

A Review on BIO-CONCRETEGeeta Mehta¹, Puja Kalita²¹Assistant Professor, Lovely Professional University²M.Tech scholar, Lovely Professional University**ABSTRACT**

Sustainability is the demand of globe. Creating and developing new resources is better than to conserve the available ones. In this study, the use of micro-bacterial influenced concrete is presented. Bio-concrete is emerging as a compatible alternative to conventional concrete with enhanced quality of self-healing. This property of self-healing along with appreciable strength requirements motivates for using Bio-concrete as a sustainable construction material. Use of Bio-concrete reduces the general flaws in performance of concrete caused due to cracks in concrete. This ultimately reduces the maintenance cost of structure as compare to conventional concrete. Microbes is an exquisite remedy for service life of concrete. Due to enormous causes, the service life of concrete structure is affected. Out of these one main cause is cracks formation. The crack formation can be due to flaws in composition, mixing and placing along with improper curing. Crack formation is difficult to control but can be handled in a better way using bio-concrete. In Bio-Concrete microbes are added for precipitation of CaCO₃. It fills the space or pore between concrete material and hence improve the strength and performance behavior of concrete. Hence, Bio concrete fulfill the demand of new generation concrete with less economic investment.

Keywords: Bio-concrete, Microbes, CaCO₃, Crack formation, Sustainable

INTRODUCTION

In a nation with one of the quickest developing economies on the planet, the expanding convergence of working class populaces, framework and lodging are key concentration territories. but constructing new structure is not piece of cake for all due to its immoderate expensive except an extremely minor few. Statistical analysis reflects that, total estate constructed every year is around 3,50,000 crore, which is 20% of the total turnover of the country. This study also reveal that 32,000 crore is needed

to rebuild the concrete structure, in which housing sector alone require more than 50,000 crore & maintenance works 17,000 crore.

Cracks formation plays the major role in the long-existence & well-being of concrete structure which is due to imperfection in material & development strategies. study reveal that RCC apartment can withstand upto 30 to 50 years rather surmise 70 to 80 years. This short life expectancy is a

monetary weight for proprietors and residents as well as to the country in general also environment effect is observed. this is cause, due to which many countries like Japan adopt goal to build housing industry with average life span of 200 years. This will empower lessening the squanders amid obliteration, vitality preservation, and concordance with condition, imperviousness to catastrophes like seismic tremors and violent winds and accomplishing great conduct by customary and simple upkeep.

Concrete is most fundamental material for this new era. For their more extended administration life we require some new method alongside great material. One of such strategy is bio concrete, where microscopic organisms is utilized to enhanced the strength of concrete and to heal the pores, through this improve the life span of concrete. Durability of concrete is weakened by splits since they give a simple way to the flow of fluids. It is essential to control the crack to recuperate splits at the earliest opportunity. Bio-concrete has the most notable feature of precipitation of CaCO_3 , through which it can fills the pores and recuperate the cracks of entire material. Lion's share of recuperating operator

. A specific group of alkali-resistant spore-forming bacteria related to the genus *Bacillus* (specially *B.pseudofirmus* and *B.cohnii*) was selected for this purpose. As the larger quantity addition Bacteria may affect negatively to the mechanical properties of concrete so its limited to 5% only. From the study, it clear that alkali-resistant spore-forming bacteria related to

comprises of the natural mineral antecedent compound which is by the microscopic organisms metabolically changed over to carbonate particles which in this way encourage with calcium particles in type of limestone on the break surface. A few natural antecedent materials, for example, particular amino acids seemed appropriate applicants as these barely influenced concrete compressive-strength (1-3). The use of microbes for biological designing purposes is turning out to be progressively well known as is reflected by late reviews (4-8), for bioremediation of polluted soils (9-12) and evacuation of nursery gasses from landfills (13-18). The relevance of particularly mineral-creating microbes for sand union and limestone landmark repair (19-25) and filling of pores and breaks in cement have been as of late examined (26-30). Their survey likewise secured extensive clarification on the chemical and organic techniques. Unlike other process of rehabilitation i.e. epoxy treatment, polymer impregnation, resin injection, retrofitting etc., bio-concrete is most useful and cheaper method to heal the concrete and increase its strength(31-33). Last but not least, Bio-concrete is eco-friendlier than any other conventional new generation concrete. the genus *Bacillus* represent promising candidates for application as self-healing agent in concrete and probably other cement-based materials (35-38). Researchers described that micro-cracks are hardly affects the mechanical strength but it indirectly harm by increasing the permeability of material due to crack formation. The results presented the applied

