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Comparative Study on Effect of Basalt and Glass Fiber on Workability and Compressive Strength of Microbial Concrete

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Abstract: **Basalt fibre (BF) is a novel sort of inorganic fibre which is produced from the expulsion of liquefied basalt shake and is industrially accessible. This investigation relatively examines the use of basalt and glass strands as fibre support in concrete. This paper also gives a concise portrayal of impact basalt and glass fibre on workability and compressive strength of microbial concrete. The fibres were added in concrete randomly by (0.25%, 0.5%, and 0.75%) of the weight of cement. For every percentage of fibre, a total of three cubes were cast to obtain average results. Addition of fibres into concrete greatly improves the engineering properties of concrete. Be that as it may, the compressive strength of concrete is still under level-headed discussion by the addition of fibres in concrete. There is no considerable improvement in compressive strength of concrete by the addition fibres. To improve the compressive strength of concrete there is a novel technique by the addition of Bacillus bacteria and its nutrients to concrete may in improves the mechanical properties of concrete. The bacteria used in this study are Bacillus Subtilis spore powder of 2 million cfu/gm with 0.5% of cement was mixed to concrete. And calcium lactate was added to concrete as a nutrient source for bacteria in concrete. Findings of this investigation indicated the influence of added bacteria in fibre concrete which is quite impressive for improving the compressive strength and workability of concrete.**

Key Words: Compressive Strength, Workability, Basalt Fibre, Glass Fibre, Bacillus Subtilis.

I. INTRODUCTION

A standout amongst the most ordinarily utilized materials for construction is concrete. Concrete has a number of advantages such as desired mechanical strength, durability and formability which gives it an edge over the other ordinary building materials yet it has few weaknesses, for example, strain limit and low elasticity [1– 3]. For improving fracture and mechanical properties of concrete usually, fibers are integrated into concrete and a number of researchers have explored the impacts of fiber consideration in concrete contingent upon the fiber sort and substance [4– 7]. Addition of fibers in concrete may enormously impact the concrete properties and different literary works have demonstrated that the addition of fibers can fundamentally enhance the building properties of concrete, such as the flexural strength, abrasion resistance, and tensile strength, load-bearing capacity after cracking and deformation capability [8]

The compressive strength of concrete is still under debate by the addition of fibers in concrete, as a few scientists observed an increment in the compressive strength with fiber consideration whereas some detailed a diminishing in the compressive strength [9– 15]. BF is a new sort of inorganic fiber that is produced from the expulsion of liquefied basalt shake and industrially accessible. The BF does not contain whatever other added substances, which makes it more efficient. It is realized that the BF has preferable tensile strength than E-glass fiber, and in addition, great protection from chemical attack, affect load and fire with less toxic vapour. Thus, BF can possibly be an appropriate substitution for carbon, steel and glass strands in numerous development applications [16-18]. Past investigations demonstrated that the impact of BF addition essentially enhanced the elasticity, diminished the brittleness, and enhanced the durability, deformation protection and modulus rupture of concrete [19, 20].

Also, there is a novel technique by the addition of bacteria and their nutrient in concrete it may improve the engineering properties of concrete. And also it may act as a self-healing material it fills the cracks formed in concrete by the action of microbial precipitated calcium carbonate. Different fibers are used in concrete, yet there is deficient data accessible on crack behaviour and mechanical properties concrete by the consideration of basalt fibers in concrete. Additionally there is exceptionally constrained data accessible on bacterial concrete by the addition of fibers. These are having splendid significance in understanding the behaviour of material and in structural design. The objective of this investigation is to examine, analyse and look at workability and compressive strength of concrete strengthened with basalt and glass fiber with and without expansion of microscopic organisms.

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2. FUNCTION OF MICRO ORGANISM:

Research has demonstrated that autogenously healing occurs because of hydration of non-responded cement particle present in the concrete when interacts with entrance water bringing about the conclusion of a closure of micro-cracks, considers additionally expressed that exclusive spore shaping gram-positive microscopic organisms can survive in high pH condition of concrete sustaining different stress. In this way, bacterially prompted calcium carbonate precipitation has been proposed as an option and ecological amicable crack repair strategy. Microbial calcite precipitation is for the most part due to urealytic movement and carbonate bio-mineralization of microscopic organisms.

