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Ecobrick – Sustainable Wall Construction Using Leaf-Derived And Plastic bottles.

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Abstract : Bricks are commonly used in construction, but the growing demand for building materials, driven by population growth and urbanization, has led to the depletion of natural resources, particularly fertile soil. This project explores the development of ecofriendly bricks (ecobricks) made from alternative materials such as clay, lime, boiler ash, and sludge, combined with Alkali Activation Technology. These materials, including waste products from thermal power plants and paper mills, are abundant and underutilized. The study focuses on recycling industrial waste to reduce environmental degradation and soil erosion. Eco bricks incorporate waste components like boiler ash, wastewater sludge, and compost from leaves, offering a sustainable solution for construction. Laboratory tests on compressive strength, soundness, hardness, and water absorption assess the performance of these bricks. Results show that eco bricks outperform traditional bricks in strength and durability while promoting waste management and environmental sustainability. By reducing reliance on fertile soil and reusing industrial byproducts, ecobricks present a viable solution to the construction industry's challenges and support eco-conscious building practices

***IndexTerms* –** Industrial brick,clay,lime

INTRODUCTION

Eco-bricks offer a sustainable solution to the environmental and economic challenges of traditional building materials. Made from a combination of soil, boiler ash, sludge, lime, and sodium hydroxide (NaOH) using alkali activation technology, they incorporate waste materials like boiler ash, reducing landfill waste and conserving non-renewable resources. In India, where over 250 billion bricks are produced annually using energy-intensive methods that degrade land and generate carbon emissions, eco-bricks provide an alternative by recycling industrial byproducts. These bricks have been tested for compressive strength, water absorption, and soundness, showing superior performance compared to conventional bricks. The construction industry, a major contributor to resource depletion and carbon emissions, can benefit from eco-bricks by reducing environmental impact and construction costs. By incorporating materials like fly ash, sugarcane bagasse ash, and plastic waste, eco-bricks improve strength, durability, and water resistance, offering a cost-effective and environmentally responsible alternative to traditional materials.

Literature Review,

1. Shriram Marathe, Mithanthaya I. R., Sahithya S. Shetty

This study emphasizes alkali-activated concrete (AAC) as an eco-friendly alternative to OPC-based concrete. Materials such as slag, fly ash, and glass powder were used to create AAC mixes with high compressive strength, particularly in early stages. Slag and fly ash-based AAC achieved superior early strength compared to glass powder-based mixes, though the latter caught up at 28 days. Statistical models provided accurate predictions of compressive strength, revealing strong positive correlations. Future research directions include assessing AAC durability in acidic and sulfate-rich environments, paving the way for sustainable, longlasting construction solutions.

2. A. M. Saleh, M. N. Rahmat, N. Ismail

This study focuses on unfired bricks utilizing waste materials, achieving compressive strengths exceeding the 5,000 kN/m^2 benchmark through extended curing periods. The reaction between lime and clay formed C-A-S-H gel, contributing to strength and long-term durability. Ground granulated blast furnace slag (GGBS) was particularly effective as a stabilizer, reducing reliance on high-CO_2-emitting lime and Portland cement. These results support the development of energy-efficient bricks that align with sustainable construction practices.

3. José G. Ascencio, Natalia Fuentes, Tatiana S. Britto

Biosolids derived from wastewater treatment plants were repurposed to manufacture eco-bricks. While these bricks displayed increased porosity and shrinkage due to thermal processing, they effectively addressed waste management challenges by reducing organic pollutants and heavy metal concentrations. The study advocates for biosolid bricks as an environmentally beneficial alternative, particularly for niche construction applications.

4. Min-Hsin Liu, Cyuan-Fu Tsai, Yi-Le Hsu

The integration of LGSC (solar industry waste) and granite sludge into brick production was examined. While increasing LGSC content led to higher water absorption and lower compressive strength, the study found that silt loam-based bricks outperformed clay loam variants in terms of strength. The addition of binder-water content (BWC) improved the mechanical performance of these bricks, making them a viable option for regions seeking sustainable waste reuse in construction.

