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Utilization of Rice Husk and Ceramic Waste as a Geopolymer Precursor for Paving Bricks

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Abstract :This study investigates the utilization of ceramic powder and rice husk ash as geopolymer precursors for the production of paving bricks. Geopolymer technology offers a sustainable alternative to traditional cement-based materials by utilizing industrial by-products and reducing carbon dioxide emissions. The experimental methodology involves mixing different ratios of ceramic powder and rice husk ash with alkaline activators to form geopolymer pastes. The pastes are then cast into brick molds and cured at ambient temperature. The properties of the geopolymer bricks, including compressive strength, water absorption, and durability, are analyzed. The results show that the addition of ceramic powder and rice husk ash significantly improves the mechanical and physical properties of the bricks. The geopolymer bricks exhibit enhanced compressive strength and low water absorption, making them suitable for paving applications. This research contributes to the sustainable utilization of waste materials in the production of construction materials, further promoting a circular economy and reducing environmental impact.

Keywords: *Geopolymer, brick mould, geopolymer brickst.*

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I.INTRODUCTION:

Certainly! The utilization of ceramic powder and rice husk ash as geopolymer precursors for paving brick is an interesting topic for thesis writing. Geopolymers are alternative materials to traditional cement-based materials, offering several advantages such as improved strength, durability, and sustainability.

Ceramic powder, which is a by product of ceramic manufacturing processes, and rice husk ash (RHA), which is a by product of rice processing, can both be used as alternative sources of materials for geopolymer production. By incorporating these waste materials into geopolymer formulations, the environmental impact of these industries can be reduced, while creating valuable construction materials.

The process of developing geopolymer paving bricks using ceramic powder and RHA typically involves several steps. Firstly, the waste materials are collected and processed to ensure they meet the required specifications. Then, they are mixed with alkaline activators, such as sodium hydroxide or potassium hydroxide, and water to form a geopolymer paste.

The geopolymer paste is then poured into moulds and allowed to cure at ambient temperatures or through a controlled curing process. The curing process allows the geopolymer paste to undergo a chemical reaction, forming a hardened material with desirable mechanical properties.

Some of the key advantages of using ceramic powder and RHA as geopolymer precursors for paving bricks include the reduction of environmental waste, the potential for cost savings, and the ability to enhance the overall performance of the final product. The resulting geopolymer bricks can exhibit good compressive strength, water absorption resistance, and resistance to chemical attacks.

Rice Husk: Rice husk ash (RHA) is rich in silica and can serve as a source of amorphous silica in the geopolymer mixture. Silica is essential for the geopolymerization process and contributes to the binding properties

II.LITERATURE SURVEY

Kene Satish & Patel Arun (2020): This survey paper gives the detail survey of the work carried out in paver block made with the help of plastic, fly ash and rice husk ash. Paver block made by three composite materials, has a high compressive strength. The main constituents of paver block are cementing concrete. The above literature survey shows that the used of plastic & fly-ash in different proportions. The desired strength is achieved but at the expense of more cements consumption which also increases the cost of product. In the view of above literature, we found that the consumption of cement may be reduce by addition of rice husk ash. A renewable zero cost material for the construction of cost-effective paver blocks.

It is found after analysis that there is need of some advanced paver block made with the help of all three basic waste materials generated in agricultural and industrial area that is plastic, fly ash and rice husk ash. The proposed paver block is also expected to be cost efficient (effective) as compared to cement concrete paver block strength as we are going to use the zero- cost waste plastic, fly ash and rice husk ash. In the proposed paver block as we are using light weight waste material like plastic and rice husk ash, replacing heavier cement material producing light weight, easily transportable paver blocks. Hence, we are proposing a process which will reduce the hazardous materials in the environment like plastic, fly ash and rice husk ash etc. therefore by implementing paver block; we are capable to offer a green technology, sustainable construction and environment friendly product to the society. All above three supplementary materials imparts good and necessary properties in paver block and also helps in saving the impact on environment due to use of the resources of mother earth.

