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A CASE STUDY ON ECO FLY ASH BRICKS USING ALKALI ACTIVATION TECHNOLOGY

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Abstract : **The production of eco-bricks using industrial waste (fly ash) has gained attention as a solution to environmental pollution caused by traditional brick production. This paper presents a comprehensive review of research studies conducted on eco-bricks using fly ash. The review examines the properties, manufacturing process, and potential applications of eco-bricks. The paper also highlights the benefits of eco-bricks, including their affordability, strength, and environmental sustainability. This paper is focused on the utilization of waste materials, specifically fly ash and boiler ash, in the production of bricks. The main objective is to investigate the feasibility of incorporating these waste materials in brick-making and to evaluate the properties of the resulting bricks. The study also compares the properties of fly ash bricks and clay bricks. The authors used various tests to evaluate the quality of the bricks, including a hardness test, soundness test, shape and size test, compressive strength test, water absorption test, and drop test. The results showed that the fly ash bricks had better properties compared to clay bricks. Fly ash bricks were harder, more sound, and had higher compressive strength. Overall, the study concludes that using waste materials in brick-making is a viable solution for waste disposal and a sustainable alternative to traditional clay bricks. The fly ash bricks produced in this study had comparable properties, if not better, than clay bricks. The authors recommend further research to optimize the production process and to evaluate the long-term durability of the bricks.**

IndexTerms - **Fly Ash, Industrial waste, Compressive Strength, Water Absorption, Durability, Soundness, Hardness.**

- **Introduction**

INTRODUCTION:

Traditional brick production has a significant environmental impact, particularly in terms of carbon emissions generated during the burning process. Eco-bricks using fly ash offer an environmentally friendly alternative to traditional bricks. Fly ash is a by-product of coal combustion, and its utilization in eco-brick production has gained attention due to its abundance and potential environmental benefits. This paper reviews the research conducted on eco-bricks using fly ash and their potential applications.

Hence, this paper provides valuable insights into the use of waste materials in brick-making and its potential as a sustainable solution for waste disposal. The study also highlights the importance of evaluating the properties of the resulting bricks to ensure their suitability for construction purposes. Further research is needed to fully explore the potential of waste materials in brick-making and to optimize the production process for maximum efficiency and sustainability.

LITERATURE REVIEW:

[1] Sahu, Manish Kumar, and Lokesh Singh. "Critical Review on Fly Ash Bricks." (2017) Reviewed Bricks made with fly ash employ 50% fly ash but no clay. Fly ash bricks' mechanical attributes are superior to those of regular brick. According to the study, fly ash from electrostatic precipitators (ESPs) used in the chemical industry can be used to make bricks. The use of fly ash in brickmaking helps reduce waste and will also aid in the preservation of natural resources including air, water, and soil. Additionally to improving the mechanical properties of brick, the addition of polymer and lime also increases the strength of the material and contributes to energy efficiency and pollution reduction.

[2] Daberao, Rushikesh, et al. "Case Study on Eco Black Brick Alkaline Activation Technology." (2021) studied that this research proposes converting toxic fly ash into efficient and cost-effective construction materials. Remarks on Clay Bricks Eco Black Brick based on this research, the above-mentioned qualities were obtained by adding the suitable quantity of alkali activator, lowering the estimated cost of bricks. This project allows us to use industrial wastes such as fly ash. The application of alkali activation technology fully reduced the influence of carbon dioxide emissions on the environment.

[**3] Aravindhan, B., et al. "EXPERIMENTAL STUDY ON ECO-BLAC BRICKS."** ***synthesis*** **6.03 (2019)** reviewed that the use of fly ash and quarry dust in brick can solve the disposal problem, lower costs, and generate an environmentally beneficial brick for construction. The compressive strength of brick I is 3.13N/mm2, brick II is 3.60N/mm2, brick III is 2.79N/mm2, brick IV is 6.24N/mm2, brick V is 5.07N/mm2, and brick VI is 3.10N/mm2. As a result, in full replacement of the clay method brick IV has excellent compressive strength and is suited for non-load-bearing wall structures. This study determined the maximum compressive strength of the correct fraction using the alkali activation technique.

[4] Kumar, Rinku, and Naveen Hooda. "An experimental study on properties of fly ash bricks." ***International Journal of Research in Aeronautical and mechanical engineering*** **2.9 (2014)** reviewed that this study compared the properties of fly ash bricks with those of normal clay bricks. The findings indicate that fly ash bricks have a harder surface and exhibit slight efflorescence. The bricks also have a compact and homogeneous structure, free from any defects, such as holes or lumps. Regarding strength, fly ash bricks showed a significant improvement in crushing strength, with a 56.72% increase compared to clay bricks. Overall, the study suggests that fly ash bricks are a promising eco-friendly alternative to traditional clay bricks.

PROPERTIES OF ECO-BRICKS::

Eco-bricks using fly ash exhibit unique properties compared to traditional bricks. They have higher compressive strength, are more durable, and have a lower water absorption rate. The properties of eco-bricks depend on several factors, including the type of fly ash used, the manufacturing process, and the additives used.

MANUFACTURING PROCESS:

The manufacturing process of eco-bricks using fly ash involves several steps, including fly ash collection, mixing, molding, and curing. The process typically involves adding an alkaline activator to the fly ash, which triggers a chemical reaction that forms a geopolymer binder. The resulting mixture is then molded and cured using either ambient or thermal conditions.

