:

A Mallet is a type of hammer with a head made of softer materials than the steel normally used in hammerheads, so as to avoid damaging a delicate surface. Wooden mallet, usually used in carpentry to knock wooden pieces together or to drive dowels or chisels. A wooden mallet will not deform the striking end of a metal tool, as most metal hammers would, but it also reduces the force available to drive the cutting edge of a chisel. Hardwood mallet is also used to knock in a cricket bat. Here the wooden mallet is used to pound and smash the soaked paper to pulp

.

Fig2. A wooden mallet

1.3.1.2 Rake

A rake is an agricultural and horticultural implement consisting of a toothed bar fixed transversely to a handle, and used to collect leaves, hay, grass, etc., and, in gardening, for loosening the soil, light weeding and leveling, and generally for purposes performed in agriculture by the harrow.

Modern hand-rakes usually have steel, plastic, or bamboo teeth or tines, though historically they have been made with wood or iron. The handle is often made of wood or metal. When rakes have longer teeth, they may be arranged in the shape of an old-style folding fan. Large versions mounted on wheels with a bar connecting long curved steel teeth can be used with tractors, descended from a horse-drawn type used prior to the growth of mechanical farming.

Fig3. Rake

1.3.1.3 CREO PARAMETRIC :

Creo Parametric is the standard in 3D CAD, featuring state-of-the-art productivity tools that promote best practices in design while ensuring compliance with your industry and company standards. Creo Parametric provides the broadest range of powerful yet flexible 3D CAD capabilities to help you address your most pressing design challenges including accommodating late stage changes, working with multi-CAD data and electromechanical design.

A scalable offering of integrated, parametric, 3D CAD, CAID, CAM, and CAE solutions allows you to design faster than ever, while maximizing innovation and quality to ultimately create exceptional products.

As part of the Creo product family, Creo Parametric can share data seamlessly with other Creo apps.

This means that no time is wasted on data translation and resulting errors are eliminated. Users can seamlessly move between different modes of modeling and 2D and 3D design data can easily move between apps while retaining design intent. This results in an unprecedented level of interoperability and delivers break-through productivity gains throughout many product development processes.

1.3.1.4 ANSYS:

NSYS develops, markets and supports engineering simulation software used to foresee how product designs will behave and how manufacturing processes will operate in real-world environments. We continually advance simulation solutions by, first, developing or acquiring the very best technology; then integrating it into a unified and customizable simulation platform that allows engineers to efficiently perform complex simulations involving the interaction of multiple physics; and, finally, providing system services to manage simulation processes and data — all so engineers and product developers can spend more time designing and improving products and less time using software and searching for data.

1.3.1.5 LATHE MACHINE :

Fig. 4 Lathe machine

1.3.1.6 CUTTING AND GRINIDING MACHINE :

Fig. 5 cutting machine

1.3.1.7 WELDING MACHINE :

Fig. 6 welding machine

1.3.1.8 DRILLING MACHINE :

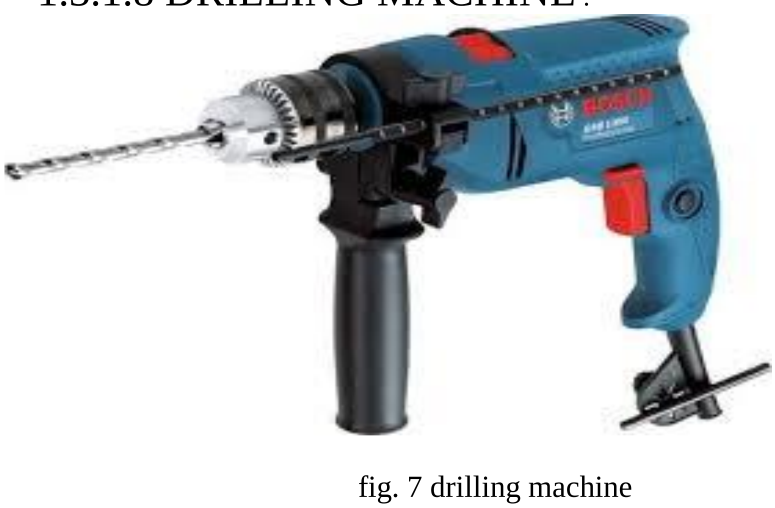

fig. 7 drilling machine

1.4 Biomass Briquetting Press

Biomass Briquette Press Working principle:
Briquetting is a process during which biomass is compressed under high pressure and high temperature.
The self bonding of biomass to form a briquette involves the thermo-plastic flow of the biomass. The lignin content that forms naturally in biomass is liberated under high pressure and temperature. Lignin serves as the glue in the briquetting process, thus no artificial binder need to be used. So the output briquette is a type of clean and green fuel that is ideal for use in furnaces, boilers and open fires. The density of the briquettes is 1100~1300kg/m.

Flow chart of the Biomass Briquette Press

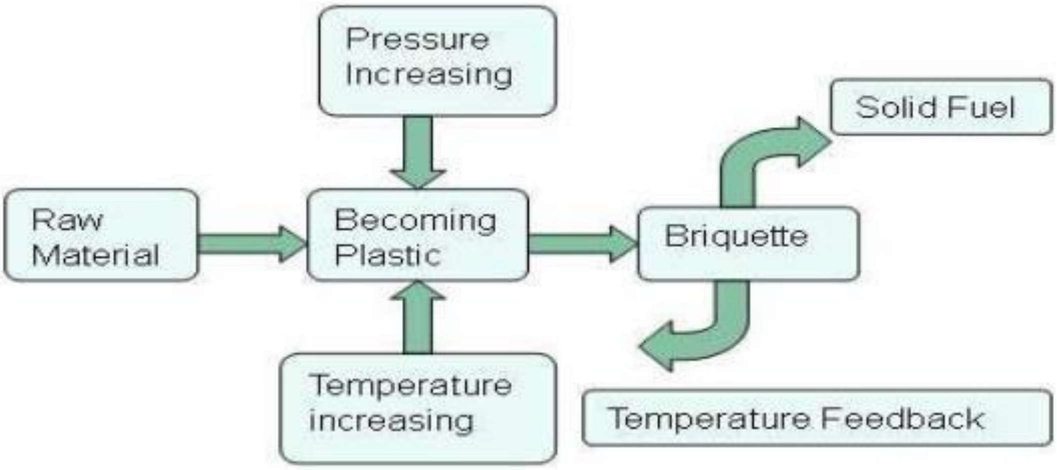

Fig 8.

Fi 9

Briquetting PressModel ZBJI(11kw motor)

Briquetting PressModel ZBJII(15kw motor)

 

Briquetting Press Model ZBJIII(18.5kw motor) **Wood Briquettes made from Briquetting**

Fig10. Fig11

Biomass Briquetting Press

Model	ZBJI	ZBJII	ZBJIII
Output kg/h	80-120	120-150	180-230
Motor Power (kw)	18.5KW	11kw(energy saving type with gear box)	15kw(without gear box)
Electric heater (kw)	1.5kw*3pcs	1.5kw*3pcs	2kw*3pcs
Weight(kg)	650kg	650kg	900kg
Overall dimension(mm)	1780*750*1290	1650*600*1260	1860*800*1360mm
Size of finished products	Diameter: 30,40, 50mm	Diameter: 30,40,50mm	Diameter: 60,70,80,90,100mm

CHAPTER 2

Literature Survey

S. Rantalaa, et.al.,[1], worked on to the monitoring of the briquette project and forest management practices in LMNP and showed that stronger marketing efforts are needed to increase the viability of the briquette business. Another alternative would be to teach families how to make briquettes for household use.

Richard Hosier [2], presented the social and economic analysis of an evaluation of biomass briquettes as a substitute for charcoal in the Dominican Republic. This analysis, Part I of the study, demonstrates four points. First, there is a need for an alternative to charcoal in the energy balance of the Dominican Republic. Secondly, there are sufficient quantities of under-utilized biomass, particularly bagasse, to substitute for a significant amount of the annual charcoal consumption. Thirdly, biomass briquettes will have to be as convenient to use as charcoal. Fourthly, the cost of briquettes sold as charcoal substitutes on the market must be less than the current price of charcoal to make it an attractive substitute fuel.

S Yaman, et.al.,[3], carried out study on briquetting that was applied to olive refuse and paper mill waste to form fuel briquettes. For this purpose, the particle sizes of both biomass samples were decreased to -250 μm and then they were briquetted in a steel die under pressure between 150 and 250 MPa at ambient temperature. Effects of the moisture content of the biomass samples and briquetting pressure on the shatter index, compressive strength, and water resistance of the briquettes obtained were investigated. This study showed that the mechanical strength of the briquettes produced only from the olive refuse was not high enough. On the other hand, strong briquettes were produced using paper mill waste. When olive refuse was blended with fibrous paper mill waste, briquettes with sufficiently high mechanical strength could be produced. Burning profiles of the samples were derived applying derivative thermo gravimetry technique under dynamic dry air atmosphere up to 1273 K with a heating rate of 40 $K\cdot min^{-1}$ and then combustion characteristics of the briquettes were compared.

S.R. Richards [4], four physical properties that are of greatest value when developing or evaluating fuel briquette formulations or processes. They are resistances to crushing, impact, abrasion and water penetration. Arbitrary tests for these properties have evolved in this laboratory during a decade of investigations of binders and formulations for briquetting coal fines and the like. The simple test methods were described and their results were given.

Tests of several types of commercial and pilot process fuel briquettes have been used to set realistic target values for these four physical properties. In the process development stages, it is suggested that the tests should relate to the briquette material, rather than the briquette as an entity, and that this can be achieved by transforming the raw data into various indices. These would allow intra-laboratory or inter-laboratory comparisons of briquette formulations. This approach is illustrated by presenting results for compressive strength, impact resistance and abrasion resistance. The same could apply to water resistance.

D. Rajputa, et.al.,[5], presented the cotton waste results from the mechanical processing of raw cotton in yarn mills. Recycle Paper Mills constitute 30% of total pulp and paper mill segment in India. With 85% average efficiency of Recycle Paper Mills, 15% waste is produced annually. Recycle Paper Mills waste and cotton waste has been utilized to make Waste Crete Bricks. It helps in solid waste management, generate additional revenue and help in earning carbon credits. Waste Crete Bricks with varying content of cotton waste (1–5 wt.%), Recycle Paper Mills waste (89–85 wt.%) and fixed content of Portland cement (10 wt.%) have been prepared and tested as per IS 3495 (Part 1–3): 1992 standards. The characteristics of raw materials, which is the base material for Waste Crete Bricks, have been determined using XRF, TG–DTA, and SEM. TG–DTA indicate that bricks is thermally stable up to a temperature of 280 °C while SEM monographs show its porous and fibrous nature. The bricks meet of IS 3495 (Part 1–3): 1992.

