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A REVIEW PAPER ON BACTERIAL CONCRETE

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Abstract:- Concrete is a major component of building material. The application of concrete is rapidly increasing worldwide, and so is the use of cement which is responsible for global carbon dioxide emission. Concrete production causes a high energy burden on the environment. where bacterial self-healing concrete reduces cost in terms of detection of damage and maintenance of concrete structures. In this study we have investigated the crack filling concrete, using bacteria, it has a self-healing ability as well as is eco-friendly nature which increases the life span of the structure.The Bacillus megaterium bacteria is effectively used to improve strength by reducing the voids.Addition of an excess amount of water during the mixing of concrete results in the development of cracks. These cracks can be healed by using the innovative technique of addition of bacteria that act as self-healing bacteria namely BACILLUS MEGATERIUM.

Keywords:- Bacteria, Concrete, Cracks, Cement, Bacillus Megaterium, Types Of Bacteria, Self Healing Concrete, Living Concrete.

I. INTRODUCTION

Self-healing concrete is a results of the biological reaction of a non reacted limestone and a calcium-based nutrient with the assistance of bacteria to heal the cracks that appeared on the building. A special type of bacteria known as bacillus is used along with calcium lactate. while preparation of concrete, these products are added to the wet concrete when the mixing is done. These bacteria can be in the dormant stage for around 200 years. when the cracks appear within the concrete, the water seeps within the cracks. The spores of bacteria germinate and start feeding on calcium lactate consuming oxygen. The soluble calcium lactate is converted to insoluble limestone, and it starts to harden. thus filling the crack without external aid.[9]

Bio-mineralization is the process of the formation of minerals such as carbonate. The mineral called calcium carbonate has high compatibility with contentious compositions. calcium carbonate can be produced with the help of bacteria.[6] Carbonate is formed with the help of two metabolic pathways which are autotropic and heterotrophic pathways. Micro-organisms from the bacillus family can produce bio-minerals with the help of metabolic reactions in the presence of a calcium source. The addition of bacteria in concrete can be done by the method called vascular network or can be directly mixed while preparation of concrete.[3]

In the vascular method, the healing agent is supplied from outside of the structure with the help of vascular networks which are previously fixed in the matrix, during the preparation of concrete. When the crack appears, bacteria(healing agent) move through the vessel due to the pressure gradient between the self-healing agent and the position of the cracks.

II. MATERIALS

Materials used in concrete are specified as per grade of concrete. The grade of concrete varies as per the changing proportion of its materials. The proportion and ratio for materials that should be mixed to obtain the grade of concrete are specified by IS 456:2000. Ordinary portland cement of 43 grade is used as per IS 8112-2013. Natural river sand is used as fine aggregate, coarse aggregate which is locally available is used with a nominal size of 20mm. The bacteria called Bacillus megaterium from the bacillus family is used to prepare bacterial concrete.

III. IDENTIFICATION OF BACTERIA

I. Colony And Cell Morphology:-

It indicates the colony characteristics that are different in appearance when compared to other bacterial species. The identification of bacterial colonies, present in agar medium showed that they are circular, smooth with flat elevation, and entire ages have cream color. The gram staining tests were used to identify whether the bacteria are gram-positive or gram-negative including the shape of the bacterial cell under the microscope.[7]

II. Biochemical Tests:-

For the precise identification of bacteria, researchers of microbiology have developed a series of biochemical tests that can be applied to differentiate closely related microorganisms. The biochemical tests were carried out for identifying the isolated bacteria used during this study.[7]

III. Scanning Electron Microscopy:-

Scanning electron microscopy has been widely used in the field of environmental microbiology to visualize the surface structure of bio-materials and the morphology of bacteria. The procedure for identifying the spore-forming bacteria was carried out by taking the culture medium in a container having boiling water to kill the non-spore-forming bacteria.[7]