two-component bio-chemical self-healing agent, consisting of a mixture of bacterial spores and calcium lactate, can be successfully applied to promote and enhance the self-healing capacity of concrete as the maximum healable crack width up to 0.46 mm-wide cracks in bacterial concrete but only up to 0.18 mm-wide cracks in control specimens after 100 days submersion in water (more than doubled than control mix). (39-42). Bacterial concrete has water permeability 10 times lesser than normal concrete. But addition of more % of microcapsule has negative effect on mechanical properties. Tensile strength decrease significantly only for a dosage of higher than 3%.

The process of crack healing phenomenon in concrete by microbial activity of bacteria. Bacteria used is *Bacillus subtilis*(42). Bacteria were introduced in concrete by direct incorporation, and thorough various carrier compounds namely **light weight aggregate** and **Graphite Nano-Platelets**. Results was in all mixes compressive strength is increased irrespective of the incorporation technique due to calcium producing bacteria in mix. Due to bacterial effects calcium producing activity is

MECHANISM

Microscopic organisms based self-healing specialists are accepted to remain rested inside the concrete up-to two hundred years. When due to enormous reasons the cracks & pores appear inside the concrete structure, these microbes are help to heal that. When there is any pores or cracks inside the

enhanced. But significant improvement was with through LWA technique i.e. **12%**. Because of their packing and compaction factor. For GNP it was **9.8%**. (41)

By improving the ability of cementitious materials crack self-repairing and reduce the possibility of erosion media through the cracks into the matrix resulting in improvement of the material durability. They had used *Sporosarcinapasteurii* cells. Used alkaphilic bacteria of genus *Bacillus*. Healing agent make the fresh concrete lighter & flowable. And somehow delay the hardening process by one day initially, but after hardening of 7 days its sustained with more strength. Enhanced the autogenous healing process & give water tightness to mortar mix.

Bio restoration & mineralization process to heal the early age cracks in concrete by precipitating CaCO_3 through bacteria. Ceramsite carrier were used to immobilized bacteria (24). Bacteria used were *Bacillus Mucilaginous* & *Brewers-yeast*. W/C ratio was 0.42. Flexural test & water permeation coefficient test was applied to portray repairing effectiveness of specimen. Flexural strength increases 56% to 72%. Area repair rate increases up to 87.5%.

concrete the water is consciously going inside the pores or cracks and the precursor is activated. Activated precursor orderly persuade the microbes to react with that precursor & form CaCO_3 (limestone) which is act as a healing (filler) material for the pores or cracks. During the time spent,

encouraging Calcite crystal through nitrogen cycle the dissolvable supplement are

changed over to insoluble CaCO_3 , in this way sealing it up.

METHODOLOGY

Bacteria may inject into the concrete material through following process.

1. Mix the microbes with concrete when it is mixing in site i.e. before keeping the concrete mix in the mould. Bacteria is directly poured to the fresh concrete and after that mix it well & put the concrete in to mould.
2. Impregnation of Light Weight Aggregate with calcium lactate solution & spores of bacteria. In this process a part of coarse aggregate is replaced by LWA& it is act as a carrier compound for the microbes.
3. Micro capsulation process to encapsulate the bacterial spores in bio-concrete. Micro capsulation is used to ensure protection of bacteria from the harsh environment of concrete. In preliminary state these encapsulate bacteria is immobilized state. But when the pressure inside the concrete is increased then capsules are broking down & bacteria come with the contact of concrete material directly and start reacting with the help of water present there.