M.J Blesa, et.al.,[6], studied about Environmental acceptable smokeless fuel briquettes that been prepared with a low-rank coal and olive stone as biomass. The binder chosen for thier study was molasses which acts with different roles, as chemical and matrix type. The effect of the curing temperature on these briquettes has been studied by Fourier transform infrared spectroscopy, temperature programmed decomposition (TPD) followed by on-line mass spectrometry and optical microscopy. TPD experiments help to predict the final properties of the briquettes more clearly than infrared spectroscopy. The aliphatic structures and methoxy groups as well as the hydrogen bonds decrease during the curing. On the other hand, the carboxylic groups tend to be formed due to the oxidation produced by the effect of curing temperature. In addition, the briquettes cured at 200 °C, 2 h showed the highest mechanical strength. These curing conditions also produce waterproof briquettes due to the presence of carboxylic groups which contribute to the stabilisation of the briquettes because of the formation of hydrogen bonds.

Lucy Wamukonya, et.al.,[7], studied about Densification of agricultural residues and wood waste into fuel briquettes can provide a relatively high-quality alternative source of fuel, especially where solid wood fuel resources are scarce. The objective of this study was to determine the possibility of producing durable briquettes from wheat straw and sawdust as fuel for Kenyan households and small-scale industries. These consumers are burning an increasing amount of these materials, which in their raw form are poor quality fuels. Briquette length expansion at specific time intervals was determined over a 1-week period. The moisture content and durability of these briquettes were measured after a storage period of 2 weeks at approximately 20°C and 50% relative humidity. Sawdust and shavings briquettes were the most durable and exhibited the least degree of length expansion. Wheat-straw briquettes were the least durable and expanded most. However, blending straw with sawdust improved this durability considerably. There appears to be a direct relationship between length expansion and the durability rating of the briquettes. All the briquettes had relatively low moisture content. Briquettes can be manufactured without a binder but with poor durability in the case of straw.

J.T. Oladeji, [8], have carried out their studies on a Physical and Fuel Characteristics of Rice Husk and Corncob Briquettes , Combustion Characteristics ,Burning Characteristics of Rice Husk and Corncob Briquettes have shown that, the Briquettes produced from rice husk and corncob would make good biomass fuels Briquette from corncob has more positive attributes of biomass fuel than rice husk briquette.

Suparin Chaiklangmuang, et.al.,[9], their research was to study the briquetting of lignite combined with biomass binders. The biomass binders were rice husk and sawdust treated with sodium hydroxide. The ratio of biomass binders and lignite was 50:50 wt./wt. Rice husk was treated with 3% wt/v sodium hydroxide at 80 oC with a heating time of 1.5-4.5 hours, while sawdust was treated with a series of sodium hydroxide solution with a concentration of 7-13 % wt/v at the same temperature. The influence of time for sawdust digestion was investigated by increasing the time from 1.5 to 2.0 and 2.5 hours. The briquettes were formed in the cylindrical mold and the hydraulic press was used in the experiments. The mechanical, physical and combustion tests were performed. The investigations indicated that mechanical and physical tests related to NaOH concentration and digestion time depending on biomass used. The experiments showed that the rice husk and sawdust treated with sodium hydroxide would yield the quality of biomass-lignite briquetting.

Chin Yee Sing et.al.,[10], this study presents a systematic approach in utilizing the large amount of oil palm mill residues that are loosely-bounded and have low energy density. The rate of waste materials (palm kernel shell, palm fiber and empty fruit bunches) generated by oil palm mills amounted to about 34 million tonnes in 2010. Efforts have been made to increase the energy density of the loosely-bounded waste materials, in which solid fuel briquettes made of densified oil palm residues would contribute towards a more efficient utilization of the waste material. This work focused on determining a fuel briquette with an optimum ratio of waste materials mixtures that has considerably high heating value and good mechanical properties. As part of the densification process, the waste material was pulverized and then compacted using a 200 kN force into 40 mm diameter briquettes. The heating values, proximate analysis, ultimate analysis and burning profile of the briquettes were studied. The end result was an optimised solid fuel with relatively high energy content made from a suitable mixing ratio of the different palm oil mill residues and an appropriate binder to ensure acceptable mechanical strength.

Anita Shrestha, et.al.,[11], this study presents an experimental production of solid waste briquettes from municipal solid waste by screw extrusion technology and piston press technology. Combustible matters present in municipal solid wastes like paper, plastic and biomass (represented by rice husk) were processed using grinders and shredders and then densified. Two varieties of Refuse derived fuel were subjected to heat (around 300 ^{0}C) in Screw Extrusion machine while seven varieties of Selective fuel in the composition 0-70% lignite and 5-30% polyethylene by weight were densified at a constant pressure of 3.12 tons/cm ^{2} at room temperature in piston press briquetting machine. Lime was added to one variety to capture emissions during fuel combustion. The production and analysis of the fuel briquettes were carried out according to Japanese Industrial Standards (JIS 8811, 8812) in the Biomass laboratory of NAST at Khumaltar. It was observed that addition of waste plastic improves fuel quality of low grade coal (lignite). High temperature and high pressure is required for briquetting the mixture of plastic and paper waste. The produced fuel briquettes might be suitable for use in industrial boilers and brick kilns but suitable control measures should be applied to capture harmful emissions.

Ramesh Man Singh , et.al.,[12], the study represents Bio briquettes are composite fuel prepared from a mixture of biomass and coal in a roller press briquetting machine. They consist of different proportions of biomass (up to 30%) and coal or lignite (up to 70%). Introduction of lime based desulfurizing agents (DSA) such as $CaCO_3$ and $Ca(OH)_2$ into the briquettes can reduce the SO_2 emissions by 80-90%, thus minimizing the pollution coming from coal combustion. Some fuel and combustion properties of these briquettes were studied. The briquette fuels have better physico-mechanical properties and combustion properties in comparison to coal/lignite. The ignition temperatures of biobriquettes are lower than coal or lignite, whereas the calorific values are greater than biomass. Hence, the biobriquettes can be used as an alternative fuel to fuel wood, coal and lignite in the kilns, boilers, combustors and for cooking as well.

A. O. Inegbenebor, [13], have carried out studies on fibrous agricultural and wood waste materials have been compressed with suitable adhesive into solid fuel briquettes in a compressing machine, which was designed and constructed for this purpose. Nine samples of fibrous waste materials were prepared into different categories:- Category A (100% saw-dust, 100% rice-husk, 50-50% rice-husk/sawdust using starch as adhesive). Category B (100% saw-dust, 100% rice-husk, 50-50% rice-husk/ saw dust using gum arabic as adhesive) and category C (100% saw-dust, 100% rice husk, 50-50% rice-husk/saw dust using bentonite as adhesive). The solid fuel briquettes in category C had the lowest average moisture content of 9.1%, categories A and B solid fuel briquettes had 10.5% and 13.0%, respectively. The results from a water boiling test (WBT), involving comparsion of the burning abilities of the solid fuel briquettes and fire wood of the same quantity (200 grammes) in boiling 1.5 litres of water showed that the solid fuel briquettes bound with each of the three adhesives; bentonite, gum arabic and starch; boiled water within a period of 14 to 22 minutes, while firewood did so within a period of 22 to 27 minutes. The open flame test showed that the solid fuel briquettes bound with starch burnt with bluish yellow flame with little black smoke indicating that the stoichiometric (air-fuel) ratio was almost correct. The solid fuel briquettes bound with gum arabic and bentonite burnt with yellow flame with moderate black smoke., indicating incomplete combustion due to poor air-fuel ratio. The reason for this cannot be ascertained.

Olawole Abiola Kuti, [14], in this research, composite sawdust briquette fuel were produced and utilized in order to simulate cooking. Within a time frame, a known amount of water was boiled to simulate cooking by burning composite sawdust briquettes in a biomass stove. The composite sawdust briquettes were produced using sawdust and charred palm kernel in percentage compositions of 50:50, 60:40, 70:30, 80:20 and 90:10, respectively. Starch gel was used as a binder. The boiling of water using the fuels was characterized into 3 namely the intermediate phase (initial boiling), high power phase (15 min after the initial boiling) and the low power phases (30 min after the high power phase). From the experiment, in respective of the percentage composition of the composite sawdust briquettes, the Percentage Heat Utilized(PHU) was found to increase from the intermediate phase through the low power phase. For other parameters like the Specific Fuel Consumption (SFC), Power Output and Burning Rate respectively, there was a sharp decrease from the intermediate phase through the low power phase

Elinge, C. M., et.al., [15], in study, five set of briquettes prepared from some agricultural wastes were studied. Sawdust blend briquette took twenty six (26) minutes to boil two litres of water while the non-blended sawdust briquettes took thirty (30) minutes. Blending with coal char generally decreased the moisture content of the briquettes and increased the ash content (from3:14 to 13.98%) and shear stress (from 76.0 to 265.0 KN/M2) thereby increasing the residence time for combustibility.

CHAPTER 3

METHODOLOGY

3.1. Primary Objectives of the Project:

- Semi-Automation of fuel briquetting machine.
- Increase the production rate.
- Reduce the production time.

