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# Development of Eco-Brick Using Industrial and Agricultural By-Products

Gokul Maharaj D[1], Gokulraj M[2], Rajarajan D[3], Sivapriyan R[4]
*Department of Civil Engineering BE Kumaraguru College of Technology, Coimbatore - 641049*

***Abstract:*** ***Housing shortages in many developing countries have stimulated efforts to develop construction methods that use cheap and durable local materials. It is essential to develop technologies that use minimal resources because of the increasing shortage of energy and raw materials. Traditionally produced in a cottage industry setting, fired clay brick production plays a major role in the informal economy of such countries. On the other hand, in many countries, electricity is often supplied by coal-powered generators. In the power stations, approximately 80-90% of the ash formed from burnt coal is carried out of the furnace, then extracted from the flue gas and is known as fly ash.***

***Large quantities of fly ash produced as a by-product of coal based power stations have been viewed as serious environmental problems. Rice husk is the by-product of the rice milling industry. Saw dust is the by-product of cutting, grinding, drilling, sanding and other pulverizing wood or other material with saw or other tool.***

***The proposed study involves the experimental investigation of effect of rice husk ash and saw dust on the properties of fly ash bricks. The main aim is to compare the fly ash bricks over conventional clay bricks, so for this purpose percentage of saw dust and rice husk can be increased by weight and with the help of laboratory tests it will be briefly studied.***

## I. INTRODUCTION

The rapid growth of industrialization and urbanization has led to an increase in the demand for construction materials, especially conventional clay bricks. However, the large-scale production of these bricks causes significant environmental problems such as depletion of topsoil, deforestation, and high carbon emissions during firing. At the same time, a large quantity of industrial and agricultural wastes such as fly ash, rice husk ash, sugarcane bagasse ash, and quarry dust remain underutilized and often cause pollution when disposed of improperly.

In this context, the development of eco-friendly bricks (eco bricks) using waste materials offers a sustainable solution to both waste management and construction needs. Eco bricks utilize industrial and agricultural by-products as partial or complete replacements for traditional raw materials, thereby reducing environmental impact and promoting the concept of sustainable development. These bricks are lightweight, cost-effective, and have good strength and durability comparable to conventional bricks. The present project focuses on developing eco bricks by incorporating various industrial and agricultural wastes in appropriate proportions and evaluating their physical and mechanical properties such as compressive strength, water absorption, and density.

## II. LITERATURE SURVEY

The disposal of saw dust and rice husk has always been by incineration or open air burning, this has hazardous effect on the air and environment at large. They can be recycled for use in construction industry without producing any harm to human and environment. Research has shown that they can be used as a binder replacement. This paper highlights the optimal material that can be added to concrete for optimum strength. Sawdust and Rice husk mixed with bone powder was added to replace cement in relative percentage of 5, 10, 15 and 20%. The result shows that rice husk and sawdust are alternative binder that can replace cement to some extent but there is reduction in strength as well. Rice husk ash and sawdust are good materials that can supplement cement to some extent but the percentage of sawdust recommended should not be more than 10 percent while the rice husk ash is permissible to 15% of cement. This mixture is permitted for lightweight structures.

All materials used for the practical are local materials and they are readily available and they can also reduce the cost of producing concrete when implemented. There has been no issue of hazardous emission generated from this material when used for construction. The mode of disposing rice husk ash and sawdust has been by open air burning which has harmful effect on the people and environment at large but with its implementation in lightweight structure, it will help in providing clean and safe environment. Reported that addition of RHA can decreases the plasticity of soil and shifted the high plasticity silt to moderate plasticity silt.

