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EXPERIMENTAL STUDY ON LIGHT WEIGHT CONCRETE USING RICE HUSK ASH, GGBS AND FLY ASH AGGREGATES

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Abstract: The assignment involves the use of folios, fly ash (FA) and floor-granulated impact heater slag (GGBS), rice husk debris related to activators, sodium silicate and sodium hydroxide that work with the salt initiation process for delivering underlying light-weight geo-polymer concrete (LGC). To find the appropriate total that could brighten the general presentation, the antacid cover proportion has been different. unique rate combos of fly debris totals ggbs totals have been acquainted with the substantial combos to conclude what they meant for the general presentation. Trial examinations were done to assess the mechanical homes, thickness, and durability of lightweight cement. From the results we can infer that the top-quality salt fastener proportion for accomplishing leaned toward not entirely set in stone to be zero.4 wherein the substantial gets a 21 MPa compressive power. prominently, the utilization of 100 percent ggbs as the coarse combination outcomes inside the greatest energy, showing its ability for underlying projects. The got most proficient relieving temperature was 90°C, with a most strength of 28MPa

Keywords: Fly ash, ground granulated blast furnace slag, rice husk ash.

INTRODUCTION

The time period “light weight concrete” that's desired via the Ameican Concrete Institute (ACI) will be used as opposed to the greater scientifically correct term of decrease density concrete. The Institute also defines everyday weight as one phrase. ACI Committee 213 “light-weight Aggregates and light-weight Concrete” defines “lightweight concrete” as being concrete made with lightweight coarse aggregates and ordinary weight first-rate aggregates with likely some lightweight aggregates.

light-weight concrete is a specialized shape of concrete this is characterized by using its reduced weight, density, and advanced thermal properties compared to conventional concrete. Lightweight concrete is produced by incorporating lightweight aggregates, such as expanded clay, and vermiculite into the concrete mixture. This type of concrete, with a density ranging from 1440 to

1840 kg/m^3, is considered comparatively lighter than normal conventional concrete, which typically has a density of 2240 to 2400 kg/m^3.

I. Types of Lightweight Aggregates

1. Aerated Concrete
2. Foamed Concrete
3. Pumice Concrete
4. Expanded Polystyrene (EPS) Concrete
5. Lightweight Aggregate Concrete
6. Perlite Concrete
7. Vermiculite Concrete

II. Applications of Lightweight Geopolymer Concrete

1. High-rise Buildings
2. Infrastructure Projects
3. Insulating Concrete
4. Fire-Resistant Structures

III. Gap Analysis

- Absence of studies investigating the utilization of GGBS and rice husk ash as binders in lightweight concrete.
- There is a need for research into the mechanical characteristics, workability, and durability of lightweight concrete that uses Rice husk ash and GGBS as a binder.
- The need for additional study in areas such mix design optimization, curing conditions, and long-term performance in various environmental settings.
- More Studies on the potential for expanding the range of options available for lightweight concrete aggregates through the study of lightweight geopolymer concrete.

IV. Objectives

- To investigate the feasibility of using rice husk ash, ggbs, and fly ash in the production of lightweight concrete.
- To study the effect of varying proportions of coarse aggregates: ggbs and fly ash aggregate.
- To perform trial mix and obtain optimum alkaline to binder ratio.
- To evaluate the mechanical properties of the resulting lightweight concrete including compressive strength, tensile strength and flexural strength.
- To analyze the durability and performance of lightweight concrete under various environmental conditions.

Materials And Methodology

A. Material used:

The various materials utilized in this examination are:

1. **Fly ash:** Fly ash is the best powder fashioned from the mineral matter in coal, which includes the noncombustible be counted in coal and a small amount of carbon that stays from incomplete combustion. Fly ash is generally light tan in shade and consists normally

of silt-sized and clay-sized glassy spheres. Fly ash may be added to concrete to enhance its workability, minimize warmth era during hydration, growth its lengthy-time period electricity and durability, and feature much less of an environmental effect for the duration of the manufacturing technique**.**

