A PROJECT REPORT

ON

"Biomass charcoal making by briquetting machine"

Submitted by

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Of

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UNDER THE GUIDANCE

Of

Prof. Amruta Karave

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CERTIFICATE

This is to certify that the project entitled

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To the Kalsekar Technical Campus, New Panvel is a record of bonafide work carried out by him under our supervision and guidance, for partial fulfillment of the requirements for the award of the Degree of Bachelor of Engineering in Mechanical Engineering as prescribed by **University Of Mumbai**, is approved.

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APPROVAL OF DISSERTATION

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Date: __________

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Abstract

This report investigates the innovation, execution, and conceivable commercialization of charcoal briquettes obtained from dry organic waste through heat treatments in developing markets. Given the absence of formal and unified waste administration framework in developing markets, we present a minimal effort heat treatment framework to deliver charcoal briquettes obtained from dry organic waste.

Bio-absorption, and other waste-to-energy advancements address potential answers for this issue, but because of mechanical, infrastructural, and transportation reasons these innovations have not hit the necessary scale to handle the huge volume of organic waste produced in metropolitan territories. With absence of framework or innovation for legitimate decomposing or reusing, organic waste addresses practically no money related incentive for cooperatives who work and fill in as true waste gatherers from metropolitan households. The briquetting innovation accessible is for the most part for the upscale business and for large scale manufacturing and which isn't feasible for the macro-associations or an individual we have likewise proposed an answer for it in this report which is prudent and attainable for such associations or a person.

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NOMENCLATURE

Abbreviations	**Descriptions**
ASEAN	Association of southeast Asian Nation
CO2	Carbon dioxide
O2	Oxygen
MCRC	Malicious code research center
UHG	United health group
USGS	United States Geological Survey
EPA	Environmental protection agency
DSC	Doctor of science
TGA	Therapeutic goods administration
DTG	Doller thrifty automotive group
FAO	Food and agricultural organization
SPF	Sun protection factor
VOC	Volatile organic compound
THM	Tril Halo Methane
GAC	Global assemble cache
HHV	High heating value

Chapter 1

1.1 Introduction:

World economy is depended and overwhelmed by advancements of fossil energy (petrol, coal, petroleum gas) to deliver fuels, powers, synthetic compounds and materials. While the utilization of regular energy like oil, coal and electricity has expanded massively in the previous 25 years in ASEAN economies, India actually imports raw petroleum and petroleum over 111.92 million tons each year. This substantial dependance on imported oil prompts monetary and social uncertainties. Presently there is a solid overall interest in the improvement of advancements that permit the misuse of sustainable power sources, both for environmental (release of pollutants and fossil reserves depletion) and economic reasons.

Biomass a household fuel source is normally plentiful and presents promising sustainable power opportunity that could give an option in contrast to the utilization of fossil fuel assets. Biomass being the third biggest essential energy asset on the planet, after coal and oil (bapat et al., 1997), it actually meets a significant part of the energy interest in rural spaces of most agricultural nations

In the entirety of its structures, biomass right now gives around 1250 million tons oil equivalent (mtoe) of essential energy which is about 14% of the world's annual energy utilization (Hall et al., 1991; Werther et al., 2000). The utilization of biomass feedstock for the replacement of fossil fuels has an extra significance from environmental change thought since biomass can possibly be CO2 neutral. Various innovative work endeavors towards the change of biomass feed stock into improved quality fuels (solid, liquid or gaseous) through natural and thermo-chemical transformation process have been made internationally over the most recent thirty years.

Raw agricultural residues have many disadvantages as an energy feedstock (Balatinecz, 1983). These include(i) moderately low calorific value,(ii) trouble in controlling the pace of consuming, (iii) trouble in automating continuos fedding (iv) huge volume or territory needed for capacity, and (v), issues in its transportation and circulation. A few of these impediments might be credited to the low mass density of rural buildups which can be changed over into high density fuel briquettes (Biomass charcoal briquettes). Charcoal is a top notch fuel generally utilized in many developing nations to meet utilization requirement just as an assortment of other need. Latest upgrades in innovation for charcoal briquettes creation with improved effectiveness has reestablished the interest in the utilization of charcoal briquettes as a fuel that can be effortlessly put stocked and moved.

Agricultural buildups establish one of the significant biomass feed stocks in India. Overall the agricultural deposits can be partitioned into two gatherings; crop buildups and agro businesses buildups created in India are straws of paddy, wheat, millet, sorghum, beats, oil seed crops; maize stalks and cobs; cotton and mustard tail; jute sticls; sugarcane refuse; leaves; sinewy materials; roots; branches and twigs with of sizes, shapes, structures and densities. The agro businesses buildups are rice husk, groundnut shell, cotton squander, coconut shell, coir essence, tamarind shell, mustard husk, coffee husk, cassava strip and so forth. A portion of the common agricultural residues accessible in huge amounts incorporate bagasse, rice husk, groundnut shell, tea squander, casuarina leaf litter, silk cotton shell, coir substance and so on.

MCRC dealing with various advancements has created a skill in biomass charcoal briquetting innovation in the course of recent years. This innovation can end up being one among many answers for enhancing the fuel prerequisites and socio-financial matters improvement of the rural regions by giving employement to provincial individuals. It is financially savvy, climatically well disposed and improve our air quality, and backing rural economies. Simultaneously, the forests would likewise be saved. Bio-char creation program could prompt foundation of new little employement situated organizations in country territories and raising the pay of individuals occupied with such exercises.

1.2 Types of coal:

1.2.1 Peat:

Peat, a natural fuel comprising of elastic material shaped by the incomplete deterioration of natural matter, essentially plant material, in wetlands like bogs, muskegs, swamps, fens, and fields. The improvement of peat is supported by warm, sodden climatic conditions; be that as it may, peat can grow even in chilly locales like Siberia, Canada, and Scandinavia. Peat is just a minor supporter of the world energy supply, yet enormous stores happen to be in Canada, China, Indonesia, Russia, Scandinavia, and the United States. In the mid 21st century the main four peat makers on the planet were Finland, Ireland, Belarus, and Sweden. Significant clients of peat incorporate Finland, Ireland, Russia, and Sweden.

The development of peat is the initial phase in the arrangement of coal. With expanding profundity of internment and expanding temperature, peat stores are slowly changed to lignite. With expanded time and higher temperatures, these low-position coals are progressively changed over to subbituminous and bituminous coal and under specific conditions to anthracite.

1.2.2 Lignite:

Lignite, is generally a yellow to dull earthy colored or once in a while dark coal that is framed from peat at shallow depths and temperatures lower than 100 °C (212 °F). It is the primary result of coalification and is halfway among peat and subbituminous coal as indicated by the coal characterization utilized in the United States and Canada. In numerous nations lignite is viewed as an earthy colored coal. Lignite contains around 25 to 30 percent carbon (on a dry, debris free premise) and has a calorific worth close to 17 mega joules for each kilogram (7,000 British warm units for every pound).

It has been assessed that almost 50% of the world's complete demonstrated coal saves are comprised of lignite and subbituminous coal, yet lignite has not been abused to any incredible degree, since it is mediocre compared to higher-position coals (e.g., bituminous coal) in calorific worth, simplicity of dealing with, and capacity strength. In zones where different fuels are scarce, the creation of earthy colored coal far surpasses that of bituminous coal.

1.2.3 Bituminous/Sub Bituminous Coal:

Bituminous coal is a natural sedimentary stone framed by diagenetic and sub transformative pressure of peat marsh material. Its essential constituents are macerals: vitrinite, and liptinite. The carbon content of bituminous coal is at around 60–80% and the rest is made out of water, air, hydrogen, and sulfur, which have not been driven off from the macerals. Bank density is roughly 1346 kg/m³ (84 lb/ft³). Mass density regularly rushes to 833 kg/m³ (52 lb/ft³). The heat content of bituminous coal goes from 24 to 35 MJ/kg (21 million to 30 million BTU for every short ton) on a clammy, mineral without matter premise. Inside the coal mining industry, this sort of coal is known for delivering the biggest measures of firedamp, a risky combination of gases that can cause underground blasts. Extraction of bituminous coal requests the most elevated safety techniques including careful gas observing, best ventilation and watchful site the executives.

Bituminous coals are explored by vitrinite reflectance, moistness content, volatile matter, pliancy and debris content. All things considered, the most raised worth bituminous coals have a specific assessment of versatility, volatility and low debris content, especially with low carbonate, phosphorus, and sulfur.

1.2.4 Steam coal:

Steam Coal is a flammable dark or tanish dark sedimentary stone for the most part occuring in rock layers in layers or veins called coal beds or coal creases. The harder structures, for example, anthracite coal, can be viewed as transformative stone in light of later exposure to raised temperature and compression factor. Coal is made essentially out of carbon, alongside factor amounts of different components, predominantly hydrogen, sulfur, oxygen, and nitrogen. Coal is a non-renewable energy source that forms when dead plant matter is changed over into peat, which thusly is changed over into lignite, at that point sub-bituminous coal, after that bituminous coal, and ultimately anthracite. This includes natural and land measures. The geographical cycles happen more than a millions of years.

1.2.5 Anthracite:

Anthracite, regularly alluded to as hard coal, is a hard, compact variety of coal that has a submetallic radiance. It has the most elevated carbon content, the least impurities, and the most noteworthy energy density of a wide range of coal aside from graphite and is the most highest positioning of coal.

Anthracite is the most transformed kind of coal (yet addresses poor quality transformation), in which the carbon content is somewhere in the range of 92% and 98%. The term is applied to those assortments of coal which don't radiate tarry or other hydrocarbon fumes when heated underneath their point of ignition. Anthracite flares off with trouble and ignites with a short, blue, and smokeless fire. It is classified into standard grade, which is utilized fundamentally in power generation, and high grade (HG) and ultra high grade (UHG), the chief employments of which are in the metallurgy sector. Anthracite represents about 1% of worldwide coal reserves, and is mined in a couple of nations all throughout the planet. China represents most of worldwide creation; different makers are Russia, Ukraine, North Korea, South Africa, Vietnam, the UK, Australia, Canada and the US.