3. EXPERIMENTAL INVESTIGATION

3.1. Materials

3.1.1 Cement:

43 Grade Ordinary Portland cement is utilized as a part of this investigation. It is used according to Indian standard particulars [21].

3.1.2 Fine and Coarse aggregate:

The natural sand having specific gravity of 2.69 and maximum size of 4.75 mm is chosen as fine aggregate and has been tested as per Indian standards [22]. Crushed stone having 2.7 specific gravity and 20 mm maximum sizes is considered to be coarse aggregate.

3.1.3 Calcium Lactate:

Calcium lactate, which is likewise known by calcium salt pentahydrate ($C_6H_{10}CaO_6$) is a white powder with efflorescent smell. This powder is framed by the reaction of lactic acid with calcium hydroxide or calcium carbonate. Calcium Lactate utilized as a part of this study was acquired from Triveni Chemicals, Gujarat India.

3.1.4 Microbial sample:

Bacillus Subtilis spore Powder samples are secured from the De Generic Bio-Tech Pvt Ltd, Hyderabad. Bacillus Subtilis spore powder of 2 million cfu/gram concentration with 0.5% cement was blended to concrete.

3.1.5 Basalt Fibers:

The basalt fibers used in this study are chopped uniformly of 12mm in length and having a diameter of 14 microns.

3.1.6 Glass Fibers:

This material is made from enormously fine fibres of glass. It is a light weight and robust material. Glass Fibers considered in this study are of Cem-FIL Anti - Crack HD Filament diameter 14 microns and having a length of 12 mm.

4 . MIX PROPORTIONS:

In this study, concrete was designed as per Indian standards [23] with water cement ratio of 0.45 and having mix proportions are 1: 1.44: 2.52. The basalt and glass fibers are added into concrete of 0.25%, 0.5% and 0.75% by weight of cement were used. Also the same work has been done with by the addition of Bacillus Subtilis bacteria with 0.5% of cement and calcium lactate with 0.5% of cement as its nutrient source.

5. RESULTS AND DISCUSSION:

5.1 Compressive Strength:

According to Indian Standards IS 516:1959 compressive strength test was performed. Cubes of size 100mm x 100mm x 100mm were prepared for each mix. After 24 hours of the casting of cubes, specimens are demoulded and kept it for curing in water. For each test three cubes are tested the compressive strength reports are an average of three results. Fig.1 shows the compressive strength details of basalt and glass fiber reinforced concrete. It shows that the compressive strength of glass and basalt fiber reinforced concrete was increased considerably when comparing to control mix. But there is no maximum difference in compressive strength of glass and basalt fiber concrete.

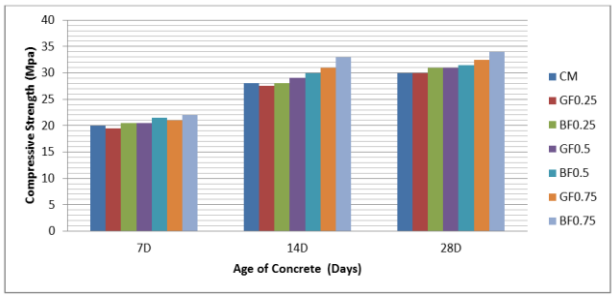

Fig.1 Compressive strength of glass and basalt fiber reinforced concrete

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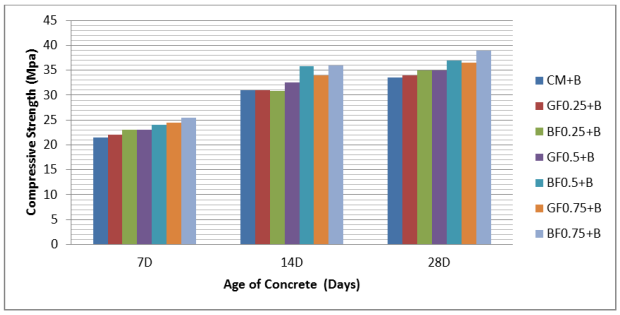

Fig.2 Compressive strength of Bacterial concrete with fibers.

Fig.2 shows the compressive strength of basalt and glass fiber concrete with the addition of bacteria. It is observed that the compressive strength of concrete was improved by the addition of Bacillus Subtilis bacteria and its nutrients to concrete. At all ages and different fiber proportions of concrete, the compressive strength of concrete was increased due to the addition of bacteria.

