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Research Paper

Manufacturing of Organic Brick Using Saw Dust and Rice Husk.

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ABSTRACT: *Today Researchers worldwide are focusing on finding ways to use waste from industries and agriculture in the construction industry. This can be both cost-effective and help create a sustainable and clean environment. The main goal of this is to develop eco-friendly and energy-saving bricks using saw dust ash and rice husk ash. These are by- products from the furniture shop and rice grinding mills, respectively. The waste materials were analyzed for their chemical composition partical size distribution. In this study, the bricks were produced by mixing a specific proportion of saw dust (SD), rice husk (RH) and clay. The experimental results showed that these bricks are lighter, durable, environmentally friendly, and have increased strength due to their pozzolanic properties. They also have reduced permeability because of pore refinement.*
KEYWORDS: Rice Husk (RH), Saw Dust (SD).

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I. INTRODUCTION

Due to rapid population growth and industrialization, In this study, the bricks were produced by mixing a specific proportion of saw dust ash (SDA), rice husk ash (RH) and clay. Clay bricks that are available may not meet the desired quality standards. They might have lower compressive strength, higher water absorption, high efflorescence, increased wastage during transportation and handling, and uneven surfaces. These challenges have prompted engineers to explore alternative materials that can help reduce the overall cost of construction. Organic brick is a new circular housing construction component, created using entirely. reusable, recyclable materials taken from the local terrain.

Rice husk and sawdust are abundant agricultural by-products, often considered waste materials with limited utilization. However, through innovative manufacturing processes, these materials can be transformed into high-quality building components, contributing to resource efficiency and waste reduction. Clay, a traditional building material, serves as a binding agent, enhancing the structural integrity and durability of organic bricks. organic bricks offer favorable thermal insulation properties, contributing to energy efficiency and indoor comfort in buildings. Their lightweight nature facilitates ease of handling and transportation, reducing construction time and costs.

Despite the promising advantages of organic bricks, there remain challenges related to standardization, performance optimization, and widespread adoption in the construction industry. This review paper aims to provide a comprehensive overview of the manufacturing process, material properties, environmental impact, and potential applications of organic bricks made with rice husk and sawdust.

The utilization of rice husk and sawdust in brick manufacturing involves a meticulous process that blends these waste materials with a natural binding agent, typically clay, to form a cohesive mixture. This blend undergoes compression, molding, drying, and curing stages to produce organic bricks characterized by their unique properties and environmental benefits.

II. LITERATURE REVIEW

There are lots of researches done on bricks, local construction Materials, reuse of industrial wastes, environment sustainability which are studied well before fixing the objectives, aims and route map to achieve the goal of research. The research gap is Identified after the intensive literature review and decided to Put an effort on contributing something to environment and to safeguard the depleting resources by developing energy efficient eco-friendly bricks using industrial waste. Some of the studies by previous researchers are discussed below.

1. Ms. Divya R. Jain et al. -2021.

Recycling waste materials such as fly ash, marble sludge, granite sludge, stone sludge, ceramic sludge, plastic, coal, wheat bran, sawdust, sugarcane bagasse (SBA), rice husk ash (RHA), residual coal, etc., undergo tests for brick properties such as compressive strength, soundness, hardness, and water absorption. Eco-bricks outperform traditional bricks, reducing soil erosion by repurposing industrial waste sludge (i.e., wastewater sludge). Boiler ash from thermal power plants and paper mills is also utilized. Various materials are employed to create eco-bricks, yielding positive outcomes. It's noted that the 28-day cylinder compressive strength is nearly 90% of the cube strength, exceeding that of OPC-based concrete. Compressive strength is assessed for different ratios of fly ash partially replacing cement (8:2, 4:6, 6:4, and 2:8) after 28 days of curing. Thus, we can affirm that the utilization of Eco-Bricks is cost-effective, energy-efficient, and commercially viable.

