Assesment of Self Healing Concrete By Bacterial Method

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Abstract- *In concrete structures, microscopic cracks have been commonly observed. In moist environments, it has been observed that the strength of concrete structures is reduced due to the penetration of chemicals through small pores as it reduces the permeability. It is advisable to restrict the cracks at the initial stage instead of repairing these cracks at a later stage as the size of the cracks increases. Traditionally, there are many methods for repairing cracks but in the latest research it has been seen that repairing these cracks biologically is very effective and eco-friendly too. By using Bio Concrete, the strength of concrete is increased as it produces calcium carbonate when cracks appear which helps in repairing the structure automatically and thus, it improves the durability of the structure. Many researchers are trying their best to address the cost of bio-concrete so that it can be used on an industrial scale because of the many positive aspects of bio-concrete.*

Keywords- Bacterial concrete, Self-healing concrete, Bio concrete, Auto repair concrete

I. INTRODUCTION

Self-healing concrete is a concrete which is heals itself when it comes into contact with air and water. It produces lime and water layer of concrete. It most of the traditional concrete mixture 20-30% of the cement is left hydrated. It cracking of the concrete occurs unreacted cement grains may become exposed to moisture penetrating the crack. In this case the hydration process may start again and hydration product may fill up and heal the crack. The width of range 0.05-0.1mm act as capillary and the water particles seep through the crack. These water particles hydrate the none or partial reacted cement and the cement expand which in turn fill turn fills the crack. But5 when the cracks are of grater width, need of other remedial work is required. One possible technique is currently being investigated and developed was based on application of mineral producing bacteria in con concrete. Self-healing of crack or self –filling of crack by the help of bacterial process after hardening is known or self-healing concrete is also known as bacterial concrete. If concrete has one flow it's that it has low tensile strength and therefore we need to add steel to make reinforced concrete. And in turn the concrete needs to protect the steel from corrosion. However, should the concrete crack that provides a pathway for harmful substances such as chlorides, carbon dioxide and ultimately oxygen and water to get to the reinforcing steel cause corrosion, covers rust and that ultimately leads to destruction of the concrete. The cracking of concrete is a problem becomes of the needs for repair which can be terribly expensive.

II. BACTERIA

The self -healing concrete bacteria are selected from a particular family

- Bacillus pasteurizing
- Bacillus spherious
- Bacillus subtills
- Escherichia coli
- Bacillus cohnii
- Bacillus halodurans
- Bacillus pseudofirmus

III. BACTERIAL CONCRETE

The self-healing concrete develops lime particles when the cement reacts with the natural moisture to heal the crack.A special bacterium from the bacillus family, calcium, nitrogen and phosphorus are mixed with the concrete ingredients to make the bacterial concrete. Those bacteria can live inactive in concrete over 200 years in dry conditions and the bacteria's act as a healing agent.

IV. HOW DOES SELF HEALINGCONCRETE WORK

The bacillus bacteria and the calcium lactate will be mixed with the concrete ingredients. The bacteria spores grow and consume the oxygen to feed the calcium lactate. When water seeps into the crack and react with bacteria, the calcium lactate produced the lime which will be transforming as a hardened lime stone to heal the crack.

V. PREPARATION OF BACTERIAL CONCRETE

There are two methods are used for bacterial concrete

- **Direct mix with the concrete**

In this method, the specific bacteria spores and calcium lactate directly mix with the other concrete ingredients (cement, aggregate, and sand). It will not affect the concrete properties.

When the water molecules seep through cracks, then the bacteria react with the oxygen and from the limesto0ne la7yer to heal the crack.

- **Encapsulation in lightweight's concrete**

This method is expansive compare to direct mix method. The bacteria and calcium lactate inserted in clay pellets. The clay pellets are mixed with the concrete in the range between 5 to 8%.

When the crack appears a concrete surface, the clay pellets will burst and the bacteria spores eat the calcium lactate and produce the hardened limestone to seal the crack.

