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A Review Paper on Cost Effective Cultivation Medium for Biocalcification of Bacillus Pasteurii and its Effect on Concrete

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Abstract
The theme of this study is to isolate and identify the bacillus bacteria are suitable for use in concrete to improve its strength or not. Bacillus is to be incorporated with concrete should be presence of alkali resistant to endure the high pH value of concrete forming to with-stand the structural strength induced in concrete while mixing. In present generation environmental related problems have been considered as serious issues in construction works. This paper includes use of bacillus bacteria in concrete to develop the strength and performance of concrete. In India the lot of research centers producing various types of bacteria's which may be useful in concrete due to their different biological properties so hereby I researched and learned from many useful advanced technical research papers related to this field and trying to improve the quality of concrete in construction field by using the bacteria. Finally this paper gives a brief review on cost effective cultivation medium for bacillus and its effect of cement and concrete properties. Also the reinforced concrete properties are studied.
Keywords: *Bacterial concrete, bacillus, calcium lactate, limestone.*

Introduction

Concrete is the most effective construction material. It is used in worldwide due to its various properties like strength, durability, readily available and versatile characteristics. It is capable to carrying until the structure gets cracks. These cracks allow ingress of sulphate and nitrates into the structures leads to strength reduction. By using self healing agent like epoxy resin, bacteria and fiber in the concrete, the cracks can be healed. Bacterial concrete is a product which biologically produces CaCo3. When the bacillus bacteria is mixed with concrete it forms calcium carbonate precipitates, these precipitates fill the cracks and voids in concrete. Selected types of the bacteria genus like Bacillus is mixed in concrete along with calcium lactate, nitrogen and phosphorous. When a structure gets damaged, the water starts to penetrate through cracks. When the water comes in contact with bacteria present in concrete, it converts calcium lactate into insoluble nitrogen by consuming oxygen's presents in water. This insoluble limestone repairs the cracks in concrete. Oxygen present in water is consumed by bacillus, it makes steel corrosion resistant. Bacterial concrete is a special concrete which is used to repair of micro-cracks. This bacterial concrete can be used in strengthening of historical monuments and other damaged concrete structures. This is cost effective and can be easily available in industries. This is most suitable method in strengthening of cracks instead of pressure grouting and other techniques.

Literature Review

Yousef Al-Salloum. et.al..(2016) has described about Adding of E. coli DH5a, a control bacterium, won't affect the compressive strength of the cement mortar. The presents of microorganism acts important role in improving the compressive strength of mortars. This study shows that the structural strength of the S. pasteurii incorporated mortar has increases due to presents of mineral precipitation by the bacterial activity. Adding of S. pasteurii will improve the compressive as well as the tensile strength of the mortar. The type of substrate solution and its molarities have an influence on the strength of the cement mortar. SEM test shows the growth of fibrous filler material within the cracks and voids due to the precipitation by S. pasteurii bacteria, which confirms that the strength of the cement mortar was increased. This improvement is attained by the modification of porosity and pore size distribution of the cement mortar it generates.

Dominique J. Tobler. et.al..(2014) explained about that S. pasteurii cells are easily trapped in sandstone at the size of 3.6 cm diameter, 1.8–7.5 cm length and having high velocity of 6.2 m/d. The continued bacterial injection will eventually lead to clogging of pore throats, voids and reduction of permeability, from that aspect values should be investigated in future studies. More bacteria's were trapped within the first few cm like 54% bacteria's in 0–3.8 cm section compared to 40% of bacteria's in 3.8–7.5 cm section and also the Bacterial distribution up to the core was fairly homogeneous. More bacteria are then injected into this modified cement mortar as would be required to continue pore space filling. For Further investigations arerequired to advance process understanding in rock and minerals to improve implementation tricks for microbial.

S.A. Abo-El-Enein. et.al..(2014) in this paper the author investigated the physico- mechanical properties, strengths and water absorption, of the mortar by using bacteria were improved due to the deposition of the new calcite and limestone material by the bacteriological activity in cement mortar. The concentration of bacterial should be reduce the water absorption of cement mortar while the compressive strength of mortar increases with level of bacterial cells up to 1 OD. From that while a decrease in strength was observed when cement mortar mixed with bacterial cell 1.5 OD concentration. Therefore, the maximum bacterial cells concentration leads to the higher compressive strength and lower water absorption in mortar at 1 OD. 1 OD of degree of crystallinity of calcite crystals precipitated for cement mortar is higher than that precipitated by of bacterial cells of 1.5 OD. Also, the amount and size of calcite crystals precipitated presents in cement mortar at 1 OD concentration is greater than that precipitated at bacterial cells of 0.5 OD.

S. Yoosathaporn. et.al. (2016) studied about chicken manure effluent from bio-gas plant and it was good source of nutrients. These are the low cost culture medium and promote bacterial growth of the mortar. The urease and calcium carbonate precipitation activity has numbering for of B. pasteurii KCTC 3558.the strength of cement cubes such as the compressive strength and split tensile is higher when the cement cubes mixed with bacterial cells in medium compared with control with-out added bacteria. Reduce the bacterial cultivation cost by more than 80% while using of chicken manure effluent as culture medium.

C. Vougidou..et.al. (2015) detailed about the 93.2% and 85.7% in sheep and goats, nutrients toxA-positive isolates that strengthens the notion that toxigenic strains of P. multocida bacteria. The present study originated from pneumonic lungs. Most of the polymorphisms and microbes are detected outside of Trans membrane domains of the OmpA protein.

G.T. Suthar. et.al..(2015) has investigated the self-healing concrete by using bacteria in concrete at the various cultivation methods. Due to metabolic turnover of growth substrates Bacterial endospores germinate to produce CO2. CO2 will chemically react with Ca(OH)2 produced from C2S and C3S hydration reactions .The CO2 locally reached high concentrations level due to rapid metabolic conversion of organic compounds. The crystals found on the surface of bacterial- but not on the surface of cement mortar samples support this hypothesis.

M Dhaarani. et.al..(2014) studied about the presents of Microorganism in the concrete fills the voids presents in the concrete specimens. It will reduce the size of void and increases the mechanical properties of the concrete. It depends on the concentration of bacteria's and strength of concrete should be increased gradually. In bacterial concrete the microbes fill the air voids in certain concentration so the water absorption percentage, Sorptivity coefficient value will be reduce and also it tends to increase the durability of the concrete.

Conclusion

- The presents of microorganism acts important role in improving the compressive strength of mortars.
- Bacillus bacteria was used in concrete at certain concentration with admixtures
- Bacteria's can be repair the cracks in concrete and acts like a self healing
- The maximum bacterial cells concentration leads to the higher compressive strength and lower water absorption in mortar at 1 OD.
- CO_2 will chemically react with $Ca(OH)_2$ produced from C_2S and C_3S hydration reactions
- S. pasteurii cells are easily trapped in sandstone at the size of 3.6 cm diameter, 1.8–7.5 cm length and having high velocity of 6.2 m/d.
- 54% bacteria's in 0–3.8 cm section compared to 40% of bacteria's in 3.8–7.5 cm section and also the Bacterial distribution up to the core was fairly homogeneous.

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