

METHODS OF INCREASING CALORIFIC VALUE OF BRIQUETTES USING BIOMASS

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Abstract- The use of biomass as fuel source is becoming increasingly popular due to its renewable nature and lower environmental impact compared to production of briquettes, which are compressed block of biomass that can be used as a fuel source. However the calorific value (CV) of this briquette can be lower than that of traditional fuel making them less attractive to consumer. This paper explores the potential for increasing the CV of briquettes using biomass. The study examines various techniques for increasing the CV, including the use of densification methods, additives, pre treatment processes. The result of the study indicates that this techniques can be effective in increasing the CV of briquettes. Densification methods, such as pelletizing and briquetting, can increase the density of biomass, resulting in a higher CV. Additives, such as binders and fillers, can also increase the density and combustion properties of the briquettes. Pre treatment processes such as torrefaction and carbonization, can also increase the CV by removing the moisture and increasing the carbon content of the biomass.

Keywords: carbonization, cow dung, cashew nuts, charcoal, Coconut flakes and shell, saw dust, rice husk.

I. INTRODUCTION

There are several reasons why biomass is needed as source of energy. First and foremost biomass is a renewable energy source which means that it can be replenished relatively quickly compare to traditional fossil fuels which are finite resources that take million of years to form. This makes biomass a more suitable and environmentally friendly option for meeting our energy needs

Another important need for biomass is its potential to reduce greenhouse gas emissions. Burning fossil fuels releases carbon dioxide and other pollutants into the atmosphere to, contributing climate change. In contrast, using biomass as a fuel source can reduce net carbon emission by sequestering carbon in plants and trees by displacing fossil fuels. Biomass can provide energy security, particularly for communities and countries

that rely heavily on imported fossil fuels by producing their own biomass waste energy these communities can reduce their dependence on foreign oil and gas, which can subject to price volatility and geopolitical tensions.

Finally, the use of biomass can provide economical benefits particularly in rural areas where farming and forestry are important industries. The production and use of biomass can create jobs and stimulate local economics providing a source of income for farmers and forest owners. Overall, the need for biomass as a source of energy is driven by its potential to provide sustainable, environmentally friendly, and economically viable energy solutions for the future.

II. THE PRESENT STUDY WAS UNDERTAKEN WITH THE FOLLOWING OBJECTIVES :

- 1) **To increase the energy efficiency:** A higher CV means the briquettes can produce more energy per unit of mass. This can help improve their energy efficiency and make them more competitive with traditional fossil fuels.
- 2) **To reduce emission:** A higher CV means that less biomass is needed to produce the same amount of energy. This can help reduce the emissions of greenhouse gases and other pollutants associated with the production and use of biomass briquettes.
- 3) **Education and outreach:** Educating others about the benefits of biomass briquetting and how to increase the CV of biomass briquettes can help raise awareness and generate interest in this field. We can participate in outreach programs, develop educational materials, or gift presentations to share our knowledge with others.
- 4) **Research and Development:** Participating in research and development initiatives related to biomass briquetting technology can be a

great way to increase your knowledge and experience in this field. We also contribute to the development of a new and innovative methods to increase the CV of biomass briquettes.

III. METHODOLOGY

India is heavily dependent on fossil fuel particularly coal which accounts for over 70% of the country electricity generation this reliance on coal has led to issues such as air pollution greenhouse gas emission and environmental degradation despite significant progress in recent year a large portion of India population still lack access to modern energy sources this has implications for health education and economic development. Biomass a renewable and sustainable source of energy as it is derived from organic matters such as agriculture waste wood chips and other plant material unlike fossil fuels which are finite and non renewable biomass can be continually replenished sustainable harvesting and cultivation practices. We address the problems that are pollution and energy demand running through worldwide and try to resolve it.

IV. The whole study was conducted in two phases: Phase 1: Analysis of Briquettes.

Phase 2: Upcoming opportunities for biofuels (briquettes) in India.

Phase 1:- Analysis of Briquettes History of Briquettes

- Briquettes are blocks of compressed biomass or coal dust that are used as fuel. The history of briquettes dates back to the late 19 century when a Frenchman named Eller and Swiss named Rane Antoine Gauthier developed a briquette making process using sawdust and cuttings from wood mills. This process was pa in Switzerland in 1895 and in the United states in 1896.
- Briquette Gained popularity during the early 20th century as of way to use waste materials from sawmills and other word processing industries. The briquette making process was refined over the years, and different types of briquettes were developed using different materials, including coal dust and various types of biomass such as straw, rice husks, and even coffee husks.