3.2 Project Description

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Fig11 Briquette machine in AKCAKISLA

3.3 Design Of Briquette Press :

The design of the machine is shown as in figures :

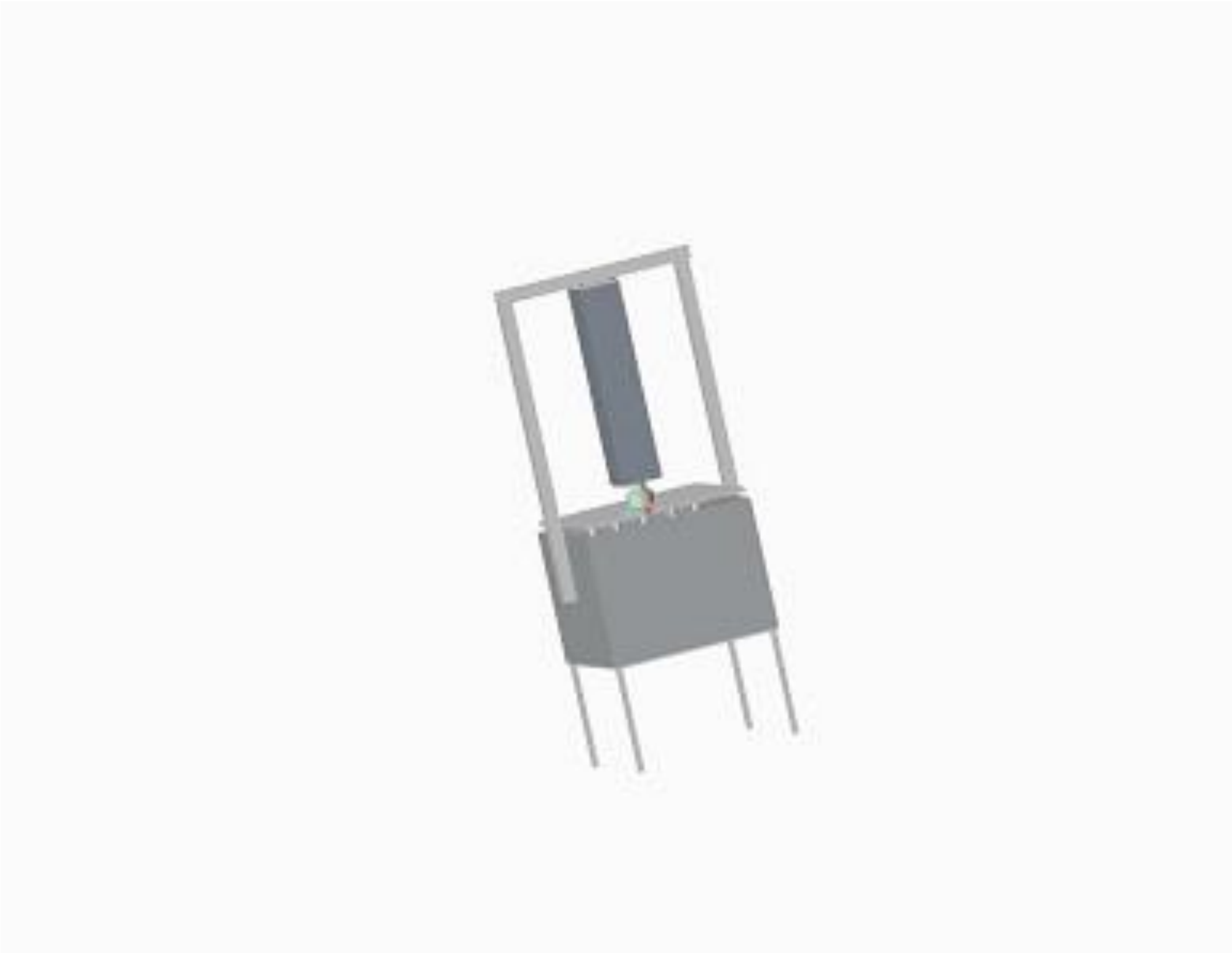


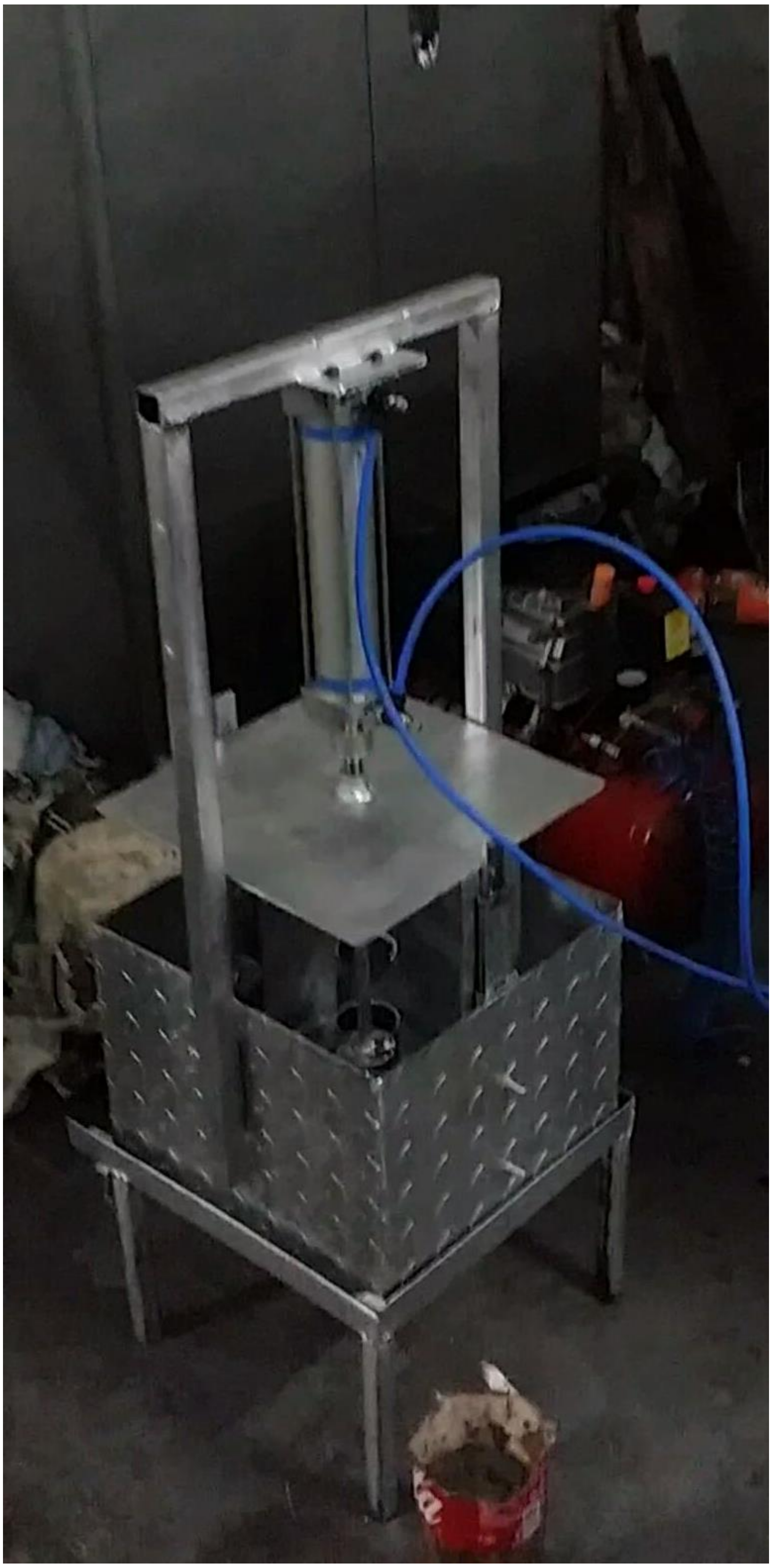
Fig. 13 fuel briquetting machine

Parts of the machine :

1. Base plate
2. Ramming plate
3. Moulding plate
4. Stand
5. Casing
6. Pneumatic cylinder setup
7. Pneumatic cylinder

FUEL BRIQUETTING MACHINE :

