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PREPARATION OF BRIQUETTES USING BIO-DEGRADABLE WASTE

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Abstract: Solid waste management is a significant challenge on college campuses, where large amounts of biodegradable and non-biodegradable waste are produced daily. Effective waste management is essential for maintaining a clean environment and promoting sustainability. At the D.Y. Patil College of Engineering Akurdi, Pune, green waste is prevalent, necessitating innovative solutions. One effective approach is the production of briquettes from biodegradable waste, transforming materials like food scraps and yard clippings into valuable fuel. Utilizing natural binders such as cow dung and molasses, this process is cost-effective and eco-friendly, enhancing the cohesion of the green waste materials to produce dense, efficient briquettes.

The process involves collecting and drying green waste, shredding it, mixing it with binders, and compressing it into briquettes. These briquettes are then dried again to ensure durability and stability. The study explores the feasibility and benefits of this method, aiming to improve waste management, promote sustainability, and provide a cost-effective energy solution. Additionally, it offers educational and research opportunities for students and promotes energy security by providing an alternative energy source.

Testing revealed that molasses-based briquettes have higher calorific values, while cow dung briquettes have higher ash content. Biomass briquettes offer a clean alternative to wood fuel, contributing to health improvement, climate change mitigation, and economic benefits. This method aligns with sustainable development goals, providing renewable energy, managing waste effectively, and promoting economic growth through job creation and improved rural livelihoods.

IndexTerms - Solid waste management, Biodegradable Waste, Briquettes, Natural binders, Sustainability, Renewable energy

INTRODUCTION

Solid waste management is a critical issue faced by many institutions, including college campuses, where large quantities of biodegradable and Non-Biodegradable waste are generated daily. Effective management of this waste is essential for maintaining a clean and healthy environment and for promoting sustainability and reducing the environmental impact of waste disposal practices. Biodegradable waste consists of organic materials that decompose naturally over time, such as food scraps, yard waste, and paper products. Proper management of both types is crucial for minimizing environmental impact. A large amount of green waste is produced at College. Non-biodegradable waste includes materials that do not easily break down in the environment, like plastics, metals, and glass. College of Engineering Akurdi, Pune. This waste has a low heating value per unit volume and becomes a problem for transportation and storage at the D.Y. Patil College of Engineering Akurdi campus. One innovative and environmentally friendly solution to this challenge is the production of briquettes from biodegradable green waste. This process involves converting organic waste, such as food scraps, yard clippings, and other biodegradable materials, into a valuable fuel source. This approach addresses waste management challenges and provides an environmentally friendly alternative to traditional fuels. By utilizing natural binders such as cow dung and molasses, the production of briquettes becomes a cost-effective and eco-friendly solution. These natural binders enhance the briqueting process by providing necessary cohesion to the green waste materials, resulting in dense, compact, and efficient fuel briquettes. The process involves collecting green waste, processing it to remove contaminants, and then mixing it with the natural binders before compressing the mixture into briquettes. This paper explores the feasibility and benefits of generating briquettes from green waste on a college campus, focusing on the use of natural binders to optimize the briqueting process. The study aims to demonstrate how this approach can contribute to sustainable waste management and energy production, reduce the environmental impact associated with waste disposal and fossil fuel use, and promote renewable energy practices within educational institutions. By implementing this method, college campuses can not only manage their organic waste more effectively but also produce a renewable energy source that can be used as fuel briquettes, thus advancing their sustainability goals and reducing their carbon footprint. Transforming green waste into fuel briquettes offers an effective and sustainable solution for cooking and heating needs. These briquettes, produced through densification processes, are dense, compact disks of organic waste that burn cleaner than traditional fuels like firewood and charcoal, thereby reducing environmental impact and improving air quality.

NEED OF STUDY

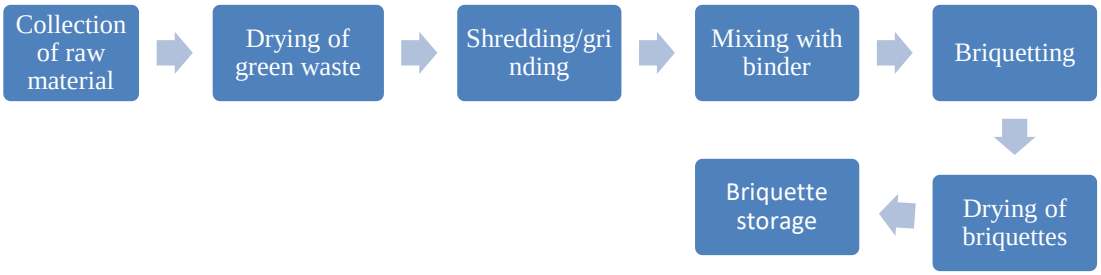
1. Employing organic solid waste for environmental betterment.
2. Achieving cleanliness goals via solid waste reduction.
3. Non-renewable resource preservation, e.g., oil, kerosene.
4. Environmental equilibrium through renewable energy adoption.
5. Utilizing raw waste for eco-friendly energy solutions.

