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ANALYSIS OF BLENDED CONCRETE USING VARIOUS PERCENTAGE OF GLASS CULLET WITH GEOPOLYMER IN FINE AGGREGATE

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ABSTRACT :

Researchers from all over the world are experimenting with different proportions and admixtures to create unmatched concrete. This study's goal is to investigate the characteristics of glass cullet-reinforced high-performance concrete (GCRHC), which is used to prepare high-performance trail mixes with 20% geo polymer (GP) replacements ranging from 10% to 40%. An ideal mixture is selected, which replicates cement at a constant 20 percent with geo polymer. Glass cullet are induced at 10 percent, 20 percent, 30 percent, and 40 percent by weight of fine aggregate for that optimized mix along with geo polymer.

Cube moulds measuring 150x150x150 mm, cylinder moulds measuring 100x300 mm, and beam moulds measuring 100x100x500 mm are made, cured for 7 to 28 days, and then their hardened strength is assessed.

Keywords: Geo polymer, Glass-cullet reinforced high-performance concrete, Compressive strength, flexural strength, tensile strength, waste glass.

INTRODUCTION

Concrete is a structural material used in construction that is made up of aggregate, or hard, chemically inert particulate material (typically sand and gravel), which is then bound together by cement and water. The most popular bonding material among the ancient Assyrians and Babylonians was clay. The use of lime and gypsum as binders allowed the Egyptians to create a substance that is more comparable to modern concrete. Up until the early 1800s, lime (calcium oxide), derived from limestone, chalk, or (where available) oyster shells, remained the main pozzolanic, or cement-forming, agent. Clay and limestone were burned and ground together in 1824 by an English inventor named Joseph Aspdin. The primary cementing substance used in the creation of concrete has continued to be this mixture, known as portland cement. Another innovation in masonry construction is the use of prestressed concrete. It is achieved by either pre-tensioning or post-tensioning processes. In pre tensioning, lengths of steel wire, cables, or ropes are laid in the empty mold and then stretched and anchored. After the concrete has been poured and allowed to set, the anchors are released and, as the steel seeks to return to its original length, it compresses the concrete. In the posttensioning process, the steel is run through ducts formed in the concrete. When the concrete has hardened, the steel is anchored to the exterior of the member by some sort of gripping device. By applying a measured amount of stretching force to the steel, the amount of compression transmitted to the concrete can be carefully regulated. Prestressed concrete neutralizes the stretching forces that would rupture ordinary concrete by compressing an area to the point at which no tension is experienced until the strength of the compressed section is overcome. Because it achieves strength without using heavy steel reinforcements, it has been used to great effect to build lighter, shallower, and more elegant structures such as bridges and vast roofs.

LITERATURE REVIEW

Manishankar S (2024) concrete industry is a major user of natural resources, which puts its sustainability in jeopardy. Considering this, this work explores how to partially replace fine aggregates in concrete production with waste glass cullets, thus addressing economic problems. With an emphasis on the M-20 mix, several weight percentages of leftover glass cullet—0%, 10%, 20%, and 30%—were used in place of fine aggregates. **Oksana and Serhii (2023)** is widely used construction material in the present industry. The concrete con-sists of cement, fine aggregates and coarse aggregates. Concrete is strong in compression and weak in tension. Also, the cement manufacturing industry on an average emits 7% of greenhouse gases to earth's atmosphere which leads to global warming. In order to address these environmental affects ex-tensive research is ongoing into the use of cement replacements, using many waste materials (like waste glass, plastics, fly ash, etc.) and industry's by-products. **Noor Md. Hasan et. al. (2023)** all of which lead to long term sustainable development. From this perspective, this experimental investigation was carried out to determine the cumulative influence of waste glass cullet and metakaolin (MK) as partial replacements for coarse aggregates and cement in an isolated and combined manner. This

research demonstrated the influence of integrating glass aggregate and metakaolin wherein coarse aggregate was substituted by 10%, 15%, 20%, 25%, and 30% glass cullet (by weight), and cement was supplemented with 10% metakaolin. **A. S. Pasana et. al. (2023)** disposal of the huge volume of glass waste is one of the significant environmental issues that need to be addressed. One of the efficient ways to solve this problem is to incorporate ground glass waste in concrete mixtures. However, its inherent surface smoothness and microcracks within the glass particle harm the hardened properties of concrete.