Fig 14 uel briquetting machine



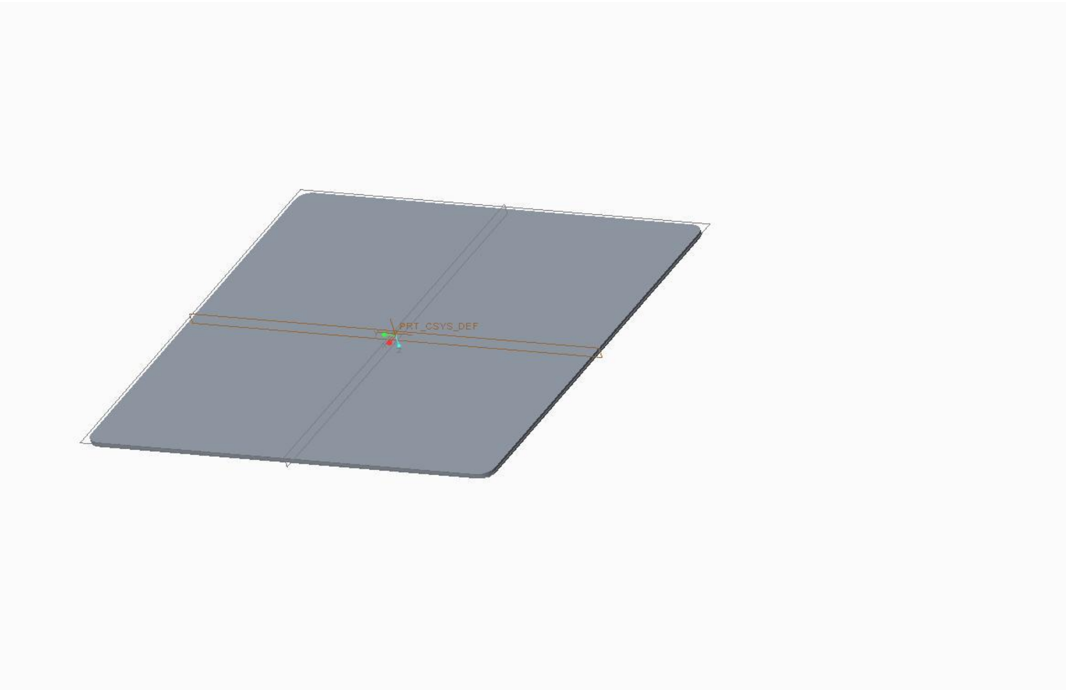


FIG I : BASE PLATE

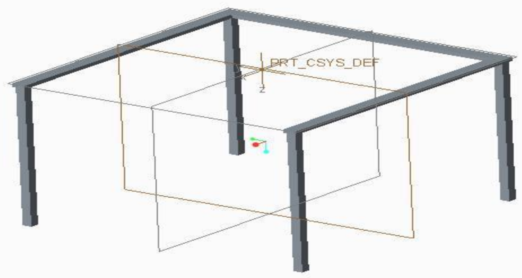


FIG II : STAND

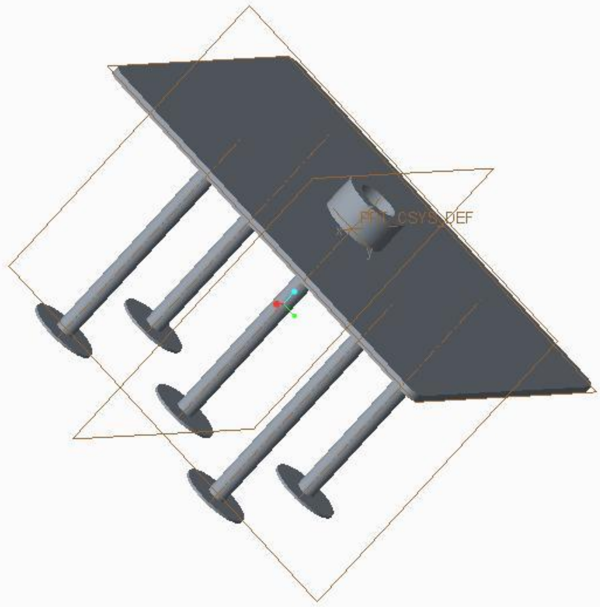
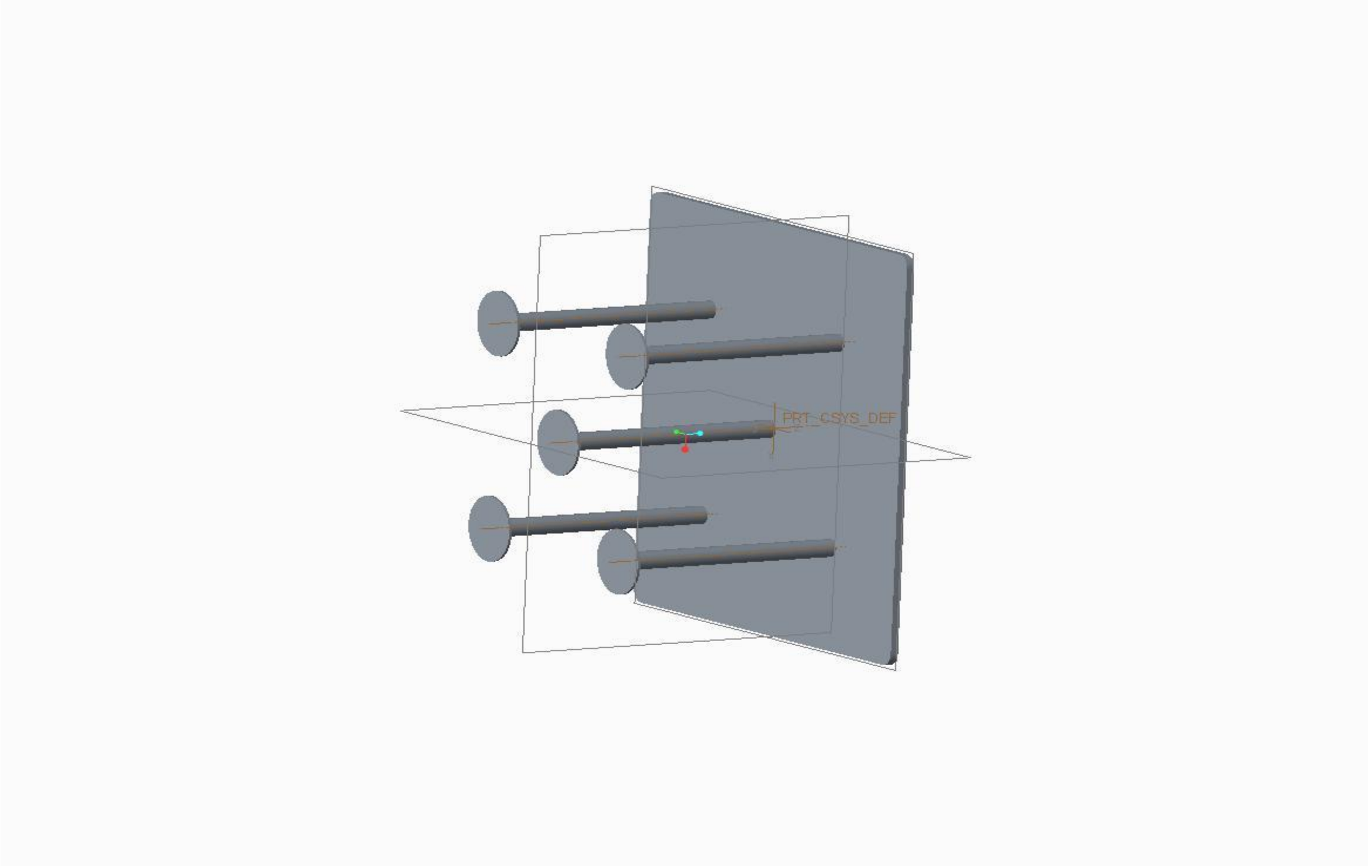


FIG III : RAMMING
PLATE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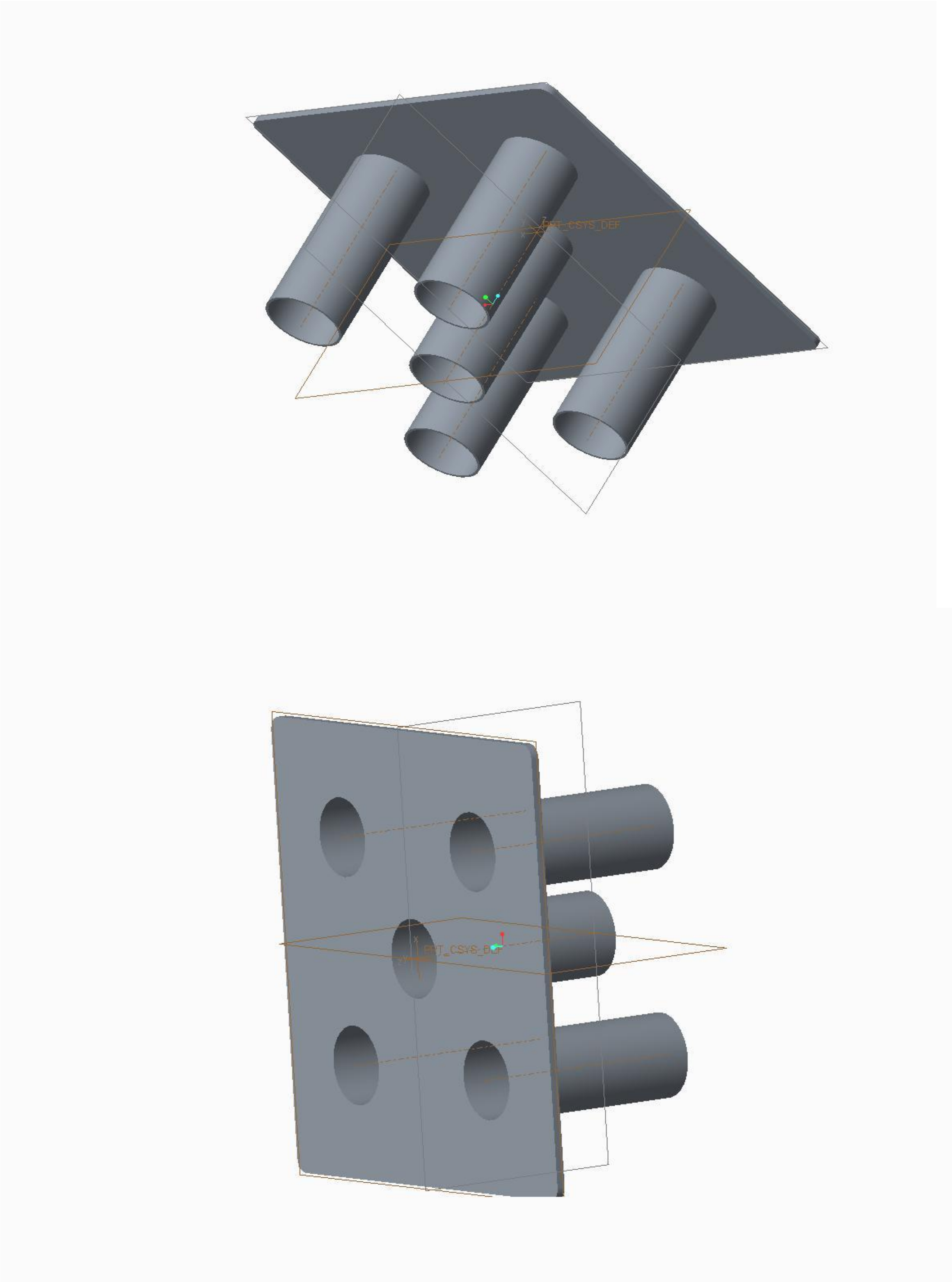