- During World War 2 briquettes became even more popular as fuel shortages led to rationing and the need for alternative sources of energy. In Europe, briquettes were used for used extensively for heating and cooking, and in some cases they were even used as currency.
- In the post war era, briquettes continued to be a popular source of fuel, particularly in developing countries where traditional sources of energy were scarce of expensive. Today, briquettes are still used around the world as a source of fuel for cooking and heating, and they are also used in industrial processes, such as production of steel and cement. With growing concerns about climate change and the need to reduce greenhouse gas emissions there has been renewed interest in briquettes as a sustainable and renewable source of energy.

Briquettes are different from other fuel

- Environmental impact briquettes considered to be more environmentally friendly fueled and traditional sources such as coal oil or wood.
- They are made from renewable resources and have a lower carbon footprint than fossil fuels efficient burning requests are designed to burn more efficiently and produce less smoke and ash than traditional fuels. This makes them a popular choice for cooking and heating in developing countries where indoor air pollution from traditional fuel is a significant health concern.
- Ease of use requests are easy to use and transport as they are compact and uniform in size and shape. They are also convenient to store as they do not require large amount of space. Cost brick can be cost effective fuel option.
- Versatility Briquettes can be used in a variety of applications including cooking eating and industrial processes. They can also be used as a replacement for charcoal in barbecue grills as they burn longer and produce less smoke.

The production process for biomass briquette be optimized to improve efficiency, reduce waste and minimize environmental impacts by following methods:-



Raw material selection: Choosing the right raw material is crucial for producing high quality biomass briquettes. It's important to select materials that have consistent size, low moisture content, and high calorific value to ensure optimal combustion efficiency and reduce waste.

Drying: Drying the raw materials before briquetting can significantly reduce the moisture content and improve the efficiency of briquetting. Using waste heat from production process or renewable energy sources like solar energy can help reduce energy consumption and environmental impact.

Briquetting: The briquetting process itself can be optimized to improve efficiency and minimize waste. Using the right pressure, temperature, and binders can help produce briquette with high density and low ash content, While minimizing the amount of material that is lost or wasted during the process

Energy recovery: Recovering energy from waste heat of gases energy of gases generated during the briquetting process can help reduce energy consumption and environmental impacts

New technologies which helps to improve the calorific value of biomass briquettes Binder-less briquetting: This technology involves the use of high pressure and temperature to compress the biomass material without the need of binders or additives. The

result is high quality briquettes that burns cleaner and longer.

Torrefaction: This process involves eating the biomass material in the absence of oxygen, which reduces its moisture content and increases its energy density. The torrefied biomass can then be compressed into high quality briquettes that have higher energy content and better combustion properties.

Carbonization: This is a process that involves heating the biomass material in the presence of limited oxygen to produce charcoal. Charcoal briquettes have a higher energy content and burn longer than regular biomass briquettes.

Densification: This technology involves compressing the biomass material to increase the density and reduce its volume. The result is more compact and transportable product that is easier to handle and store.

Pelletization: Pelletization involves compressing the biomass material into small pellets using the pellet mills. Pellets are denser and more uniform product than briquettes which makes them easier to handle and transport. They also have a higher energy content and more efficiently.

Pyrolysis: Pyrolysis is a thermal process that involves heating biomass at high temperature in the absence of oxygen. This process can breakdown biomass volatile gases, liquids and char. The char produced through this process can be used to make high calorific value biomass briquettes.

Briquettes making process

Here are 5 key steps involved in the process of making briquettes:



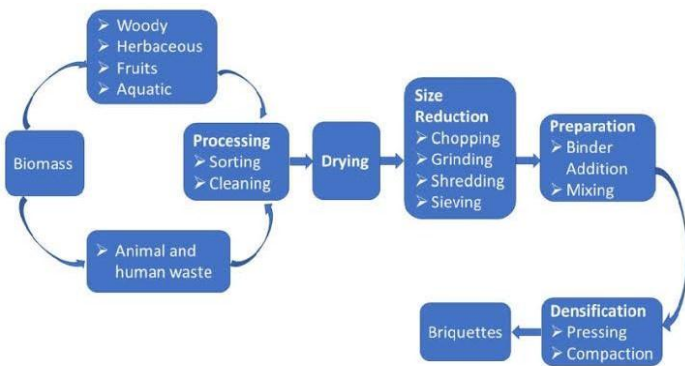
Preparation of raw materials : The first step is to collect the raw material, which can be agricultural waste, sawdust, wood chips, or charcoal dust. The raw materials is then dried to reduce its moisture content, which is important for achieving high quality briquettes.

Grinding the raw materials: The dried raw material is then ground into a fine powder. The grinding process helps to breakdown the raw materials into small particles, which makes it easier to compress into briquettes.