1.3 Problem definition:

A large portion of the coal reserves happen in the north-eastern territory in India. Different territories of the nation either have no coal reserves or restricted reserves of low-quality coal. Coal circulation is profoundly unbiased all through India.

Coal needs to bear exceptionally significant expense of transportation from the mines to the burning-through centers. Accordingly, the coal-consuming businesses need to address a significant expense for coal. A large part of the Indian coal is non-coking grade. This is unacceptable for metallurgical businesses. The Gondwana coal has high ash content, while the Tertiary coal has high Sulfur content. More than 90% of the coal is moved by rail routes. The issue in transportation emerges because of absence of railroad offices, variety in checks, deficiency of carts, sluggish movement of trains, pilferage, etc.

The coal mining strategies are old and obsolete and a large portion of the work is done through manual work. This prompts high creation cost in India. The coal dust in the mines and close to the pit-heads makes natural contamination, antagonistically influencing the miners and their families.

The consuming of coal in industrial facilities and thermal plants discharges numerous poisonous gases in the climate. The safety measures are costly. There are substantial losses because of pilferage, and fire in the coal mineshafts and at pit-heads. This prompts a climb in the coal costs. Powers issues, particularly in the Damodar Valley area hampers the mining work. It is a serious issue.

There are extreme health impacts brought about by consuming coal. As indicated by a report by the World Health Organization in 2008, coal particulates contamination are assessed to abbreviate around 1,000,000 lives every year around the world. the rundown of recorded coal mining calamities is a long one, despite the fact that it ought to be noted business related coal deaths has declined considerably as safety measures have been sanctioned and underground mining has surrendered piece of the market to surface mining. Open cut perils are basically mine divider disappointments and vehicle crashes.

1.4 Aim of project:

- The study aims to evaluate the fuel properties of charcoal briquettes made from combinations sugarcane bagasse, dried leaves and dried branches at specified ratios.
- To design and manufacture a briquetting machine which is economical and feasible for small organization or an individual. With a production rate of 40kg/hr – 60kg/hr.
- To produce biomass briquettes with a calorific worth of around 3700 – 4600 kcal/kg.
- To use the labor to create biomass briquettes.
- To produce biomass briquettes with a lower debris content of around 0.7 – 18 % when contrasted with that of coal which is around 20-40 %.
- To produce biomass briquettes of thickness 1000 – 1200 kg/m3 relying on the raw materials put into the kiln.
- To produce strong briquettes which would consume for longer timeframe when contrasted with that old style densified biomass.

Chapter 2

2.1 Literature Review:

In the previous chapter we have studied about coal and discussed its different types and the problems raised in India regarding the coal and its availability. the problem needs to be solved and the need for an effective tree waste management technique and the alternative source for the fossil fuel for domestic as well as industrial purpose. Literature survey is done out to identify the types of tree biomass which can be used for the production of charcoal. Study the percentage of components present in the natural charcoal and its calorific value in order to compare it with charcoal made by briquetting technique. Select the optimum way to burn the biomass and considering the cost effectiveness. And the energy consumption and suitability for different operating conditions.

2.2 Literature review on Evaluation of Fuel Properties of Charcoal:

Gino Martin T. Arellano [1] The study aims to evaluate the fuel properties of charcoal briquettes made from combinations of coconut shell, corn cob and sugarcane bagasse at specified ratios. In the study, single (100%), double (50%-50%) and triple (33%-33%-33%, 50%-25%-25%, 50%-37.5%-12.5%) constituent briquettes were produced with compaction pressures of 2.2 MPa, 4.4 MPa and 6.6 MPa. The fuel properties evaluated are calorific value as well as density, relaxation and compaction ratios. Blending combinations of charcoal from different raw materials showed an improvement in the calorific value. Among the multiple constituent briquettes, 50% coconut shell – 25% corn cob – 25% sugarcane bagasse combination yielded the highest calorific value at 19951.4 J/g which was comparable to coconut shell charcoal, having the highest calorific value among all charcoal at 21693.3 J/g. The compaction pressure had a significant effect only on the volume displacement of the briquettes due to more void space in the raw materials that can be filled up upon the application of higher compaction pressure. The mixture ratio greatly affected the stability and calorific value of the product briquettes.

S.R.Teixeira [1] Brazil is the largest worldwide producer of alcohol and sugar from sugar-cane and has an extensive alternative program for car fuel which is unique. The objective of this work is to offer one management option of a solid residue produced by this industrial segment. The pressed sugar-cane bagasse is burned to produce steam and electricity by cogeneration. The combustion yields both bottom and fly ashes which contain high amounts of silicon oxide as a major component. Fly ash which contains a high volume (>30% by weight) of charcoal was used in this work. The ash was sieved to separate the thick charcoal from inorganic materials which are concentrated in the thinner fraction. The briquettes were hand pressed using charcoal mixed with a binder (starch) obtained from cassava flour (a tropical root). The results (density, mechanical resistance) obtained with 8% by weight of starch binder are presented here. Thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) were used to characterize the ashes and the briquettes. The results show that sugar-cane bagasse fly ash (SCBFA) can be used to produce briquettes With an average density of 1.12 g cm_3 and an average calorific value of 25,551 kJ/kg.

2.3 Literature review on briquetting technology:

Gino Martin T. Arellano[2] This study proved that stable charcoal briquettes made from combinations of coconut shell, corn cob and sugarcane bagasse charcoal can be produced at the specific conditions. Even though the multi-constituent mixtures did not yield a higher calorific value than single-constituent charcoal, blending combinations of charcoal from different raw materials caused an improvement in the calorific value. Combinations with higher coconut shell content yielded higher calorific value compared to mixtures with high corn cob and sugarcane content. Coconut shell charcoal yielded the highest calorific value among all combinations while 50-25-25 coconut shell, corn cob and sugarcane bagasse combination had the highest calorific value for all muti-constituent mixtures. Even though the 50-25-25 coconut shell, corn cob and sugarcane bagasse combination did not meet all the standards for good commercial briquettes, the calorific value was enough for cooking and boiler heating purposes. In the study, the compaction pressure had a significant effect only on the compaction ratio. The compaction pressure greatly affected the volume displacement of the briquettes. On the other hand, the mixture ratio had a significant effect on the calorific value, density, relaxation and compaction ratio. The ratio at which raw material charcoal were blended is a major factor on the stability and calorific value of the products. Briquettes with higher coconut shell charcoal content yielded high density ratios which is an indicator of more stable briquettes. On other hand, higher compaction ratios were achieved with briquettes of high corn cob and sugarcane bagasse charcoal content. This signifies that more volume was displaced in the briquetting of the charcoal.

Kevin Kung [3] In many regions of the developing and emerging markets, proper management (disposal or recycling) of organic waste represents a significant and continued challenge. Bio-digestion, composting, and other waste-to-energy technologies represent possible solutions to this problem, however due to technological, infrastructural, and logistical reasons these technologies have not hit the required scale to tackle the significant volume of organic waste generated in urban areas. With lack of infrastructure or technology for proper composting or recycling, organic waste represents little to no monetary value for waste picker cooperatives who operate and serve as de-facto waste collectors from urban households. This paper explores the technology, implementation, and possible commercialization of charcoal briquettes derived from organic waste through thermal treatments in emerging markets. Given the lack of formal and centralized waste management system in emerging markets, we present a low-cost thermal treatment system to produce charcoal briquettes derived from organic waste. Our project and subsequent experiments take place in both the rural and urban areas of Kenya.

We first explored the market in early 2012, interviewing 17 waste picker cooperatives and 5 charcoal producers. Subsequently we conducted our first test in rural area of Rumuruti, Kenya where we successfully demonstrated the use of our low-cost kiln design for the production of charcoal briquettes using agricultural waste. This process has now been scaled to 50 kilns in the community. In urban areas, specifically Kibera, Nairobi, Kenya we partnered with waste picker cooperatives to conducted trials with urban waste. Different methods of briquette-making and binding have been quantitatively tested for carbon monoxide and particulate emissions, and we demonstrated that there are viable methods to make briquettes that are within the safety standards. After one year of field study and operations (establishment of organic waste derived charcoal briquettes), we have demonstrated the technical viability of such an operation. However, challenges persist in the standardization and commercialization of organic-waste derived charcoal briquettes. We present a hypothesis on the commercialization strategy and possible business model that can be utilized by enterprises looking to venture into commercial scale operations.

2.4 Literature review on charcoal properties:

L.Wang[4] in this work, effects of storage time and conditions on the properties of one woody charcoal were studied. Prior to the storage test, the untreated charcoal was characterized by thermogravimetry/mass spectrometry (TG/MS). Weight loss (TG) and evolution profile curves of selected gaseous products were obtained from charcoal pieces that have various appearances, apparent densities and sizes. The result implies that the charcoal pieces have experienced different carbonization conditions. The charcoal samples were collected during the storage test under well controlled conditions and further characterized. It was found that the volatile content of the collected charcoal samples decreases along the storage time. The ash content of sampled charcoal only changed slightly. Accordingly, the fixed carbon content of sampled charcoal decreased about 3% in comparison to the initially loaded untreated charcoal samples. Such decrease of fixed carbon content of charcoal during storage might cause considerable reduction of profitability for an industry that consumes large amounts of charcoal at a relatively high price.

In this work, thermal decomposition behaviors of one type of wood charcoal was studied by thermogravimetric analysis combined with mass spectrometry. TG, DTG and evolution profile curves of selected gaseous products imply that untreated charcoal samples have different properties and might experience different carbonization conditions.

Effects of storage time and conditions on the properties of the woody charcoal were also studied. It was observed that volatile content of the collected charcoal samples generally increased along the storage time, whereas the fixed carbon content of the samples decreased on average by about 3%. Findings of the present work indicate that properties of charcoal might change considerably after certain storage and transportation time. Such changes are related to storage conditions, and charcoal properties and size. Further work is needed to establish the mechanisms behind the changing charcoal properties.

