COMPARATIVE STUDY ON MECHANICAL PROPERTIES OF WASTE REINFORCED MUD-BRICKS

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Keywords

Waste Reinforced, Mud- Bricks, Mechanical properties

Introduction

Housing, a fundamental human necessity, relies significantly on the integral component of bricks. Among various types of bricks, one stands out for its widespread use due to factors such as cost-effectiveness, raw material accessibility, strength, ease of construction, and manpower availability. Among different types of bricks burned clay bricks have dominated traditional bricks for construction globally. Bricks, renowned for their cost-effectiveness, durability, and ease of handling, play a pivotal role in construction projects. However, the reliance on clay, the primary raw material for brick production, has reached an annual consumption of approximately 340 billion tons, resulting in concerning variations in this natural resource. In response, researchers are exploring alternative resources and recycling methods for industrial waste to address this challenge. Numerous waste materials, including marble dust, sludge from water treatment plants, fly ash, sugarcane bagasse ash, rice husk ash (RHA), and eggshell powder (ESP), have been investigated for their potential in brick manufacturing. The incorporation of these materials requires careful adjustment of clay properties within specified ranges, ensuring no adverse effects on strength and durability. Fly ash, a byproduct of coal combustion in power plants, exhibits a diverse composition with mullite (alumina and silica) and iron oxides (hematite and magnetite). Its elemental composition resembles that of brick soils, and its addition to clay has been found to enhance brick strength and reduce water absorption. RHA, obtained from rice hull combustion, releases amorphous reactive silica and offers excellent thermal insulation, contributing to enhanced compressive strength in brick materials. Eggshell powder, a byproduct from food processing, contains calcium carbonate, positioning it as a potential substitute for clay in brick production.

Objectives

To prepare bricks by adding different proportions of waste materials.

- Waste materials that can be utilized in the manufacturing of bricks. Materials such as fly ash, rice husk, eggshell, and sugarcane in various ratios are used for making waste-reinforced bricks.

2. To evaluate the mechanical properties of waste reinforced bricks.

- Compressive Strength Test: The compressive test involves the maximum compressive load that a brick can withstand before failure.

- Water Absorption Test: which determines the amount of water absorption during submersion in water for a certain time? Inadequately fired bricks have increased water absorption, which might hasten brick deterioration over time.
- Drilling test: By drilling different types of drill bit into waste reinforced bricks.

Methodology

1. Collecting waste materials
2. Preparation of waste materials
3. Production of waste reinforced bricks
4. Drying
5. Pre-heating/ Burning
6. Testing of bricks.

Collecting waste materials: Waste materials, such as fly ash, rice husk, eggshell, and sugarcane bagasse, were collected according to their availability. Fly ash was collected at the RTPS thermal power plant in Raichur, rice husk was collected at the Savitri Group rice mill in Raichur, eggshell was collected from local mess and hotels, and sugarcane bagasse was collected at the local juice shop in Bagalkot.

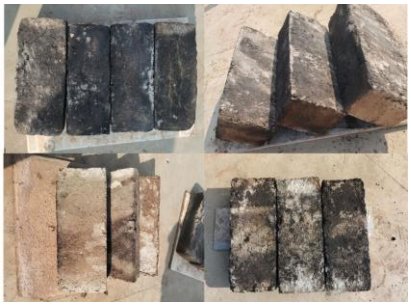
Preparation of waste materials: Waste materials were cleaned and sorted to remove contaminants or unwanted elements from them. Sugar cane bagasse was dried and ground into smaller pieces with the help of a mixer grinder. Also, the eggshell was dried in the sun and ground into a smaller size.

Production of waste reinforced bricks:

Different proportions of waste materials were added in red mud and clay to produce bricks of size of 230x100x50 mm by using a wooden mould

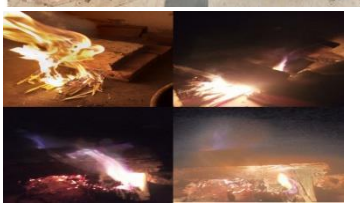
Drying:

The bricks are left to cure in the sun for 48 hours after the brick mixture has been shaped using a mould.



Pre-heating/ Burning:

Waste reinforced bricks are burned in direct fire for enhancing the strength and durability of bricks. The bricks are burned using sugar cane bagasse, wood and coal as a burning fuel.



Testing of bricks: Bricks are tested for water absorption and compression strength after they have been burned on fire.

Result and Conclusion

Compression test:

TYPE OF BRICK	COMPOSITION	LOAD IN (N)	AREA IN (cm^2)	COMPRESSION STRENGTH, [P/A] IN N/CM^2
BRICK 1	F-35%, RH-35%, RM-15%, C-15%	215746.3	230	938.027
BRICK 2	F-30%, RH-16%, RM-26.6%, C-26.2%	98066.5	230	426.376
BRICK 3	F-25%, SCB-5%, RM-35%, C-35%	220649.62	230	959.34
BRICK 4	ES-25%, SCB-5%, RM-35%, C-35%	102969.82	230	447.694

Water Absorption Test

Water absorption test on bricks is conducted to determine durability property of bricks such as quality and behavior of bricks in weather. A brick with water absorption of less than 7% provides better resistance to damage by freezing. The degree of compactness of bricks can be obtained by water absorption test, as water is absorbed by pores in bricks. The water absorption by bricks increases with increase in pores. This test provides the percentage of water absorption of bricks and procedure of the same is discussed below

Results of water absorption test

TYPE OF BRICK	COMPOSITION	W_1 IN GMS	W_2 IN GMS	WATER ABSORPTION RATE IN PERCENTAGE
BRICK 1	F-35%, RH-35%, RM-15%, C-15%	2105	2566.8-(10min) 2811.8-(13min)	21.96%-(10min) 33.57%-(13min)
BRICK 2	F-30%, RH-16%, RM26.6%, C-26.2%	2194.8	2380.6-(10min) 2565.6-(15min)	8.46%-(10min) 16.88%-(15min)
BRICK 3	F-25%, SBC-5%, RM-35%, C-35%	1510.6	1817.2-(10min) 1758.8-(15min)	20.29%-(10min) 16.43%-(15min)
BRICK 4	ES-25%, SCB-5%, RM-35%, C-35%	1367.4	1791.6-(10min) 1990.8-(13min)	31.02%-(10min) 45.59%-(13min)

Scope for Future Study

The future works on the subject "Comparative Study on Mechanical Properties of Waste Reinforced Mud-Bricks" could include waste material optimization. To better reinforce the mud-bricks, an analysis of different types of waste materials and their amounts to be used for the reinforcement is required. With the help of the long-term durability, the plan for assessing the performance of the waste materials for mud-brick reinforcement in a particular environment must be based. New economic impact research could be conducted to test the cost-effectiveness of using waste materials in the mud-bricks instead of regular building materials. The advanced testing methods, including non-destructive testing, should be used to analyze the mechanical properties and defects of the mud-brick construction. It is essential to scale up the production for large-scale construction projects and evaluate their feasibility and performance it is absolutely critical to conduct an environmental impact assessment throughout the entire life cycle of waste-reinforced mud-bricks. Furthermore, there should be a contribution toward building codes and standards development for the application of waste-reinforced mud bricks. The activities that can promote the use of such materials, then raising awareness about the use of sustainable building materials within local communities. Finally, enhancing the mechanical properties and performance of mud bricks when using of waste material investigations as well as using some innovative technologies related to construction.