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INVESTIGATION OF THE POTENTIAL OF INCORPORATING NANOMATERIALS TO ENHANCE SELF-HEALING CAPABILITIES IN CONCRETE STRUCTURES

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ABSTRACT

This project is mainly undertaken to study the behavior and performance of concrete using materials such as silica fume. This type of use of a waste material can solve problems in various construction sites and reduce environmental problems. The use of SILICA FUME can also reduce the cost of the concrete production and increase the workability.
Keywords: Concrete mix, Silica Fume, Strength parameter, sustainable construction, workability

1. INTRODUCTION

Durability of concrete is partly and sometime significantly affected by the occurrence of cracks in the surface layer; therefore, it is necessary to develop new methods to eliminate cracks in concrete structures. Different measures have been attempted to address the environmental impact related to frequent repairs of concrete structures. Bio-mineralisation of calcium carbonate by using certain bacterial species is one of these measures toward solving this issue. Alkali-resistant spore-forming bacteria with self-healing attribute will heal the cracks by utilising its microbial activity and inorganic precursors embedded in concrete to precipitate calcium carbonate. It will be an alternative for the other self-healing materials to improve concrete durability by decreasing the potential for the ingress of detrimental substances and enhancing strength properties.

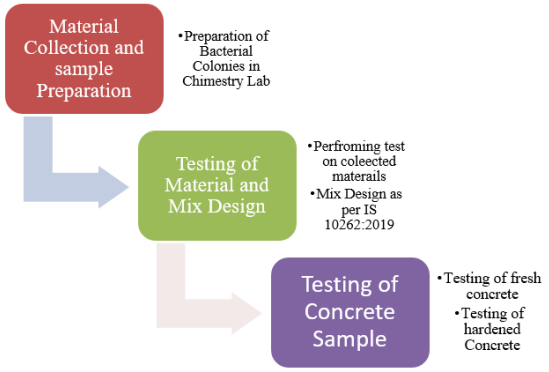
Unavailability of test data for self-healing cementitious composites subjected to accelerated and weathering exposure observed in the existing literatures necessitates the investigation of bacteria based self-healing cementitious composites behaviour under accelerated and weathering exposure. Considering the identified gabs in the previous studies on long term performance of SHCC, the research study presented in this thesis has mainly focused on the experimental investigation of the long-term performance of SHCC under three separate environmental conditions, namely, freeze-thaw cycles, wet-dry cycles and outdoor environment up to 18 months. The outcomes of this study will help generate comprehensive data bases for long term performance of bacteria based self-healing concrete and develop an expert system to disseminate knowledge on bacterial concrete for constructing infrastructures in real life..

Material Used

The following materials are used during the research work-

- Cement
- Fine aggregates (Sand)
- Coarse Aggregates(10-20 mm)
- Bacillus Bacteria
- Silica Fume
- Super Plasticizer
- Water

2. METHODOLOGY



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3. RESULTS

Table 3.1: slump value on varying Silica Fume Dose

%SF used	0	5	10	15	20
Slump value mm	75	73	72	69	68

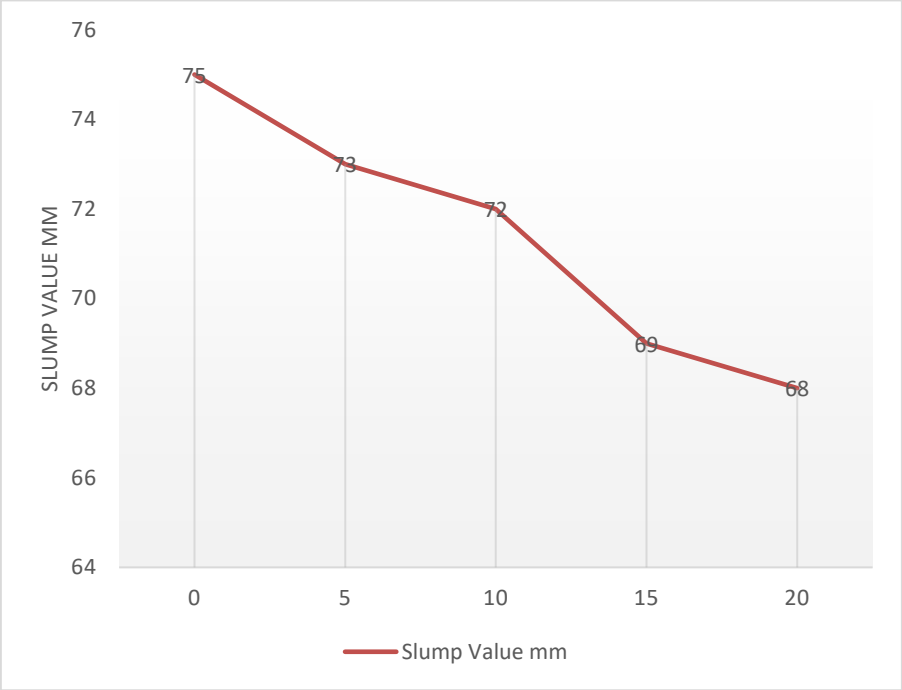

Table 3.1: Graphical Representation of variation of slump value on varying Silica Fume