2. **GGBS:** GGBS, also known as Ground Granulated Blast Furnace Slag, is a by-product of the iron industry that is created in blast furnaces during the manufacturing of pig iron. It is frequently employed in construction as an additional cementitious element. Glassy granules that are crushed into a fine powder are produced when molten iron slag is rapidly cooled in water or steam. It mainly contains silica, alumina, calcium, and other minor elements, with a high glass content contributing to its cementitious properties.
3. **Fine aggregates:** Manufactured Sand (M Sand) is an eco-friendly and economical alternative to natural river sand, widely used in the construction industry. M Sand is produced by crushing hard granite stones, ensuring consistent quality and gradation. It has gained popularity due to its sustainable characteristics and superior quality compared to river sand, which has become scarce due to extensive mining and environmental regulations. M Sand is often more economical than river sand due to lower transportation costs and availability.
4. **Coarse aggregates:**
   Fly ash coarse aggregates: Fly ash aggregates are synthetic lightweight coarse aggregates made from fly ash, cement, and other substances. Fly ash aggregates are used as a filler cloth in the manufacturing of concrete merchandise which include blocks and panels to be able to offer volume and hardness.
5. **GGBS aggregates:** GGBS aggregates are artificial lightweight coarse aggregates made from ggbs, cement, and other materials. (GGBS) Coarse Aggregates are a sustainable alternative to traditional coarse aggregates used in construction. These aggregates are produced from the by-products of the steel manufacturing process, specifically the slag that forms when iron ore is reduced in a blast furnace.
6. **Rice husk ash:** Rice Husk Ash (RHA) is a by-product obtained from the burning of rice husks, which are the protective coverings of rice grains. Rice husks are generated in large quantities during the milling of rice and are often used as fuel in various industrial processes. When rice husks are burned, they produce ash that is rich in silica, making RHA a valuable material for various applications, particularly in the construction industry.
7. **Cement:** Cement is a folio, a synthetic substance utilized for development that sets, solidifies, and sticks to different materials to all in all tight spot them. Ccement is rarely utilized on its own, yet rather to tie sand and rock (mix) overall. Ccement blended in with top notch mix produces mortar for brick work, or with sand and rock, produces ccement. It is the most extreme extensively involved material in ways of life and is toward the rear of best water in light of the fact that the planet's greatest benefited from asset.
8. **Water:** Water plays a crucial role in construction, where it is used for various purposes from the preparation of materials to the execution of construction activities.

9. **Alkaline solution:** Sodium hydroxide and Sodium silicate solution were used as the alkaline activators in geopolymer concrete. The binder solution consists of a combination of NaOH and Na2SiO3solution in the ratio of 1:2.5. The water/binder ratio is the ratio of solution (NaOH, Na2SiO3and water) to fly ash or ggbs.
10. **Sodium hydroxide:** Sodium hydroxide (NaOH), commonly known as caustic soda or lye, plays a significant role in the construction industry. It is valued for its strong alkaline properties and its ability to interact with various materials.
11. **Sodium silicate:** Sodium silicate, often referred to as water glass or liquid glass, is a versatile compound with a wide range of applications in the construction industry. Its unique properties make it valuable for various construction processes, from soil stabilization to enhancing concrete durability.

Methodology:

These laboratory tests are being carried out,

1. Compression strength test
2. Split tensile test
3. Flexural test
4. Acid resistance test
5. Sulphate resistance test
6. Water absorption test
7. Optimum curing temperature
8. Effect of curing duration
9. Ambient curing

B. ***Sampling of soil:***

Quantities	**Trial mix 1**	**Trial mix 2**	**Trial mix 3**
Alkaline to Binder ratio	0.35	0.4	0.45
Rice huskAsh (kg)	0.03666	0.03535	0.03414
GGBS (kg)	0.69667	0.67178	0.64862
Na2SiO3	0.089	0.08920	0.09689
NaOH (solids)	0.046	0.05076	0.05515
Water (kg)	0.1296	0.1428	0.1552
Fly ash Coarse aggregate (kg)	1.0395	1.0395	1.0395
GGBS Coarse aggregate (kg)	1.0395	1.0395	1.0395
Fine aggregate (kg)	0.891	0.891	0.891
Compressive Strength (MPa)	8.4	21	12

Compressive strength test:

For each alkaline binder ratio of 0.3, 0.4, and 0.45, three 100 x 100 x 100 mm cubes were cast, cured at room temperature for 3days, and tested for compression. The optimum alkaline binder ratio was determined and a further three cubes in that ratio each and varying percentage of the coarse aggregates were cast and tested for compression. The results are in the table.

