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EXPERIMENTAL STUDY ON FIBRE REINFORCED BACTERIAL CONCRETE

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Abstract— ***The Fibre Reinforced Bacterial Concrete is a combination of concrete matrix and embedding bacteria in the concrete is to provide crack resistance, crack control and gives high strengths and ductility. It has been found that FRBC added in specific percentages concrete improves mechanical properties, durability and serviceability of structures. In this paper effect of Glass fibres in Bacterial (Bacillus Subtilis) concrete on the strength of M-25 grade have been studied by constant bacteria percentage of 0.2% of weight of cement and varying the fibre percentages of 0.5%, 1.0%, 1.5%, 2.0% of weight of concrete. All the specimens were tested for a curing period of 3, 7, 14 and 28 days. The results of FRBC for 28 days curing it has been found and also durability tests on same samples carried out for 7 days after 28 days curing period. In this study it is found that there is a significant increase in strength and durability. And also little decrease was found in workability due to presence of fibres.***

Keywords— *FRBC, Bacillus Subtilis, Glass fibres, Carbonation*

I. INTRODUCTION

One of most extensively used construction material is concrete. But it is weak in ductility tension and cracks occur sustained loading. The strength and durability of concrete is by using bacteria and fibres in the concrete. FRBC is used to increase the flexural strength, crack control and durability of the structures. Addition of fiber reinforced bacterial concrete enhances ductility, tensile strength, flexural strength. Furthermore adding fiber reinforced bacterial concrete percentage reduces in workability.

1.1 Objectives:

To determine the

1. Workability of fiber reinforced bacterial concrete
2. Strength characteristics of FRBC
3. Durability of FRBC

II. MATERIALS AND METHODS

2.1 *Materials*

A) *Cement:*

In this study, Ordinary Portland Cement (OPC) is used. It is tested as per Indian standard specifications [17].

B) C*oarse and Fine aggregate:*

The natural sand having the 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 [18]. Crushed stone having 2.45 specific gravity and 20 mm maximum sizes are considered to be coarse aggregate.

C) *Glass Fibre:*

It is the material made from extremely fine fibres of glass. It is a light weight, extremely strong and robust material. There are distinctive sorts of fiber however in these we have taken glass fiber length 12mm to show better resistance and a very good insulation to electricity. The specific gravity of glass fiber is 2.68.

D) Bacillus subtilis

In this Study Bacillus subtilis was used. Bacillus subtilis spore powder is procured from the De Generic Bio-Tech Pvt Ltd, Hyderabad. This also has the advantage to survive for a long duration and is also an effective crack healing agent. Bacillus subtilis is a rod-shaped. The specific gravity of bacillus subtilis is 2.41, this Bacteria cultivated in laboratory [10].

2.2 ***Manufacturing of Concrete and testing***

Grade of concrete M25 (1:1.56:2.42) was adopted with water cement ratio of 0.45. The mixture was designed as per IS 10262 -2009 and IS 456-2000. The materials were mixed by hand mixing process and the workability of the mix was checked simultaneously by performing various workability tests such as Slump cone test. The concrete is mixing with adding 0.2% of bacteria of weight of cement and different percentages of fibre with weight of concrete. There represent by M (conventional concrete Mix), B.C (Bacterial concrete), Mix-1 (B-0.2%, F-0.2%), Mix-2 (B-0.2%, F-0.3%), Mix-3 (B-0.2%, F-0.4%), Mix-4 (B-0.2%, F-0.5) mentioned in table 2.1. This concrete tested for compressive, flexural and tensile strength at 3,7,14 and 27 days. Also acid tests and carbonation test were carried out.

Table 2.1 Mixed quantities for $1m^3$

Mix	Cement (kg)	Fine Aggregate (kg)	Coarse Aggregate (kg)	Water (liters)	Bacteria (kg)	Fiber (kg)
M	462.2	723.38	1119.87	208	Nil	Nil
B.C	462.2	723.38	1119.87	208	0.056	Nil
M_1	462.2	723.38	1119.87	208	0.056	0.268
M_2	462.2	723.38	1119.87	208	0.056	0.402
M_3	462.2	723.38	1119.87	208	0.056	0.536
M_4	462.2	723.38	1119.87	208	0.056	0.670

III. RESULTS AND DISCUSSION

3.1 *Slump cone test*: Slump values are increasing up M_2, with increasing the dosage of fibres slump is decreasing. These values are tabulated in below