2.5 Production and Characterization of Briquette Charcoal:

Abdu Zubairu, Sadiq Abba Gana [1] studied that the Waste agricultural biomass (corn cobs) was carbonized in a metal kiln, 90cm in height and 60cm diameter. Four different briquette charcoal grades were produced using locally sourced tapioca starch as binder at concentrations of 6.0, 10.0, 14.0 and 19.0 % w/w. Characterization test was carried out for the charcoal briquettes. The fixed carbon content of the briquette grades is 72.776, 73.958, 78.794, 81.884% w/w respectively. Similarly, the ash content for the briquette grades is 21.38, 20.70, 14.24 and 11.49 % w/w respectively. The bulk density is 425.6, 425.7, 425.0 and 358.3 kg/m3 respectively and the moisture content is 5.88, 5.34, 6.99 and 6.63 % w/w respectively. The properties of the produced briquette charcoal were compared with that of sugarcane bagasse and wood charcoal. The briquette charcoal was found to be a better fuel when compared to both sugarcane bagasse and wood charcoal, having a highest fixed carbon content and highest bulk density. The corn cobs briquettes have lower moisture content compared to sugarcane bagasse however has higher moisture content than wood charcoal. In addition, the sugarcane bagasse and wood charcoal were found to have lower ash content (4.33 % and 9.80% respectively) compared to all the five charcoal grades produced. The briquette charcoal has a mean calorific value of 32.4 MJ/kg which is significantly higher than that of both bagasse at 23.4 MJ/kg and wood charcoal at 8.27MJ/kg.

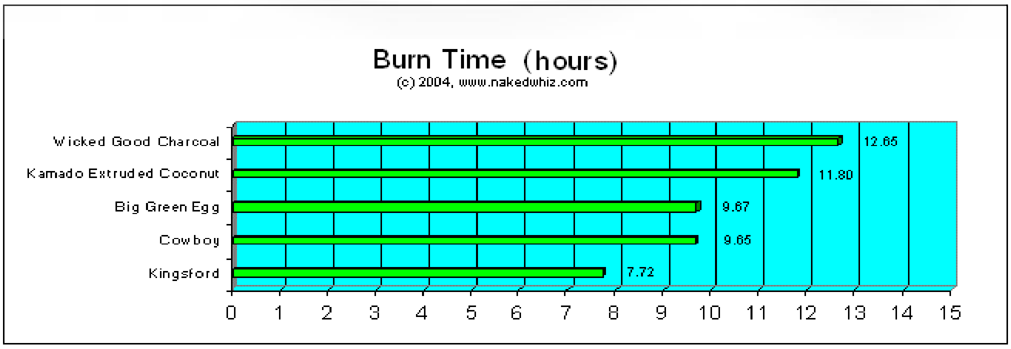


Fig 2.1 burn time comparison of charcoal 1

Chapter 3

3.1 Methodology:

Charcoal briquettes are derived from two fundamental raw materials, charcoal fines and starch. The fines result from the production of charcoal from sustainably managed planted eucalyptus or from the steel industry, a major consumer of charcoal.

Charcoal fines are a material thoroughly ailing in pliancy and along these lines need the expansion of an adhering or agglomerating material to empower a briquette to be shaped. The binder ought to ideally be ignitable, however a non-flammable binder that is compelling at low concentration might be reasonable. In our cycle, starch was used as a binder despite the fact that it is generally costly. The starch utilized was extracated from babaçu mash in the Amazon area, as a side-product of the babaçu nut-based initiated charcoal industry. Essentially, briquetting requires a binder to be blended in with the charcoal fines, and a press to shape the combination into a cake or briquette, which is then taken through a dryer to fix or set it by drying out the water, so the briquette is sufficiently able to be utilized in a similar consuming device as typical charcoal.

Charcoal briquettes are made of two essential ingredients (including about 90% of the end result) and a few minor ones. One of the essential ingredients, known as char, is fundamentally the conventional charcoal, as portrayed previously. It is liable for the briquette's capacity to light effectively and to create the ideal wood-smoke flavor. The best raw material for this segment is hardwoods like beech, birch, hard maple, hickory, and oak. A few makers likewise use softwoods like pine, or other natural materials like organic product pits and nutshells. The other essential ingredient, used to create a high-temperature, enduring fire, is coal. Different sorts of coal might be utilized, going from sub-bituminous lignite to anthracite. Minor ingredients incorporate a binding specialist (regularly starch produced using corn, milo, or wheat), an catalyst (like nitrate), and a ash brightening specialist (like lime) to allow the grill to know when the briquettes are prepared to cook stove.

The following process are carried out to achieve the desired final product:

3.1.1 Pyrolysis:

Pyrolysis is a cycle of chemically breaking down natural materials at raised temperatures without oxygen. The cycle commonly happens at temperatures over 430 °C (800 °F) and under pressure. It all the while includes the difference in actual and compound structure and is an irreversible cycle.

3.1.2 Carbonization:

Carbonization is a pyrolytic response, hence, is viewed as a perplexing cycle in which numerous responses happen simultaneously like dehydrogenation, compresstion, hydrogen movement and isomerization. Carbonization contrasts from coalification in that it happens a lot quicker, because of its response rate being quicker by numerous significant degrees.

For the last pyrolysis temperature, the measure of heat applied controls the level of carbonization and the leftover substance of unfamiliar elements. For instance, at T=1200 K the carbon substance of the buildup surpasses a mass part of 90 wt.%, while at T=1600 K more than 99 wt.% carbon is found. Carbonization is frequently exothermic, which implies that it could on a basic level be made self-supporting and be utilized as a wellspring of energy that doesn't create carbon dioxide. On account of glucose, the response discharges around 237 calories for every gram.

When biomaterial is presented to unexpected smearing heat (as on account of an atomic blast or pyroclastic stream from a fountain of liquid magma, for example), it very well may be carbonized incredibly rapidly, transforming it into strong carbon. In the obliteration of Herculaneum by a fountain of liquid magma, numerous natural articles, for example, furniture were carbonized by the extreme heat.

3.1.3 Tree waste burning process:

The purpose of the kiln is to utilize the daily tree biomass produced or the leafs and stems of the tree in the garden area. For feeding the kiln almost 2 to 3 kg of the tree bio mass is required. When it is completely filled some amount of fuel ex. Kerosene is added to it in or to burn the waste thoroughly. One it's got done, the kiln is covered and the waste is ignited with the help of lighter. The waste should be dry and should burn until all the waste is converted to black carbon the waste burns due and the oxygen is supplied from the vent holes provided at the bottom of the kiln. This oxygen prevent the biomass of tree to turn into ash and the carbon dioxide leaves in the atmosphere after the flame reaches the bottom of the kiln which can be seen by the vent holes provided at the bottom of the kiln. After the process is completed the kiln is moved and the remaining is the black carbon. This carbon is then crushed and mixed with the binder. Binder is a kind of adhesive substance which holds the carbon partials together when the shaping process is done by the briquetting machine this binder or adhesive is made by the wheat flour and some hot water.

3.1.4 Briquetting:

One of the methodologies that is being sought after in certain places of the world, for improved and effective usage of agrarian residues, is their densification into strong fuel pellets or briquettes. This includes lessening the size by squeezing the massive mass together. The simplicity of putting away and moving a particularly improved strong fuel briquette (typically in log type) of high explicit weight makes them alluring for use at home and in industry. In contrast to the free and cumbersome structure, burning of briquettes can be more uniform. This could make it workable for briquetted materials to be scorched straightforwardly as fuel in to some degree comparative style as the fuel wood and coal in homegrown (maybe retrofitted) ovens and stoves. The briquetting cycle is the change of agrarian waste into consistently formed briquettes that are not difficult to utilize, transport, and store.

Chapter 4

4.1 Designing:

Designing is the formation of new and better machines and improving the current ones. A new and better machine is a one which is more prudent in the general expense of creation and activity. The interaction of designing is a long and tedious one. From the investigation of existing thoughts, a groundbreaking thought must be considered. The thought is than contemplated remembering its business achievement and given shape and structure as drawings. In the readiness of these drawings, care should be taken in the accessibility of assets in cash, in men and in materials needed for the effective culmination of the groundbreaking thought into the real world. In designing a machine segment, it is important to have a decent information regarding numerous subjects like Mathematics, Engineering mechanics, Strength of materials, Theory of machines, Workshop and Engineering drawing.

4.2 Design Calculations:

- Design of Power Transmission

N_1 = 1420 rpm

N_2 = 450 rpm

P = 1.4914 kw

μ = 0.25

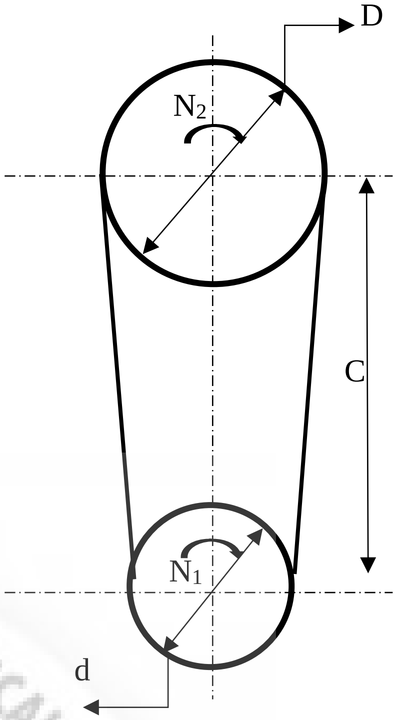


Fig: Belt Drive

<u>Design Power:</u>

P_d = P x S.F

Assume service Factor as 1.3

P_d = 1.491 x 1.3

P_d = 1.938 kw

From the PSG design data book for

P_d = 1.938 kw

A – section V-belt is selected.

d_{min} = 75 mm

width (w) = 13 mm

Thickness (T) = 8 mm

Weight per meter = 0.106 kgf

<u>Calculation of pulley Diameters</u>:

Assuming the belt speed of 5 m/s

$$v = \frac{\pi\, d\, N_1}{60\ x\ 1000}$$

$$5 = \frac{\pi\ x\ d\ x\ 1420}{60\ x\ 1000}$$

$$d = 67.24\ mm \cong 80\ mm$$

$$\frac{N_2}{N_1} = \frac{D}{d}$$

$$\therefore \frac{1420}{450} = \frac{D}{80}$$

$$\therefore D = 252.44\ mm$$

$$\therefore D \cong 280\ mm$$

Correct speed:

$$v = \frac{\pi\ d\ N_1}{60\ x\ 1000}$$

$$v = \frac{\pi\ x\ 80\ x\ 1420}{60\ x\ 1000}$$

$$\therefore v = 5.94\ m/s$$

Approximate center distance:

$$C \approx (D + d)$$

$$\therefore C \approx (280 + 80)$$

$$\therefore C \approx 360\ mm$$

Pitch length:

$$L = 2C + \frac{\pi}{2} + (D + d) + \frac{(D+d)^2}{4C}$$

$$\therefore L = 2\ x\ 360 + \frac{\pi}{2} + (280 + 80) + \frac{(280+80)^2}{4\ x\ 360}$$

$$\therefore L = 1045.39\ mm$$

Selecting the standard length from PSG 7.60

$$L = 1051\ mm$$

Exact center distance:

$$C = A + \sqrt{A^2 - B}$$ PSG 7.61

Where, $A = \frac{L}{4} - \pi\left(\frac{D+d}{8}\right)$

$$\therefore A = \frac{1051}{4} - \pi\left(\frac{280+80}{8}\right)$$

$$\therefore A = 129.3\ mm$$

$B = \frac{(D-d)^2}{8}$

$\therefore B = \frac{(280-80)^2}{8}$

$\therefore B = 4050\ mm$

$C = 129.23 + \sqrt{129.23^2 - 4050}$

$\therefore C = 268.8\ mm$

Angle of lap:

From PSG 7.54

$\theta = 180° - \left(\frac{D-d}{C}\right) x\ 60$

$\therefore \theta = 180° - \left(\frac{280-80}{268.8}\right) x\ 60$

$\therefore \theta = 139.821° \quad > 120°\ Hence\ Ok$

Belt tensions:

$Assuming, 2\beta = 38°$

$\therefore \beta = 19°$

$\mu = 0.25, v = 5.94\ m/s$

$P_d = (T_1 - T_2)\ x\ v$

$1.938x10^3 = (T_1 - T_2)\ x\ 5.94$

$(T_1 - T_2) = 326.26 \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (equation\ i)$

$\frac{T_1}{T_2} = e^{\mu\theta cosec\beta}$

$\therefore \frac{T_1}{T_2} = e^{0.25x139.821x\frac{\pi}{180}x\frac{1}{sin19}}$

$\therefore \frac{T_1}{T_2} = 6.513$

$\therefore T_1 = 6.513\ T_2 \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (equation\ ii)$

From equation i & ii

$6.513T_2 - T_2 = 326.26$

$\therefore T_2 = 58.19\ N$

$\therefore T_1 = 6.513\ x\ 58.19$

$\therefore T_1 = 385.44\ N$

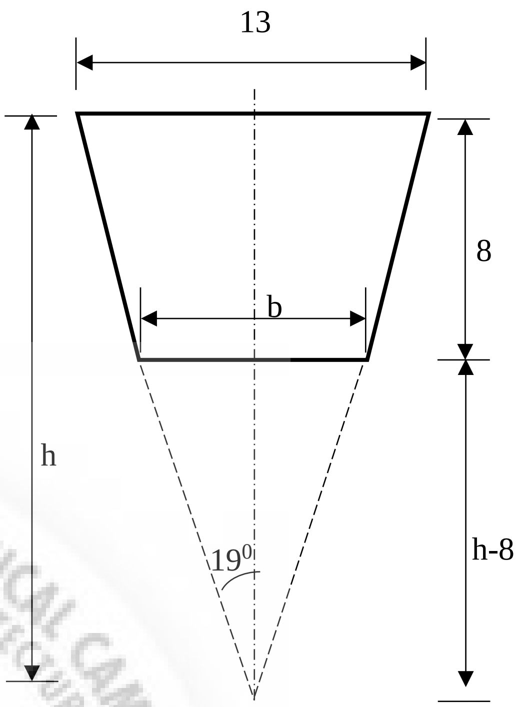


Fig – cross-section of v-belt

Area of belt: $\tan 19 = \frac{16}{h}$

$h = 46.46\ mm$

$from\ similar\ triangles$

$\frac{b}{46.46-8} = \frac{13}{46.46}$

$b = 10.761\ mm$

$a_b = Trapezoidal\ area\ of\ belt$

$\therefore a_b = (13 + 10.761)x\frac{8}{2}$

$\therefore a_b = 95.044\ mm$

Weight per meter of selected C/S 'A' type

$\frac{wt}{m} = 0.106\ kgf$

$\therefore \frac{wt}{m} = 0.106\ x\ 9.81\ N$

Specific weight of belt per meter length

$w = \frac{0.106\ x\ 9.81}{a_b}$

$Density\ of\ material\ \rho = \frac{w}{g}$

$\therefore \rho = \frac{0.106x9.81}{a_b x9.81x10^{-6}}$

$\therefore \rho = \frac{0.106x9.81}{95.044x9.81x10^{-6}}$

$\therefore \rho = 1115.2729\ kg/m$

$\frac{N_b}{10^7} = [\frac{\sigma_{-1}}{\sigma_m}]^m$

Assume belt material as rubber canvas

$E = 100\frac{N}{mm^2}\ \&\ \sigma_{-1} = 10\frac{N}{mm^2}$

$Where,$

$N_b = \frac{v}{L} x\ no. of\ pulley\ x\ H\ x\ 3600$

$\therefore N_b = \frac{5.94}{1.102} x2x25x8x14x\ 3600$

$\therefore N_b = 10.866x10^7$

$Now,$

$\frac{10.866x10^7}{10^7} = [\frac{10}{\sigma_{max}}]^8 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \{m = 2(constant\ for\ v - belt)\}$

$\sigma_{max}{}^8 = \frac{10^8}{10.866}$

$\sigma_{max} = 7.421 \frac{N}{mm^2}$

$Using: \sigma_{max} = \frac{T_1}{A_b} + (\rho v^2 x10^{-6}) + \frac{E_1}{d}$

$\therefore 7.421 = \left(\frac{194.56}{A_b}\right) + (1115.2729\ x\ 5.94^2\ x\ 10^{-6}) + \left(\frac{100x5}{80}\right)$

$\therefore 7.421 = \left(\frac{194.56}{A_b}\right) + 5.7835$

$\therefore 7.421 - 5.7835 = \left(\frac{194.56}{A_b}\right)$

$\therefore A_b = 118.815\ mm^2$

$\therefore No. of\ Belts\ (n_b) = \frac{Total\ area\ required}{Area\ of\ belt}$

$\therefore n_b = \frac{118.815}{95.044}$

$\therefore n_b = 1.25$

$\therefore n_b \cong 1\ Belt$

Bearing Selection:

From PSG 4.14 for bearing no SKF-6306

$C = 2200$

$C_o = 1460$

$f_r = 0.3\ KN = 0.3\ x\ 10^3 N$

$f_a = 0.1\ KN = 0.1\ x\ 10^3 N$

$Now,$

$\frac{f_a}{C_o} = \frac{0.1x10^3}{1460} = 6.068$

$\frac{f_a}{f_r} = \frac{0.1x10^3}{0.3x10^3} = 0.333$

$e = 0.27$

$\therefore \frac{f_a}{f_r} > e$

$X = 1\ \&\ Y = 0$

$Equivalent\ Load, P_e = [X.V.f_r + f_a.Y]xS$

$V = 1.2$

$For\ medium\ shock\ or\ moderate:\quad 1.5 < S < 2.5$

$\therefore S = 2$

$\therefore P_e = [1x1.2x300 + 100x0]x2$

$\therefore P_e = 720\ N$

$Dynamic\ capacity, C = P_e[L_{90}]^{\frac{1}{R}}$

$2200 = 720x[L_{90}]^{\frac{1}{3}}$

$L_{90} = 28.52\ mr$

$Life\ in\ hrs,$

$L_{90} = \frac{60xNxLhrs}{10^6}$

$28.52 = \frac{60x1200xLhrs}{10^6}$

$Lhrs = 396.11\ hrs \cong 397\ hrs$

Selection of shaft (d_s):

$T = \frac{P\ x\ 60}{2\pi N_2}$

$\therefore T = \frac{1.938\ x\ 60}{2\pi x 450}$

$\therefore T = 41.1\ Nm$

Taking Material C45 from PSG 1.9

$\sigma_y = 360\ N/mm^2$

$\tau = 0.5\ x\ \frac{\sigma_y}{4}$

$\therefore \tau = 0.5\ x\ \frac{360}{4}$

$\therefore \tau = 45\ N/mm^2$

$T = \frac{\pi}{16} x\ \tau d_s^3$

$\therefore 41.1 = \frac{\pi}{16} x\ 45x\ d_s^3$

$\therefore d_s = 11.88\ mm$

$\therefore d_s \cong 15\ mm$

Selected parameters:

- Belt section = C
- Number of belts = 1
- Pitch length of belt = 1102 mm
- Diameter of small pulley = 80 mm
- Diameter of big pulley = 280 mm
- Center distance = 270 mm

Design of frame:

Material C45

$\sigma_{ut} = 360N/mm^2$

$FOS = 3$

$\sigma_t = \sigma_b = \frac{\sigma_{ut}}{FOS} = \frac{360}{3} = 120N/mm^2$

$\tau = \frac{\sigma_t}{2} = \frac{120}{2} = 60N/mm^2$

Assume the total weight of the machine as 45kg

$Now,$

$P = \frac{45}{4}$

$\therefore P = 11.25\ kg = 110.36\ N$

$\sigma_t = \frac{F}{A}$

$\therefore 120 = \frac{45\ x\ 9.81}{A}$

$\therefore A = 3.67mm^2$

$Therefore\ selecting\ section\ of\ 19x19x3\ mm.$

$L = 800\ mm$

$M = \frac{WL}{4}$

$\therefore M = \frac{110.36\ x\ 800}{4}$

$\therefore M = 22072\ Nmm$

$z = \frac{B^3}{6} - \frac{b^4}{6B}$

$\therefore z = \frac{19^3}{6} - \frac{3^4}{6x19}$

$\therefore z = 4499.74\ mm^3$

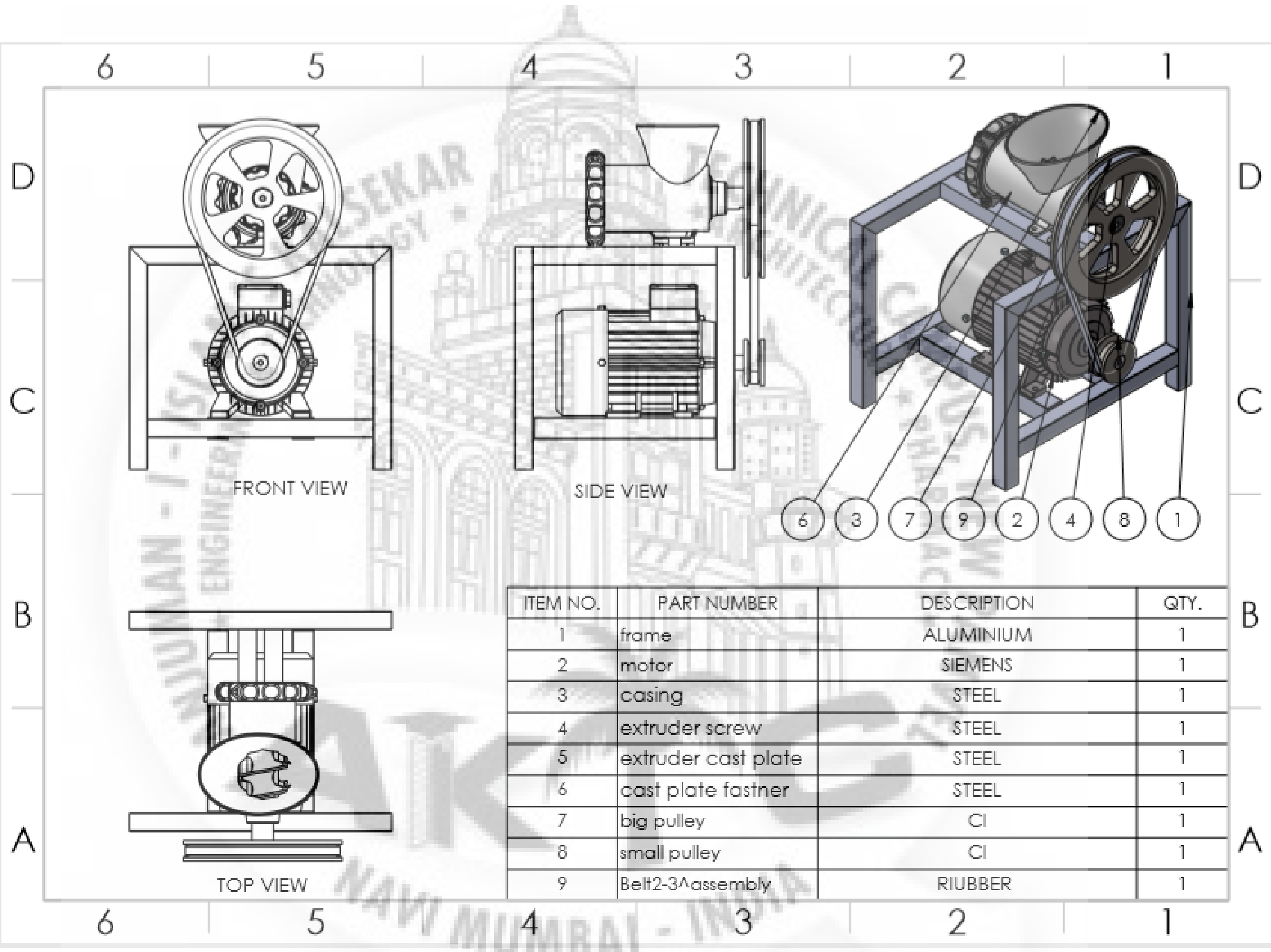
$$\sigma_{bind} = \frac{M}{z}$$

$$\therefore \sigma_{bind} = \frac{22072}{4499.74}$$

$$\therefore \sigma_{bind} = 4.90\ N/mm^2$$

As the induced stress is less than the allowable bending stress, hence the design is safe.

4.3 Design of model in solidworks:



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	frame	ALUMINIUM	1
2	motor	SIEMENS	1
3	casing	STEEL	1
4	extruder screw	STEEL	1
5	extruder cast plate	STEEL	1
6	cast plate fastner	STEEL	1
7	big pulley	CI	1
8	small pulley	CI	1
9	Belt2-3^assembly	RIUBBER	1