Sl. No	Alkaline binder ratio	Compression Strength (MPa)
1	0.3	8.4
2	0.4	21
3	0.45	12

Table 1: Compression results for optimum alkali binder ratio

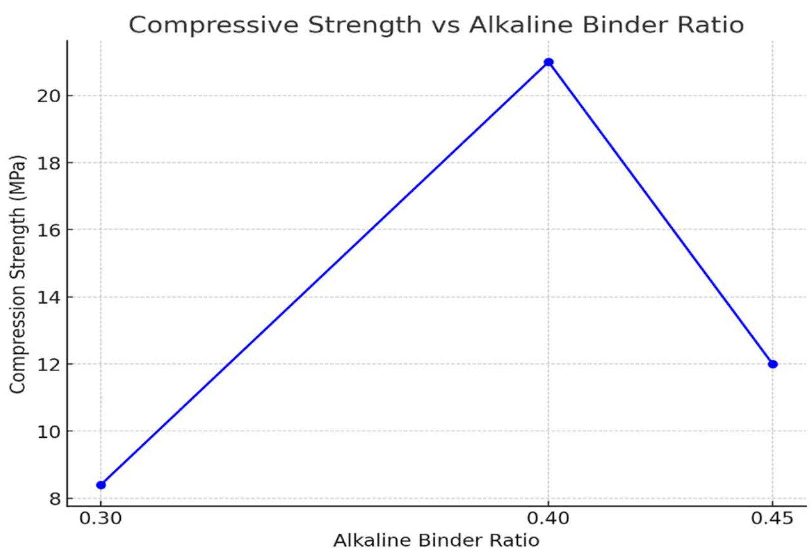


Fig 1: Compressive strength vs Alkaline binder ratio

Split tensile test:

Three numbers of cylindrical specimens with a diameter of 100 mm and a length of 200 mm were cast using the optimal alkaline binder ratio and two unique coarse aggregate variations. The samples were dried at room temperature.

SL N0.	Specimen	Tensile strength (MPa)
1	1	2.5
2	2	3

3	3	3

Table 2: Results of ST test for cylinder specimens

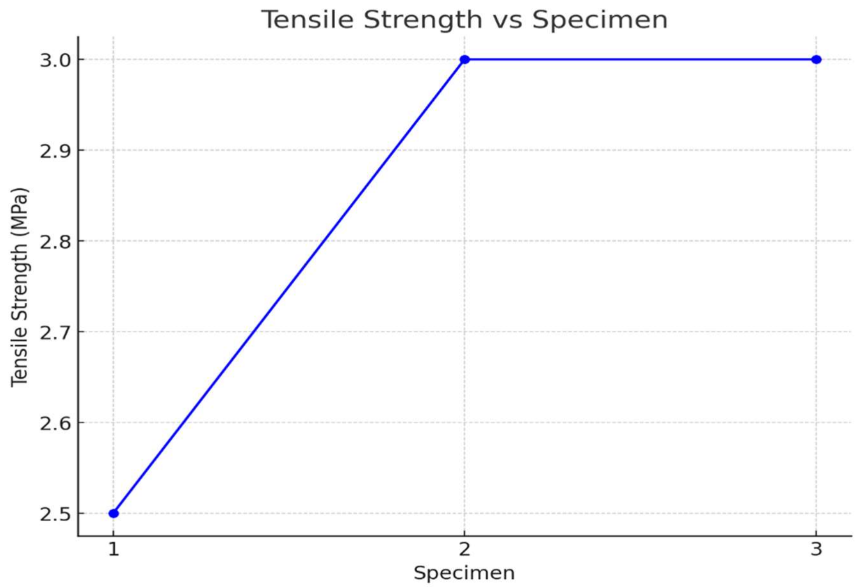


Fig 2: Split tensile strength of Concrete

Flexural strength:

Three prisms with dimensions of 450mm75mm75mm were fabricated. The results from the flexural strength tests revealed consistent values, indicating that the geopolymer mortar with a 0.4 alkaline binder ratio.