FIG IV : MOULDING PLATE

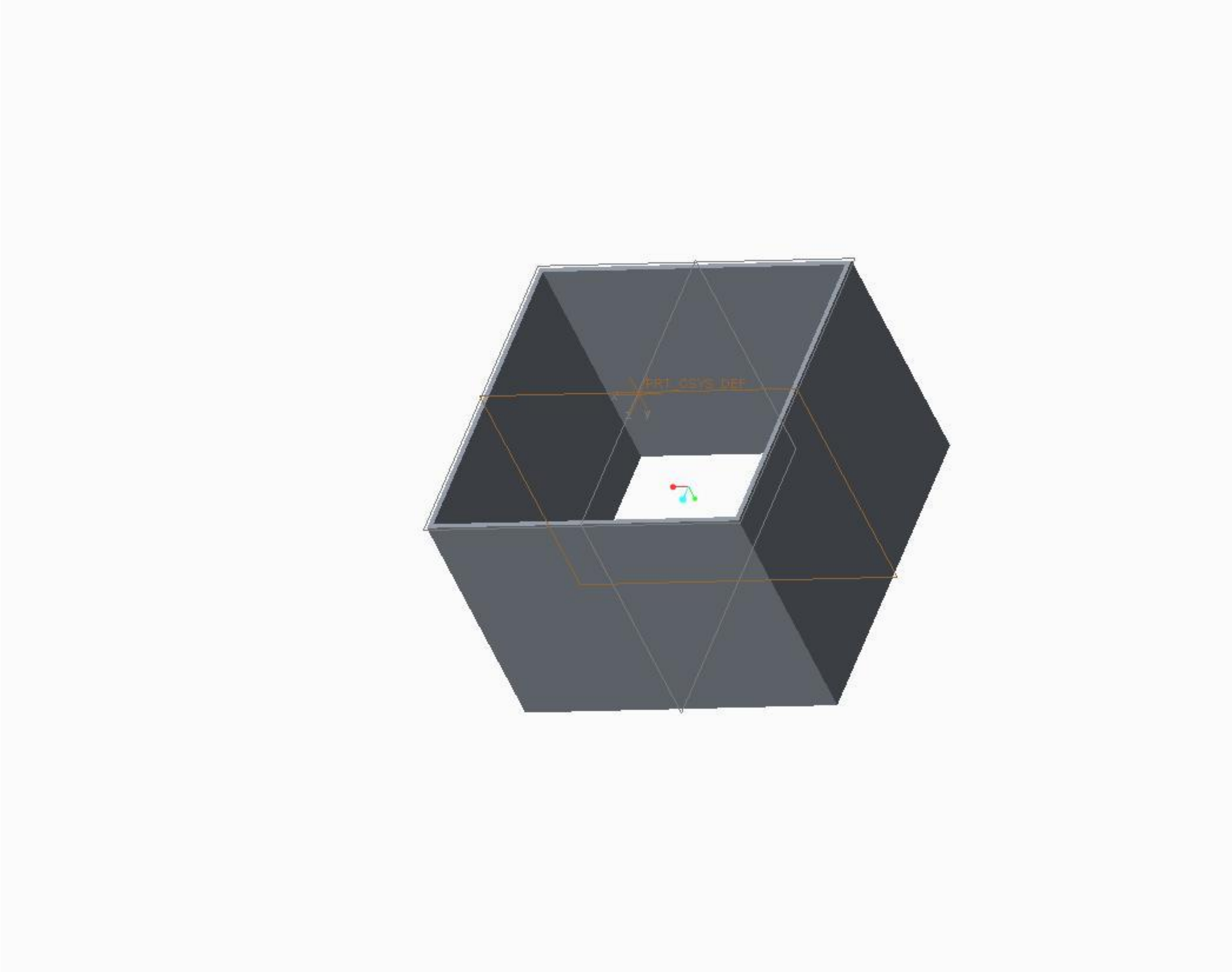


FIG V : CASING

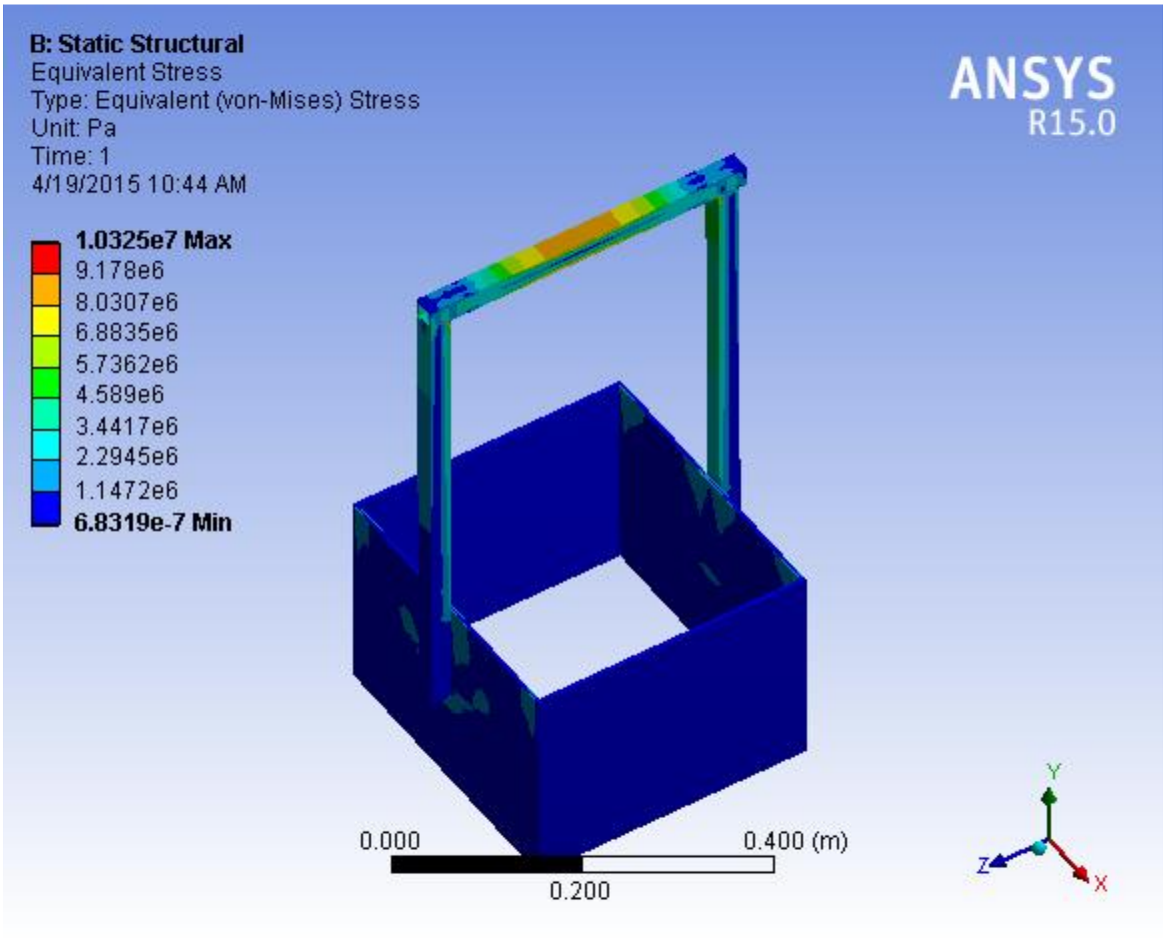
3.4 ANALYSIS:

Equivalent Stress

Subject:

Date Sunday, April 19, 2015

Comments:

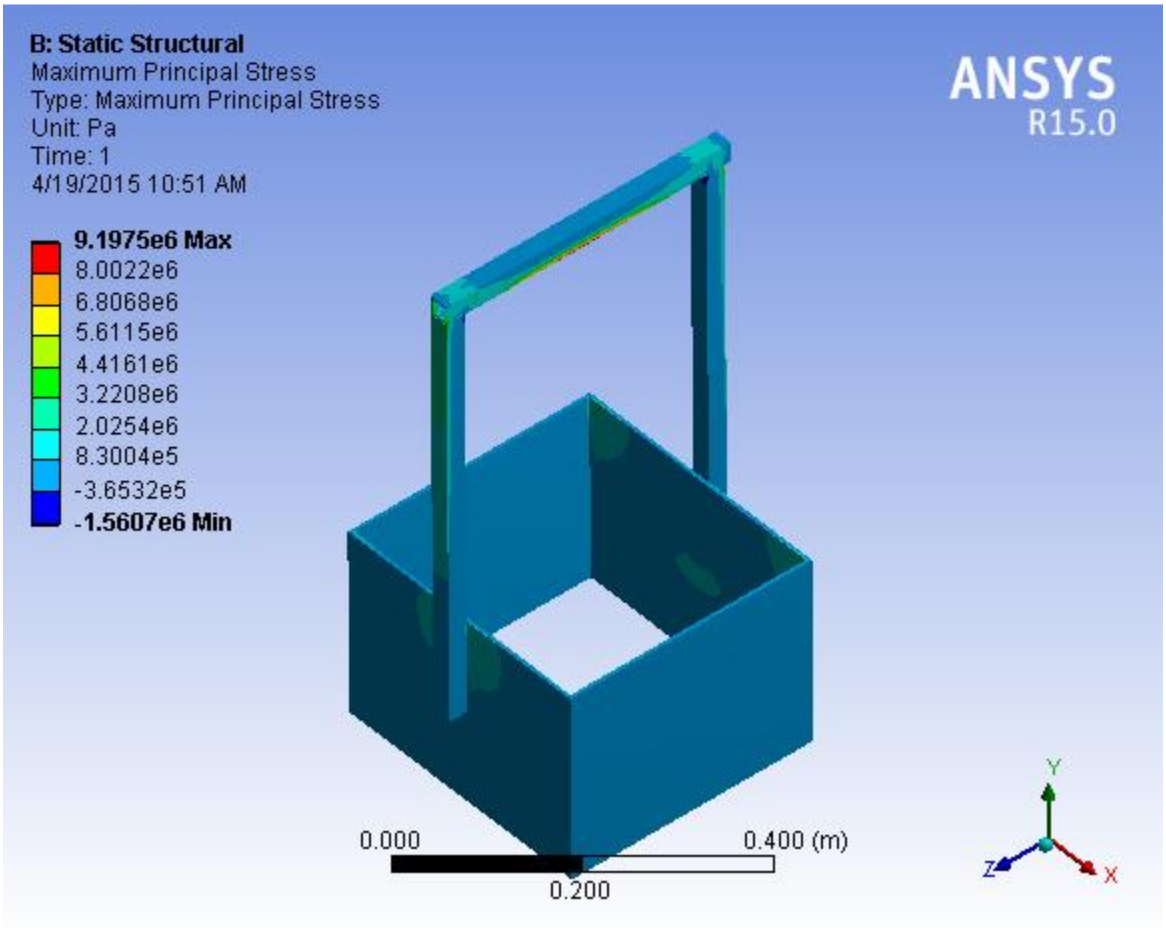


Maximum Principal Stress

Subject:

Date Sunday, April 19, 2015

Comments:

