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Impact of Chloride Attack on Basalt Fibre Reinforced Concrete

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Abstract: ***Basalt fibers are extensively used construction materials due to its advantages. This paper emphasizes the behavior of basalt fiber reinforced concrete (BFRC) subjected to chloride attack. Basalt fibers are added in proportions of 0.5%, 1.0%, 1.5%, 2%, and 2.5%. Grade of concrete is M40. Cubes were casted for a standard size of 150*150*150mm and cured for a period of 28 days. Chloride attack is calculated by dipping the cubes in 5% of sodium chloride solution for a span of 28, 60 and 90 days. To estimate the chloride attack impact on BFRC, BFRC is tested for compressive strength, Acid attack and Rapid chloride penetration test.***

Keywords: Basalt fibers, Basalt fiber reinforced concrete, Acid attack, Rapid chloride penetration test.

I. INTRODUCTION

Basalt is formed from the flow of volcano and it is a type of igneous rock too. Due to most advantageous chemical compositions, its use has been extended in many industries. Basalt fibres are extracted from basalt rock. These fibres have high physiochemical characteristics compared to fibre glass and economical compared to carbon fibre.

Basalt fibre reinforced concrete is the new trend of concrete, which is form of concrete that is using most of natural available basalt fibres. In Some scenarios BFRC is considered as green concrete.

In this study BFRC is tested for chloride attack, so that this type of concrete is used in chloride environment.

II. EXPERIMENTAL PROCEDURE

A. Materials

Materials used to produce BFRC are ordinary Portland cement, river sand as fine aggregate; 12mm sized coarse aggregates, basalt fibers of dimensions 20mm in length and 16mm in diameter. Chemical composition of OPC is analyzed using XRF analysis and results were plotted in the Table 1.

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B. Mix Design

5 mixes were designed to test the chloride attack on BFRC. Basal fibres are added in proportion of 0.5%, 1%, 1.5%, 2%, 2.5%. Mix designs of BFRC are shown in table 2. BFRC is designed for M40 grade.

With the same proportions, cubes were casted and cured for 28 days before going to the test procedure.

COMPOSITION	*OPC (%)*
SiO_2	14.01
Al_2O_3	2.69
Fe_2O_3	2.58
CaO	42.85
MgO	0.63
SO_3	0.39
Na_2O	0.26
K_2O	0.32
Mn_2O_3	0.2
TiO_2	0.00
Cl	0.00

Table 1: XRF analysis of OPC

mix	Cement (kg/m^3)	F.A (kg/m^3)	C.A (Kg/m^3)	water	Basalt (%)
BFRC1	465	680	589	200	0.5
BFRC2	465	680	589	200	1
BFRC3	465	680	589	200	1.5
BFRC4	465	680	589	200	2
BFRC5	465	680	589	200	2.5

Table 2: mix proportions with different dosages of basalt fibers

III. TESTS CONDUCTED

I. Compression test:

To test the compressive strength of BFRC, cubes were casted with a standard size of 150*150*150mm. A total of 30 cubes were casted in mould and tested for compressive strength. Compressive strength values of BFRC are shown in fig 1.

II. Split tensile test:

Cylinders of size Ø150mm and length of 300mm are casted to find out the tensile strength of the specimen. Split tensile strength values of BFRC are shown in fig 2.

III. Acid attack:

Cubes and cylinders were cured for 28 days and exposed to acid environment by dipping in 5% of sodium chloride solution for a span of 28, 60, 90 and 120days.

Initial weight of the specimens is taken before soaking in sodium chloride solution and after specified time cubes were taken out from solution. Specimens were kept under a running water tap and washed thoroughly to clean chloride layer formed on surface. Final weights are taken for cleaned specimen. After weighing, specimen is tested for compressive strength and results are compared with results of cubes cured in water.

Comparison graph for compressive strength for 28days curing are shown in fig 3.