5.2 Workability:

In this study slump cone test was performed to know the workability of concrete. Slump cone test is a quick measure of workability of concrete. The test was performed is according Indian standards IS 1199 – 1959.

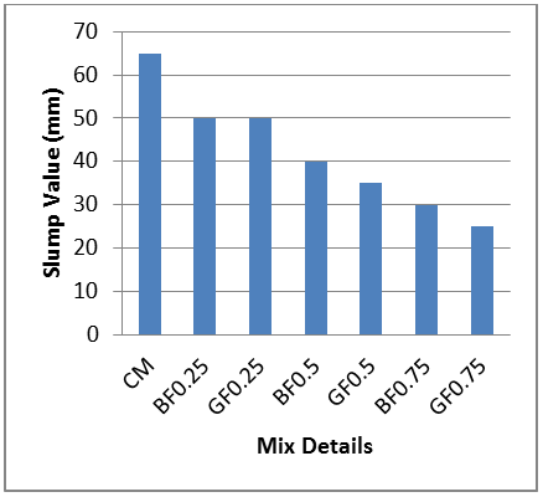

Fig.3 Slump values of fiber reinforced concrete

Addition of fibers into concrete may reduce the workability of concrete. Table.1 shows the slump values of basalt and glass fiber concrete. There is no maximum difference in the slump values of basalt and glass fiber concrete. But workability of basalt and glass fiber concrete was reduced by an increase in the proportion of fibers in concrete.

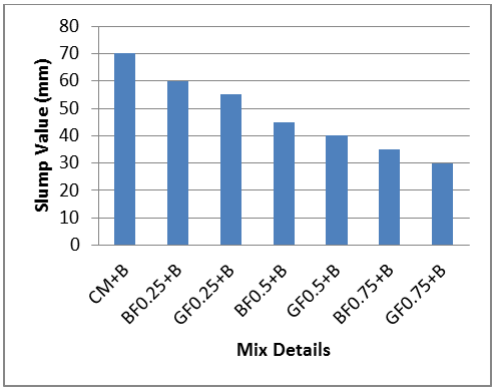

Fig.4 Slump values of bacterial concrete with addition of fibers.

Addition of bacteria and its nutrient source calcium lactate into concrete may increase the workability of concrete. It was found that the workability of fiber concrete also enhanced by addition of bacteria by comparing with the fiber concrete.

5.3 Scanning Electron Microscope:

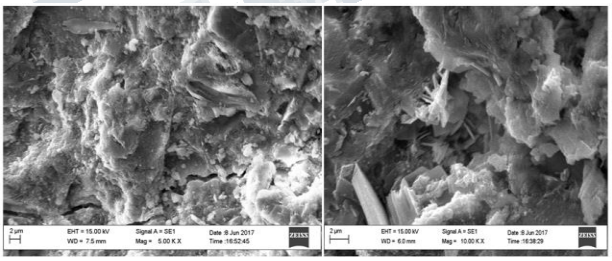

Fig.5 SEM image of a) Normal concrete b) Bacterial concrete

SEM is basically a high amplification magnifying instrument, which utilizes a cantered checked electron pillar to deliver pictures of the sample. SEM is a capable instrument which allows the portrayal of heterogeneous materials and surfaces. The pictures obtained from SEM, it was clear that presence of calcite and needle-formed aragonite gems of CaCO3 were observed. From SEM pictures we can observe that there is a dense structure in bacterial concrete compared with the control concrete. This is because of the precipitation of calcium carbonate in the miniaturized scale pores of the concrete. The increase in compressive strength in microbial

fiber reinforced concrete is due to the action microbial precipitated calcium carbonate.

6. CONCLUSION:

The addition of GF and BF in the concrete blend diminished the workability of concrete. However, GFRC indicated lower workability when contrasted with BFRC. The addition microorganisms and its supplement source calcium lactate into fiber strengthened concrete may increase the workability of concrete. There is the least increment in the compressive strength of concrete by the addition of basalt and glass fibers. Yet, there is no impressive contrast in compressive strength of basalt and glass fiber fortified concrete. The compressive strength of basalt and glass fiber strengthened concrete was expanded by the addition of Bacillus Subtilis microorganisms and its supplement source calcium lactate into concrete.

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