APPLICATIONS:

Eco-bricks using fly ash have potential applications in various construction projects, including low-cost housing, infrastructure, and road construction. They have been used as a substitute for traditional bricks, concrete, and even wood. The use of eco-bricks in construction can significantly reduce the environmental impact of construction activities and promote sustainable development.

EXPERIMENTAL PROGRAMME:

Bricks are widely used as construction materials for building walls, foundations, and other structures. In recent times, the production of bricks using industrial waste materials such as fly ash and boiler ash has gained popularity due to their potential economic and environmental benefits. This paper aims to compare the properties of fly ash bricks with conventional clay bricks, including their hardness, soundness, shape and size, compressive strength, water absorption, and drop test.

[1] HARDNESS TEST:

The hardness test is carried out to determine the strength and durability of bricks. To conduct the test, a sample brick is placed on a flat surface and an impression is made on the surface of the brick with the help of a fingernail. The impression should not be easily visible, and the brick should be sufficiently hard. This test is carried out for all samples of fly ash bricks and clay bricks.

NORMAL CLAY BRICK (RED)	ECO FLY ASH BRICK
No Impression after Scratching with a fingernail.	No Impression after Scratching with a fingernail.

[2] SOUNDNESS TEST:

The soundness test is used to determine the quality of the bricks in terms of their soundness. To perform the test, two bricks are struck with each other without breaking any of the two bricks. If the two bricks are not broken after striking with each other and a clear ringing sound is produced, then it means that the bricks are sufficiently sound.

NORMAL CLAY BRICK (RED)	ECO FLY ASH BRICK
Good Sound	A clear Ringing Sound indicates Good Quality.

[3] SHAPE AND SIZE TEST:

The shape and size test is done to examine the structure of the brick when the brick is broken. It is seen that the structure of the brick is homogeneous, compact, and free from any defects such as holes, lumps, etc. The main defects such as holes and lumps should not be there.

[4] COMPRESSIVE STRENGTH TEST:

The compressive strength test is used to determine the load at which the specimen fails per area of the specimen. When waste materials such as boiler ash are added to the brick material, the compressive strength increases when compared to the compressive strength of conventional bricks. A compressive testing machine with a compression plate with a ball seating in the shape of a portion of a sphere, the center of which coincides with the center of the plate, shall be used.

TYPE OF BRICK	AVERAGE COMPRESSIVE STRENGTH (N/MM2)	% INCREASE IN STRENGTH
CLAY BRICK	3.77	-
ECO FLY ASH BRICK	7.87	62.4

[5] WATER ABSORPTION TEST:

The water absorption test is carried out to determine the durability of the brick. It is an indicator of the sustainability of the brick in a moist environment. Lower absorption indicates the presence of fewer pores and hence reduces the weight. The amount of water absorbed can be calculated using the following formula: {(W2 – W1)/W1} X 100, where W1 is the weight of dry bricks and W2 is the weight of wet bricks. As the weight of boiler ash and lime added increases, the water of the bricks also increases gradually due to the presence of pores in the waste material.

TABLE 5.1

S.No.	WEIGHT OF DRY FLY ASH BRICKS W1 (KG)	WEIGHT OF WET FLY ASH BRICKS W2 (KG)	WATER ABSORPTION OF BRICKS (%)
1.	2.60	2.95	13.46
2.	2.64	2.92	10.60
3.	2.65	3.00	13.20

This Table represents the water absorption of Eco Fly Ash Brick.

The Average Water Absorption of Eco Fly Ash Brick is 12.42%.

TABLE 5.2

S.No.	WEIGHT OF DRY NORMAL BRICKS W1 (KG)	WEIGHT OF WET NORMAL BRICKS W2 (KG)	WATER ABSORPTION OF BRICKS (%)
1.	2.50	2.95	17.6
2.	2.60	3.00	15.38
3.	2.79	3.05	9.31

This Table represents the water absorption of Normal Clay Bricks.

The Average Water Absorption of normal Clay Brick (Red) is 14%.

[6] DROP TEST:

The drop test is a popular method for evaluating the strength and durability of bricks used in construction. It involves dropping a brick from a specified height and analyzing the damage sustained by the brick upon impact. The test is conducted by dropping the brick from a height of one meter onto a hard surface. The damage sustained by the brick is analyzed, and the bricks with minimal damage are considered to be more durable.

CONCLUSION:

The properties of fly ash bricks and clay bricks were compared using various tests such as hardness, soundness, shape and size, compressive strength, water absorption, and drop test. It was observed that the addition of waste materials such as fly ash and boiler ash to brick material improves their strength and durability. The tests showed that fly ash bricks were at par or superior to conventional clay bricks in terms of their properties. Therefore, fly ash bricks can be a good substitute for conventional clay bricks in construction. Eco-bricks using fly ash offer a promising solution to environmental pollution

caused by traditional brick production. The review highlights the properties, manufacturing process, and potential applications of eco-bricks. Eco-bricks using fly ash have unique properties, are affordable, and have environmental sustainability benefits. The use of eco-bricks in construction can contribute to sustainable development and reduce the environmental impact of construction activities. However, further research is needed to optimize the manufacturing process and identify potential drawbacks.

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