5. M. Ezzat, H. M. Khater, Abdeen M. El Nagar

The use of geopolymer bricks with slag and grog demonstrated impressive mechanical properties, with compressive strengths exceeding 40 MPa. The slag replacement ratio optimized performance at 40%, balancing strength and durability. Geopolymerization resulted in significant CO_2 emission reductions—up to 90% compared to traditional fired clay bricks. Water absorption rates of 1116% met severe weather standards, confirming the bricks' suitability for diverse climates.

6. Mohammed Yaseen, Ravitej M. Bandlekar, Pruthviraj, Shrinivas

Innovative trial mixes using waste materials like glass, plastic, fly ash, and bed ash produced bricks with compressive strengths surpassing conventional standards. Mixes with an 8:2 fly ash-to-cement ratio showed optimal results. These eco-friendly bricks demonstrate economic viability, offering a dual benefit of waste reduction and affordable construction material production.

7. B. Dhanalaxmi, K. N. Sujatha, E. Rakesh Reddy

This study evaluated bricks made from paint sludge and binders like cement, fly ash, and quarry dust. These bricks hardened within two days, displaying compressive strengths significantly higher than conventional bricks. Lightweight properties reduced transportation costs, and the bricks were deemed suitable for external applications, addressing both sustainability and functionality.

8. B. Aravindhan et al.

Fly ash and quarry dust were combined to develop eco-friendly bricks, achieving compressive strengths of up to 6.24 N/mm^2. These materials not only mitigate waste disposal challenges but also provide cost-effective alternatives for non-load-bearing construction.

9. S. Madan Raj et al.

Recycled material-based eco-bricks demonstrated light weight and excellent fire resistance, making them ideal for seismic zones. However, further studies are necessary to refine mix proportions and enhance compressive strength for broader application.

10. Akshaita Saini, Abhinav Aggarwal

Fly ash, paper, marble waste, and tile powder were utilized to create lightweight, eco-friendly bricks. These materials reduced construction costs by 20-30%, while maintaining structural integrity for non-load-bearing walls and earthquake-prone regions.

11. Manisha, Navinderdeep Singh

PET bottle bricks demonstrated durability, water resistance, and affordability. By repurposing plastic waste, these bricks reduce landfill burden. However, challenges include CO_2 emissions during production, necessitating further optimization to improve environmental impact.

Conclusion,

Eco-bricks made from industrial and solid waste materials offer a sustainable, environmentally friendly alternative to traditional construction materials. Studies show these eco-bricks achieve high compressive strength, durability, and cost efficiency, proving their viability for various applications. In alkali-activated concrete (AAC), industrial waste materials like slag, fly ash, and glass powder significantly improve strength over conventional OPC-based concrete. Slag-fly ash mixes offer better early strength, while glass powder-based AAC reaches comparable performance by 28 days. These materials also resist acid and sulfate environments, making them suitable for long-lasting eco-friendly constructions. Unfired bricks stabilized with ground granulated blast furnace slag (GGBS) and lime achieve strengths over 5,000 kN/m^2 due to calcium-alumino-silicate-hydrate (C-A-S-H) gel formation. Similarly, biosolid bricks face waste management challenges but require improved water absorption and shrinkage resistance. Geopolymer bricks made from slag and grog show high compressive strength and reduced CO_2 emissions. Using fly ash, quarry dust, and other solid wastes for lightweight, durable eco-bricks also reduces construction costs by 20–30%. Innovative materials like kenaf fiber, plantain fiber, and bagasse ash enhance brick properties, improving insulation, sustainability, and compressive strength. Despite some limitations, these bricks meet industry standards, and further research will unlock their full potential. Ecobricks present a resource-efficient, cost-effective, and sustainable alternative to conventional materials, driving greener construction practices.

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