Akinyemi B. A & Akinosun T. A. (2013): The results of the research carried out on concrete paving blocks (CPBs), has shown that the production of CPBs with cement replacement with RHA up to 30% and addition of bamboo (3% by weight of cement) is technically possible, this supports the assumptions that RHA is a potential partial replacement for cement in the production of CPB.

Shanmugavadivu P. M (2021): The pavers are designed for M30 grade and on 56th day, the compressive strength for 25% RHA is equal to that of the conventional paver block. The compressive strength decreases as the ash content increases. The deflection decreases up to 50% replacement of RHA and increases with higher ash content. Hence 25% replacement of RHA is found to be the optimum level of replacement. Since the specific gravity of RHA is low, it is found to be a light-weight material. As RHA is a carbon neutral green product, there are no hazardous effects on the environment while burning it. Moreover, the green house gas emission from the cement production can be cut down by opting for a replacement material like RHA. For optimum replacement level of RHA, the cost is reduced by 24.5% per block when compared to that of the conventional. Hence the paver block using RHA is found to be economical and trustworthy.

Kene Satish & Patel Arun (2021): Compressive strength of paver block increases with the increase in the percentage of Fly ash and Rice Husk Ash up to replacement (14 %FA and 6 % RHA) of Cement and 10 % plastic of aggregate in Concrete for different mix proportions. Paver block concrete requires approximate increase in water cement ratio due to increase in percentage of RHA. Because RHA is highly porous material. The workability of RHA concrete of paver block has been found to decrease with increase in RHA replacement. The water absorption of paver block increases after the addition of percentage increase of rice husk ash as compare to control mix. Rice husk ash contains more silica, and hence we prefer rice husk ash use in concrete paver block than silica fume to increase the strength. Through Rice husk ash is harmful for human being, but the cost of rice husk ash is zero and thus we prefer RHA use in concrete as compared to silica fumes.

III.METHODOLOGY

A possible methodology for utilizing rice husk and ceramic waste as a geopolymer precursor for paving bricks is as follows:

Materials Collection and Characterization:

1. Collect rice husk and ceramic waste from local sources.
2. Characterize the materials for their chemical composition and physical properties.
3. Evaluating the performance and durability of structural materials, such as concrete, steel, wood, and plastics.
4. Assessing the quality and consistency of manufactured products, such as screws, bolts, springs, and bearings.
5. Investigating the behavior and failure modes of materials under extreme conditions, such as high temperature, high pressure, and high strain rate

Developing and optimizing new materials and processes,such as additive manufacturing, nanomaterials, and biomaterials.

Fig 3.1 Material Collection

Preparation of Raw Materials:

1. Clean and process the rice husk and ceramic waste to remove impurities.
2. Grind the ceramic waste to a suitable particle size.
3. To perform a compression test, you need to select the material to be tested, prepare the material according to the standard geometry and size, set up the testing equipment, preload the material, define the test parameters, start the compression test, monitor the test, determine the compressive strength, and report the result.
4. Compression testing can reveal important information about a material's mechanical properties, such as compressive strength, yield strength, and modulus of elasticity.
5. Compression testing is widely used in material science and engineering for material selection, quality control, research and development, and failure analysis.
6. Some of the main applications of compression testing are evaluating the performance and durability of structural materials, assessing the quality and consistency of manufactured products, investigating the behavior and failure modes of materials under extreme conditions, and developing and optimizing new materials and processes.

Fig 3.2 Rice Husk

Fig 3.3 Burning of Rice Husk

Fig 3.4 Rice Husk in the Form of Powdered

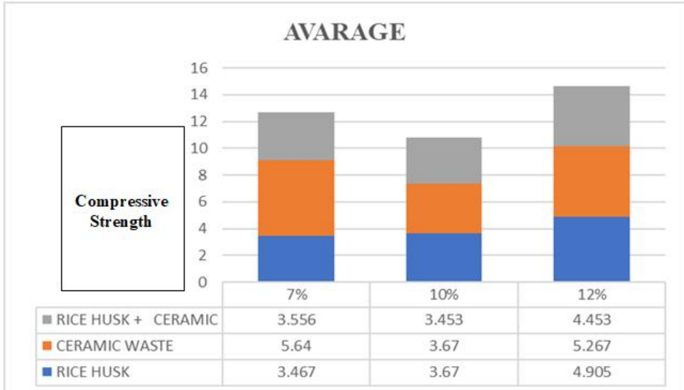
Alkaline Activator Preparation:

1. Prepare an alkaline activator by mixing an alkali source (e.g., sodium hydroxide) with a silicate source (e.g., sodium silicate) in the right proportions.
2. Some of the main applications of compression testing are evaluating the performance and durability of structural materials, assessing the quality and consistency of manufactured products, investigating the behavior and failure modes of materials under extreme conditions, and developing and optimizing new materials and processes.
3. The properties and performance of geopolymer concrete depend on various factors, such as the type and source of fly ash, the molarity and ratio of alkaline activator, the curing temperature and duration, and the water-to-geopolymer binder ratio.

IV.EXPERIMENTAL RESULTS

The utilization of rice husk and ceramic waste as geopolymer precursors for paving brick production has gained significant attention due to its potential to address environmental concerns and promote sustainable practices. Geopolymer technology offers an alternative to traditional cement-based materials by utilizing industrial by-products and reducing carbon emissions associated with cement production. The combination of rice husk and ceramic waste as geopolymer precursors for paving brick production offers several advantages. Geopolymer bricks manufactured using these precursors exhibit good mechanical strength, durability, and resistance to chemical attack. The geopolymerization process also results in lower carbon dioxide emissions compared to conventional cement production. However, there are certain challenges associated with the utilization of rice husk and ceramic waste. Proper characterization and processing of these waste materials are essential to ensure consistent quality and performance of the geopolymer bricks. Additionally, optimizing the geopolymer mix design and curing conditions is crucial to achieve the desired properties.

MATERIAL	7%	10%	12%	AVARAGE
RICE HUSK	3.467	3.67	4.905	4.014 N/mm2
CERAMIC WASTE	5.640	3.670	5.267	4.855 N/mm2
RICE HUSK + CERAMIC	3.556	3.453	4.453	3.820 N/mm2



Graphical form of compressive strength for 7 days

The utilization of rice husk ash and ceramic waste as a geopolymer precursor for paving bricks is a promising and sustainable alternative to traditional clay-based bricks. It offers a number of advantages, including:

Reduced environmental impact: Geopolymer paving bricks use waste materials as their precursors, which reduces the need for virgin materials and reduces the amount of waste that is sent to landfills.

Improved mechanical properties: Geopolymer paving bricks have been shown to have higher compressive strength and lower water absorption than traditional clay-based bricks. This makes them more durable and less susceptible to cracking and erosion.

Reduced energy consumption: Geopolymer paving bricks can be produced at lower temperatures than clay-based bricks, which reduces energy consumption and greenhouse gas emissions.

Improved durability: Geopolymer paving bricks have been shown to be more resistant to weathering and chemical attack than traditional clay-based bricks.

However, there are also some challenges that need to be addressed before geopolymer paving bricks can be widely adopted. One challenge is the cost of the alkali activator, which is a key ingredient in geopolymers. Another challenge is the need to develop new mixing and curing techniques for geopolymer paving bricks.

Despite these challenges, the potential benefits of geopolymer paving bricks are significant. As the technology continues to develop and the cost of alkali activators decreases, geopolymer paving bricks are likely to become a more viable and attractive option for sustainable construction.

V.CONCLUSION

1. The utilization of rice husk and ceramic waste as geopolymer precursors for paving brick production holds great potential in promoting sustainable construction practices.
2. By reducing waste generation, conserving natural resources, and reducing carbon emissions, this innovative approach contributes to a more environmentally friendly and efficient construction industry.
3. The cement replacement materials such as rice husk and sand replacement materials such as ceramic waste is less effective.
4. The compressive Strength of rice husk and ceramic powder brick are less as compare to normal brick.
5. The cement and sand replacement bricks such as 0%, 7%, 10%, 12% of compressive strength is low as compare to normal bricks.
6. The compressive strength of rice husk ash brick, ceramic waste brick, rice husk ash & ceramic waste brick is 5.260 N/mm2, 4.598 N/mm2, 4.561 N/mm2.

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