COMPRESSIVE STRENGTH

Table 3.2: Compressive strength of sample containing Silica Fume

Compressive strength (N/mm^2) on Cement replacement					
Silica Fume %	**0**	**5**	**10**	**15**	**20**
Compressive strength MPa after 7 days	32.59	35.35	36.30	31.10	29.23
Compressive strength MPa after 28 days	43.59	45.23	45.66	46.00	48.05

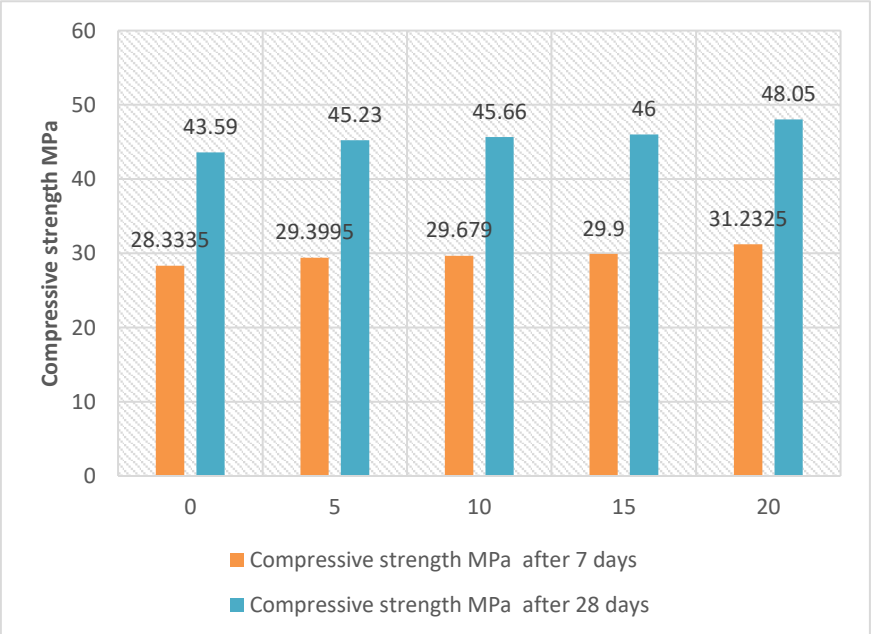

Figure 3.2: Compressive Strength Contain of Silica Fume

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SPLIT TENSILE STRENGTH

Table 3.3: split tensile strength of sample containing Silica Fume

split tensile strength (N/mm^2) on Cement replacement					
Silica Fume %	**0**	**5**	**10**	**15**	**20**
split tensile strength MPa after 28 days	3.87951	4.02547	4.06374	4.094	4.27645