OBJECTIVE

- Waste Management Improvement:
  Minimize the volume of organic waste requiring disposal by converting it into fuel briquettes.
  Promote efficient utilization of organic waste materials.
- Environmental Sustainability:
  Reduce the campus's carbon footprint by using cleaner fuel alternatives to traditional fossil fuels.
  Support the adoption and promotion of renewable energy sources.
- Cost-Effective Energy Solution:
  Develop a cost-effective method for producing fuel briquettes.
  Utilize natural binders like cow dung and molasses to lower production costs and environmental impact.
- Educational and Research Opportunities:
  Provide practical, hands-on learning experiences for students in environmental science, engineering, and sustainability.
  Encourage research into optimizing briquette production and improving binder formulations.
- Energy Security and Independence:
  Provide an alternative energy source to reduce dependency on external energy supplies.
  Ensure a reliable and consistent energy supply for campus heating and cooking needs.

METHODOLOGY

The production of briquettes from green waste involves several key steps. Initially, a collection of raw material, primarily consisting of organic green waste such as residues, wood chips, or sawdust, is gathered. This raw material undergoes drying to reduce its moisture content, making it suitable for further processing. Next, the dried waste is shredded or ground into smaller, uniform particles to facilitate the mixing process. These particles are then mixed with natural binders such as cow dung and molasses, which act as adhesives to hold the briquettes together. The mixture is compressed into briquettes using specialized equipment, a process known as briqueting. The newly formed briquettes are then dried again to remove any remaining moisture, ensuring their durability and stability. Finally, the dried briquettes are stored in appropriate facilities until they are ready for use or distribution.



EQUIPMENT AND EQUIPMENT

Fig:1 Briquette Mould, CTM Machine**,** Shredding Machine

Fig:2 Green waste, molasses, siris beans, cow-dung.

PROCEDURE

1-Green waste and Cow-dung briquettes

1.1) for cow-dung 10% briquettes

a) Quantity
Weight of raw material = 250 gm
Weight of cow-dung = 25 gm
b) Ratio - 1:10
c) Mix the raw material with cow-dung binder. Add some mixing. Water if required for mixing.
d) Take a mold and give shape to mixed material by mold pressing, remove excess water.
e) Dry the briquettes by natural drying.

1.2) for cow-dung 20%. Briquettes

a) Quantity
Weight of raw material = 250 gm
Weight of cow-dung = 50 gm
b) Ratio -1:5
c) Mix the raw material with cow-dung binder. Add some mixing. Water if required for mixing.
d) Take a mold and give shape to mixed material by mold pressing, remove excess water.
e) Dry the briquettes by natural drying.

2-Green waste and molasses briquettes

2.1) for molasses 50% briquettes

a) Quantity
Weight of raw material = 250 gm
Weight of molasses = 125 gm
b) Ratio – 1:2
c) Mix the raw material with molasses binder. Add some mixing. Water if required for mixing.
d) Take a mold and give shape to mixed material by mold pressing in CTM machine, remove excess water.
e) Dry the briquettes by natural drying.

2.2) for molasses 75% briquettes

a) Quantity
Weight of raw material = 250 gm
Weight of molasses = 187 gm
b) Ratio – 1:2
c) Mix the raw material with molasses binder. Add some mixing. Water if required for mixing.
d) Take a mold and give shape to mixed material by mold pressing in CTM machine, remove excess water.
e) Dry the briquettes by natural drying.

3- Green waste and carob beans

3.1) for siris beans

a) Quantity
Weight of raw material = 250 gm
Weight of beans = 50 gm
b) Ratio – 1:2
c) Mix the raw material with a bean binder. Add some mixing. Water if required for mixing.
d) Take a mold and give shape to mixed material by mold pressing in CTM machine, remove excess water.
e) Dry the briquettes by natural drying.