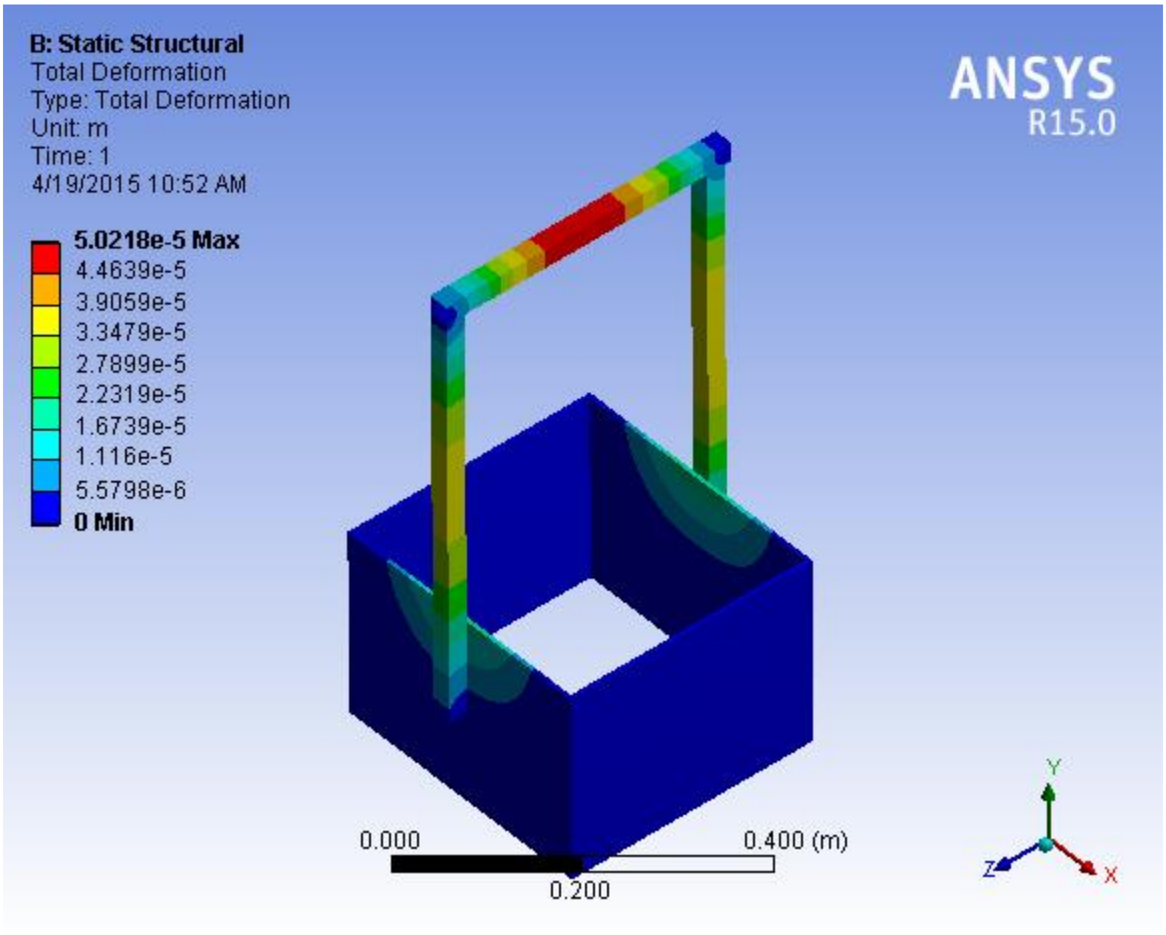


Total Deformation

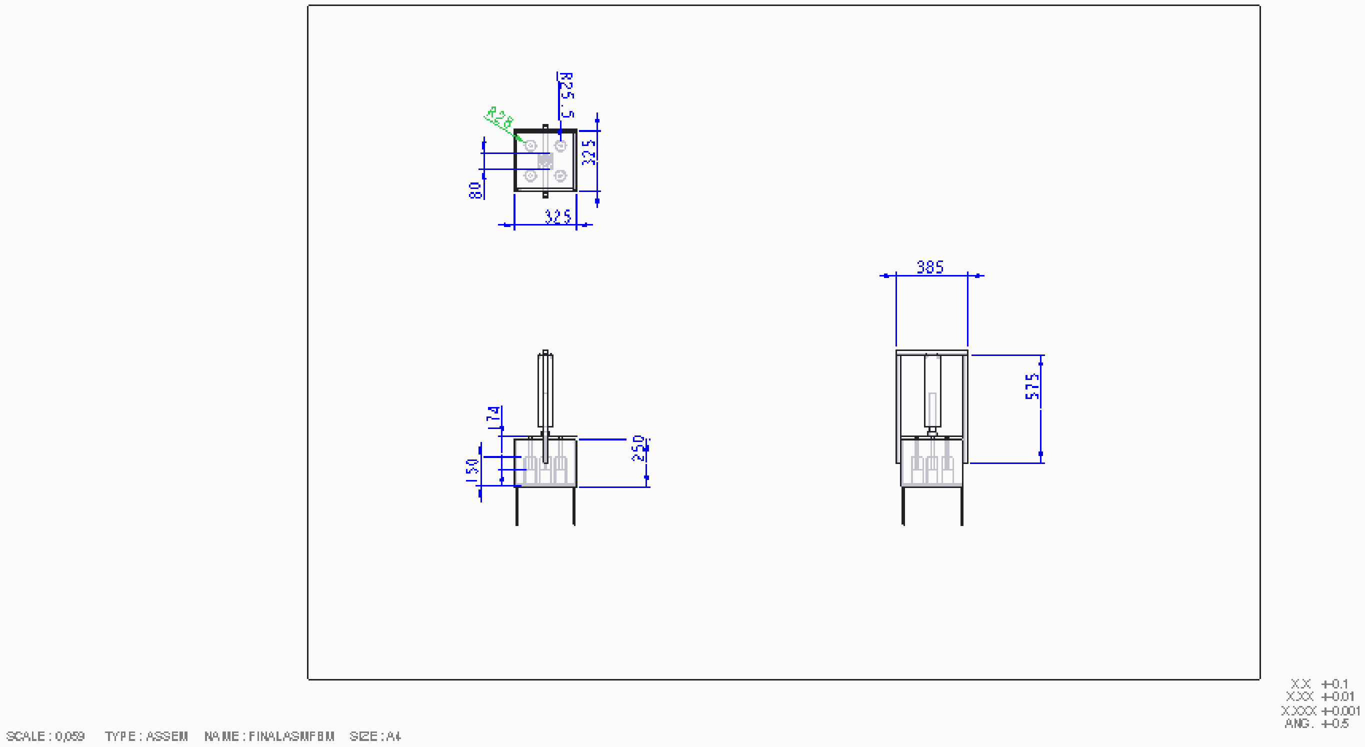
Subject:

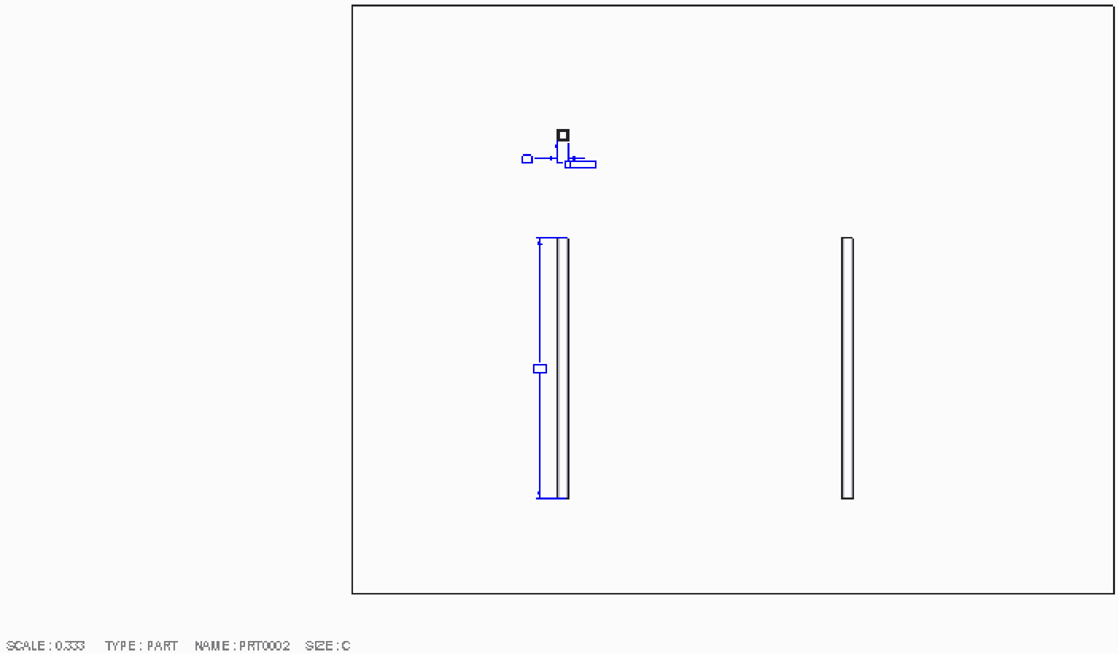
Date Sunday, April 19, 2015

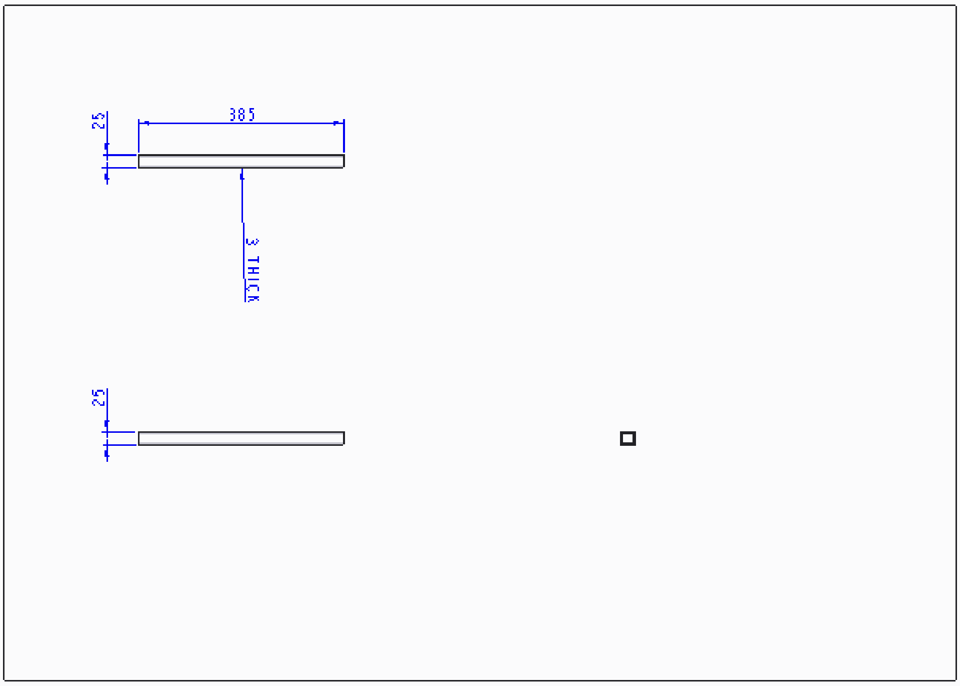
Comments:



3.5 2D DRAWINGS :