IV. ADDITION OF BACTERIA IN CONCRETE:-

I. Direct Addition of microbial both in fresh concrete:

Embedding the bacteria in fresh concrete through direct addition is a very simple method. Using this method is very economic as well as it shows higher biological concrete workability. This possibility of survival of micro-organisms is less in this method, thus results achieved through this can be less effective.[5]

II. Immobilized form onto the activated carbon or silica gel form:

In this method, the effect of bacteria on strength, permeability, and durability is less.[5]

III. Encapsulation method:

In this method, there is the direct addition of encapsulated micro-organisms in concrete. The encapsulation method is expensive and complex.[5]

IV. Vascular Network Method:

In this method, the micro-organisms circulate in micro-vessels throughout the concrete. The durability of concrete increases in this method as well as it is effective for the repair of cracks in concrete. The disadvantage of this method is it is expensive and complex.[5]

V. DILUTION OF BACTERIA:

Dilution is the process of making a weaker bacterial solution or less concentrated. In microbiology, serial dilutions are used to decrease a bacterial concentration to a required concentration for a specified test method. To test different cell concentrations of bacteria ranging from dilution factor of 10^3 to 10^7 [cfu/ml] was introduced during the making of concrete for determining the appropriate stage of serial dilution. The different number of cell concentrations of bacteria obtained from the appropriate serial dilution were applied to concrete for achieving the optimum concentration of bacteria.[7]

VI. APPLICATIONS:

I. Repair of limestone monuments.
II. Sealing of concrete cracks.
III. Enhancement in the durability of cementitious materials to improvement in sand properties.
IV. Used in the construction of low-cost durable housing and durable roads.

CONCLUSION:

According to the given study, the bacteria called Bacillus megaterium can be used to form bacterial concrete and give a positive result on high-strength structural concrete. It provides a result based on calcite precipitation to improve the strength of structural concrete. Performance of effect of bacteria contributed based on the concrete mix.

REFERENCES:-

[1] Sachin Tiwari, Shilpa Pal, Rekha Puria,Vikrant Nain Rajendra Prasad Pathak, “Microbial Crack Healing And Mechanical Strength Of Light Weight Bacterial Concrete” (IJCIET : Dec 2018) (ISSN Online : 0976-6316)
[2] Abhishek Pandit, Sahila Shaikh, Pranjali Mangalwedhekar, Sakshi Jagtap, Swapnil Gorade “ A Review Paper On Bacterial Concrete” (IJIERE volume 5, issue 5, 2018) (p-ISSN : 2394-5494)
[3] R. Sri Bhavana, P. Polu Raju, S. S. Asadi “Experimental Study On Bacterial Concrete With Partial Replacement Of Cement By Fly Ash” [IJCIET volume 08, issue 4 , April 2017] [ISSN Online: 0976-6316]
[4] Magudeaswaran palanisamy “ Bacterial concrete” (IJCIET-08-02-061) (publish on Feb- 2017)
[5] Abhishek thakur, Akshay Phogat, Khushpreet singh. “Bacterial concrete and effect of different bacteria on the strength and water absorption characteristics of concrete ” [IJCIET Volume 7 , issue 5 , Sep-Oct 2016] [ISSN Online : 0976-6316] [Article ID:- IJCIET_07_05_006]
[6] Mostafa seifan & Ali Khajeh Samani1 & Aydin Berenjian1.“Bio-concrete: Next generation of self healing concrete” (ResearchGate,) (published on march 2016)
[7] Ramin Andalib, Muhd. ZaimiAb Majid, M. W. Hussin, Ponraj Mohanadoss “ Optimum concentration of Bacillus megaterium for strengthening structural concrete.” (ResearchGate , published on Aug-2016) (ISSN : 2591-2602)
[8] Magudeaswaran palanisamy “ Bacterial concrete” (IJCIET-08-02-061) (publish on Feb- 2017)
[9] Henk. M. Jonkers, Arjan Thijssena, Gerard Muyzer b, Oguzhan Copuroglua, Erik Schlangena “application of bacteria as self agent for the development of sustainable concrete” (Elsevier)