Fig: 3 Final Briquettes.

TESTING

Produced briquettes were kept on a flat surface for sun drying for about 10 days. The highest temperature varies between 35^0C – 38^0C.humidity ranges between 45% to 50%.

Briquette Characterization

A test was carried out to characterize briquettes to determine the percentage of moisture content, volatile matter, fixed carbon, ash content, and calorific value of the produced briquettes.

1. Moisture Content

Moisture Content refers to the amount of water present in the briquettes It affects the combustion efficiency and energy output of the briquettes. High moisture content in briquettes reduces their calorific value because a significant portion of the energy released during combustion is used to evaporate the water. For most types of biomass briquettes, the ideal moisture content is between 8% and 12%. This range ensures optimal combustion and energy output.

Formula:

Moisture Content (%) = (Initial Weight of Sample - Dry Weight of Sample/Initial Weight of Sample)×100

2. Fixed Carbon

Fixed Carbon is the solid combustible residue that remains after a briquette sample has been heated and the volatile matter has been expelled. It represents the carbon content in the material that burns off when the material is heated in the absence of air.

Formula:

Fixed Carbon (%) =100− (Moisture Content (%) +Volatile Matter (%) +Ash Content (%))

3. Ash Content

Ash Content is the inorganic residue left after the complete combustion of a briquette sample. It represents the mineral content of the briquettes, which does not contribute to energy production and can affect the handling and processing of the material.

Formula:

Ash Content (%) = (Weight of Ash/Initial Weight of Sample) ×100

4. Calorific Value

Calorific Value (also known as heating value) is the amount of energy released when a certain amount of briquettes is completely combusted. It is usually measured in kilocalories per kilogram (kcal/kg) or megajoules per kilogram (MJ/kg).

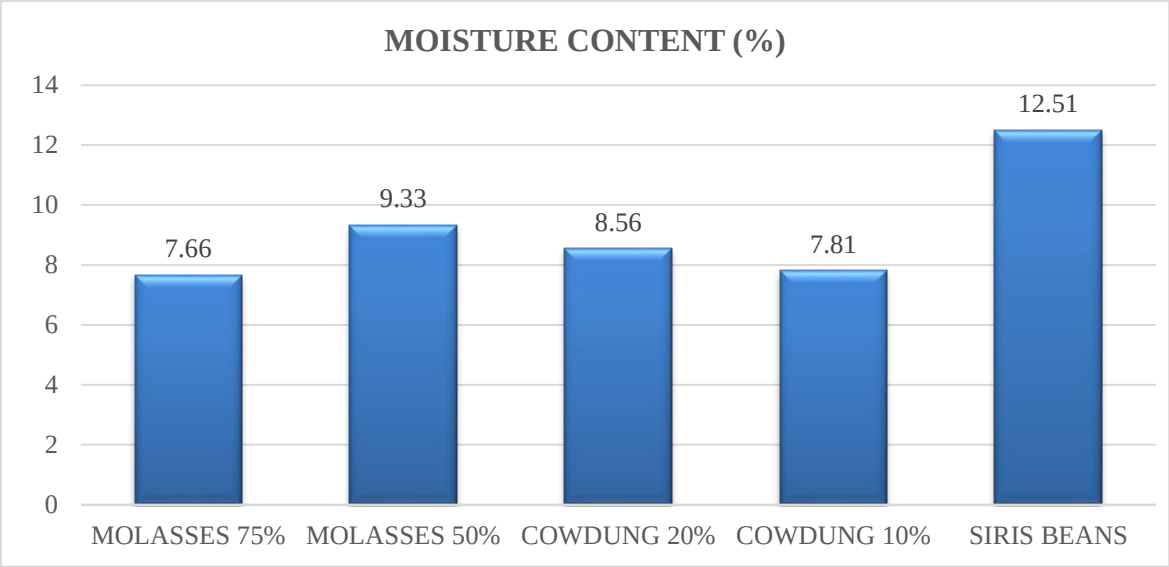
Formula:

Calorific Value = (Energy Released (kcal or MJ)/Weight of Sample (kg))