3.1 Workability Test (Slump Values)

Mix	M	B.C	M_1	M_2	M_3	M_4
Slump value(mm)	80	95	170	210	180	150

3.2 *Compressive strength*: Concrete Cube of 100mm x 100mm tested in compression testing machine (CTM), found that Compressive strength increasing with adding of bacteria and glass fibre up to Mix-3. Results are shown in fig 3.1

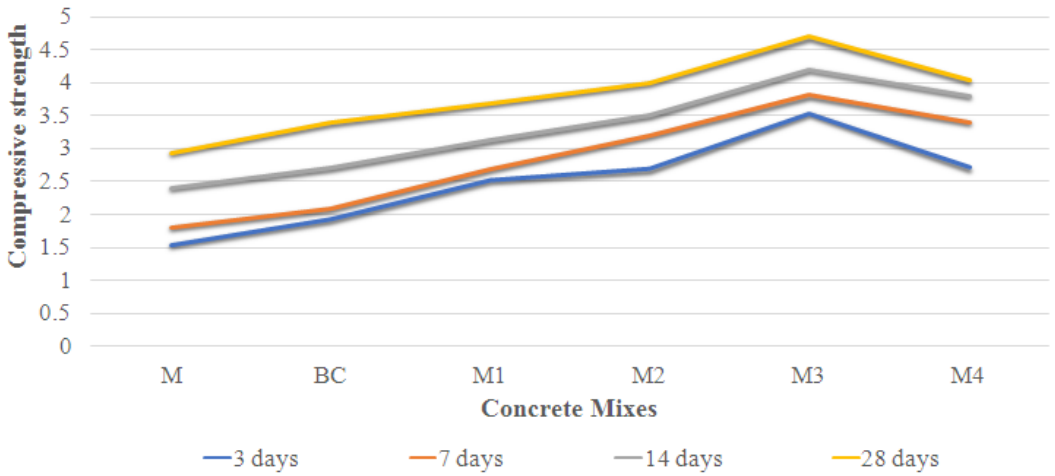

Fig. 3.1 Compressive strength of concrete with different concentrations of fibre with bacteria during test period

3.3 *Split Tensile Test:* Concrete cylinder of 100mm x 200mm tested in CTM, it was found that sample M_3 showing higher values among all at 28 days.

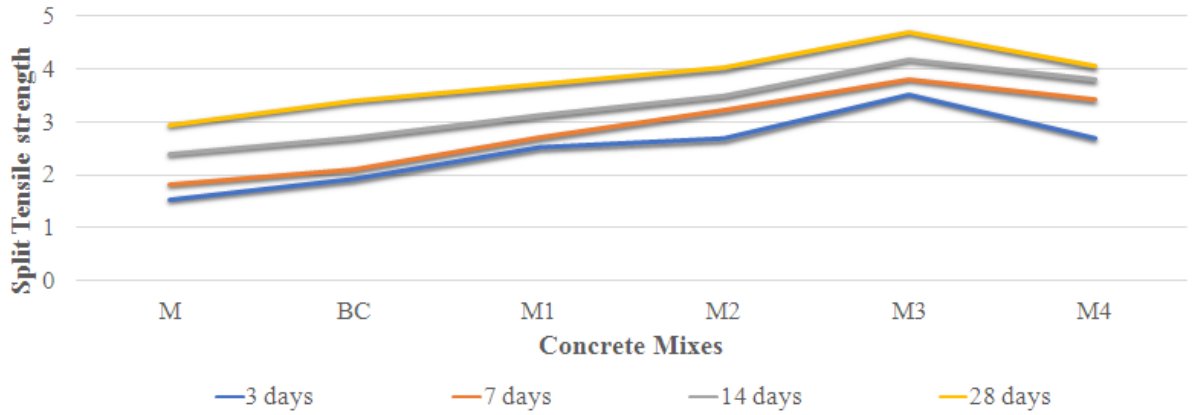

Fig 3.3 Split tensile strength of concrete with different concentrations of fibre with bacteria during test period

3.4 *Flexural strength:* Concrete beam of 100mm x 100mm x 500mm is used in flexural testing machine, it was founfd that Sample M_3 giving maximum values at 28 days.