VI. CHEMICAL PROCESS

As discussed earlier, generally 20% to30% of cement in concrete would not be hydrated. So when water comes into contact with the crack, the anhydrate calcium reacts with the water and produces calcium hydroxide. Here the bacteria act as a catalyst to induce the chemical reaction

$$CaO+H_2O \longrightarrow Ca(OH)_2$$
$$Ca(OH)_2+CO \longrightarrow CaCO_3+ H_2O$$

The calcium hydroxide reacts with the environmental carbon dioxide and forms the limestone to seal the crack.

The structure may stand beyond it life span by using bacterial concrete, the cement will emit 7% to 9% of carbon dioxide during the production. By using self -healing concrete the use of the cement and concrete will be reduced and it is beneficial to reduce environmental pollution. The compressive strength and tensile strength of the self-healing concrete is 10% to 20% higher than the standard concrete.

VII. MATERIAL

Picture of materials used (aggregate, sand, cement and water)

- **PORTLAND CEMENT**

Cement is one of the most important constituents of concrete, which possesses strong adhesive premises. It binds all other ingredient of concrete through a series of chemical reaction known as hydration reaction with the help of water and does it harden. Cement is a bluish grey colored fined powder, which is manufactured by smashing, milling and proportioning of Cao (calcium oxide, 67% - 61%), SiO2(silica, 23%- 19%) & Al2O3 (alumina, 6%-2.5%) in a kiln at 2600 F. Portland cement also called Ordinary Portland Cement (OPC) is categorized into three grades i.e., OPC33grades, 43grades, 53grades on account of their 28day. Compressive strength. In the current study, OPC43 grade of cement is used for mix design.

- **AGGREGATE**

Aggregates are the crushed stone which forms a predominant part of concrete mixture by making concrete unyielding. Aggregate provides firmness and makes dense the resulting mix when using two or more dimensions of it. Fine aggregate fills the pores and most essential capacity of it to help with creating workability and consistency in mixture. It facilitates the cement paste to clasp the coarse aggregate to respite.

- **COARSE AGGREGATE**

Crashed stone whoever sized from 10mm- 20mm which retained over IS sieve4.75mm is used as coarse aggregate in casting the concrete. As to qualities of various sort so aggregate, coarse aggregate has a tendency to enhance the strength of the concrete material by interlocking the angular particles while the smooth round shaped aggregate helps in fluidity of the fresh concrete mixture. Aggregates are locally available which is used in concrete mix after removing the dirt and dust particle and drying it in oven. IS 383:1972 is used for the specification of coarse aggregate. Below the testing results of coarse aggregate is discussed.

- **FINE AGGREGATE**

Fine aggregate is found from natural disintegration of rock sand by crushing natural gravel and by crushing hard stone. According to IS 383:1970, depending upon the region from where it is available, is divided into four parts i.e., Zone I, II, III, IV and it should retain in IS sieve 4.75mm. In the present study, brown sand is used for the casting of specimen.

- **WATER**

Plain portable water is conventionally measured equitable when blending and curing of concrete. Water which is available for curing and blending purpose, having pH of 7 and free from impurities. Pure water is also not suitable to use with OPC, it is good to use with high alumina cement.

VIII. APLLICATION

- Self-healing concrete can be used for sectors such as tunnel-lining, structure, basement wall, highways, bridges, concrete floors and mari8ne structures.
- This is new technology can provides way to durable roads.
- High strength building with more bearing capacity, long lasting river banks and erosion prevention of loose sands.

IX. ADVANTAGE OF SELF-HEALING CONCRETE

- It can last decades or centuries. This is biggest advantage of self-healing concrete. This ensures we shall never have to replace your concrete surface again during its lifespan.
- Self-healing concrete decrease concrete maintenance. In normal concrete, you have to fill and seal the crack. But you do not have to do or worry about this with self-healing concrete.
- It is an eco-friendly technique reducing carbon dioxide emission.
- Self-healing concrete is increase the moisture impermeability.
- It is improved in compressive strength of concrete.

X. CONCLUSION

Hence, self-healing concrete is crack resistant. Which protect the concrete and reinforcement from concrete and from corrosion .By doing the, it prevent water to percolate into reinforcement steel concrete and hence it does not comes in contact with reinforcement. Increase in the strength of the concrete as compared to conventional concrete. Self-healing concrete is an innovative raising interest today. It can be produce autogenously, chemically or biologically. It can provide more durable structure around the world.

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