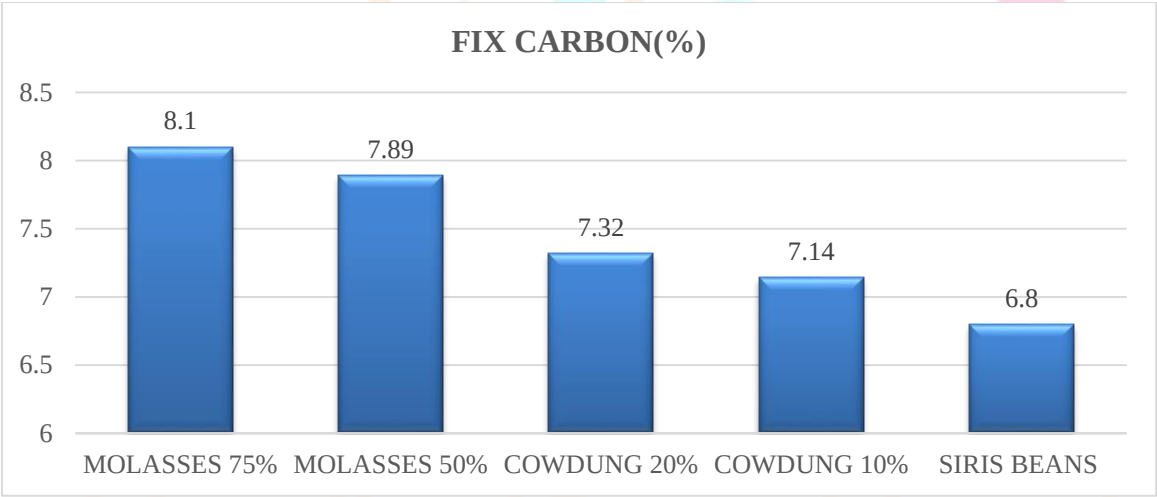
RESULT

Sample Type	Test Performed			
	Ash Content (%)	Fix Carbon (%)	Moisture Content (%)	C.V (Kcal)
MOLASSES 75%	11.82	8.1	7.66	3991
MOLASSES 50%	10.91	7.89	9.33	3808
COWDUNG 20%	14	7.32	8.56	3825
COWDUNG 10%	12.5	7.14	7.81	3376
SIRIS BEANS	11.2	6.8	12.51	3680

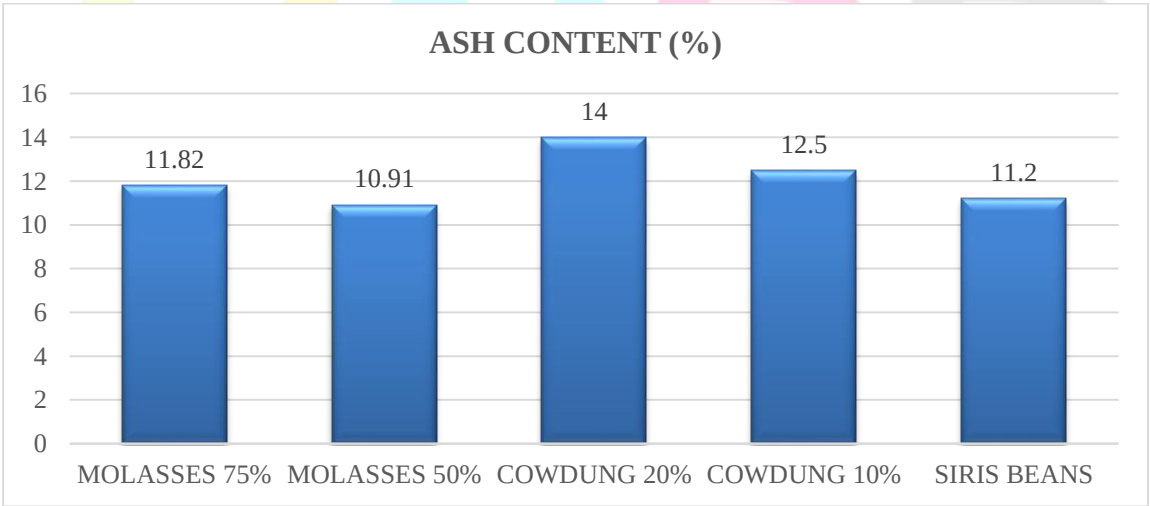
As mentioned above four tests were conducted on five different samples.