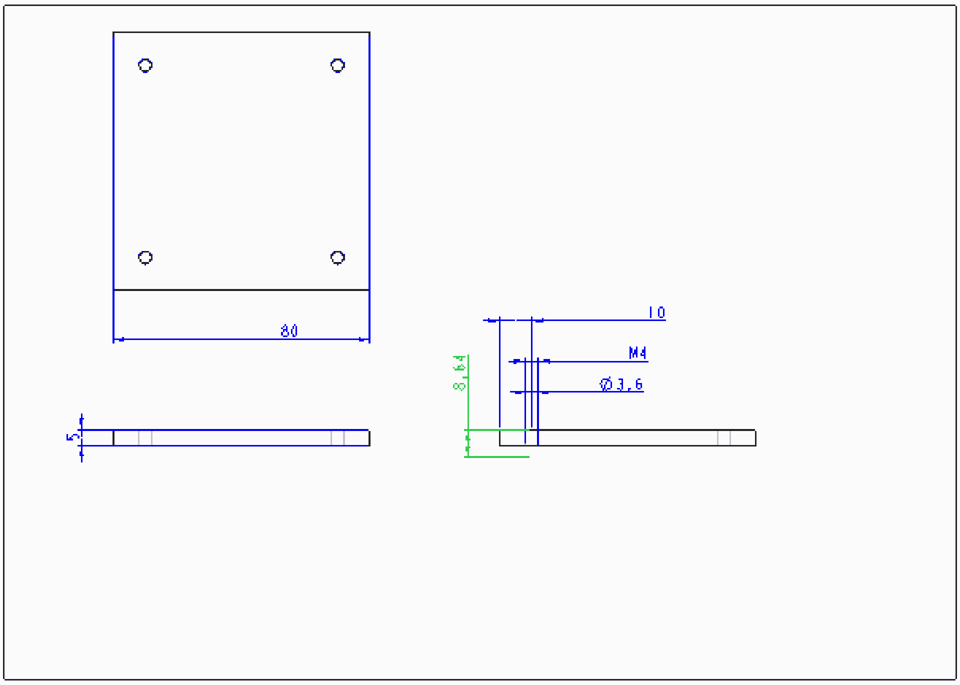






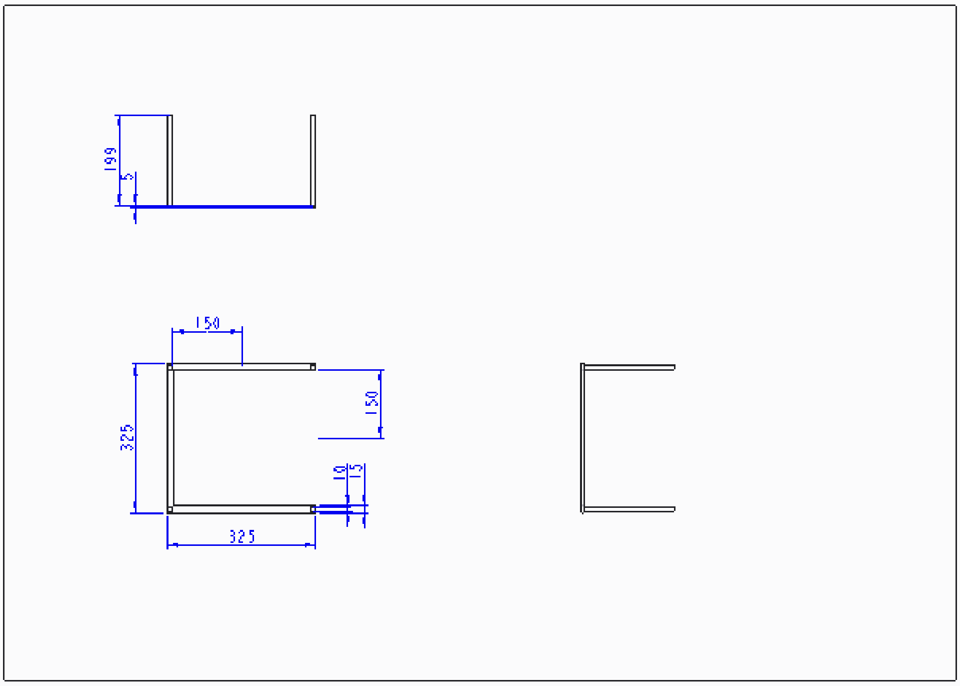
X.X +-0.1
X.XX +-0.01
X.XXX +-0.001
ANG. +-0.5

SCALE : 0,167 TYPE : PART NAME : PRT0003 SIZE : A4



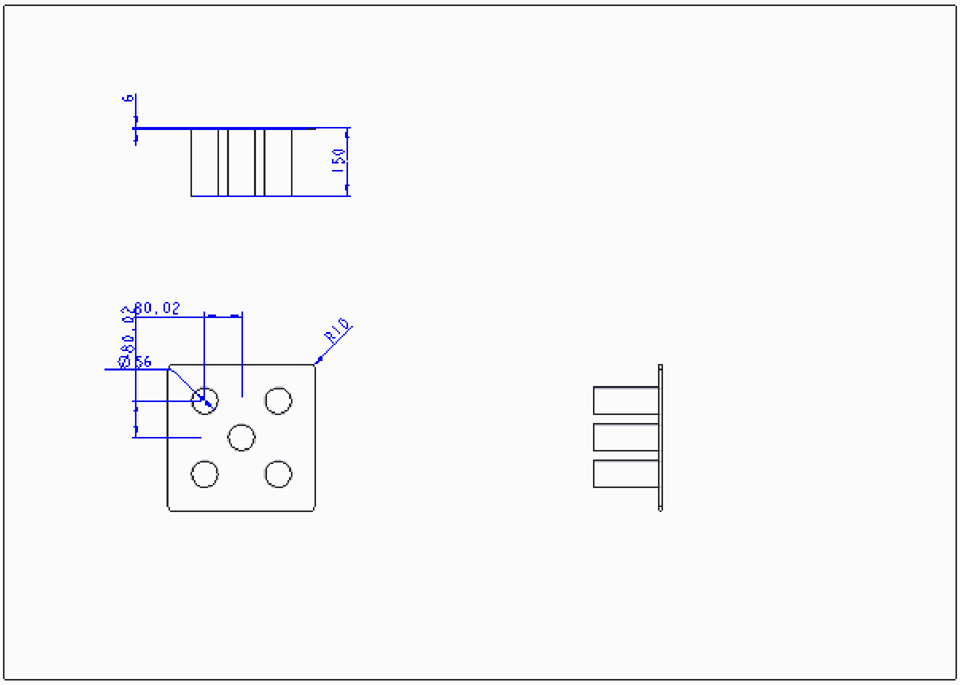
X.X +-0.1
X.XX +-0.01
X.XXX +-0.001
ANG. +-0.5

SCALE : 1,000 TYPE : PART NAME : PRT0004 SIZE : A4



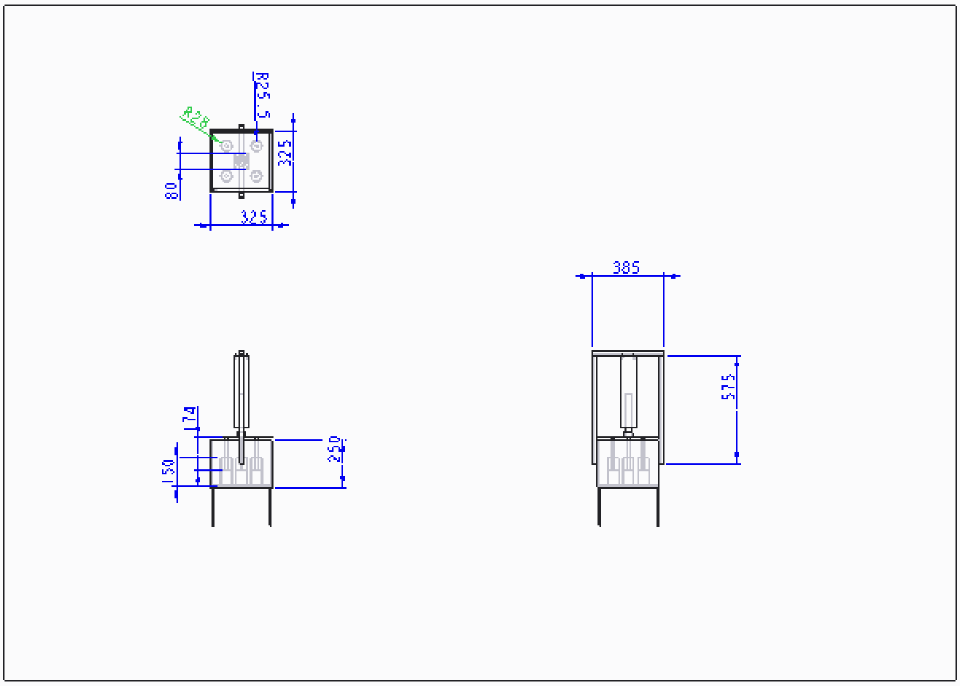
X.X +-0.1
X.XX +-0.01
X.XXX +-0.001
ANG. +-0.5

SCALE : 0,143 TYPE : PART NAME : STAND SIZE : A4



X.X +-0.1
X.XX +-0.01
X.XXX +-0.001
ANG. +-0.5

SCALE : 0,143 TYPE : PART NAME : PLATE_CYL SIZE : A4



X.X ±0.1
X.XX ±0.01
X.XXX ±0.001
ANG. ±0.5

SCALE : 0,059 TYPE : ASSEM NAME : FINALASMFBM SIZE : A4

3.6 Raw Material to make Biomass Briquette :

Almost all type of Agro-Forestry waste can be used, including:

• Wood chips Wood shavings

• Saw dust

• Wheat straw

• Rice husk

• Sunflower husk

• Peanut-shell

• sugar cane bagasse

• Maize stalk

• Corncob

• palm fruit bunch

• Cotton Stalks

• Coffee Husk

• Paddy Straw

• Tobacco waste

• Mustard Stalk

• Jute waste

• Bamboo Dust

• Tea waste

• Soybeans husk

• Forestry wastes and many other Agro wastes.

Flowchart of the Biomass Briquetting Machine Technology:

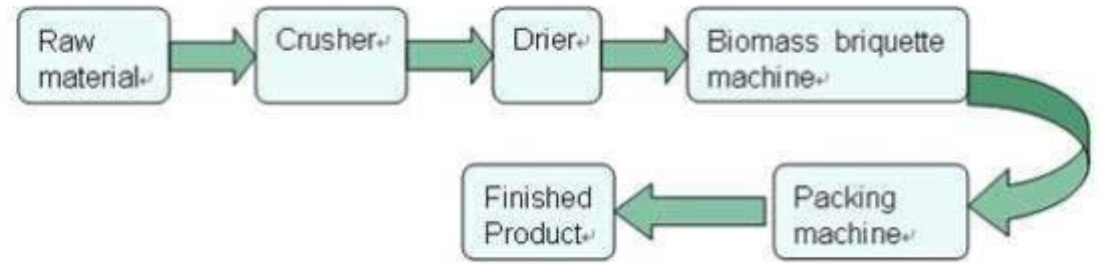


Fig30. Flow chart of the biomass briquette making

Anyang General International Co., Ltd is a leading biomass briquetting machine company in China, who have specialized in the design and manufacture of Biomass Briquetting Plant and Briquetting Machines.

3.7 Stepwise Sequence of Production of Fuel Briquettes From Agricultural, Domestic & Industrial Waste Materials

Process Document:

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Weigh saw dust and remove all thick sticks. Spread a 4 inch thick layer of saw dust on a plastic sheet.

Pour the used engine oil on the layer of saw dust. Cover the saw dust layer as if making a pizza with toppings.

Mix the oil and the saw dust well – either by walking on it with rubber boots or with your hands.

Collect mixed saw dust and oil in the center to make a pyramid. Cover the pyramid with oil and walk on it.

Be sure to mix the saw dust with the oil well, this will form the base for briquettes.

Put the mixture in drums or buckets, add water to the drum and stir and mix the pulpy solution well.

Put this pulp into the press to make a briquette. Operate the press as shown to make briquettes.

Dry the briquettes in the sun on a plastic sheet or on rods.