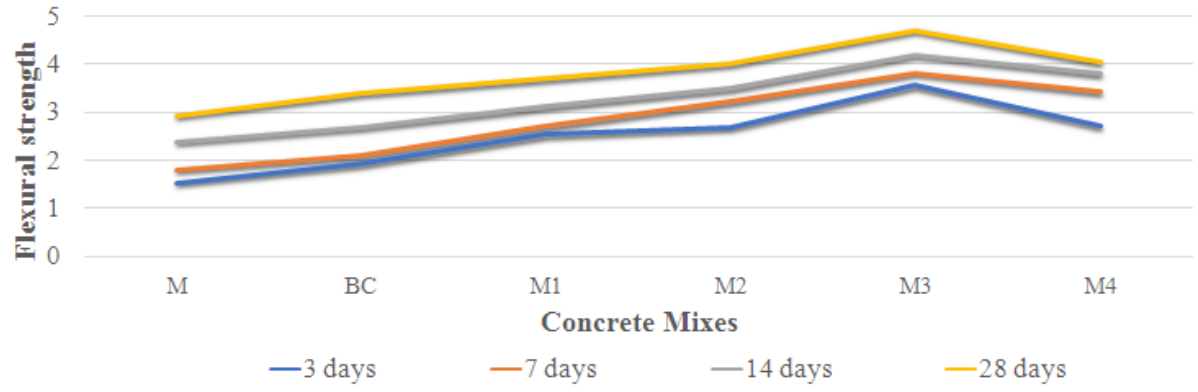

Fig 3.4 Split tensile strength of concrete with different concentrations of fibre with bacteria during test period

3.5 *Acid Attack Tests:* diiferent acids like H_2SO_4, HCl and Na_2So_4 are used to determine the durability of BFRC samples, Weight loss of all sample in acids taken at 28 days after curing period, Here strength loss of sample immersed in different acids also taken. Percentage of weight loss and loss strength calculated and all the acid test results shown in below figures.