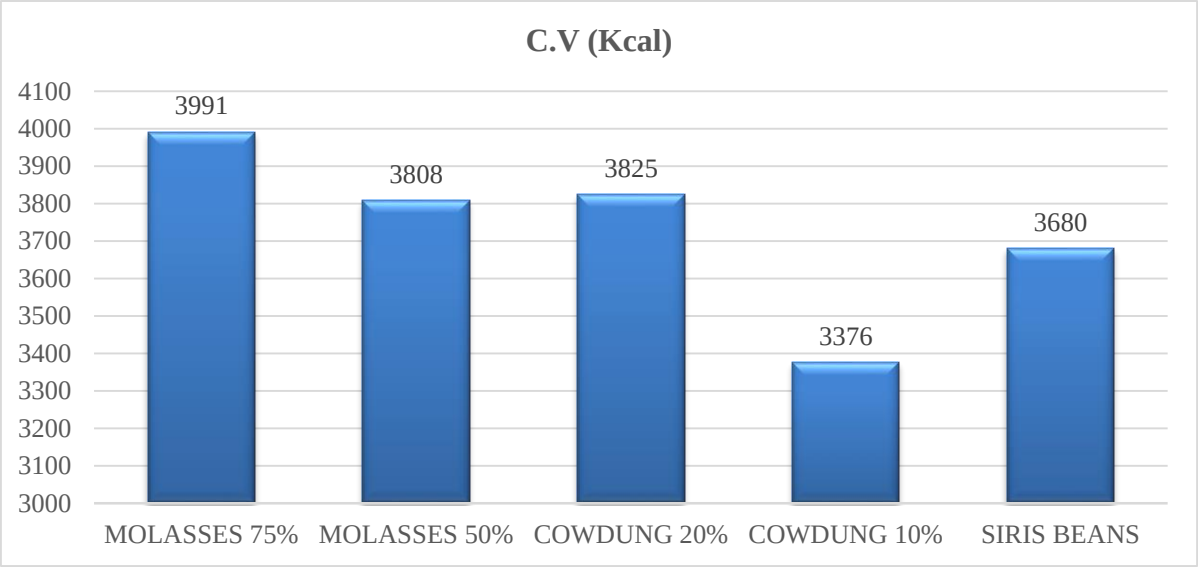
Moisture Content: Molasses samples consistently show lower moisture content compared to cow dung and Siri beans samples. Among molasses samples, the 50% molasses sample exhibits slightly higher moisture content, possibly due to processing or storage conditions. Cow dung samples generally have moderate moisture content, with the 20% cow dung sample having the highest among them. Siri beans sample stands out with the highest moisture content among all samples.



Fixed Carbon: While there's minimal variation in fixed carbon content across all samples, cow dung samples tend to have slightly higher fixed carbon content compared to molasses and Siri beans samples. This suggests that cow dung could potentially contribute to better combustion efficiency and heat generation in briquettes.



Ash Content: Molasses-based samples, despite variations in molasses concentration, generally show lower ash content compared to cow dung and Siri beans samples. The 75% molasses sample has the highest ash content among molasses-based samples, possibly due to impurities or additives. Cow dung samples, especially the 20% cow dung sample, exhibit relatively higher ash content, likely due to the presence of mineral matter in cow dung. Siri beans sample falls within a moderate range of ash content.



Calorific Value: Molasses-based samples consistently demonstrate higher calorific values compared to cow dung and Siri beans samples. The 75% molasses sample exhibits the highest calorific value among all samples, indicating its potential for producing briquettes with greater energy output. Cow dung samples show moderate calorific values, with the 20% cow dung sample having the highest among them. Siri beans sample has the lowest calorific value, suggesting it may be less efficient as a biomass feedstock for briquette production.

CONCLUSION

- The highest calorific value is obtained when green waste is mired with molasses binder. The calorific value of briquettes produced is compared with the calorific value of conventional fuel that is used in boilers like firewood. Hence making the use of briquettes is a suitable alternative to these fuels in terms of calorific value.
- Briquettes made with Cow-dung binder show a high amount of ash Content as compared to other briquettes. Hence It is not advisable to use it in boilers since it may cause slagging.
- It can be concluded that when green waste is fused with appropriate proportions have the potential to become an effective replacement for conventional fuels like firewood and coal in boilers and for domestic purposes. Analysis of other important characteristics like Sulphur content and specific density is to be included in the future scope of the project.
- Utilizing biodegradable waste to produce briquettes significantly enhances environmental sustainability by reducing landfill waste and greenhouse gas emissions. This process conserves natural resources by providing a renewable, cleaner alternative to fossil fuels. It promotes a circular economy by repurposing waste into valuable energy sources, contributing to long-term environmental protection and resource conservation.

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