OBJECTIVE OF THE STUDY

The main focus of this study, is the behavior of the glass cullet-reinforced high-performance concrete (GCRHC), which is used to prepare high-performance trail mixes with 20% geo polymer (GP).

- To study the properties of the glass cullet-reinforced high-performance concrete (GCRHC), which is used to prepare high-performance trail mixes with 20% geo polymer (GP).
- To achieve durability of the glass cullet-reinforced high-performance concrete (GCRHC), which is used to prepare high-performance trail mixes with 20% geo polymer (GP).
- To achieve economy by selecting appropriate concrete ingredients.
- To study the workability of the glass cullet-reinforced high-performance concrete (GCRHC), which is used to prepare high-performance trail mixes with 20% geo polymer (GP).
- To study the compressive strength and tensile strength of the glass cullet-reinforced high-performance concrete (GCRHC), which is used to prepare high-performance trail mixes with 20% geo polymer (GP).

METHODOLOGY

Following test were conducted on prepared samples and materials also as per relevant IS code of Practice:

1. Slump Cone Test
2. Compressive Strength Test

SLUMP CONE TEST

This is a test used extensively in site work all over the work. The slump test does not measure the workability of concrete although ACI 116R – 90 describes it as a measure of consistency, but the test is very useful in detecting variations in the uniformity of a mix of given nominal proportions. The slump test is prescribed by IS: 456 (2000), ASTM C 143 90A and BS 1881 Part 102:1983.

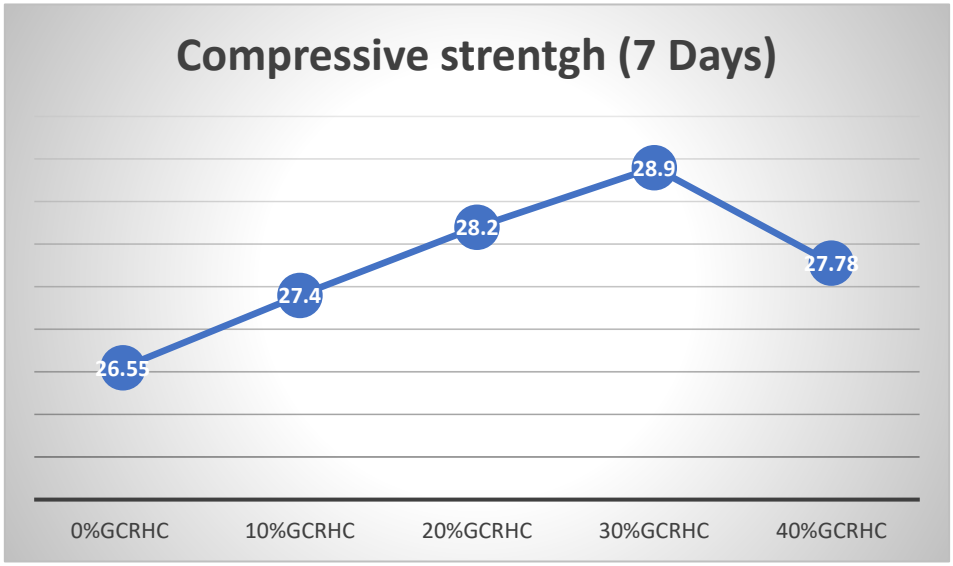
COMPRESSIVE STRENGTH TEST

Compressive strength of concrete depends on many factors such as water-cement ratio, cement strength, quality of concrete material, quality control during production of concrete etc. Test for compressive strength is carried out either on cube or cylinder. Various standard codes recommend concrete cylinder or concrete cube as the standard specimen for the test. Out of test applied to the concrete, this is the utmost important which gives an idea about all the characteristics of concrete. By this single test one judge that whether Concreting has been done properly or not.