 

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## III. SCOPE OF THE PROJECT

The scope of this project involves the experimental evaluation and performance analysis of cementitious materials containing saw dust ash and rice husk ash as partial replacements for ordinary Portland cement. The major areas covered include:

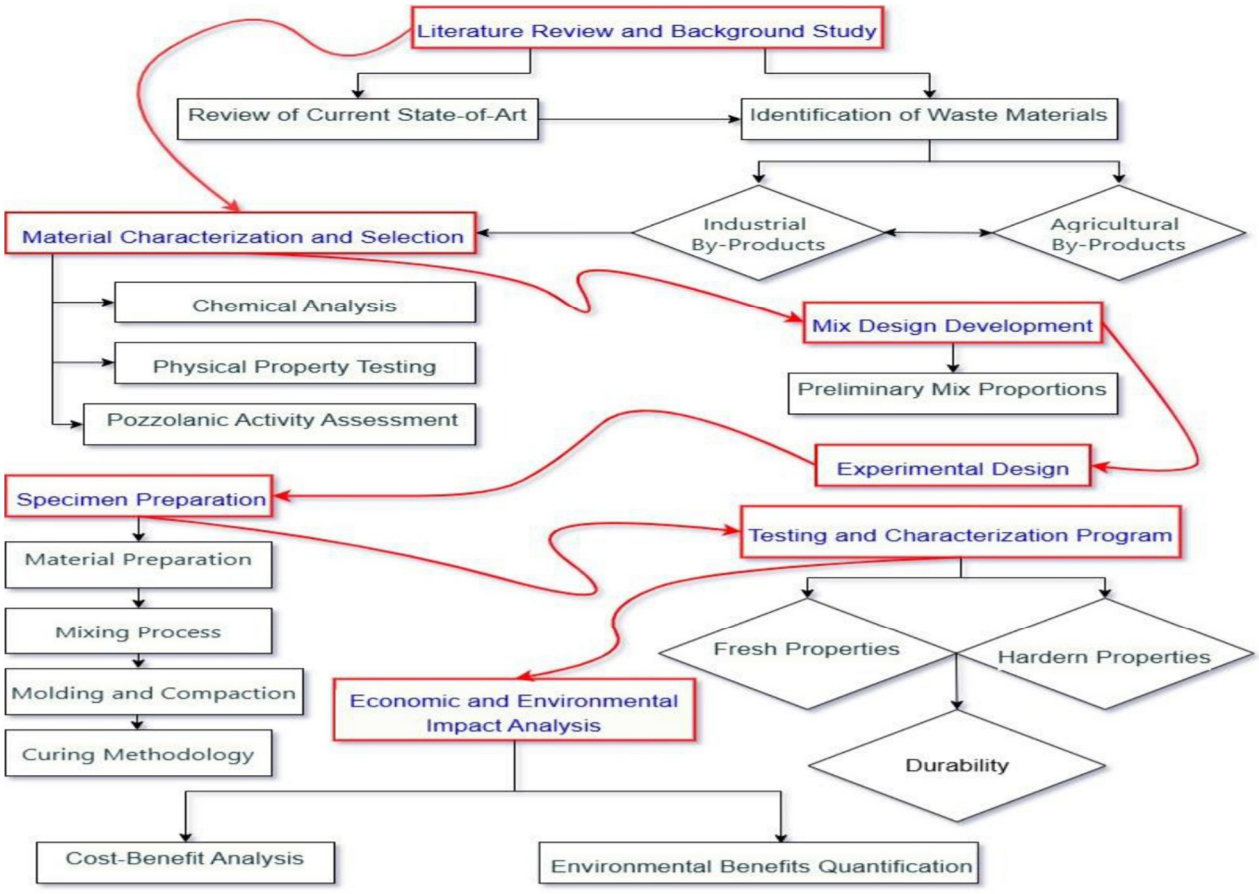
*1)* Collection and preparation of saw dust ash and rice husk ash through controlled burning.
*2)* Determination of physical and chemical properties of SDA and RHA.
*3)* Preparation of mix proportions with varying percentages of ash (e.g., 5%, 10%, 15%, and 20%) replacing cement.
*4)* Casting and curing of specimens such as bricks or concrete cubes for testing.
*5)* Evaluation of mechanical properties like compressive strength, water absorption, and durability.
*6)* Comparison of results with conventional cement bricks or concrete.