SL N0.	Specimen	Flexural strength (MPa)
1	1	2.8
2	2	2.52
3	3	2.3

Table 3: Results of flexural test for cylinder Specimens

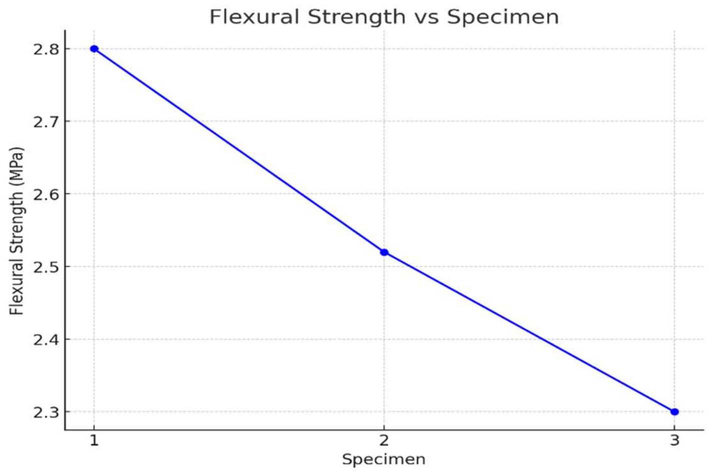


Fig 3: Flexural strength of Concrete

Optimum curing temperature:

Cubes with dimensions of 100 x 100 x 100 mm were cast, and they underwent oven curing at70°C, 80°C, and 90°C.

Sl. No.	Temperature (°C)	Compressive Strength (MPa)
2	70	8
3	80	13
4	90	26

Table 4: Results of compression test for optimum curing temperature

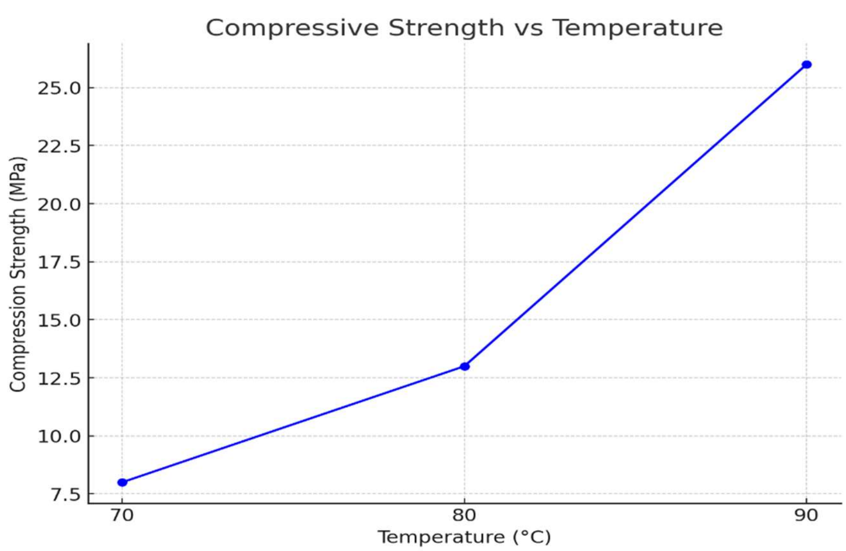


Fig 4: Optimum curing temperature vs compressive strength of Concrete

Effect of curing duration:

Cubes of 100mm*100mm*100 mm dimension were cast and were subjected to oven curing at optimum temperature of 90°C at varying durations 6hrs, 24hrs and compression tests were performed.