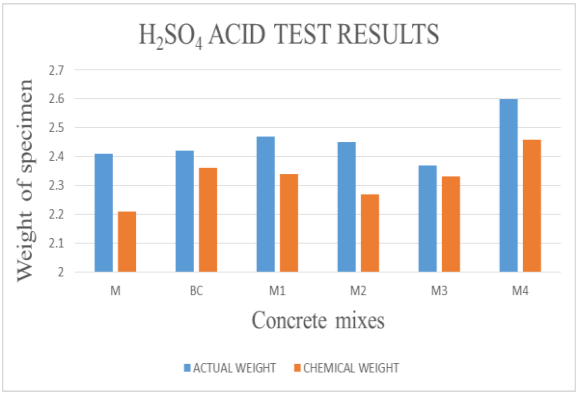

Fig 3.5 Weight loss of concrete immersed in H_2SO_4

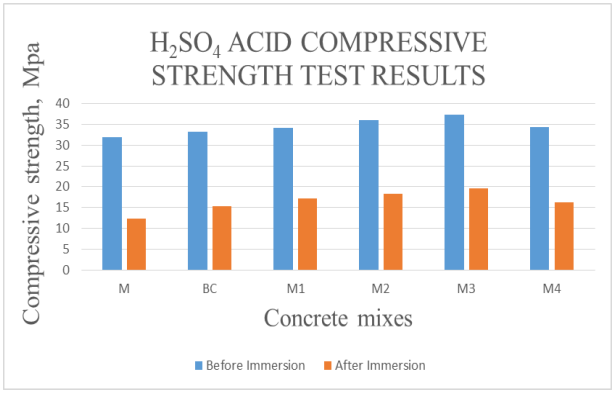

Fig 3.6 Strength loss of concrete immersed in H_2SO_4

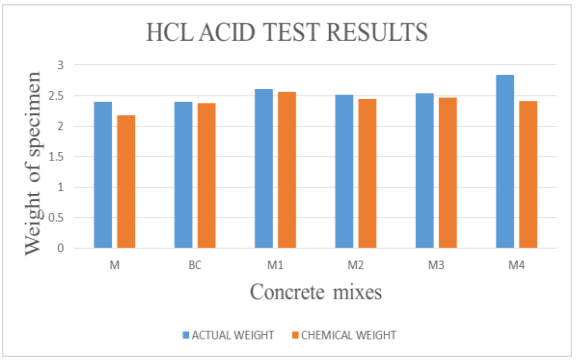

Fig 3.7 Weight loss of concrete immersed in HCl

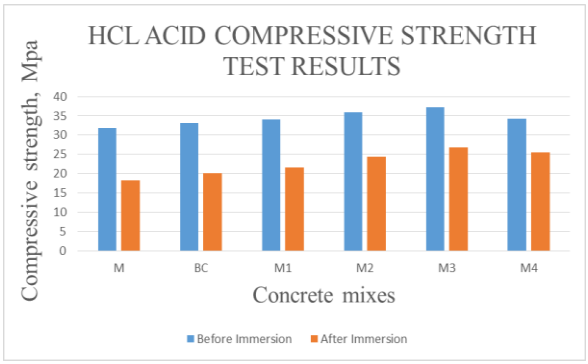

Fig 3.8 Strength loss of concrete immersed in HCl

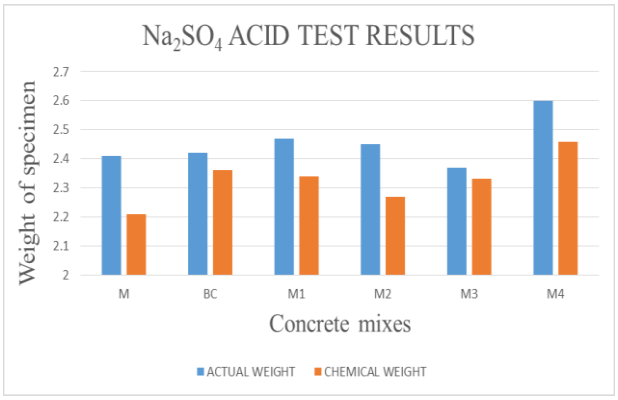

Fig 3.9 Weight loss of concrete immersed in Na_2SO_4

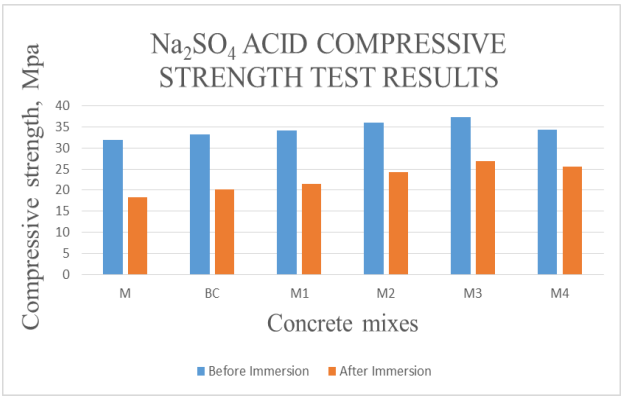

Fig 3.10 Strength loss of concrete immersed in Na_2So_4

3.6 *Carbonation Test:* The carbonation test was carried for cylinders of size 200mm x 100mm, which are cut in to different depth of 25mm, 50mm and 75mm. Phenolphthalein indicator spread on surface of samples to find the carbonation reaction at different depth.

Fig 3.11 before test

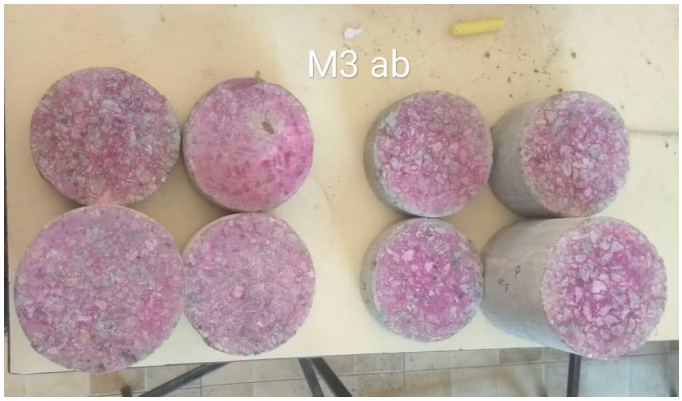

Fig 3.12 after Test

IV. CONCLUSIONS

Based on the experimental study carried out in the laboratory, the following conclusions are drawn

1. There is a significant effect on compressive strength. The compressive strength increased by 2% compare to conventional concrete at 0.4% of fiber reinforced bacterial concrete.
2. Similarly, there is a significant effect on split tensile strength. The split tensile strength increased by 1% compare to conventional concrete at 0.5% of fiber reinforced bacterial concrete.
3. Similarly, there is a significant effect on flexural strength. The flexural strength increased by 5% compare to conventional concrete at 0.4% of fiber reinforced bacterial concrete.
4. The maximum percent loss in weight due to HCL - 9.16%, H2SO4 - 8.29%, and Na2SO4 - 14.70%. For M25 grade concrete.
5. Similarly, the maximum percent loss in compressive strength due to HCL – 51.25%, H2SO4 -61.0%, Na2SO4 – 42.45%,
6. It is observed that carbonation attack taken place at a depth of 25mm for all samples. It can be recommended this for using reinforced concrete a cover of more than 25mm should be used. Finally it may be concluded that and durability Compressive, split tensile, flexural strength increases.

Scope of future Studies

• The different fibers may be use for increasing the flexural strength.

• To study the different dosage of the bacteria in FRBC.

• The test can be carried out for FRBC as shrinkage, creep, elasticity properties to find durability aspects.

• To study the performance of replacing any cementious materials in FRBC.

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