Fig: Briquetting Machine

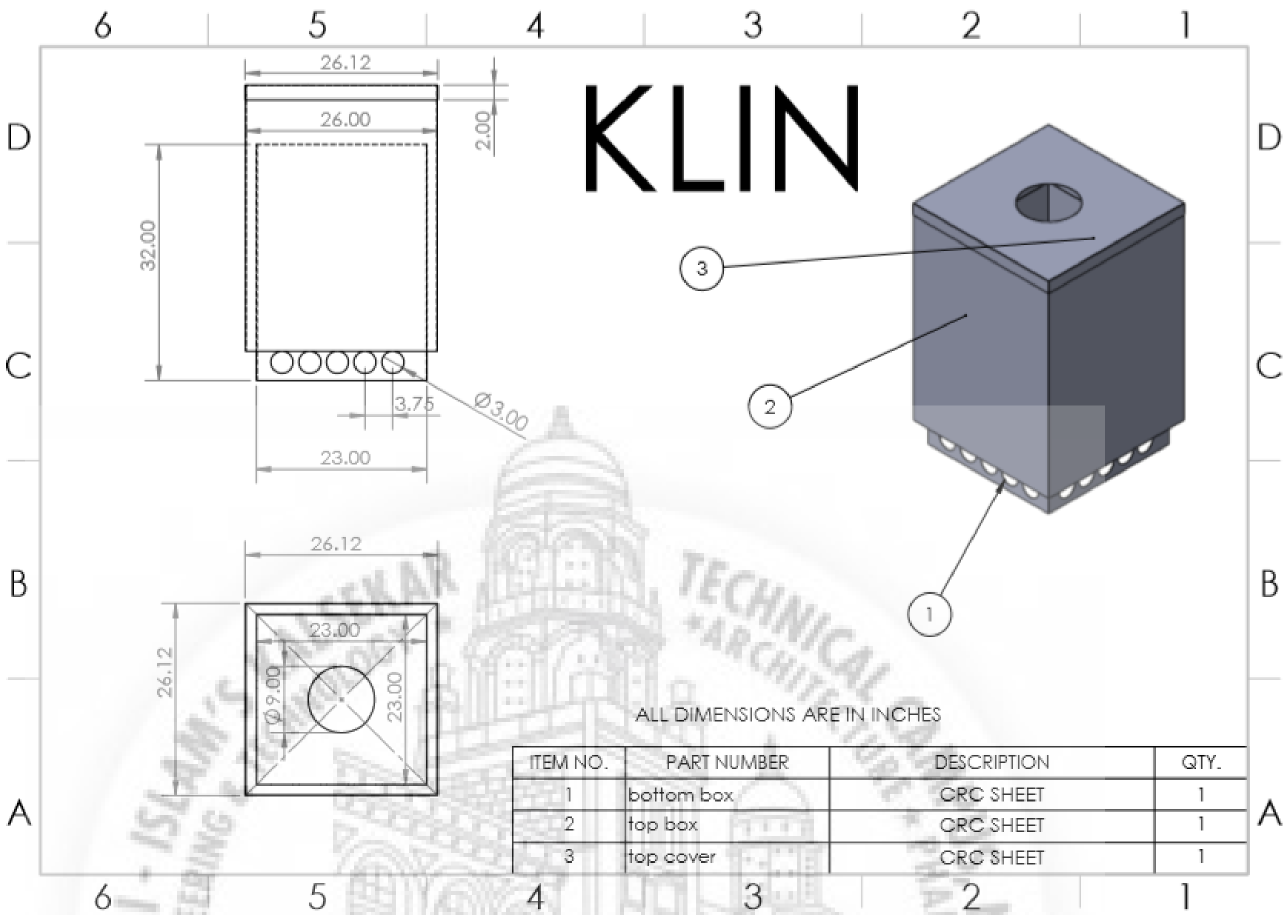


Fig: Kiln

4.4 Validation of model in ansys:

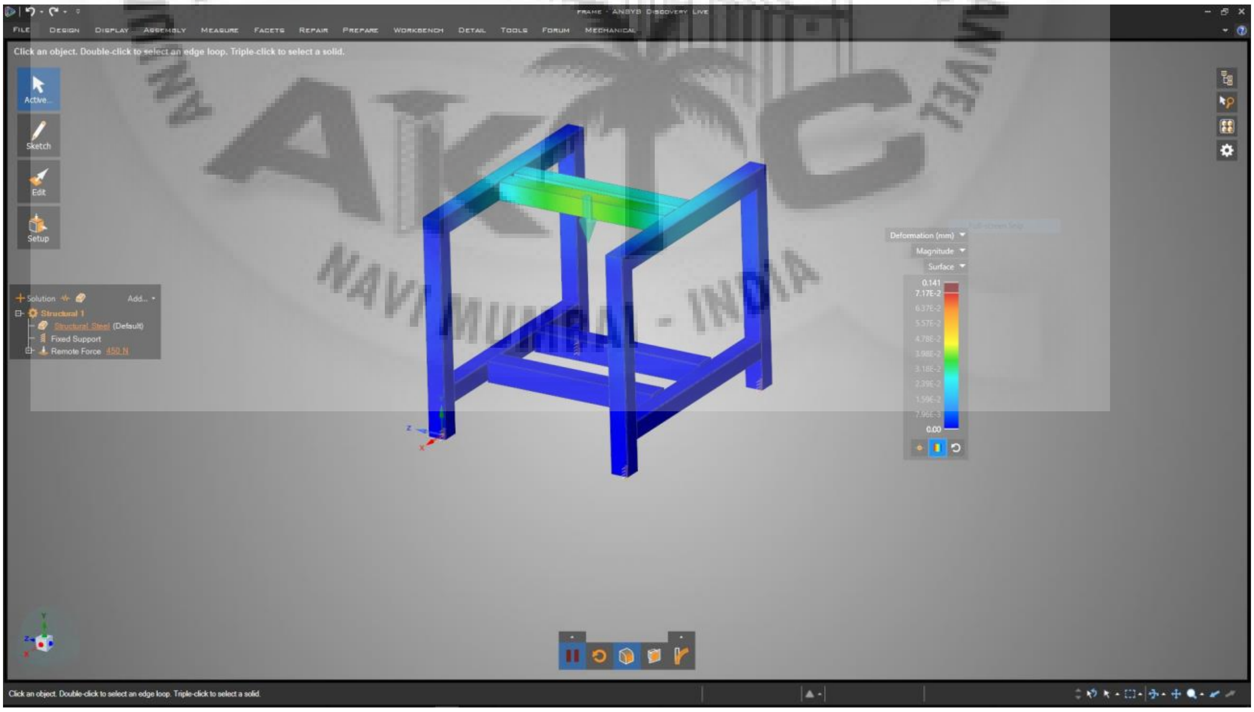


Fig: Analysis of frame

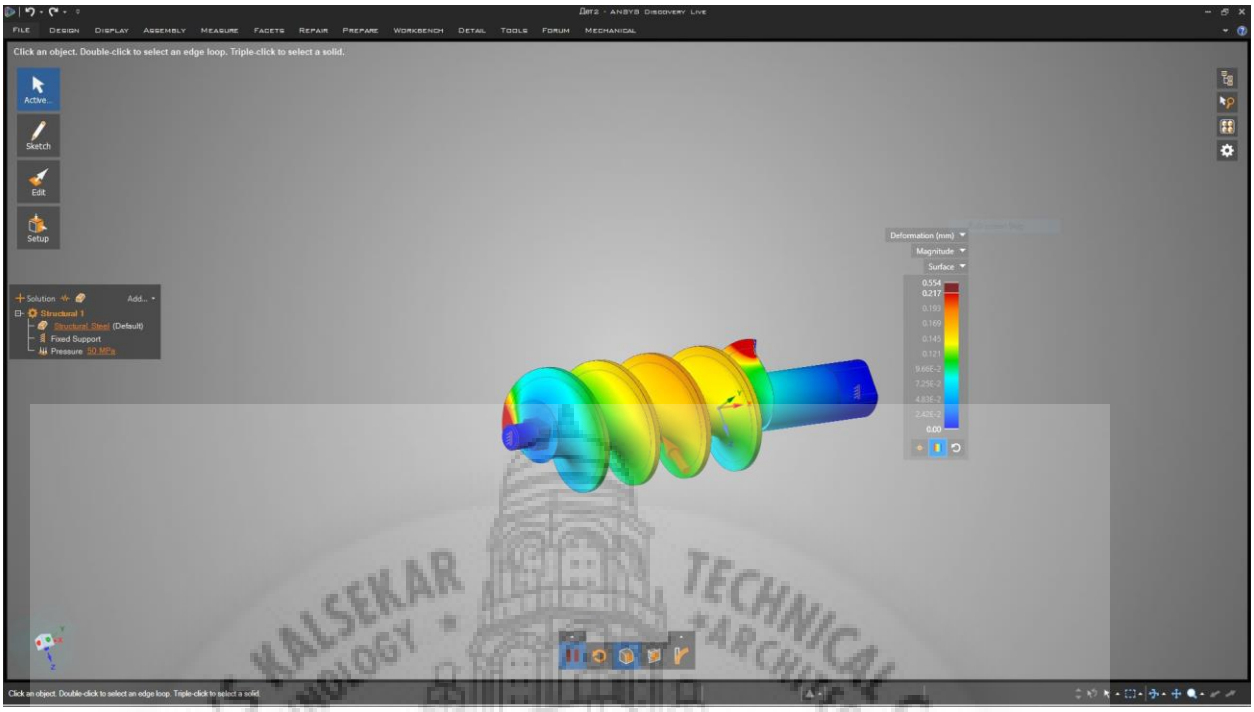


Fig: Analysis of screw

Fig: Analysis of Pulley

4.5 Material used for manufacturing:

We required to make the charcoal and test the system therefore, we manufactured the kiln and the briquetting machine on small scale as our requirements and the components available in the market and set it up. The components used is listed down below.

Sr.no	Item	Quantity
1	32 X 23 CRC sheets	4
2	36 X 26 CRC sheets	4
3	Nut, bolts (M12)	4
4	Nut, bolts (M8)	4
5	Nut, bolts (M5)	24
6	G.I pipe	2
7	Mild steel plates	1
8	Briquetting M/C	1
9	Washers	14
10	Mild steel handles	3
11	Electric Motor [1HP]	1
12	Angle frame [0.75”x0.75”x0.125”]	Dim
13	V-belt Pulley [280mm & 80mm]	2
14	V-belt	1

Table: List of materials

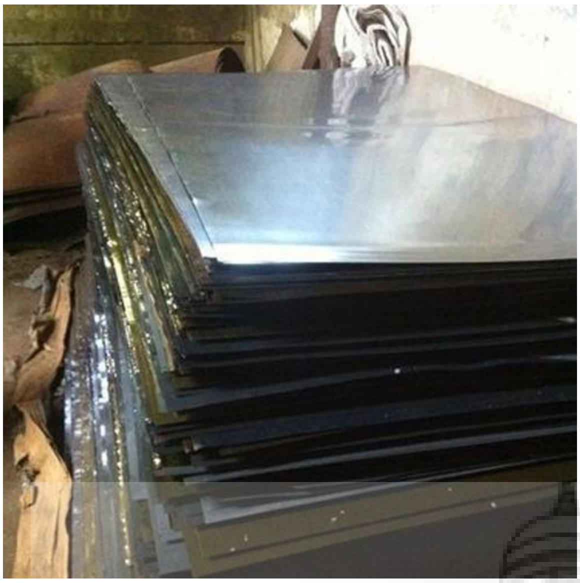


Fig: CRC sheets

Fig: G.I pipes

Fig: Bolt

Fig: Nuts

4.6 Method of construction of Kiln:

Step 1: first take the CRC sheet and cut it into 4 pieces as the side of the kiln (i.e. 2 sheet of 36 x 26 inches and 2 sheets of 36 x 30 inches)

Step 2: cut the second sheet in 4 pieces with height 32 inches and breadth 27 inches.

Step 3: take the first 2 sheet and leave 2 inches from the sides so as to bend those 2 inches inside.

Step 4: also bend the 4 small sheets from 2 inches from the sides. In order to joint them.

Step 5: make holes on the bottom of the all-large sheets and joint them with the help of the nut and bolts from the sides.

Step 6: now also joint the 4 small sheets by the sides with help of nuts and bolts.

Step 7: once it got done. Them keep the 2 boxes align, one touching the ground and the outer one as suspended in the air, joint them centrally with the help of 4 bolts, 2 on either side. Maintaining 1.5 inches distance between the 2 boxes.

Step 8: take the metal sheet as the size of the boxes and bend it from each end in the same direction.

Step 9: now make a hole of 13 inches diameter in it and wild a mild steel handle so as to easily cover or remove

Step 10: weld the 2 big size handles on each opposite side of the kiln and in order to have easy operation.

4.7 Actual Setup:

Fig: kiln

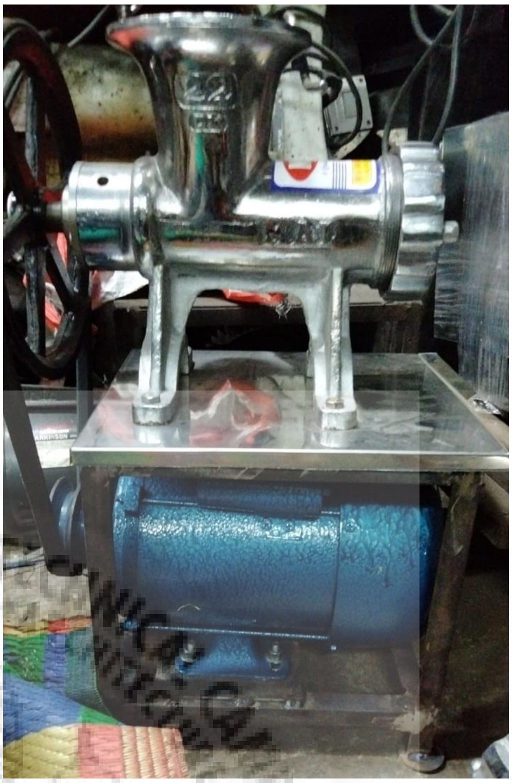


Fig: Briquetting

Fig: Kiln filled with Sugarcane Bagasse

Fig: kiln filled with dry leaves and branches

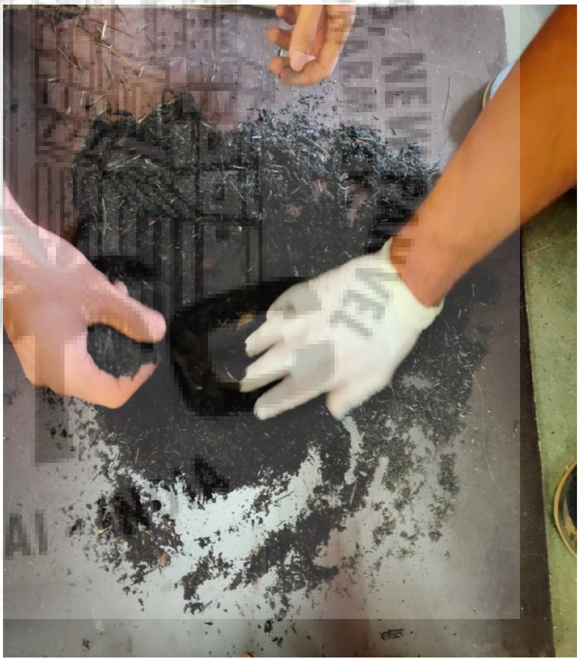


Fig: Carbonized waste **Fig: Crushed carbonized char**

Fig: Char mixed with binder

Fig: Sugarcane Briquettes

Fig: Sugarcane & Dry leaves, branches briquettes

Fig: Dry leaves & branches briquettes

4.8 Costing:

Serial No.	Items	Cost (INR)
1	CRC Sheet	4500
2	Briquetting Machine	2600
3	1 HP Motor	2000
4	Angle Frame	1500
5	Machining	2700
6	Miscellaneous Cost	1200
7	Transportation Cost	1500
	Total Cost	16000