3.8 Calorific value of the briquettes:

After the briquettes are free undesirable moisture, it is analyzed in a bomb calorimeter and the results were obtained. Electrical energy is used to ignite the fuel; as the fuel is burning, it will heat up the surrounding air, which expands and escapes through a tube that leads the air out of the calorimeter. When the air is escaping through the copper tube it will also heat up the water outside the tube. The temperature of the water allows for calculating calorie content of the fuel.

3.9 Theoretical Background

About 2 billion or 1/3 inhabitants of the earth have no access to modern sources of cooking fuel, such as LPG gas. They rely on traditional fuels like scraps and pieces of wood, crop wastes and animal dung. Another, less common, cooking fuel source is kerosene. Usage of crop wastes without briquetting adds to air pollution, increases cooking time, affects health and leaves behind higher ash content.

Briquetting refers to the agglomeration or compaction into lumps of powdered, crushed or chipped material. Briquetted material is more easily transported and handled, and is more effectively utilized as a fuel. The art of briquetting is not a new discovery; coal briquetting has been practiced in Japan for over a century. Other materials have been briquetted since the early 1900's. In Japan, briquetting was first used to make coal briquettes as a replacement for wood for household cooking and heating. In Switzerland, the shortage of industrial fuel (coal) during the World War II led to the development of a new machine called a Glomera high pressure briquettor which could convert wood waste, paper waste, peat, charcoal dust and many other waste materials into industrial fuel. Densified sunflower biomass has been shown to be an acceptable combustion fuel. Physical properties of briquettes are closely related to the conditions under which they are made. Charbonnier and Vinnsman (1959) indicated the most important factors were binder, size, pressure, temperature, moisture and the nature of the material being briquetted. There are some thirty factors which could be related to the physical properties of briquettes. Tests of shatter resistance, moisture and density have been used to determine the quality of briquettes.

Rumph (1962) classified binding mechanisms into five general categories: (1) solid bridges, (2) adhesive and cohesive forces in non-freely-movable binders, (3) interfacial forces and capillary pressure at freely movable liquid surfaces, (4) attractive forces between solid particles (molecular – Vander Waal's or electrostatic forces), and (5) interlocking bonds. .In a particular briquetting process, some or all of the binding mechanisms are utilized. Usually one or two of them play a major role in the cohesion of briquettes. For instance, in briquetting metal turnings, borings and grindings, "interlocking bonds" is the mechanism most commonly utilized, while in briquetting binder less powder-like materials under high pressure, cohesion of the individual grains is affected by "Vander Wall's" forces, binding the gra in surfaces together.

In general, briquette strength increases with briquetting pressure and binding content. The effect of adding binder is simply to supplement or to substitute for the forces of cohesion between particles under pressure (Waters, 1971). Waters also indicated that some materials, as brown coal and vegetable wastes, are more briquettable (with no binder added) than others (i.e., bituminous coals). He explains that these materials contain "Built-in" binders (i.e., moisture, humic compounds , resins and waxes). Therefore, when briquetted at moderate pressure and temperature, their coking constituents soften and serve as a binder.

In binder less briquetting, as external compressive forces are applied to and transmitted through an aggregate of particles, a sequence of changes in the configuration of particles occurs (Waters, 1971). In stage 1, under very low pressure (<14 kg/cm2), the initially loose packed particles slide over each other into a tighter packing arrangement and the void space between particles decreases. In stage 2, with increasing pressure (up to 300 kg/cm2), closer packing of particles can only be achieved by their fracturing into smaller particles and by their plastic deformation. And in stage 3 (>300 kg/cm2), further compaction and reduction of void space can then occur by the plastic deformation of very small particles.

Water is one of the most useful agents that are employed as binders and lubricants (Moore, 1965). Water is particularly suitable as an aid in briquetting mixtures containing water-soluble constituents, such as starches, sugars, soda ash, sodium phosphate, potassium salts, calcium chloride, etc. Several investigations of different materials indicate that the strength and density of the briquettes would increase with increasing moisture until an optimum is reached. Iyengar (1959) investigated the effect of moisture on slack coal in India. He found an optimum moisture level of 12% for all briquetting pressures. At this moisture level, the highest compressive strengths were obtained. Landers (1959) obtained the best results from laboratory tests of Indian lignite at the same (12%) moisture content (m.c.). Haussmann (1975) found 15% m.c. favorable for briquetting sawdust, sander dust, shavings, peanut hulls or rice husks, etc. He recommended 10% m.c. as the optimum for fireplace log production.

Many materials can be briquetted better at a moderately elevated temperature than at room temperature. Materials containing heat-softening binders, such as pitch and tar, benefitted by mixing and briquetting at temperatures near the melting point of the binder (Moore, 1965). Iyengar (1959) noted an increase in the crushing strength of the coal briquettes from 16.94 kg/cm2 (241 psi) at 30 °C, to 247.63 kg/cm2 (3,552 psi) at 250 °C.

At North Dakota State University, Larue (1976) investigated the physical characteristics of sunflower stalk and wheat straw briquettes. Densities of 1.0 g/cm3 and greater were obtained for both. Density was found to increase slightly with increases in moisture content. A density of 0.12 g/cm3 was reported at 49% m.c. These observations were true .

BRIQUETTE MADE OF SAW DUST AND USED OIL

CHAPTER 4
Results & Discussions

MATERIALS USED IN BRIQUETTES		INDIVIDUAL PERCENTAGES OF USED MATERIALS		BURNING TIME	CALORIFIC VALUE	POLLUTANT PERCENTAGES IN SMOKE LIBERATED ON BURNING				ASH CONTENT
I	II	I	II	in secs	Kcal/ Kg	%C	%H	%N	%O	gms/unitgms
Paper	Saw dust	20	80	364 (6min4sec)	4523	52.28	5.20	0.47	40.85	14/270
Paper	Sugar cane	30	70	384 (6min24 sec)	3950	39.75	5.55	0.17	46.82	38/280
Paper	Dry leaves	30	70	250 (4min10 sec)	4256	45.95	5.40	2.76	39.17	16/270
Methi	Saw dust	10	90	390 (6min30 sec)	4625	51.9	4.8	0.39	41.20	16/286
Methi	Sugar cane	10	90	396 (6min36 sec)	4095	40.55	5.38	0.21	45.62	28/275
Paper	Wood chips	40	60	460 (7min40 sec)	4320	52.30	5.20	0.50	42.08	35/360

From the above table Calorific value, Pollutant percentages and Ash content of fuel briquettes are known.

CHAPTER 4

Conclusion

A fuel briquetting machine made up of mild steel has been fabricated which can produce five briquettes in one cycle. . As it is made of mild steel the machine is more rigid and durable , greatrer force could be applied. Since the machine produces five briquettes at a time , there has a been a tremendous increase in productivity. Manual labour cost was reduced .There by it can be said that it is a feasible, sustainable fuel briquetting machine.

two types of briquettes have been formed i.e

- used engine oil and sawdust
- Paper and banana peeels
- Tea and sawdust

If paper availability is there than it is better to go for paper and sawdust fuel briquettes. The amount of emission that are released using tea and sawdust are least in terms of percentage of hydrogen. Where as percentage of carbon emission is less in paper and banana peels fuel briquettes. The ash content is least in sawdust and paper fuel briquettes .With respect to burning time it is preferable to utilize sawdust and engine oil.

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Further work can be carried out by using other combinations of briquettes materials.

References

1. S. Rantalaa, T. Tyyneläb& M. Vickersc, Organic matter fuel briquettes as a forest conservation tool, Source :Publication of the Southern African Institute of Forestry, volume 202 ,year of publication 2004, pages 55-60.

2. Richard Hosier, Biomass briquettes in the Dominican Republic part I: Social and economic feasibility Biomass, January 1987, 13 (3), pg. 199-217.

3. S Yaman, M Sahan, H Haykiri-axca, K Sesen, S Kukbcuayrak, Production of fuel briquettes from olive refuse and paper mill waste, Fuel Processing Technology, Volume 68, Issue 1, October 2000, Pages: 23–.

4. S.R. Richards, Physical testing of fuel briquettes, Fuel Processing Technology,Volume 25, Issue 2, June 1990, Pages 89–100.

5. D. Rajputa, S.S. Bhagadea, S.P. Rautb, R.V. Ralegaonkarb, Sachin A. Mandavganec, , Reuse of cotton and recycle paper mill waste as building material, Construction and Building Material Volume 34, September 2012, Pages: 470–475.

6. M.J Blesa, , J.L Miranda, M.T Izquierdo, R Moliner, Curing temperature effect on smokeless fuel briquettes prepared with molasses and H_3PO_4, Published first on the web via Fuelfirst.com—http://www.fuelfirst.c om, Volume 82, Issue 13, September 2003, Pages 1669–1673

7. Lucy Wamukonya, Bryan Jenkins, Durability and relaxation of sawdust and wheat---straw briquettes as possible fuels, vol8,jan1 1995,pages :175-179.

8. J.T. Oladeji, M.Sc., Briquettes Produced from Corncob and Rice Husk Resides ,The Pacific Journal of Science and Technology, Fuel Characterization of, Volume 11. Number 1. May 2010 (Spring), pages 101-106.

9. Suparin Chaiklangmuang, Suwit Supa and Prattana Kaewpet, Development of Fuel Briquettes from Biomass-Lignite Blends, journal of science faculty of Chiang Mai University, Vol.35 No.1, january 2008,pages 43-50.

10. Chin Yee Sing and M. Shiraz Aris, A Study of Biomass Fuel Briquettes from Oil Palm Mill Residues, Asian Journal of Scientific Research, volume 6,year 2013, pages 537-545.

11. Anita Shrestha, Ramesh M Singh, Energy Recovery from Municipal Solid Waste by Briquetting Process: Evaluation of Physical and Combustion Properties of the Fuel, Nepal Journal of Science and Technology, vol.12, 2011, pages:238-241.

12. Ramesh Man Singh, Hee Joon Kim, Mitsushi Kamide, Toran Sharma, Biobriquettes-an Alternative Fuel for Sustainable Development, Nepal Journal of Science and Technology, Vol. 10, 2009, Page: 121-127.

13. A.O.Inegbenebor, Production of Solid Fuel Briquettes from Agricultural and Wood Waste (Saw Dust and Rice Husk), African Journal of Science and Technology, Vol 3, No.2, 2002.

14. Olawole Abiola Kuti Evaluation Of Composite Sawdust Briquette As A High Grade Fuel For Domestic Cooking , Publisher:Federal University Of Technology Akure , Issue:Aug-2003.

15. C. M. Elinge, A. U. Itodo, H Yusuf, Birnin – Yauri U. A, A. N Mbongo, Blending coal char on the combustion profiles of fuel briquettes, Academic Journal, vol2 , 01/2011, pages: 152-157.