BIO BRICK FROM RICE HUSK AND COCONUT PEAT

Mrs. Yasmin N [a], Athira k [b], Fathima Risana A [c], Mohamed Nihal P [d], Mohammed Junaidh k [e]

[a] *Associate Professor, Department of Civil Engineering, MEA Engg. College, yasminnalakath@meaec.edu.in;* Final year *B. Tech Scholar s, MEA Engg. College,* [b] *athirakoolipilakkal@gmail.com;* [c] *fathimarisana258@gmail.com;* [d] *mohammednihal175@gmail.com;* [e] *junaidhmjk@gmail.com ;* [f]

Abstract

Bio-Bricks from Rice Husk and Coconut Coir: A Sustainable Construction Material This research investigates the potential of producing eco-friendly bio-bricks using a agricultural waste materials: rice husk and coconut coir. These waste products, often discarded, possess inherent properties that can be harnessed for construction purposes. The study explores the optimal composition of rice husk and coconut coir mixtures, along with suitable binding agents, to develop bio-bricks with desirable mechanical properties such as compressive strength and water resistance. By utilizing waste materials, this research aims to contribute to sustainable construction practices while reducing environmental impact. The performance of the developed bio-bricks will be evaluated through comprehensive testing and compared to conventional clay bricks.

Keywords: Bio bricks, Aro waste

1. Introduction

Industrialization is one of the important emergent from urbanization that has created greater impact over the scarcity in the construction materials. Also, it had to lead to the over consumption of natural resources that had depleted it as well. So, this had necessitated the utilization of alternative waste materials that achieved the sustainability in environment. Apart conducted from wastes generated through agriculture, WS from Treatment plants was dried and used as ingredient in the Manufacture of bricks. From the previous studies conducted by the maximum percentage of addition of dried sludge was limited to 10%, as beyond it decreases the compressive Strength compared to clay bricks which was too evident from.

The study conducted by Now day′s researchers are Focusing on use of waste materials in improving the strength and durability of characteristic materials Usage of as an additive material for the manufacture of bricks resulted in compressive strength at even smaller percentages but Addition beyond the limitation reduced its durability Characteristics as it absorbs more water due to its increased Surface area. Similar to studies on rice husk shows the same phenomenon of deprived durability characteristics brick manufactured with waste material rice husk indicate that combination with 25%of water Absorption as the optimum level of addition of chemical Activators. Use of such Pre-treated waste materials not only improves the Performance of construction materials but also prominent in Achieving the sustainability towards the environment. Bio-bricks are economical and are found to be 1/8 and 1/10 of weight for similar volume compared to burnt clay bricks and concrete blocks, respectively. Compared to burnt clay bricks, Bio-bricks will cost about Rs 2-3 when mass produced. Farmers can make this material at the site and further reduce labour costs. Manufacturing bio-bricks can add to the marginal farmers′ income and create a new employment opportunity during off-seasons.

Agricultural waste burning is a significant source of pollution in India, especially after the harvesting season. Bio-brick was developed as an alternative and sustainable building material that acts as an alternative to stubble burning. Bio-bricks or agro-waste based bricks are one such material that can create an alternative building material and create new jobs at the grassroots level. This material has good thermal and sound insulation; it is breathable and helps maintain a comfortable living condition during harsh summer or cold winters.

Bio-bricks created from rice husk and coconut peat are an innovative and sustainable solution in the construction industry, addressing both environmental and economic concerns by utilizing agricultural waste. Rice husk, the protective covering of rice grains, is a significant by product of rice production, particularly in countries like India, China, and Southeast Asia. Typically, rice husk is discarded or used in low value applications, but its high silica content makes it an excellent raw material for bio bricks, providing both strength and thermal insulation. Coconut peat, also known as coir pith, is another abundant agricultural by product derived from coconut husks during the coir fiber extraction process. Known for its highwater retention capacity and resistance to decomposition, coconut peat adds valuable properties to bio-bricks, such as enhanced moisture regulation and biodegradability. The combination of rice husk and coconut peat results in a lightweight, durable brick that offers superior thermal and acoustic insulation compared to traditional bricks.