2. Trupti D. Khati, et al. -2017.

In this review paper, Researchers investigate that utilizing RHA and MD bricks in construction mirrors the application of traditional clay bricks, offering lighter weight and superior strength. Moreover, by repurposing RHA and MD waste, sourced abundantly from rice mills and marble cutting sites, we not only address environmental pollution but also foster a sustainable solution to waste management. Optimal compressive strength is achieved in RHA and MD bricks when using a mix ratio of 30% rice husk ash and 70% marble dust, surpassing red clay bricks by 1.92 times and fly ash bricks by 1.33 times.These bricks exceed the minimum compressive strength requirements, falling within the 5 to 7.5 class designation. Increasing the proportion of marble dust results in denser bricks with reduced water absorption, contrasting with the higher porosity of ordinary red clay bricks. By eliminating the firing process from brick manufacturing, CO2 emissions are mitigated, aligning with eco-environmental practices for brick production.

3. Mrs. K. Saranya et al. -2016.

In this review paper, The researcher looked into the Durability of bricks made with industrial sludge. The findings showed that the sludge can replace up to 40% of the weight of the earth brick while still maintaining satisfactory strength. The compressive strength of the brick without sludge was 11.7 MPa, and with 5% sludge, it increased to 17.6 MPa. However, adding more than 5% sludge caused a decrease in compressive strength to 10.5 MPa. As for water absorption, when the sludge exceeded 10% of the weight, the water absorption gradually increased. This study demonstrates that adding sludge to bricks not only provides a safe way to dispose of industrial waste but also helps in brick production.

4. Gokhan And Osman -2013.

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III. SCOPE AND OBJECTIVE

3.1 SCOPE

The scope of the review paper on manufacturing a new kind of organic brick by using Rice Husk and Saw Dust defines the boundries and focus of the research. The production of bricks by using Rice husk and Saw dust having some cement poperties is done. A number of 9 bricks are to be cast for each replacement levels (5%,10%,) with combination of Rice husk and clay and Saw dust and clay and combination of RHSD is done. The results are compared with the conventional bar chart and graphs.

3.2 OBJECTIVE

1. To create building materials that minimize environmental impact by utilizing renewable resources and reducing reliance on non- renewable materials.
2. To ensure that the organic bricks maintain sufficient structural integrity and durability to meet building standards and withstand environmental factors such as weathering and seismic activity.

3. To minimize and reuse generation of organic wastes in construction industry.

4. To produce cost-effective materials which a common person can afford easily.

5. To compare the results of organic brick with red conventional brick.

IV. MATERIALS USED

4.1. Rice husk
Rice husk, a byproduct of rice milling, is an abundantly available agricultural waste material that holds significant promise for various applications, including its utilization in the manufacturing of organic bricks. Comprising the outer layer of ricegrains, rice husk is predominantly composed of cellulose, hemicellulose, and lignin, along with silica and other minerals. This section explores the characteristics, properties, and potential uses of rice husk in the context of brick production.

4.2. Saw Dust Ash
Sawdust ash is a byproduct obtained from the combustion or incineration of sawdust, a common waste material generated from wood processing industries, carpentry workshops, and furniture manufacturing. When sawdust is burned under controlled conditions, it undergoes combustion, leaving behind ash as a residual material. This ash predominantly consists of inorganic compounds derived from the minerals present in the wood, as well as organic residues that were not fully combusted during the burning process.

4.3. Clay
Clay is a fundamental raw material extensively utilized in brick manufacturing due to its
abundance, plasticity, and ability to undergo firing processes to form. Clay serves as a versatile and indispensable material in brick manufacturing, offering a combination of plasticity, firing characteristics, and mineralogical properties essential for producing durable and aesthetically pleasing bricks used in construction.

4.4. Fly Ash
Fly ash is a byproduct generated from the combustion of pulverized coal in thermal power plants. It is a fine, powdery material that is typically collected from the flue gases during coal combustion. Due to its pozzolanic properties and abundance, fly ash has been widely used as a supplementary cementitious material in various construction applications, including brick manufacturing.