Table: Costing

Chapter 5

5.1 Applications:

5.1.1 Metallurgical fuel:

In days of yore charcoal was the fundamental raw material for steel creation, until the mid-eighteenth century, when the British, who had not very many backwoods, imagined the innovation of utilization of coal for refining. From that point forward, the portion of bio item in the steel business fell sharply. Notwithstanding, it has held its need in certain districts and metallurgical advances, particularly in reestablishing. Numerous enterprises keep on utilizing dark biofuel in the creation of cast iron, ferroalloys, lead, aluminum, copper, tin, Nickel, lanthanides, uncommon and valuable metals. It is likewise utilized as the covering flux in the purifying of certain kinds of bronze and metal, Nickel amalgams (Melchior and Nickel silver). The charcoal can be utilized as a carburizer for grouting in the creation of defensive armor. Other than that, this bio item is innovatively very fit to replace his "stone sibling" and coke breeze in any blast furnace. Assessments of the volume of world charcoal creation are altogether different – from 9 to 23 million tons each year, as its greatest piece is delivered by little limit in high quality manner in developing nations, where measurements is gravely evolved. It is accepted that the steel business gets about 20% of the item. The decrease in the utilization of charcoal in the worldwide steel industry increased in the 80-ies of the most recent century because of its replacement by coke, the pressing factor of the natural control specialists and exhaustion of backwoods. The value rivalry turned into the conclusive factor – cast iron made with coke has gotten a lot less expensive in the worldwide market. In any case, until the current days and utilization of its items in metallurgy.

Fig: Charcoal as metallurgical fuel

5.1.2 Industrial Fuel:

Charcoal in industrial production Charcoal contains in its structure a large amount of carbon, which is isolated by combustion of much energy. It is a natural type of fuel, which is obtained from different types of wood. The best representatives of the charcoal is industrially processed products oak, maple and fruit tree varieties. The process of charcoal production to wood turned into high-quality fuel, it will go through the pyrolysis process. It is a process of decomposition of raw materials, which occurs under the influence of high temperatures without oxygen. At the initial stage of drying is performed at a temperature of the raw material 150 ° C. Then the pyrolysis process, ie gassing and formation of organic products at a temperature up to 350 ° C. The final step is the treatment of charcoal from the resin and non-condensable gases. This is achieved at high temperatures up to 550 ° C. The quality of raw materials and specifications determine the quality of the fuel produced. Areas of use of charcoal in the industry Charcoal as an efficient form of fuel known to people since ancient times. Without it did not do blacksmiths, steel makers and physicians. In today's world, a list of applications charcoal expanded significantly. Charcoal is widely used in the chemical industry, as a filter in the production of chlorine, gasoline, organic fertilizers and chemicals for weed and pest destruction. Charcoal in demand in today's steel production.

This is the most expensive type of fuel for combustion in furnaces, so only high-quality and high-tech materials used in this industry. With the help of melted bronze, brass, manganese, nickel and other alloys. As a result of the burning of charcoal ash is formed, which is an excellent fertilizer for the soil forestry and agriculture. Broadly utilized in the creation of iron decreasing charcoal capacities. The completed item not contains phosphorus and sulfur, rather than the utilization of coke, whereby the iron has a more prominent strength.

5.1.3 Cooking Fuel:

Proof that has been assembled in numerous nations doesn't uphold the idea that a change from wood-based energy to fuels, for example, LPG follows any regularized design. Choices identified with energy utilization and fuel type are unequivocally impacted by openness, reasonableness and the convenience of the fuel. These models are firmly identified with one other and furthermore rely upon family pay. The decision-making cycle is mind boggling with monetary and specialized perspectives interlinked with cultural and social issues. Cooking with wood, for example, is so profoundly imbued in numerous neighborhood societies that different fuels have little allure, in any event, when the possible wellbeing and natural advantages are perceived by clients. Besides, the pervasiveness of wood fuel in many developing nations can be clarified by the way that it is as yet the most promptly accessible, reasonable or even expense free cooking and heating fuel. The possibilities for exchanging fuels inside families just as for viable government intercessions are notably extraordinary for metropolitan and rural zones.

Charcoal creation has been singled out as a significant reason for woodland corruption and deforestation in numerous African nations, especially in peri-metropolitan regions. This is because of the way that more wood and subsequently more timberland territory are required for creating charcoal to meet a similar energy needs contrasted with firewood. Besides, uncontrolled business charcoal creation prevalently happens nearby a market so that transport costs are held down. In any case, because of the practical creation limit of backwoods, charcoal creation can really add to protecting timberlands when it is all around controlled and gives clear monetary advantages to the nearby people.

Notwithstanding the issue of deforestation, significant ozone depleting substance outflows are additionally delivered during carbonization, running somewhere in the range of 7.2 and 9.0kg CO2 comparable per kilogram of created charcoal. Improved kilns advances can build carbonization effectiveness while furthermore lessening ozone harming substance emanations. Nonetheless, the reception pace of more proficient kilns for charcoal creation is still low, generally because of the casual – and regularly illicit – nature of charcoal creation. In regions where wood is an openly open great, customary charcoal creators have no motivating force for improving creation.

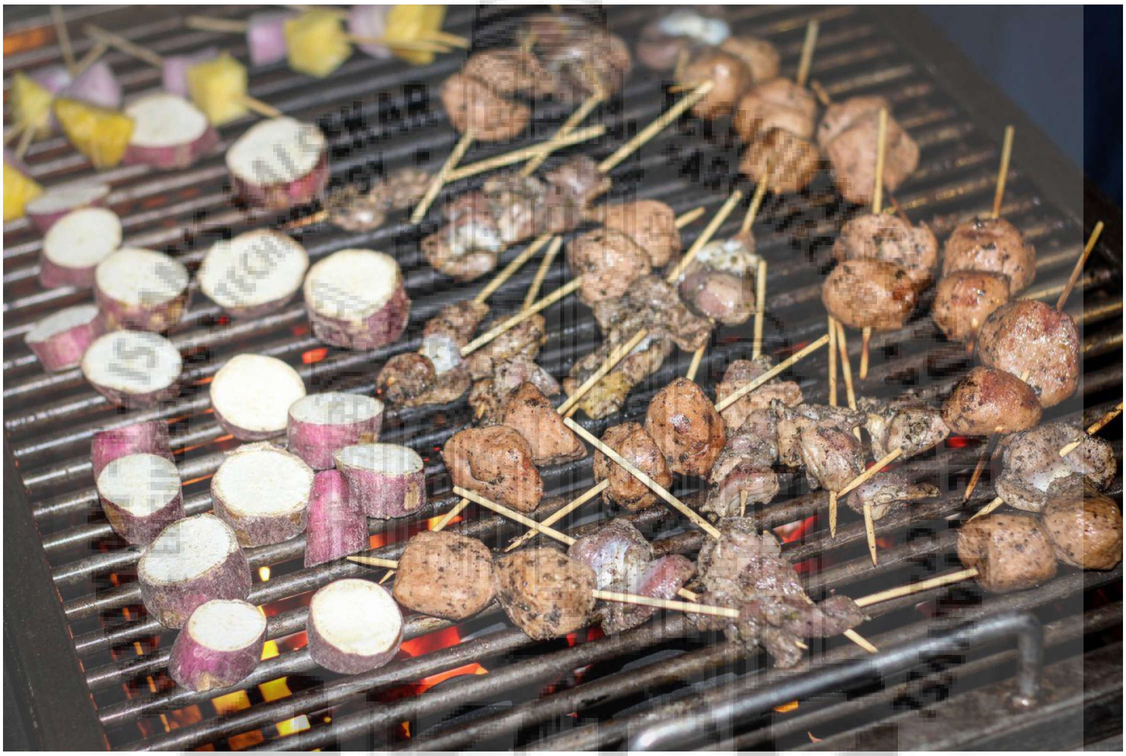


Fig: Charcoal as Cooking Fuel

5.1.4 Cosmetic use of charcoal:

The cosmetic industry is known for its creative and "breaking new ground" items. Most recent in the cosmetic business world has been the utilization of activated charcoal for more white teeth and more clear skin. The thought behind this recent fad of adding charcoal to pretty much everything depends on similar thought of how activated charcoal functions in purifiers. It eliminates foreign substances and poisons from whatever it is in contact with because of its enormous surface region on a tiny level making it have significant ingestion properties. Accordingly the thought is that it traps contaminations previously or while they are in the body prior to causing undesirable harm, for example, skin inflammation or other skin medical problems.