SL No.	curing duration	Compressive strength (MPa)
1	6 hours	11
2	24 hours	21

Table 5: Results of compression test for curing duration

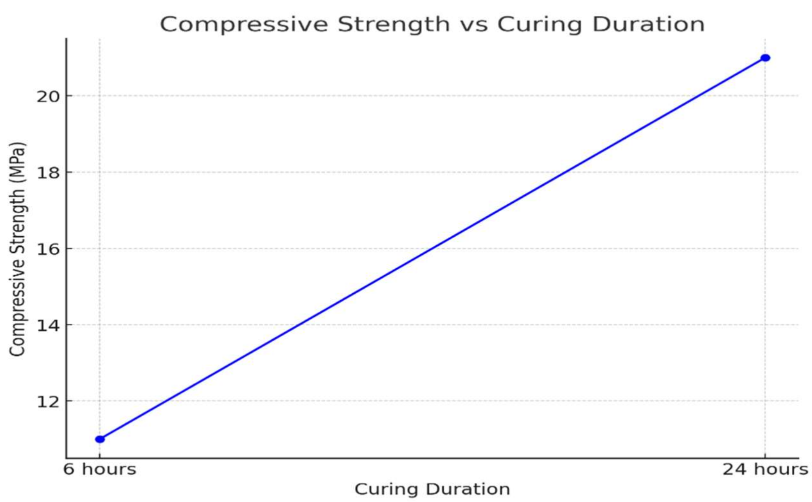


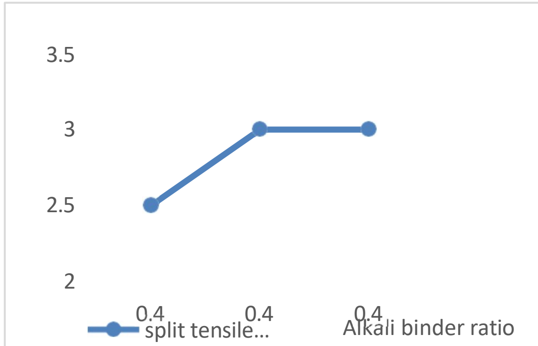
Fig 5: Effect of curing duration on compressive strength of concrete

Acid resistance:

Concrete cubes measuring 100 x 100 x 100 mm were submerged in a solution of 5N 10% sulphuric acid for the acid attack test.

SL NO.	Time (Days)	Compressive Strength (MPa)
1	7	10
2	28	6

Table 6: Results of compression test for acid resistance



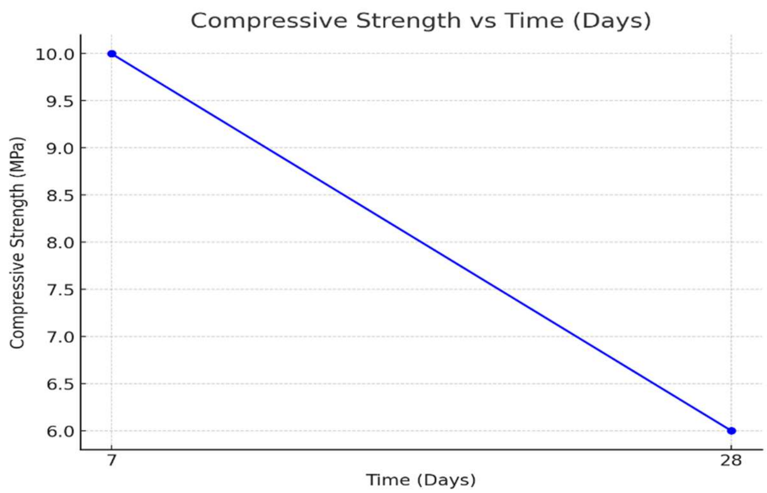


Fig 6: Acid resistance on compressive strength of concrete

Sulphate resistance:

Cubes were cast to immerse them in 5N 10% Sodium sulphate solution for sulphate attack test. After seven and twenty-eight days, the concrete cubes' compression strength was evaluated

SL No.	Duration (days)	Compression Strength (MPa)
1	7	8
2	28	7

Table 8: Results of compression test for sulphate resistance test

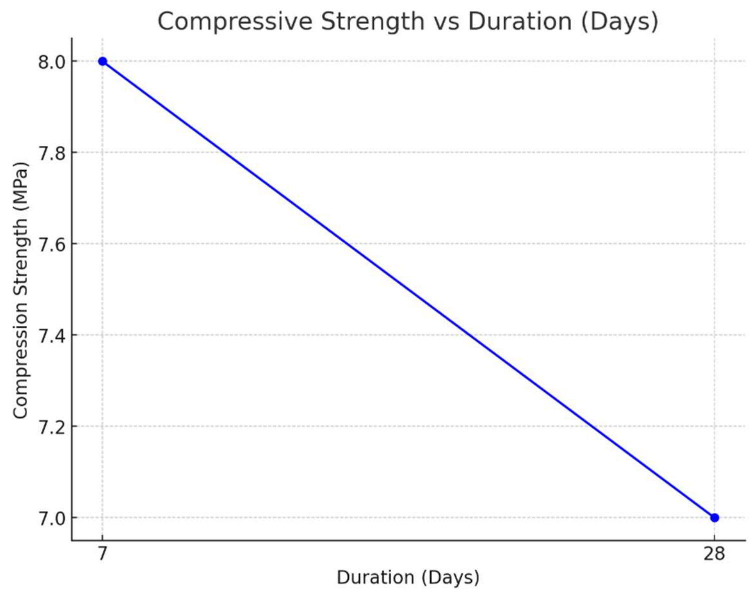


Fig 7: Sulphate resistance on compressive strength of concrete

Fire resistance:

The specimens are subjected to fire resistance testing at temperatures of 200°C, 400°C for durations of 2 and 4 hours. The specimens were placed in an oven. After the duration they are taken out cooled and compressive strength test is conducted.