Fig. 1. Rice husk

Fig. 2. Saw dust

Fig. 3. Clay

Fig. 4. Fly ash

Table 1. Chemical Properties of Rice Husk

Chemical Properties	***Mehta 1992 et. Al***	***Zheng et. al***	***Bui et. al***	***V. Ramasamy et. Al***
SiO_2	87.2%	87.3%	86.98%	87.20%
Al_2O_3	0.15%	0.15%	0.84%	0.15%
Fe_2O_3	0.16%	0.16%	0.73%	0.16%
CaO	0.55%	0.55%	1.40%	0.55%
MgO	0.35%	0.35%	0.57%	0.35%
SO_3	0.24%	0.24%	0.11%	0.24%
Na_2O	1.12%	1.12%	2.46%	-
K_2O	3.68%	3.68%	-	-
Loss on Ignition	8.55%	8.55%	5.14%	5.44%

Table 2. Physical properties and chemical composition of the sawdust ash *(Hussein Karim et. al)*

Index Property	**Index Value**
Specific gravity	2.02
Fineness	75 μm
Fineness Silica (SiO_2)	76.3 %
Alumina (Al_2O_3)	5.8 %
Lime (Cao)	4.7%
Iron oxide (Fe_2O_3)	2.9 %
SO_3	1.6 %
MgO	1.2 %
Other oxides	2.5 %
Loss in ignition	3.9 %

V. METHODOLOGY

Step-1: Preparation of Sample:

Material Selection: Rice husk, sawdust, and fly ash are chosen as the primary materials due to their availability and potential for eco-friendly brick production. Rice husk and sawdust are agricultural waste products, while fly ash is a byproduct of coal combustion. The materials are mixed with water to create a paste-like consistency. This step is crucial for homogenizing the mixture and ensuring proper bonding between the particles during brick formation.

Step-2: Binder preparation:

Paste Formation: Water is added to the fly ash to create a paste-like consistency. Care is taken to ensure that the mixture is well-mixed and free from lumps, as uniform distribution of the binder is essential for effective binding of the particles.

Step-3: Formation of Bricks:

Molding Process: The prepared sample paste, along with the binder, is placed into brick mold boxes. These molds are designed to impart the desired shape and dimensions to the bricks. 9 bricks of 3 sample is made which is of 5% and 10. The rice husk (RH), fly ash, and saw dust (SD) sample was taken and thoroughly mixed with binder until the paste will obtained. This paste will placed in brick mould box and leveled as shown in fig. no. 3.1.

Fig. 3.1 Molding process

Compaction and Leveling: The paste is compacted and leveled within the mold to ensure uniform density and shape of the bricks. Proper compaction is essential For preventing voids or weak spots in the bricks.

Fig. 3.2 Compacting and leveling

Drying and Firing: After molding, the bricks are allowed to air dry in an outdoor dry place. Once dried, they are fired in a furnace at high temperatures 800° to further strengthen them through sintering and vitrification processes.

Fig. 3.3. Drying process

Fig. 3.4. Bricks for firing in the kiln

VI. TESTING ON MATERIALS

1. Specific gravity of materials:

To determine the specific gravity of clay as per the Indian Standard (IS) code, the procedure outlined in IS 2720 Part 5:1985 . In this investigation, well- graded natural soil was used. And it met all of the criteria for producing Organic bricks. This standard provides detailed instructions on how to conduct the test, including the equipment

required and the step-by- step procedure. It typically involves measuring the weight of the soil sample in air and in water to calculate the specific gravity.

Formula:

Specific Gravity = (W2-W1)/ (W2–W1))-(W3–W4)

Fig. 4.1 Saw dust sample

Fig. 4.2 Rice husk ash sample

Table 3. Specific gravity of organic waste samples

Sr. No.	Sample	Weight of clay	Weight of rice husk	Weight of saw dust
1.	W1	880	580	650
2.	W2	480	480	480
3.	W3	1120	1120	1120
4.	W4	1340	1220	760
Specific gravity		2.22	1.25	1.43