The findings of this study will help determine the optimum replacement level of saw dust ash and rice husk ash for achieving desirable strength and performance. It will also demonstrate the feasibility of using these waste materials in large-scale construction applications, thereby supporting sustainable development, resource conservation, and eco-friendly construction practices.

### *A. Objectives*

*1)* To investigate the potential of industrial and agricultural by-products as raw materials in brick production
*2)* To manufacture eco-friendly bricks using binder (OPC), industrial and agricultural by-products.
*3)* To analyze the mechanical and physical properties of the eco bricks.
*4)* To identify the optimum mix ratio for strength, durability, and cost efficiency.
*5)* To compare the performance of eco-friendly bricks with conventional clay bricks

## IV. METHODOLOGY



In this project, OPC 43 grade cement, Fly ash, Saw Dust and Rice Husk Ash are used to manufacturing the Eco-Brick. The Bricks are cast in 190 × 90 × 90 mm size, demolded after 24 hours, and cured for 7,14 and 28 days.
Various tests are conducted such as Standard Consistency Test, Initial Setting Time, Final Setting Time, Specific Gravity Test, Compression Test, Water Absorption Test..

| Stipulations for Eco-Brick Preparation | |
|---|---|
| Type of material | Eco-brick using Rice Husk Ash (RHA) and Saw Dust Ash (RDA) |
| Binder material | OPC 43 |
| Brick size | 190 x 90 x 90 mm |
| Batching method | Volume batching |
| Method of mixing | Hand mixing |
| Method of casting | Manual placing in brick moulds |
| Compaction method | Hand compaction |
| Curing method | Water curing for 7, 14, and 28 days |
| Degree of supervision | Good |

*1) Test data for materials*

| | | |
|---|---|---|
| Cement used: | | OPC 43 grade Water curing for 7, 14, and 28 days |
| Specific gravity of cement: | | 3.0 |
| Specific gravity of fly Ash : | | 2.24 |
| Specific gravity of M Sand : | | 2.53 |
| Water absorption | | |
| Saw Dust Ash | : | 4 times of dry weight |
| Rice Husk Ash | : | 1.4 times of dry weight |

*2) Mix Proportions:*

| Materials | |
|---|---|
| Fly Ash | 55% |
| Cement | 15% |
| Fine Aggregate | 20% |
| Rice Husk Ash | 5% |
| Saw Dust Ash | 5% |

*B. Calculation proportion*

| | |
|---|---|
| Volume of Fly ash | 1400g |
| Volume of Cement | 350g |
| Volume of Fine Aggregate | 500g |
| Volume of Rice Husk Ash | 100g |
| Volume of Saw Dust Ash | 150g |

Ratio: 11:3:4:1:1

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*1) Standard Consistency Test*

The standard consistency test of cement is carried out to determine the minimum amount of water required to prepare a cement paste of normal or standard consistency.

This test ensures that the cement paste has proper workability and plasticity for further testing and practical use.

*2) Setting Time of cement*

- Initial Setting Time:
  The time between adding water to cement and when the paste starts losing its plasticity.
  For Ordinary Portland Cement, it should be not less than 30 minutes.
- Final Setting Time:
  The time between adding water to cement and when the paste completely loses plasticity and becomes hard.
  It should be not more than 10 hours (600 minutes).

*3) Specific Gravity Test*

Specific gravity is the ratio of the density (or weight) of a material to the density of water at a specified temperature.