The production of these bio-bricks involves blending rice husk and coconut peat with a natural or biodegradable binder, shaping the mixture into bricks, and curing them through low-energy processes like air drying. This method drastically reduces the carbon footprint associated with conventional brick production, which typically requires high-temperature firing and significant energy consumption. By repurposing agricultural waste, the manufacturing of bio-bricks not only mitigates the environmental impact of waste disposal but also reduces the demand for non-renewable resources, making it a more sustainable choice for the construction industry.

Additionally, the cost-effectiveness of bio-bricks is significant, as the raw materials are inexpensive and readily available, particularly in regions where rice and coconut are widely cultivated. However, while bio-bricks from rice husk and coconut peat offer numerous advantages, they also face challenges, such as ensuring consistent quality, meeting structural standards, and scaling up production to meet market demand. Despite these challenges, ongoing research and development efforts are focused on optimizing the properties of these bio-bricks and making them a viable alternative to traditional construction materials. As the global construction industry increasingly emphasizes sustainability, bio-bricks made from rice husk and coconut peat hold great promise for reducing environmental impact, supporting sustainable building practices, and contributing to the circular economy by transforming agricultural waste into valuable resources.

2. Material properties

2.1 Agro waste

Agricultural waste is produced from crop and animal farming. Include fruit trees, plant fibers, nutshells, and forest residue. Agricultural waste supports landfill conservation and improved building materials. Rice husk and coconut peat are used here for making bio bricks.

2.1.1 Coconut peat

It derived from coconut husk, a byproduct of coconut processing industries. Characteristics of coconut peat is light weight, water –retentive, and biodegradable. It is ideal for sustainable construction materials.

Fig.2.1.1 Coconut peat

2.1.2 Rice husk ash

Rice husk ash is a by product of agriculture and is generated in rice mills, often discarded or burnt High silica content makes it an excellent pozzolanic material for construction. Reduce waste, improve brick strength, and lowers carbon footprint of construction.

Fig.2.1.2 Rice husk ash

2.2 Clay

The inclusion of clay acts as a natural binder, helping to hold the bio brick together. Clay strengthens the overall structure of the bio brick, making it more resistant to weathering and wear.

Fig.2.2 Clay

2.3 River sand

River sand serves as a filler material, helping to maintain the desired shape and structure of the bio brick. The addition of river sand improves the overall workability and moldability of the bio brick mixture.

Fig.2.3 River sand

2.4 Lime

The addition of lime helps to increase the PH of the bio brick, making it more alkaline. Lime improves the overall strength and durability of the bio brick, contributing to its longterm performance.

Fig.2.4 Lime

2.5 Iron oxide

Iron oxide serves as a natural pigment , adding a warm, earthy tone to the bio brick. The incorporation of iron oxide enhances the aesthetic appeal of the bio brick.

Fig.2.5 Iron oxide

3. Experimental Test Program

3.1 Compressive strength test

As per IS 1077:1992 and IS 3495 (part 2): For this test well brunt clay brick is selected. The top and bottom faces of bricks are grinded to provide a smooth and even surface for the test. The brick sample is then placed in water at room temperature. Clean top flogs of brick and fills it with cement mortar (1 part of cement and 1 part of clean coarse sand of grade 3 mm and down), store under damp jute bags for 24 hours, and then immerse in clean water for 3 days. Take out the brick sample and clean extra water from the surface. Place brick sample between two plywood sheets, each 3 mm thick, with flat faces horizontal and mortar-filled face facing upwards. The brick sample between plywood sheets is carefully set in the centre of the compression testing machine. Fix the gauge of the machine and tight it and start applying the axial load at a uniform rate of 140 kg/cm2 per minute till failure. The maximum load on the dial gauge at the failure of the brick sample is noted.