Sl. No.	Temperature	Compressive strength (Mpa)
1	200	10
2	400	4

Table 9: Results of compression test for fire resistance test

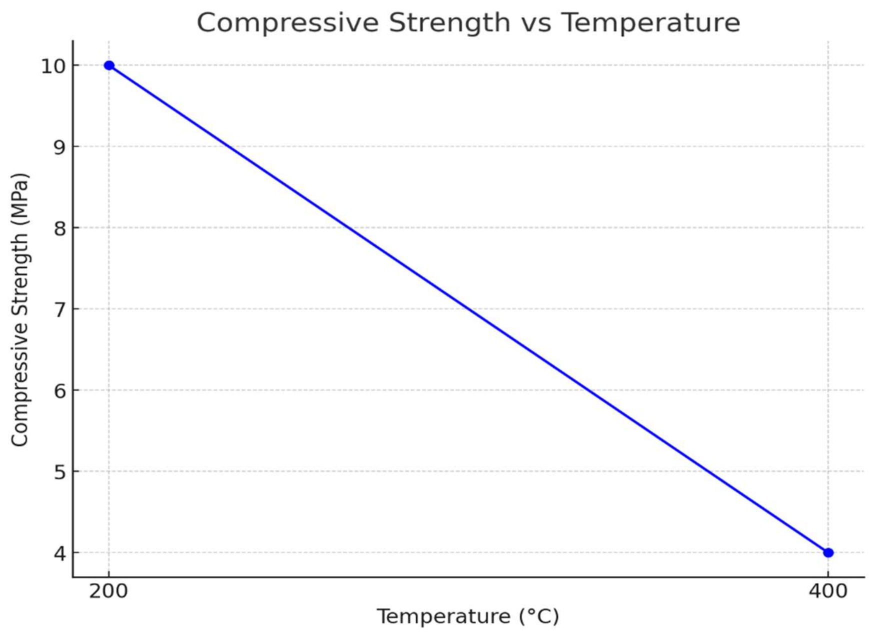


Fig 8: Fire resistance test on compressive strength of concrete

Conclusions:

1. Optimum Alkali Binder Ratio: According to the findings, 0.4 is the ideal alkali binder ratio for lightweight concrete. The concrete shows a compressive strength of 21 MPa at this ratio, indicating a level of strength appropriate for structural purposes. This ratio makes sure that the binders are activated properly and makes the Geo- polymerization process easier.
2. Influence of Aggregate Composition: In comparison to employing fly ash aggregates, adding ggbs as the coarse aggregate increased the compressive strength. The highest strength was shown when 100% cinder as the coarse aggregate was used, demonstrating its suitability for structural applications. The compressive strength was observed to be reduced by the addition of fly-ash aggregates, indicating the need for careful consideration of aggregate selection while producing lightweight concrete.
3. Optimum Curing Temperature: The trials showed that 90 °C was the ideal curing temperature for the LWC to achieve its maximum compressive strength. Concrete exhibited a compression strength of 26 MPa at this temperature. Higher curing temperatures promote polymerization processes, which improve strength development.
4. Effect of varying curing temperature: The compression strength consistently increases from 6 hours of curing (11 MPa) and further to 24 hours (21 MPa). This trend suggests that prolonging the curing duration enhances the material's strength
5. Durability parameters: The specimens demonstrate similar fire resistance at 200°C and 400°C, maintaining their structural integrity. However, at 400°C, significant degradation occurs, resulting in a substantial decrease in compression strength. The specimens exhibit notable resistance to acid and sulphate attack, with compression strengths of 8 MPa and 7 MPa, respectively. The material can withstand the corrosive effects of acids and sulphates to

a considerable extent. The specimens demonstrate notable resistance to water absorption of 7.5 %. Overall, the concrete shows promising durability in terms of acid and sulphate attack resistance, and water absorption resistance.

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