Mixing the raw materials: The ground raw material is then mixed with binder, such as starch or clay, to help hold the briquette shape together during compression process. Water may also be added to the mixture to help with binding.

Compression of mixture: The mixture is then fed into a briquetting machine, where it is compressed under high pressure and temperature to form briquette shape. The compression process helps to remove excess moisture and bind the raw materials and binder together.

Drying and storage: Once the briquettes are formed, they are cooled and then dried to remove any remaining moisture. The dried briquettes are then stored for later used or transportation.



Phase 2:

Scope of biomass briquettes in India

Biomass briquettes have a great scope in India due to their potential to replace fossil fuels and contribute to a more sustainable energy mix. Here are some factors that contribute to the scope of biomass briquette in India:-

Availability of biomass resources:- India has large amount of biomass resources, including agricultural waste, forestry residue and municipal solid waste these

resources can be used to produce biomass briquettes, which can be used as a source of renewable energy.

Increasing demand for energy:- India is one of the fastest growing economies in the world, with a rapidly increasing demand for energy. Biomass briquettes can help meet this demand by providing a renewable and sustainable source of energy.

Economic benefits:- Biomass briquettes can provide economic benefits to farmers and rural communities by providing a source of income from waste biomass resources. This can help promote rural development and reduce poverty in India.

Government schemes and incentives for renewable energy

The Indian government has implemented various policies and incentives to promote the use of renewable energy sources, including biomass briquette. These policies and incentives provide financial support and other benefits to entrepreneurs and organizations for setting of biomass briquettes production units.

Subsidies: Some governments provide financial subsidies to manufacturers of biomass briquettes to encourage the production of this renewable energy sources.

Tax incentives:- Governments may offer tax credits or deductions to individuals or companies who use biomass briquettes as an alternative to fossil fuels.

Energy credits:- In some countries, biomass briquettes are eligible for energy credits, which can be sold to companies or individuals who need to meet their renewable energy targets.

Grant programs:- Some governments offer grant programs that provide funding for research and development of new biomass briquette technologies or for the installation of equipment to produce or use biomass briquettes.

Awareness campaigns:- Governments may run awareness campaigns to promote the use of biomass briquettes as a renewable energy source, and to educate consumers on the benefits of these alternative food.

Subsidies for users:- Some government may also provide subsidies for financial incentives to households or business that use biomass briquettes for heating or cooking, to make the renewable energy source more affordable and accessible.

Machinery, Land requirements, Plant cost, Product cost

The total cost of biomass briquette production machine and the land requirement can vary depending on several factors such as the production capacity, type of machine, automation level, and location.



Biomass briquette production machine cost:- The cost of biomass briquette production machine can vary from around INR 1lakh to several crores depending on the capacity, automation level, and type of machine. Small manual machine can cost around INR 1-2lakh, while the larger fully automated machines can cause to several crores.



Land requirement:- The land requirement for a biomass briquette production unit will depend on the production capacity and the location. A small scale production unit may require a land area of around 500

to 1000 square metres, while a large scale unit may require several acres of land. The land should have proper access to roads, water, and electricity.

In addition to the machine and land cost, other factors such as raw material cost, labor cost, and transportation cost should also be considered while estimating the total cost of producing biomass briquettes. It is important to do through cost benefit analysis before starting a biomass briquette production units to ensure its profitability and sustainability.

The cost of briquettes in India can vary depending on the several factors such as the location, the type of briquettes, and the quantity purchase. However, as general estimate, the cost of briquettes in India can range from around INR 3,500 to INR 5,000 per metric ton (MT) for non processed biomass briquettes. According to report by research and Markets published in August 2021 the Indian biomass briquette market was valued at USD 698.2 million in 2020 and is projected to reach USD 1,797.8 million by 2026, growing at a CAGR of 17.4% during the forecast period (2021-2026). Around 326 firms producing different types of briquettes in India.

Types of briquettes



Charcoal briquettes:- These are made from charcoal dust made with a binding agent such as clay or starch, and then compressed into blocks. They are commonly used for grilling and barbecuing.

Biomass briquettes:- These are made from various organic materials such as sawdust, rice husk, and other agricultural waste. They are compressed without the use of binding agent and are used for heating and cooking.

Paper briquettes:- These are made from shredded paper mixed with a binding agent such as water and then compressed into blocks. They are used as a fuel for fireplaces and stoves.

Lignite briquettes:- This are made from lignite coal, which isa low grade coal that is abundant in many parts of the world. They are commonly used for heating and cooking.

Coconut shell charcoal briquettes:- These are made from coconut shells that are burned and then compressed into blocks. They are commonly used for grilling and barbecuing.