As this is getting increasingly more well known among beauty products, it is imperative to ask what impacts it will have on your body over the long haul. Likewise with every single new fixing, next to no is said concerning what it will do over the long haul. Notwithstanding, a few investigations have presumed that it is ok for outer use-breathing in it isn't protected and processing it is fine in little amounts and the FDA has additionally considered it innocuous because of its mineral like characteristics.

Activated charcoal is derived from carbonaceous source materials-nutshells, wood, coal-and by either having it go through actual activation with hot gases or through synthetic activation utilizing a corrosive, solid base or salt brought into the carbon and afterward carbonized at temperatures somewhere in the range of 450 and 900 degrees celsius. This is the place where guideline is significant since, supposing that carbonized with perilous synthetic compounds that stay in the eventual outcome it could then be adverse to the clients wellbeing. Guidelines additionally take into account the Activated Charcoal to truth be told be "enacted" like the buyer anticipates.

5.1.5 Purification and filtration:

Activated carbon filters eliminate/decrease numerous volatile organic chemicals (VOC), pesticides and herbicides, just as chlorine, benzene, trihalomethane (THM) compounds, radon, solvents, and many other man-made synthetic substances found in faucet water. Some initiated carbon filters are decently powerful at eliminating a few, however not every single, weighty metal. Reactant carbon filters are compelling at eliminating chloramine and hydrogen sulfide. Also, thickly compacted carbon block filters down to 0.5 micron, including Giardia and Cryptosporidium, turbidity, and particulates. Carbon channels are NOT for the most part effective at eliminating broke down inorganic pollutants or metals like minerals/salts (hardness or scale-causing foreign substances), certain radio nuclides. Eliminating these impurities requires either a converse assimilation water channel framework or a distiller (some can likewise be taken out by KDF-55). GAC doesn't eliminate residue/particulate material quite well, so they are frequently gone before by a silt channel. Dregs pre-channels likewise delay the enact carbon cartridge life by wiping out net foreign substances that would some way or another obstruct the actuated carbon along these lines diminishing the surface territory accessible for retention.

Carbon block channels are for the most part better compared to GAC channels at eliminating silt. Actuated carbon filtration is normal in various home water treatment frameworks. It very well may be utilized as an independent channel to diminish or wipe out terrible preferences and scents, chlorine, and numerous natural foreign substances in civil (pre-treated or chlorinated) water supplies to deliver an essentially improved drinking water. It is additionally generally utilized as a pre-treatment as a component of an opposite assimilation framework to lessen numerous natural impurities, chlorine, and different things that could foul the converse assimilation film. 0.5 micron carbon block channels are normally used to eliminate debasements.

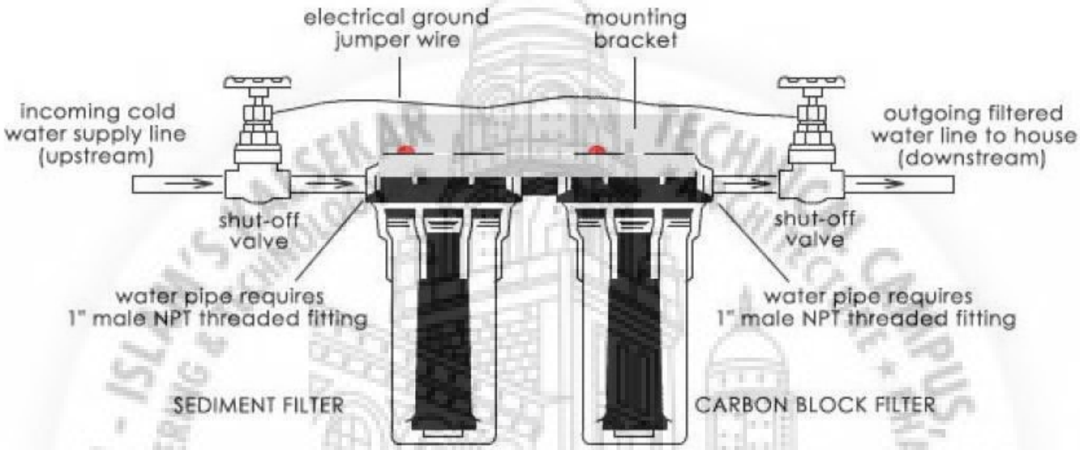


Fig: Charcoal used in filtration

Chapter 6

6.1 Daily input-output data sheet:

Initially the kiln is fed with the tree biomass like leaves and stems only. And the charcoal powder formed is analyzed is in less quantity. The burning time is also less as it depends on the quantity of the tree biomass fed into the kiln. The quantity of the biomass is gradually increased to check the capacity of the kiln. Also, different other types of the biomass is tried and fed to the kiln in order to get the desired results. Regarding the quality of the charcoal the leaves and stems are good but the quantity of the charcoal powder produced due to them will also be less. The feeding of kiln was gradually increased day by day to its full capacity. The following table below shows the activity of feeding the kiln.

Table: Input-output data sheet

Date	Type of feed	Quantity of feed (in kg)	Quantity of binder (in grams)	Actual mass of charcoal (in kg)
24/03/2021	Sugarcane bagasse	2.5	600	1.2
27/03/2021	Leafs and Branches	1.5	300	0.8
30/03/2021	Sugarcane bagasses and Leafs and Branches	4	850	1.9

6.2 Results:

Results show that charcoal from sugarcane bagasse can be utilized to manufacture briquettes. This sort of briquette is another choice of inexhaustible fuel, and its usage can diminish deforestation for charcoal creation or for use as wood fuel. Results likewise show that the method adopted for the creation of briquettes dependent on charcoal powder from the sugarcane bagasse and starch as the binder is proficient, yielding briquettes with properties that meet market specialized necessities. Additionally, the most delegate boundaries are viable with or better than those boundaries acquired using different sources of charcoal. The shape and size of briquettes didn't have effect on consuming time and a sign of briquette corruption with soil. Hence further exploration needs to see briquette producing methods that produce briquettes whose unit cost per energy yield is lower or practically identical to that of charcoal without bargaining the quality boundaries.

Due to the ongoing pandemic situation the testing of the manufactured samples was not possible, so for reference here is the properties of some similar sample from **[2] Gino Martin T.Arellano:**

PARAMETRES	100 CS(%w/w)	50-25-25 CS-SB-CC(%w/w)
Moisture	10.55	3.46
Volatile Combustible Matter	10.85	21.2
Ash	3.22	29.8
Fixed Carbon	78.32	49.0

Table: Proximate Analysis of Coconut Shell Charcoal and 50% Shell – 25% Bagasse – 25% Corn Cob Charcoal Combination

Type	Calorific Value (J/g)
50% CS – 25% SB – 25% CC	19951.4
Indian Coal	16736
Indonesian Coal	23012
South African Coal	25104

Table: Net Calorific Values of Various Coals

Carbon (%w/w)	65.3
Hydrogen (%w/w)	2.92
Nitrogen (%w/w)	0
Sulfur (%w/w)	0.101
Oxygen (%w/w)	10.479

Table: Ultimate Analysis of 50% Shell – 25% Bagasse – 25% Corn Cob Briquette Combination

6.3 Conclusion:

A huge volume of farming by products are being produced in India and which establish natural risks. Call for viable usage of those high evaluation biomass material for solid fuel called briquette. Thus, it tends to be inferred that the waste material like dry leaves, branches, sugarcane bagasse and so forth, are feed stocks for the biomass briquette. By and large dry leaves and branches are scorched to decrease squander, which causes contamination of climate, however on the off chance that admirably took care of these squanders can then could be a superior choice for briquetting. Consequently, for an agrarian nation like India that produces tremendous measure of farming waste each year, use of these wastes as a briquette can be monetarily feasible, manageable and nature friendly well-disposed arrangement.

Process for charcoal briquette creation from biomass residues with no covers has been advanced. Dry group measure diminishes the dampness substance of the came about biomass tests and gives a slight increment on HHV, yet it hurts the densification execution of the treated biomass. Aqueous pretreatment makes momentous enhancement for the biomass densification exhibitions including mass density and compressive strength. The HHV and energy density of HT biomass briquette likewise increment clearly. The energy densities and compressive qualities of the charcoal briquettes arranged from the biomass briquettes from SB and LB treated above 400 °C are fundamentally higher than those of the charcoal briquette arranged from the raw and dry alarmed biomass. The low compressive qualities of the raw and dry panicked briquettes are disadvantageous to their transportation and capacity. The energy densities and compressive qualities of the charcoal briquette are higher. Besides, the charcoal briquette has a far lower ash yield. The fixed carbon yield and combustion properties for charcoal briquettes satisfy the market interest.

This process demonstrated that steady charcoal briquettes produced using blends of dry leaves, branches and sugarcane bagasse charcoal can be delivered at the predetermined conditions. In the examination, the compaction pressure had a critical impact just on the compaction proportion. The compaction pressure significantly influenced the volume removal of the briquettes. Then again, the combination proportion significantly affected the density, relaxation and compaction proportion. The proportion at which raw material charcoal were mixed is a central point on the strength. Briquettes with higher sugarcane bagasse charcoal substance yielded high density proportions which is a pointer of more steady briquettes. This means that more volume was dislodged in the briquetting of the charcoal.

6.4 Future Scope:

- As there is consistently a degree for development like that further examination in this field is needed to pause and limit the fossil fuel byproduct while creating briquettes by mixing with some other material to save the climate from harmful Sulfur pollutants. To make it more versatile and less tedious.
- To increase the limit of the briquetting machine without expanding the expense significantly which is feasible from point of view of an independent individual.
- To make the method more energy proficient the briquetting machine can be fused with solar energy. Further, more exploration is possible about the heat energy lost in the burning cycle that can used to improve the efficiency of the arrangement.
- All the thermal energy which is not used in the carbonization process is can be utilized with an arrangement which can be used to bake the briquettes thereby increasing the efficiency of the whole process.
- Mindfulness ought to be spread in rural regions where there is as yet the utilization of customary solid fuels which has numerous unfavorable effects on wellbeing and envoirment, and its advantages.

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