OBSERVATION AND RESULTS

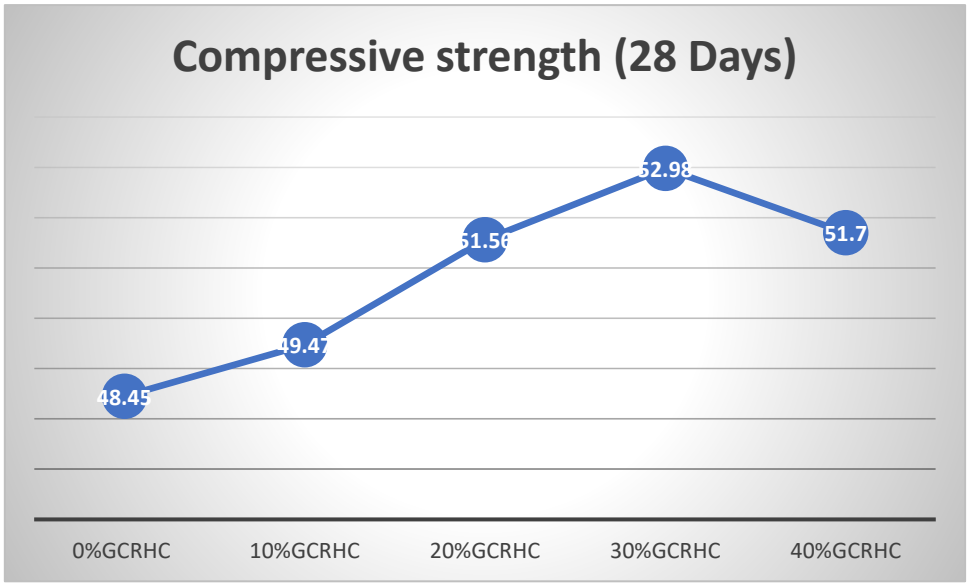
Table : The compressive strength of glass cullet-reinforced high-performance concrete (GCRHC) replaced with fine aggregate in different % in concrete mix with 20% geo polymer (GP) at 7 days

Mix-Type	Mix ID	Compressive Strength 7 days
0%GCRHC	Mix-CC	26.55
10%GCRHC	Mix-10%GCRHC	27.40
20%GCRHC	Mix-20%GCRHC	28.20
30%GCRHC	Mix-30%GCRHC	28.90
40%GCRHC	Mix-40%GCRHC	27.78



Mix-Type	Mix ID	Compressive Strength 28 days
0%GCRHC	Mix-CC	48.45
10%GCRHC	Mix-10%GCRHC	49.47
20%GCRHC	Mix-20%GCRHC	51.56
30%GCRHC	Mix-30%GCRHC	52.98
40%GCRHC	Mix-40%GCRHC	51.70

Table : The compressive strength of glass cullet-reinforced high-performance concrete (GCRHC) replaced with fine aggregate in different % in concrete mix with 20% geo polymer (GP) at 28 days



CONCLUSION

The following conclusions are made from the study:

1. Without reducing the water-cement ratio, the target mean strength of M40 grade concrete can be reached by using glass cullet-reinforced high-performance concrete (GCRHC) to partially replace aggregate.
2. 40 MPa is typically used for a variety of structural applications.
3. The compressive strength of different percentages of glass cullet-reinforced high-performance concrete (GCRHC) replaced with fine aggregate in different % in concrete mix with 20% geo polymer (GP) at 7 days.

4. The compressive strength of different percentages of glass cullet-reinforced high-performance concrete (GCRHC) replaced with fine aggregate in different % in concrete mix with 20% geo polymer (GP) at 28 days.

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