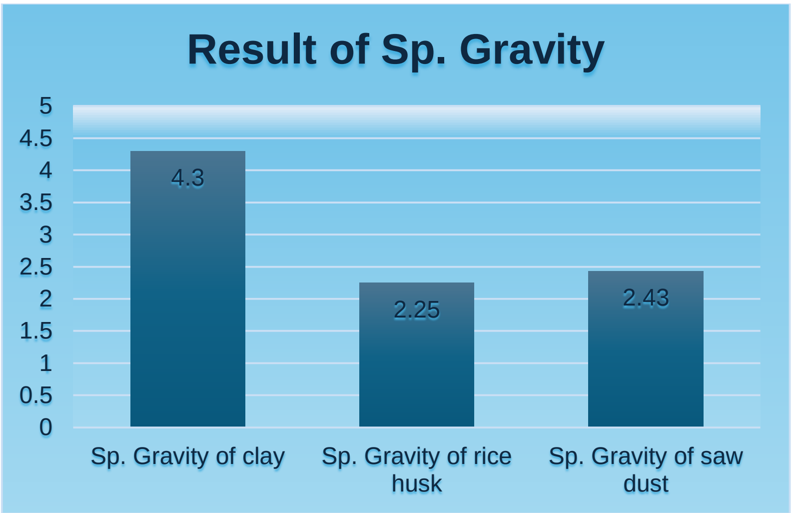

Fig. 5. Weight of samples for Specific gravity

2. Moisture content of material:

To determine the moisture content of material followed by Indian Standard (IS) code IS 2720 Part 2:1973. After Preparing soil sample, Weigh an empty container and record its weight as (W1). Take a known weight of the prepared soil sample and place it into the container. Record the weight of the container withthe wet soil (W2). Place the container with the wet soil sample in an oven set at a temperature between 105°C to 110°C. Dry the soil until its weight remains constant for at least two consecutive weighings atintervals of not less than one hour. This ensures that all moisture has been driven off. After drying, removethe container from the oven and allow it to cool in a desiccator. Weigh the container with the dried soil (W3).

Calculate the moisture content (MC) using tformula:

$$\mathbf{MC = ((W2 - W3) / (W3 - W1)) \times 100}$$

Table 4. Moisture Content of organic waste materials

Sr. No.	Sample	Weight of clay	Weight of rice husk	Weight of saw dust	Fly Ash
1.	W1	1130	1215	1165	1130
2.	W2	480	480	480	480
3.	W3	1120	1120	1120	1120
Moisture Content of Sample		**25%**	**8%**	**13%**	**2.5%**

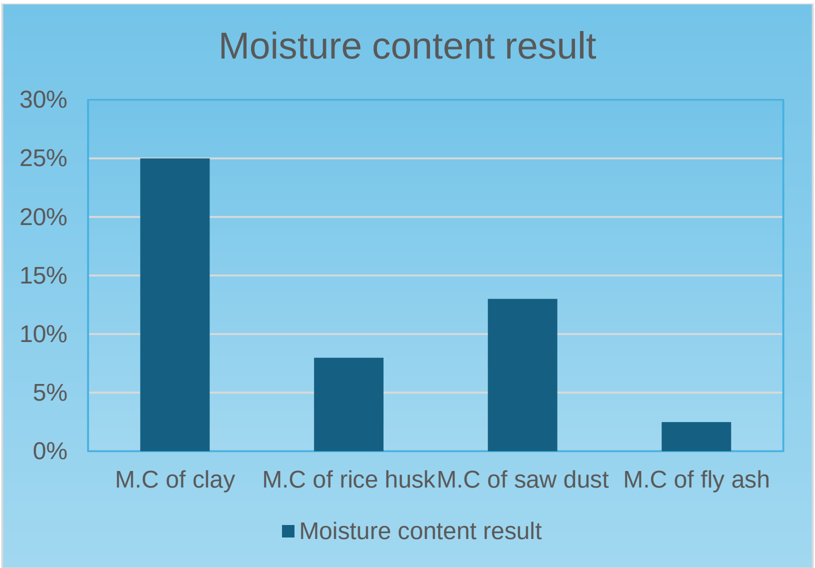

Fig. 6. Weight of sample for Moisture Content

VII. EXPERIMENTAL WORK

7.1 Testing on bricks

1. Compression Testing:

Compression testing is conducted to determine the compressive strength of the bricks. This test involves subjecting the bricks to a gradually increasing compressive load until they fail. The maximum load sustained by the brick before failure is recorded as its compressive strength. It provides valuable information about the load-bearing capacity of the bricks and theirability to withstand external pressures.

