

STRENGTH COMPARISON BETWEEN NORMAL CONCRETE AND SELF HEALING CONCRETE

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ABSTRACT-

The strength can be defined as the ability to resist force. With regard to concrete for structural purpose it can be defined as the unit force required to cause rupture concrete is very good material to resist the compressive load to a limit but if the load applied on the concrete is more than their limit of resisting load, it causes the strength reduction of concrete by producing the cracks in the concrete and the treatment of the cracks is very expensive.

Key Words: Concrete, Microstructure, Mineral, Polymer, Autonomic Self Healing

1. INTRODUCTION-

Normal cement concrete has clearly emerged as the material of choice for the construction in the world today. This is mainly due to low cost of materials and construction for concrete structure as well as low cost of maintenance. Therefore, much advancement of concrete technology has occurred depending on the speed of construction, the strength of concrete, the durability of concrete and the environmental friendliness of industrial material like, fly ash, blast furnace slag, silica fume etc.

2. OBJECTIVES-

To develop and observe the strength comparison of self healing concrete with normal concrete

- To Develop efficient self-healing techniques for bending cracks in concrete
- To heal cracks by bacterial precipitation.
- To investigate the effect of bacillus species bacteria in gaining strength.
- Enhancing the durability and compressive strength of concrete.

3. METHODOLOGY-

3.1 MATERIALS & METHODS

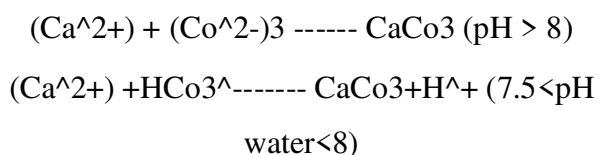
Self-healing concrete is one of the modern smart concretes, which can heal the cracks formed in it by itself

1. Chemical encapsulation.
2. Bacterial encapsulation.
3. Mineral admixtures.
4. Chemical in glass tubing
5. Self healing with self controlled tight crack width

3.2 MECHANICAL AND PHYSICAL PROPERTIES OF SELF HEALING CONCRETE

Self-Healing Phenomenon: Self-healing concrete is one of the modern and smart concretes, in which the cracks can be healed by themselves. French Academy of Science has been the first to notice autogenous shealing of cracks in fractured concrete in water retaining structures in 1836. Calcium carbonate crystallization within the crack fracture surface is the major mechanism for self-healing of matured concrete.

particular, a calcite formation in the region of water-effecting cracks takes place in the material arrangement $\text{CaCO}_3\text{-CO}_2\text{-H}_2\text{O}$ corresponding to the following reactions:



3.3 Mix Design:-

Design of Concrete mixes is made according to ACI 211-91 Concrete with compressive strength of 35 MPa , slump of 75 to 100 mm, and unit mass equal to 2280 kg/m³.

The mixing proportion used is 1:2 ½: 5:0.45 along with 30 ml liquid form of Bacillus Subtilis with the cell concentration of 105 cells/ml

Mix proportion by weight of concrete materials according to ACI 211-91

| Material | Cement | Gravel | Sand | Water |
|---|--------|--------|-------|-------|
| Mix proportion by weight (kg/m ³) | 456 | 1040 | 555 | 205 |
| Mix proportion | 1 | 2.281 | 1.217 | 0.45 |

Cement:

Ordinary Portland Cement(OPC) of 53 grade having specific gravity of 3.16 is used.

Fine aggregate:

River sand belongs to Zone II having specific gravity of 2.668 is used.

Coarse aggregate:

Crushed angular aggregate of size 20mm having specific gravity of 2.686 is used.

Water:

Locally available potable water is used.

Bacteria:

Bacillus Subtilis bacteria of gene Bacillus, a laboratory cultured bacteria is used.

Mix Design:

We designed a mix for M25 grade concrete for the following data:

- a. Grade designation : M25
- b. Type of cement : OPC 53 grade
- c. Maximum nominal size of aggregate : 20mm

- d. Minimum cement content : 320kg/m³
- e. Maximum water-cement ratio : 0.50
- f. Workability :100mm(Slump)
- g. Exposure condition : Moderate
- h. Method of placing : Manual
- i. Degree of supervision : Good

Comparison of Compressive Strength for 28 days

| 28-DAYS RESULT | STRENGTH (N/MM ²) | INCREASE IN STRENGTH (%) |
|-----------------|-------------------------------|--------------------------|
| NORMAL CONCRETE | 20.25 | - |
| BS of 10ml | 26.10 | 28.88 |
| BS of 20ml | 34.03 | 30.34 |
| BS of 30ml | 38.36 | 33.41 |

Comparison of Compressive Strength results

The change of compression strength for the 7 days, 14 days & 28 days

Comparison of Compressive Strength for 7 days

| 7-DAYS RESULT | STRENGTH (N/MM ²) | INCREASE IN STRENGTH (%) |
|-----------------|-------------------------------|--------------------------|
| NORMAL CONCRETE | 16.25 | - |
| BS of 10ml | 17.18 | 5.72 |
| BS of 20ml | 18.41 | 7.15 |
| BS of 30ml | 24.55 | 9.23 |

Comparison of Compressive Strength for 14 days

| 14-DAYS RESULT | STRENGTH (N/MM ²) | INCREASE IN STRENGTH (%) |
|-----------------|-------------------------------|--------------------------|
| NORMAL CONCRETE | 17.61 | - |
| BS of 10ml | 19.65 | 11.58 |
| BS of 20ml | 25.16 | 20.15 |
| BS of 30ml | 36.37 | 24.37 |

4. RESULTS-

Compressive Strength =

$$(9.81 \times 380 \times 1000) / (150 / 150) = 16.5 \text{ N/mm}^2$$

Compressive Strength =

$$(9.81 \times 400 \times 1000) / (150 / 150) = 17.59 \text{ N/mm}^2$$

Compressive Strength =

$$(9.81 \times 410 \times 1000) / (150 / 150) = 18.25 \text{ N/mm}^2$$

5. CONCLUSIONS-

- Water mixed with microsilica particles supports an external crack closure as well as induces flexural strength regain.
- The silica particles possible act as nucleation sites for the formation of self-healing products.
- From the compressive test results, it can be observed that on addition of certain minimum quantity of bacillus subtilis, the increase in strength is maximum for BS-30% and at-least BS-10%.
- On addition of bacillus subtilis there is a substantial increase in the earlier age strength of concrete compared to 28 days increase in strength.
- The overall strength of concrete is the compression strength test results shows that quality

of self healing concrete is prevented on addition of bacillus subtilis.

6. REFERENCE-

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