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BEHAVIOURAL STUDY OF BACTERIAS IN FORMATION OF M35 GRADE CONCRETE AS A BIOCONCRETE.

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Abstract - *As there is massive growth in civil engineering in construction department the main ingredient used is concrete the various grades utilize for the minimum particle size of cement thus increasing the strength of concrete but due to greater extent of hybrid cement used it is susceptible to cracks generated by microcracks. Recent invention by Dr. Henk Jonkers as a great solution on this micro cracks our project deals with "Behavioral study of bacteria's in formation of M35 grade concrete as a bio-concrete". The research informs increasing the strength and durability of concrete by using bacteria's by process of bio-calcification as a part of metabolism of bacteria. In this bacterium secretes calcium precipitation and fill up the voids in concrete matrix, reducing the porosity and making it more compact A comparative study and analysis was done with the concrete cubes and beams subjected to compressive and flexural tests of infused bacterial specimen. In the study we found that there was increasing strength and calcium precipitation inside the concrete matrix.*

Key Words: **microcracks, bio-concrete, bio-calcification, bacterium, concrete matrix.**

1.INTRODUCTION

In the olden days, the structure was built with the structure the locally available materials such as stones, mud, sand, lime etc. after that cement was used as a binding material. Later on, steel was adopted with cement building material for the sustainability of the structures and the durability of the structure and is known as RCC Structure. There is an excess demand of concrete nowadays. The rapid haphazard development of cities required for super-structures such as Dams, Retaining Walls, Skyscrapers etc. but concrete of high grades requires special kind of admixtures which gives better result of concrete and requires skilled labour for utilization. The main disadvantage of concrete is that all structures made from it will induce cracks at some point, due to shrinkage the cracks are induced increasing the permeability of the structure causing the reduction in the strength of the structure and finally structure fails.

Due to large cracks, structural integrity is affected while due to micro cracks the durability of structure reduces. The micro cracks further lead to the formation of porous matrix of concrete leading to increase chances of corrosion of steel reinforcement. In order to reduce crack formation the structure periodical inspection and maintenance. The average maintainer's costs up to 20-200 billion of dollars. One of the best way of reducing this maintenance cost is to adopt bio-concrete also called as bacterial concrete or self healing concrete. In scientific terms the bio-concrete is basically Biomineralization of specific bacteria in a concrete. The strength and durability of concrete is increased by using these microorganism or bacteria's as binder and fillers. The other treatment such as epoxy treatment are currently used which is harmful to environment, emitting toxic fumes and harmful gases causing serious skin problem and breathing issues.

Hence biomineralization technique in a concrete leads as a green building material. The carbon dioxide is emitted during the formation of the concrete also heat is emitted due to the C_3S content present in Ordinary Portland Cement leading it to increase the temperature and green house effects. The Carbon Dioxide emitted from it is absorbed by the bacteria present in bio concrete reducing the effects of green house effect.

1.1 MATERIALS & METHODS:

- **CEMENT:** Ordinary Portland Cement manufactured by Ambuja was used. Test conducted on cement were normal consistency, initial setting time, fineness test and specific gravity.
- **FINE AGGREGATE:** Fine aggregates locally available were used and were tested, the results were as per

Indian standards BIS: 383: 1970. Specific gravity of fine aggregate was 2.8 of zone 1.

- **COARSE AGGREGATE:** Coarse aggregate of size 4.75 mm-20mm (passing through 4.75 mm and retained on 20mm IS sieve). Specific gravity of coarse aggregate is 2.83 of zone 1 which is within the permissible limit (BIS: 10262, BIS :383). Water absorption of coarse aggregate was 0.9%. No aggregate which has water absorption more than 2% shall be used in concrete mix.

- **WATER:** Potable water was used for production of concrete with the pH value 7.3 at zero turbidity.

- **Calcium Lactate :** Calcium lactate was adopted readily in an powder form from the dealer.