*4) Casting of Brick*

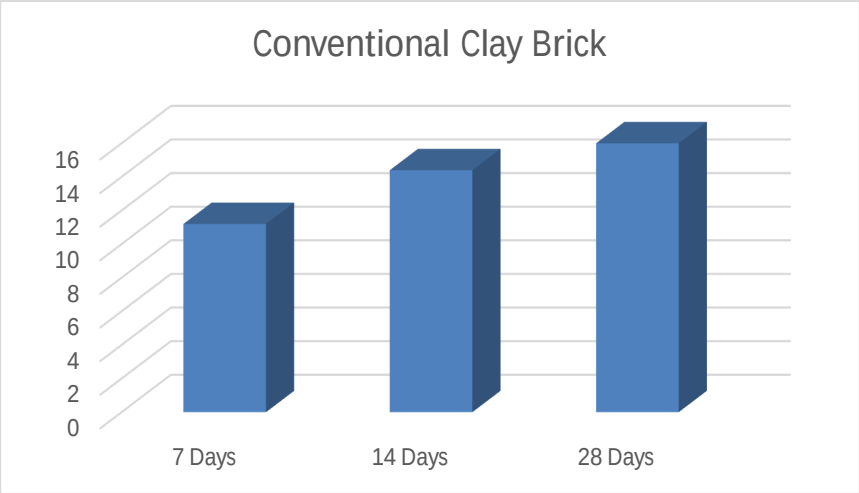
After Calculating mix design and taking material in proportion we are conducted mixing of material process and casting of Eco-Brick size 190 x 90 x 90 mm.

## V. COMPRESSIVE TEST ON BRICK

Compressive strength of Eco-Brick is tested using a Compression Testing Machine as per Bureau of Indian Standards Guidelines. Brick mould (190mm × 90mm × 90mm) are cured for 7 and 14 days and then loaded until failure.

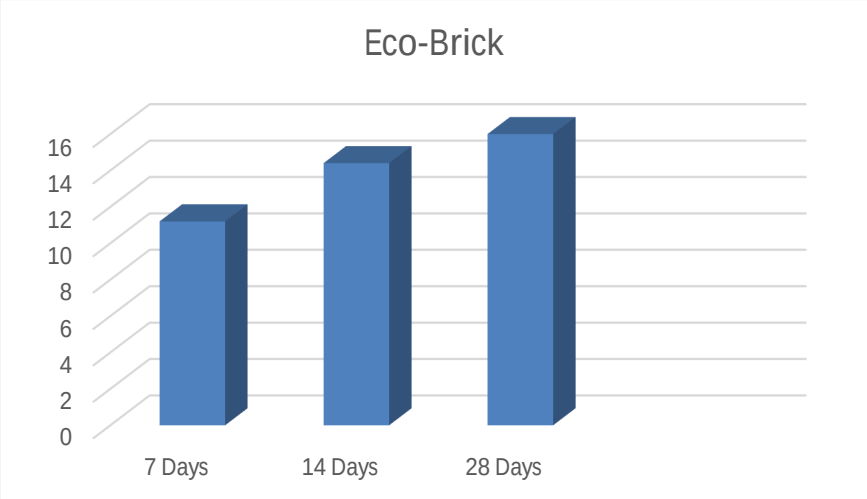
Compressive strength of conventional clay brick

| Curing | Compressive Strength ($N/mm^2$) |
|---|---|
| 7 days | 7.35 |
| 14 days | 9.45 |
| 28 days | 10.5 |




Compressive strength of Eco-Brick

| **Curing** | **Compressive Strength(N/mm$^2$)** |
|---|---|
| 7 days | 11.2 |
| 14 days | 14.4 |
| 28 days | 16 |




## VI. COST ESTIMATING

| MATERIAL | PERCENTAGE | WT/KG | ₹ RATE/KG | PRICE |
|---|---|---|---|---|
| Fly Ash | 55% | 1.4 | 3.1 | 4.34 |
| Cement | 15% | 0.35 | 6.6 | 2.31 |
| Fine Aggregate | 20% | 0.5 | 1 | 0.5 |
| Rice Husk Ash | 5% | 0.1 | 2 | 0.2 |
| Saw Dust Ash | 5% | 0.15 | 3.5 | 0.52 |
| Total Cost | | | | 8.65(Include Labor Charge |

## VII. CONCLUSION

The study focused on the development of eco-bricks using industrial and agricultural by-products such as fly ash, rice husk ash, and saw dust ash with cement as a binding material. The bricks were prepared, cured, and tested to evaluate their mechanical and physical properties. The experimental results indicate that the eco-bricks possess satisfactory strength and performance when compared with conventional clay bricks

The utilization of waste materials in brick production helps reduce environmental pollution, conserve natural resources, and promote sustainable construction practices. Therefore, eco-bricks made with these materials can be considered a cost-effective and environmentally friendly alternative to traditional bricks for construction purposes.