Wood briquettes:- These are made from compressed wood shavings and sawdust. They are commonly used for heating and cooking and are popular alternative to firewood.

Briquette market industry in India

Increasing demand for renewable energy sources and the governments focus on clean energy.

According to a report by ResearchAndMarkets.com, the Indian biomass briquette market was valued at around \$575 million in 2020 and is expected to grow at a compound annual growth rate of over 10% during the forecast period of 2021 to 2026 .

The demand for briquettes in India is driven by several factors, including the rising cost of the traditional fuels such as coal and petroleum, increasing awareness about the environmental benefits of using renewable energy sources, at the government’s initiative to promote clean energy.

The market for briquette in India is fragmented, with many small and medium sized player operating in the sector. Some of the major players in Indian briquette market include Green Energy Biofuel, Biomass power, Jay Khodiyar Machine Tools, and Radhe Engineering Corporation.

Overall, the briquette market in the India is expected to continue its growth trajectory in the coming years, driven by the increasing demand for clean and sustainable energy sources

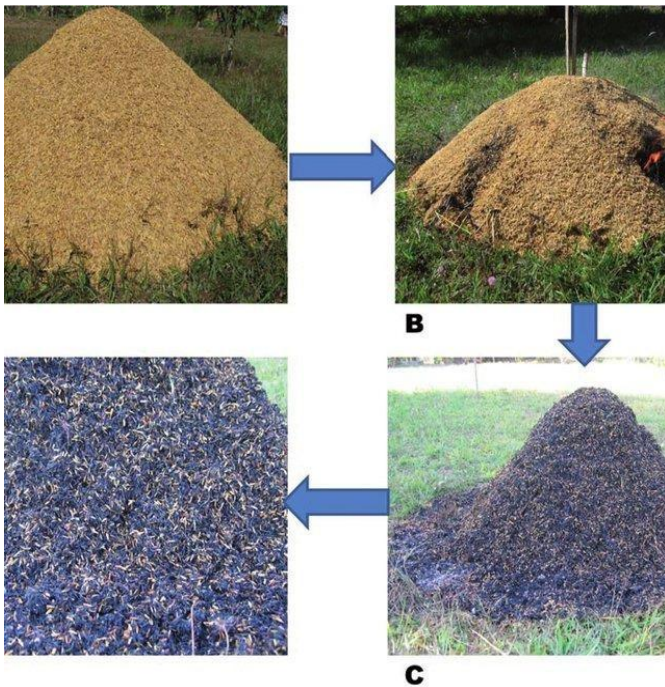
Hypothesis and Postulates:

1. **We can use different biofuel crop waste in order to increase calorific value (CV) of biomass briquettes. For example:**

- **Jatropha :** Jatropha is a crop that is often grow for its oil, which can be used as a biofuel. There are several other crops that can also be used for biofuel production.

- **Soybeans:** Soybeans are a versatile crop that can be used for a variety of purposes, including biofuel production. Theoil from soyabean can be extracted and converted into biodiesel.
 - **Corn:** Corn is another crop that can be used for biofuel production. Corn ethanol is a popular type of biofuel that is made by fermenting the stars in corn.
 - **Sugarcane:** sugarcane is the popular crop for biofuel production in countries like Brazil. The juice from sugarcane can be fermented and distilled to produce ethanol.
 - **Switchgrass:** Switchgrass is the type of grass that is native to North America and is being studied as a potential biofuel crops. The plant can be grown on marginal land and can be converted into biofuels using variety of processes.
 - **Algae:** Algae a promising crop for a biofuel production because it grows quickly and can be grown in variety of environments including ponds and tanks. The oil from algae can be extracted and converted into biofuels.
2. **Making charcoal by using local methods to increase the calorific value of biomass briquettes.**
- **Carbonization:** This is a process that involves heating the biomass material in the presence of limited oxygen to produce charcoal. Charcoal briquettes have a higher energy content and burn longer than regular biomass briquettes.





Here are some examples for making charcoal with the help of traditional ways in cheap price. We can use this method to increase the calorific value of briquettes.

Conclusion:

We conducted our research in two phases.

In Phase 1 we did analysis on briquettes in which we deals with how briquettes are different from other fuels, process of making briquettes other than that new technologies which enhance its calorific value.

In phase 2 we did study on upcoming opportunities for biofuels in India in which we studied government has implemented various policies and incentives to promote the use of renewable energy sources other than that we also studied about machinery, land requirement, and briquette market industry in India. After researching on topic we give some thesis in that we believe the calorific value of briquette will increase if we use it in briquette making process.

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