Fig. 3.1 Compressive strength test

compressive strength= (load at failure area) / (area of brick)

Table 3.1 Compressive strength test results

Sl No.	% added RHA	% added coconut peat	Compressive strength N/mm2
1	25	25	1.33
2	30	20	2.55
3	35	15	3.51

The Compressive strength of bricks is found to be 1.33,2.55 and 3.51 for 25% RHA and 25% coconut peat, 30 % RHA and 20% coconut peat and 35% RHA and 15% coconut peat respectively. It can be observed that, highest compressive strength was achieved for the ratio of 35% RHA and 15% coconut peat and the strength was 3.51 N/mm2, hence it is 3rd class brick.

3.2 Water absorption test

Sample of brick is weighed in dry condition (w1) The sample is immersed in water for 24 hours. Then the sample is weighed again (w2). Difference in weight (w2-w1) indicate the amount of water absorbed by brick.

Water absorption (%) = (w2-w1)/w1 X 100

Fig. 3.2 Water absorption test

Table 3.2 Result of water absorption test

SL No	% added RHA	% added Coconut peat	Dry Weight (kg) W1	Wet Weight (kg) W2	Water absorption (%)
1	25	25	1.997	2.4	20.18
2	30	20	1.980	2.352	18.79
3	35	15	1.975	2.340	18.48

As per IS 1077:1992 and IS 3495 (part 2): 2019, The water absorption of common burnt bricks should not more than 20% of their weight after being immersed in water for 24 hours. From the table 3.2 it can be observed that rate of water absorption of brick 18.79 % and 18.48 % for 30 % RHA and 20% coconut peat and 35% RHA and 15% are within the limit. Rate of water absorption of brick 20.18% for 25% RHA and 25% coconut peat, which is not within the limit.

3.3 Efflorescence Test

As per IS 3495 (part 3): 2019 This test is done to find out the efflorescence in bricks. This happens due to presence of soluble salts. Brick is immersed in water for 24 hours. Then it is taken out and dried under the shade. After drying if a thin layer of white or grey powder is seen on the surface of the brick, there are soluble salts in the bricks. The different grades are assumed based on the coverage of white deposits on the surface as follows.

- Nil: When a salt deposit is imperceptible, then it is said to be Nil. Slight: When efflorescence does not cover more than 10% of the exposed area of the bricks, it is said to be slight.
- Moderate: When the deposit of efflorescence is heavier than slight and does not cover more than 50 percent of the exposed area of the brick surface. There should not be powder or flake of the brick exposed surfaces.
- Heavy: When the deposit covers an area of 50 percent or more of the exposed area of the brick surface. Then it is said to be efflorescence salts are heavy. There should not powder or be flaking of the brick exposed surfaces.
- Serious: efflorescence is said to be serious when there is powdering or flaking of salt on the exposed surface of bricks.

Place one end of the bricks in a 25 mm depth of water in a dish of minimum diameter 150 mm and depth 30 mm. The dish is made of porcelain, glass, or of glazed stonework. The experiment is performed in a well-ventilated room between 20 to 30oC till all the water in the dish is either absorbed by the specimen or is evaporated. After the specimen has dried, add a similar quantity of water to the dish and let it to be absorbed by the specimen efflorescence after the second evaporation. Efflorescence in brick is denoted by nil, slight, moderate, heavy or serious as defined above.

Fig. 3.3 Efflorescence test

All brick samples showed slight efflorescence. This may be due to the presence of some salty like magnesium, calcium etc in the clay sample.

4. Conclusion

The usage of rice husk ash and coconut peat in light weight clay brick improved certain aspect in the brick itself in term of properties and strength. This investigation had demonstrated a feasible way of using incinerated RHA as brick clay to produce a high-quality brick. According to test results, the higher the amount of coconut peat added into the mixture the lower the strength of the brick as it can promote cracks due to low particle bonding and, consequently reduce the mechanical strength. Usage of RHA material in the clay mixture improved the physical and mechanical properties.

From the obtained test results, it can be concluded that bricks made with 35 % of RHA and 15% of coconut peat achieved optimal compressive strength (3.51 N/mm2). Met standard values for water absorption indicating suitability for construction applications. Increasing the amount of coconut peat causes decrease in strength of bricks.

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