Formula: $$Compressive\ strength\ N/mm^2 = \frac{\text{Maximum load at failure in N}}{\text{Average area in mm}^2}$$

Fig. 7. Compression Testing

Table. 5. Compressive Strength Result

Sr. No.	Mix	Compressive Strength
1.	Conventional Red Brick	3.74
2	Rice Husk 5% + Saw Dust 5%	3.95
3	Rice Husk 5%	3.15
4	Saw Dust 10%	3.24

2. Water Absorption:

Water absorption testing assesses the ability of the bricksto absorb moisture. In this test, the bricks are submergedin water for a specified period, and their weight is measured before and after immersion. The difference inweight indicates the amount of water absorbed by the bricks. Water absorption is an essential parameter as excessive absorption can lead to structural damage and reduced durability of the bricks. Calculate the water absorption percentage using the formula:

Formula:

$$Water\ absorption = \frac{M2-M1}{M1} \times 100\%$$

Fig. 8. Water absorption

Table. 6. Water Absorption Result

Sr. No.	Mix	Water Absorption
1.	Conventional Red Brick	19%
2	Rice Husk 5% + Saw Dust 5%	15%
3	Rice Husk 10%	12%
4	Saw Dust 10%	17%

3. Hardness Test:

The hardness test evaluates the resistance of the bricks to surface indentation or abrasion. standardized hardness testing apparatus is used to apply a controlled force to the surface of the brick, and the depth or degree of indentation is measured. This test helps determine the durability and wear resistance of the bricks, which is crucial for theirlongevity and performance in various applications.

Table .7. Hardness Result

Sr. No.	Mix	Hardness
1.	Conventional Red Brick	8
2	Rice Husk 5% + Saw Dust 5%	6
3	Rice Husk 10%	5
4	Saw Dust 10%	4

4. Soundness Test:

The soundness test assesses the ability of the bricks to resist deterioration due to exposure to environmental factors such as temperature variations, moisture, and chemical reactions. In this test, the bricks are subjected to cycles of wetting and drying or heating and cooling, simulating real-world conditions. Any changes in the physical appearance or dimensions of the bricks after the test indicate their susceptibility to weathering and deterioration.

Fig. 9. Soundness test

7.2 Comparative analysis

Table. 8. Comparative table of conventional and organic brick

	Conventional Brick	**Organic Brick**		
		Rice Husk 5% + Saw Dust 5%	**Rice Husk 10%**	**Saw Dust 10%**
Compressive Strength	3.74 N/mm^2	3.42 N/mm^2	3.24 N/mm^2	3.14 N/mm^2
Water absorption	19%	15%	12%	17%
Hardness	8	6	5	4
Soundness	Good soundness	Moderate soundness	Fair soundness	Poor Soundness