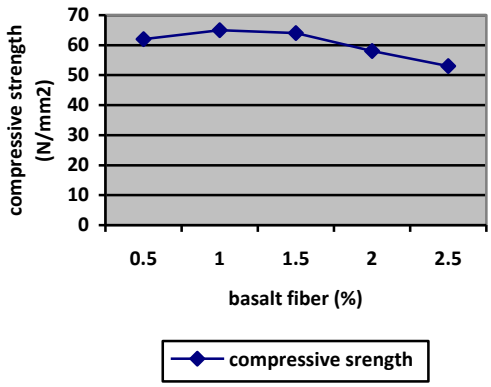
IV. Rapid chloride penetration test:

Chloride ion penetration in BFRC is stated by drilling out the powdered samples from the specimen soaked in sodium chloride solution after taking out and drying thoroughly. Surface of the specimen is wire brushed for easy penetration of the driller. Ergonometric titration of chloride with silver nitrate method is used.

IV. RESULTS

I. Compressive strength

fig 1: compressive strength of BFRC for 28 days



II. Split tensile strength

fig 2: Tensile strength of BFRC at 28 days

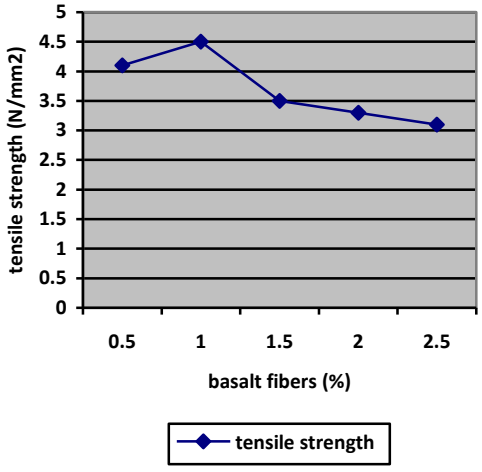


fig 3. percenatge change in compressive strength of BFRC

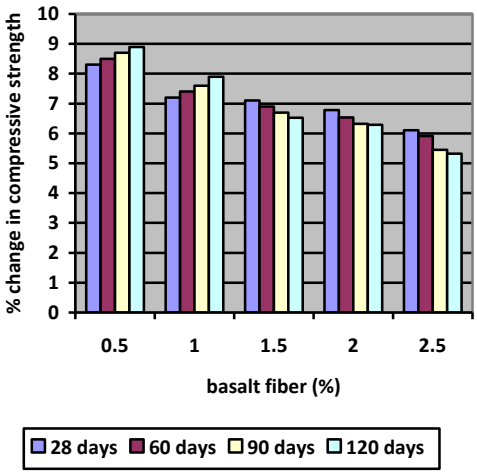


fig 4: change in weight of BFRC cube

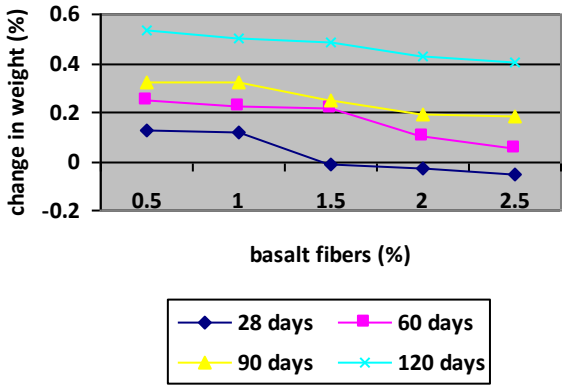


Table 3. Chloride content in BFRC concrete

Basalt fibers (%)	Chloride content (%)			
	28 days	60 days	90 days	120 days
0.5	2.51	10.58	18.12	27.3
1	2.49	9.55	16.76	25.2
1.5	2.33	8.98	15.65	23.12
2	2.12	8.53	13.33	20.19
2.5	1.93	6.52	11.22	18.99

V. CONCLUSIONS

From the experimental results following inferences can taken

- It is evident from the fig 1 that compressive strength is increased with increase in basalt fibres. Beyond 1% compressive strength values are decreasing.
- Split tensile strength of BFRC showing same characteristics of compressive strength
- For hardened properties 1% is most nominal addition of basalt fibres.
- With increase in basalt fibre percentage loss of weight of BFRC is decreasing i.e., chloride characteristics are reduced with high amount of basalt fibres percentile

- Penetration of chloride ions is increasing for small proportions with increase of time but comparatively decreasing with increase in basalt fibers.

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