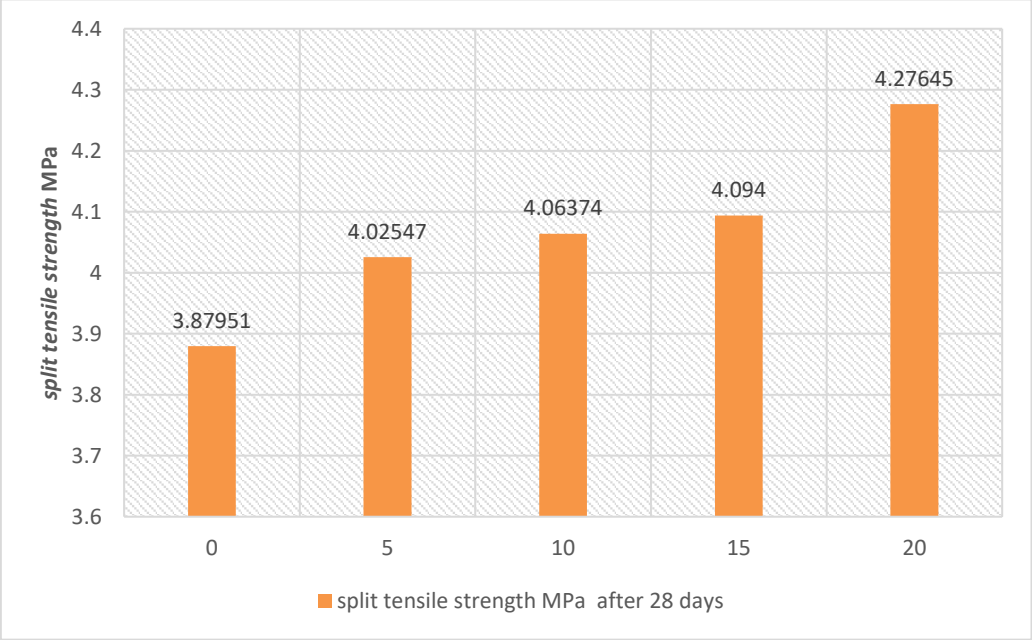

Figure 3.3: split tensile strength Contain of Silica Fume

FLEXURAL STRENGTH TEST

Table 3.4: Flexural Strength of M35 having SF

Silica Fume %	0	5	10	15	20
Flexural strength MPa after 28 days	4.07	4.10	4.20	4.25	4.55

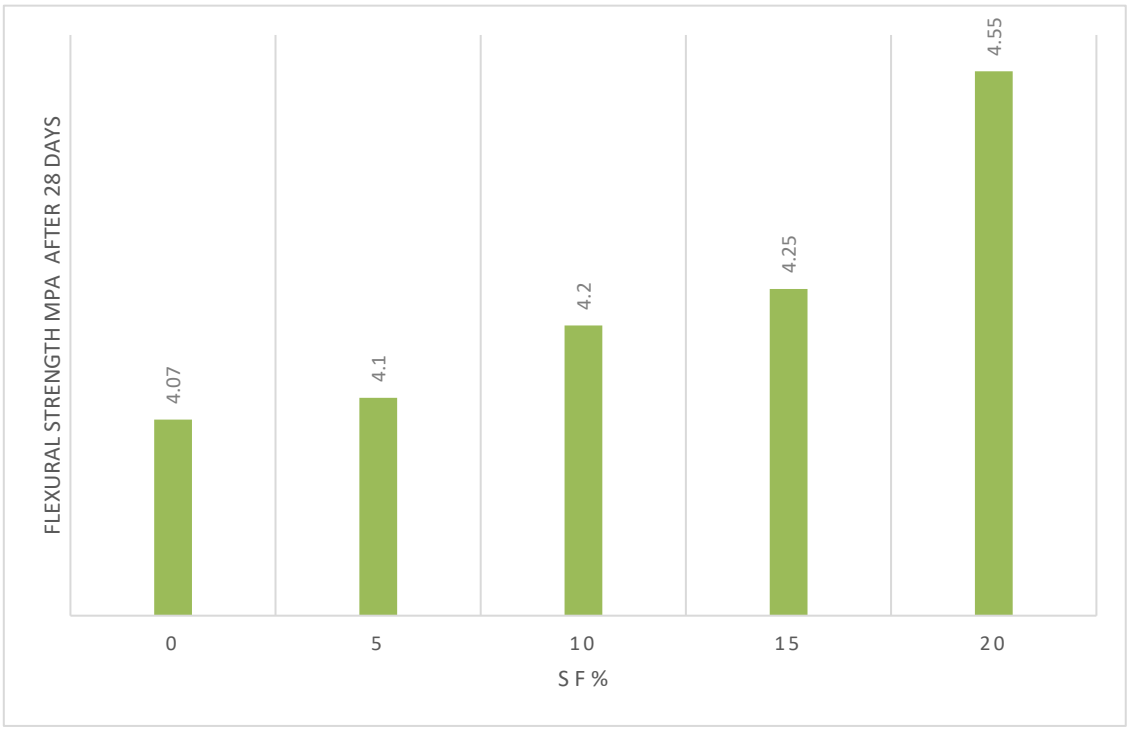

Figure 3.4: Flexural Strength of M35 having SF

4. CONCLUSION

- Addition of bacteria into a concrete makes it beneficial. Self healing concrete can be a great concrete sealant. It improves durability of concrete, life of the structure. It reduces need of regular maintenance and inspection.
- Specimens incorporated with bacteria without Nanoparticles resulted in lower compressive strength at early age and later stage when compared with Mixes prepared with nanomaterials.
- If Single-doped silica fume replaces part of the cement, then for the same curing time, and the compressive strength increases in the early stage and later stage. When the content of silica fume reaches 20%, the performance of concrete reaches the best.
- It is observed that the flexural strength for concrete with replacements was increased when the silica fume was added up to level of 20% replacement.
- It is observed that the split tensile strength for concrete with replacements was increased when the silica fume was added up to level of 20% replacement.

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