XIII. RESULT ANALYSIS

A. Compression Strength Test:

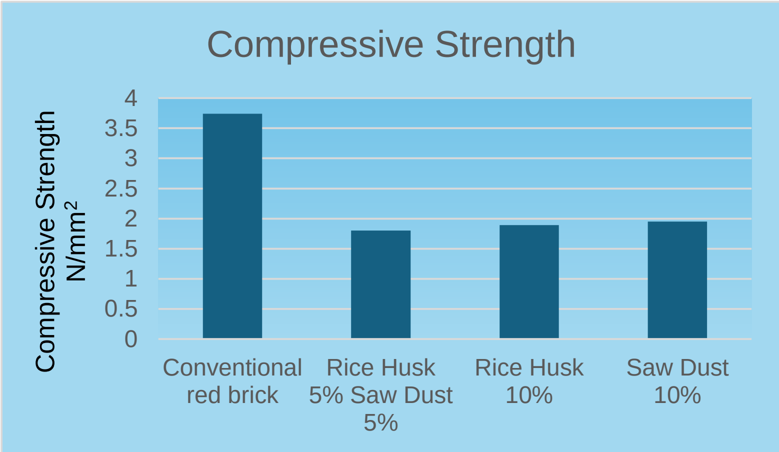

Fig. 9. Compression strength testing

B. Water Absorption Test:

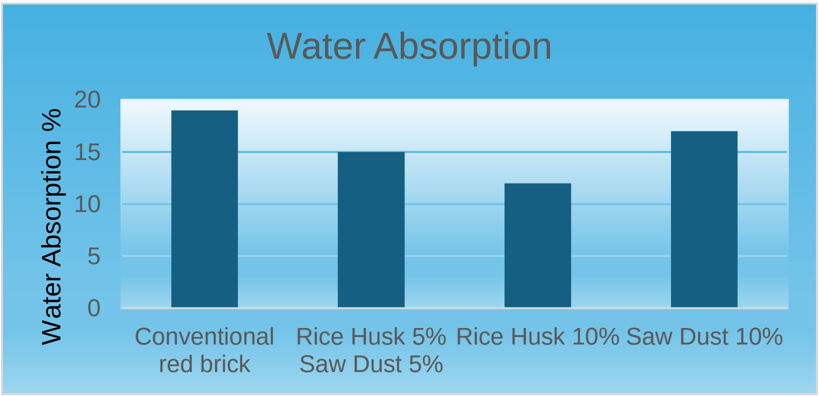

Fig. 10. Water Absorption Test

C. Hardness test:

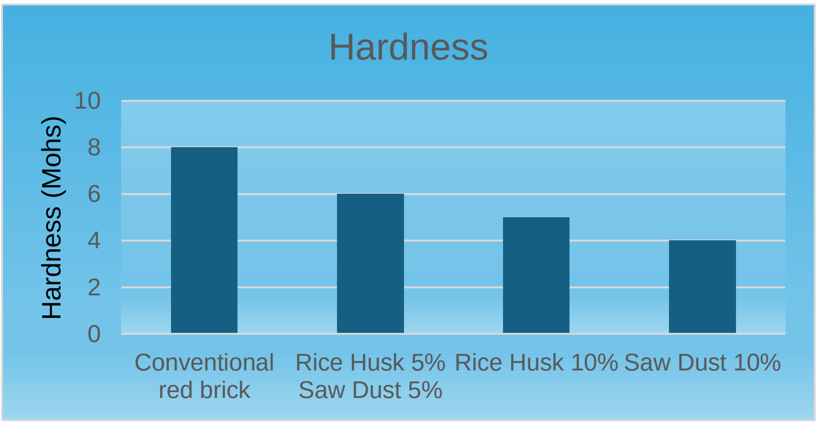

Fig. 11. Hardness test

The hardness test for Organic bricks and Conventional bricks was conducted, test brick was taken and scratch was made on bricks surface with the help of finger nail and found no impression after scratching in both the cases.

D. Soundness test

The Soundness test for clay bricks and fly ash bricks was conducted and the results were compared in which two bricks are struck with each other. It was found that a normal brick shows good results when struck with each other but fly ash bricks show clear ringing sound.

Rice Husk (5%) + Saw Dust (5%): Shows moderate soundness, with some evidence of surface wear and minor cracks under stress.

Rice Husk (5%): Exhibits fair soundness, with noticeable signs of deterioration, such as chipping or flaking, particularly in areas exposed to moisture.

Saw Dust (10%): Displays poor soundness, with significant damage and crumbling observed.

IX. CONCLUSION

1. It minimizes and reuse generation of organic wastes in construction industry and used to produce cost-effective materials which a common person can afford easily.

2. Organic bricks offer unique properties such as improved thermal insulation and potential cost savings.

3. Effective quality control measures are essential to ensure consistency in brick properties, including fineness, strength, and durability, thereby enhancing their suitability for construction projects.

4. These bricks can provide reasonable durability, they might not be as strong as traditional bricks due to the organic materials used.

5. Organic bricks have comparable compressive strength as which is nearly closed to conventional red bricks.

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