Bacterial Stock solution preparation:

Materials used for preparation of bacteria were as follows;

1. BACTERIAL CULTURE: bacterial culture was given by National chemical laboratory (N.C.L)Pashan in test tube i.e. bascillus pasturii and shwenella sp.
2. Water : water used0 was distilled water of ph. value 7 and zero turbidity
3. Glassware: - it includes the test tubes, Petridishes, cylindrical jars, stirrer etc
4. Bacterial medium: it included the Luria broth powder and nutrient broth powder, agar agar powder.

1.2 Bacterial preparation of medium:

The medium was prepared under various laboratory safety measures concerning the local safety steps and various reference papers.
The bacterial culture was given by the national chemical lab in Pune, near Pashan which was requested by us via mail to concern person, it was stored in an Incubator at a temperature of less than 5^0C. Then the colony was developed by forming the gel medium of stock solution by slant process in a petri dish
After the whole colony was developed in a petri dish the following procedure was adopted separately for two bacterial species

Process of preparation of medium for Bacillus pastuerii involves following steps:-

Day 1- We have taken the required proportion of Nutrient Broth media,we have prepared 100 ml 1 number of solution.

Day 2- We have taken the required proportion of Nutrient Broth media,we have prepared 120 ml of 2 number of solution

Day 3- We have taken the required proportion of Nutrient Broth media, we have prepared 100 ml solution from above 100 ml solution we have prepared 4 samples of 100 ml solution

Day 4- We have taken the required proportion of Nutrient Broth media, we have prepared 100 ml solution from above 200 ml solution we have prepared 8 samples of 100 ml solution

Day 5- In this way Finally we have prepared 1.6 Liters of solution which we are using for the concrete mix i.e. Bacterial concrete.

After day 5 the whole medium was mixed as a concrete as per the design with an addition of calcium lactate powder.

1.2 The design was adopted as per IS10262-2009 for M35 grade concrete as follows:

- Cement content = 492.9 Kg/m^3
- Water content = 197.0 Kg/m^3
- Fine aggregate = 680.25 Kg/m^3
- Coarse aggregate = 1095.50 Kg/m^3

RESULT TABLE

Table No. 1: Trial Mix 1(Bacillus Pastuerii)

Sr. No.	TYPE OF MIX	GRADE DESIGNATI-ON	DAYS OF CURING	NO OF CUBE TESTED	CALIBRATION LOAD (KN)	COMPRESSIVE STRENGTH (MPa)	AVERAGE COMPRESSIVE STRENGTH (MPa)
1	Trial mix 1	M35	7	3	410 440 470	18.22 19.56 20.89	19.56
			28	3	800 790 850	35.55 35.11 37.77	36.14

RESULT TABLE

Table No. 2: Trial Mix 2(Shewanella Sp.)

Sr. No.	TYPE OF MIX	GRADE DESIGNATI-ON	DAYS OF CURING	NO OF CUBE TESTED	CALIBRATION LOAD (KN)	COMPRESSIVE STRENGTH (MPa)	AVERAGE COMPRESSIVE STRENGTH (MPa)
1	Trial mix 1	M35	7	3	420 440 480	18.66 19.55 21.35	19.89
			28	3	920 880 890	40.88 39.11 39.55	39.85

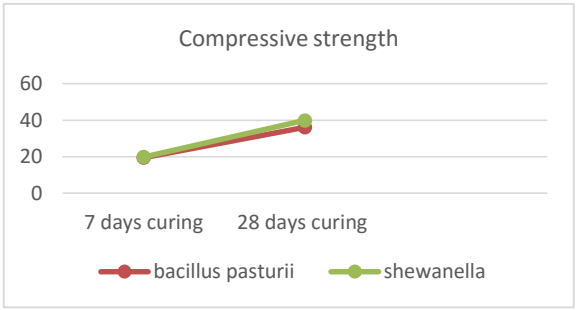

Chart -1: Compressive strength

Fig. No. 3.8: M35 grade Cube Testing (Bascillus pastuerii)

3. CONCLUSIONS

The overall conclusion from the work proposed using the adopted bacterial cultures i.e Bacillus Pastuerii and Shewanella Sp. has shown the considerable result in compression and flexural test than ordinary concrete also the reaction with calcium lactate has reduce the cracks in an eco-friendly way and in a sustainable way for alternating chemical based healing agent.

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