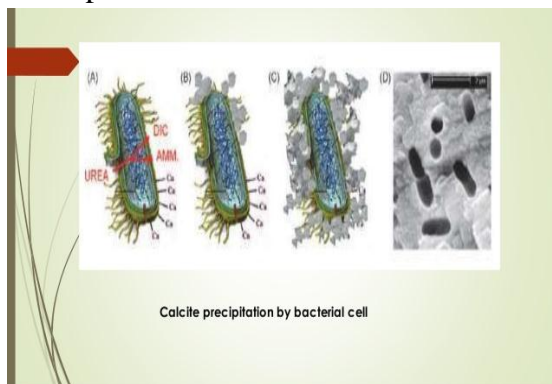


Fig1: Calcite precipitation by bacterial cell

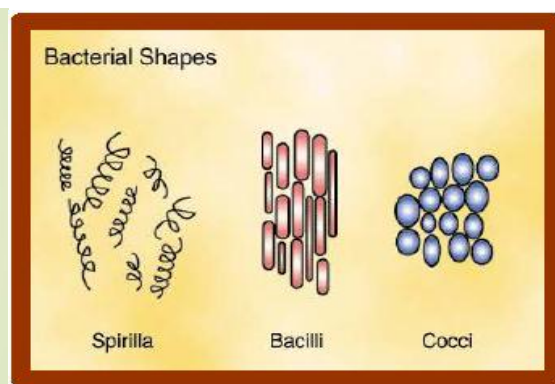


Fig2 : Types of bacterial shapes

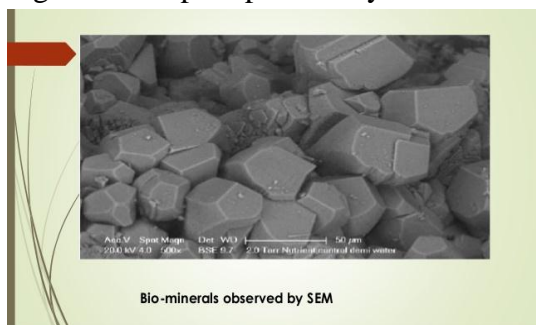


Fig3: Bio-mineral observed by SEM

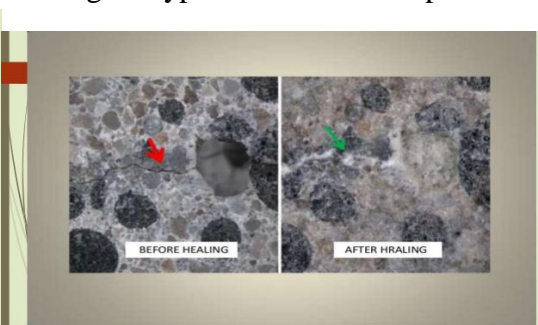


Fig4: Before & after healing of bio concrete

CONCLUSION

From previous studies, it found that, bio concrete is a sustainable one which is compatible for today's technologies. It good at strength properties, durability & water permeability but sometimes it does not give variation but it is less considerable as positive impact is more. Depending upon the attribute of different bacteria the premises of the concrete strength is varied. It is very cheap process of getting a better result. Bio concrete is mainly improved the durability/solidness quality of concrete. That's why it is widely use in new time and many more research is going on in this concern. researcher describes that self-healing phenomenon in bio-concrete is a cause of increasing compressive strength when bacteria is directly added to concrete. Reasearcher stated that due to bio-concrete the rheology of cement mortar is significantly enhanced. They added bacteria by three different process like bacteria with (i) formate, (ii) lactate & (iii) nitrate. Bacteria with formate enhanced compressive strength but incorporation of bacteria with lactate shows some different results and loss

in compressive strength. Wang et al. (2014) put forward that with bio-concrete, there is a significant self-healing process happens in concrete (48% to 80%) than without bacteria (18% to 50%). Bio-concrete heals 970 micron wide cracks which is 4 times wider than non-bacterial concrete, which heal 250 micron wide cracks. But compressive strength is somehow decreased, if dosage of encapsulate bacterial spores increased 1% to 5%, & tensile strength is also decreased after using 3% of EBS. Reasearcher presents the idea that is bacteria are used with the help of graphite Nano-plates & LWA as a carrier compound than compressive strength is increased 9.8% than CM. As being a Nano sized material GNP act like a filler material in concrete & reduce the formation of weak interfacial transition zone(ITZ). Reasearche stated that, by using light weight aggregate in bio-concrete as a replacement of sand surely enhanced the liquid tightness of structure but it might decrease the compressive strength of concrete by some extent, but he concluded that it is beneficial to use in concrete, where LWA is needed.

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