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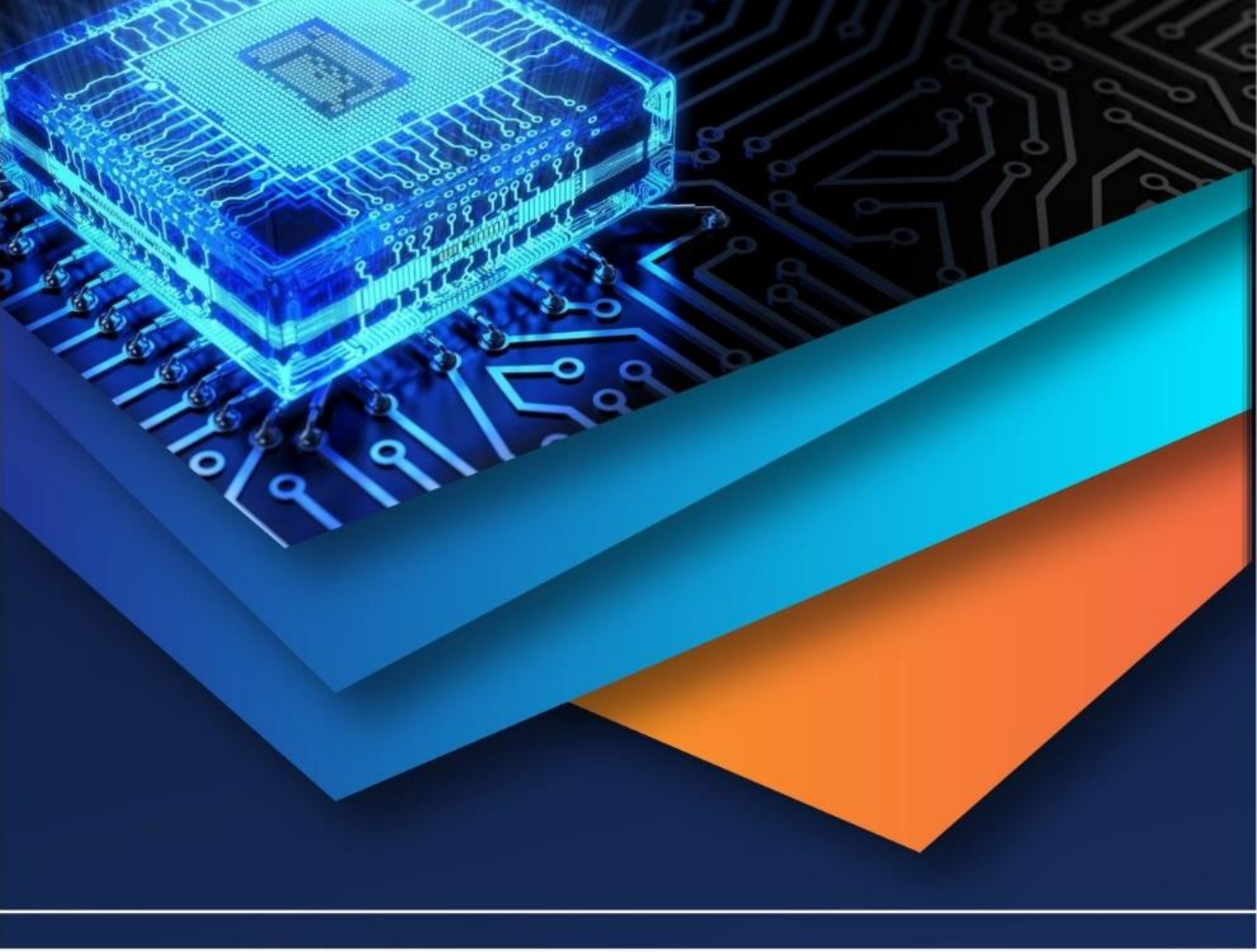

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