International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 09 | Sep 2020 www.irjet.net p-ISSN: 2395-0072

AN EXPERIMENTAL INVESTIGATION ON BACTERIAL CONCRETE WITH PARTIAL REPLACEMENT OF FOUNDARY SAND IN M-SAND

Mr.K.V.BOOBALAKRISHNAN,M.E.,*1, S.ISHA*2, V.MOHAMMED ANASH*3, P.SANTHOSH KUMAR*4

*1*Assistant Professor, Department of Civil Engineering, Dr.N.G.P. Institute of Technology, Coimbatore, Tamilnadu.*
*2,3,4*Students, Department of Civil Engineering, Dr.N.G.P.Institute of Technology, Coimbatore, Tamilnadu.*

***Abstract** - Increasing the rate of urbanization and industralization has lead to over expolitation of the natural resources such as river sand and gravels, which is giving rise to the sustainability issues .It has now become imperative to look for alternatives of constituent materials of oncrete. Waste foundry sand , a by product as partial replacements of the fine aggregate of ferrous and non ferrous metal castings industries is one such promising material which can be used as an alternatives to natural sand in concrete. .This paper presents the design of concrete mixes made with used foundry sand as partial replacements of fine aggregates by 20% of foundry sand and adding of 10ml, 15ml and 20ml of bacteria is used in the concrete mix, the remaining river sand is completely replaced with the M-sand This experimental investigations are taken up to study the strength of concrete. The first phase of investigation is carried out to culturing of bacteria. The pure culture was isolated from the soil sample and is maintained constantly on nutrient agar slants. It forms irregular dry white colonies on nutrient agar. Whenever required a single colony of the culture is inoculated into nutrient broth of 25 ml in 100 ml conical flask and the growth conditions are maintained at 37° Celsius temperature and placed in 125 rpm orbital shaker. The second phases of investigations are also carried out to study the strength characteristics of bacterial concrete. We casted cubes and cylinders to comparison of results in conventional and bacterial concrete. In compression and tension the investigations are also carried out to study the strength characteristics of cement mortar due to induction of bacteria and foundry sand.*

***Key Words**: Compressive Strength, Flexural Strength, Split Tensile Strength.*

1. INTRODUCTION

Concrete is by far the most widely using building material in the world. Concrete has a large load bearing capacity for compression load, but the material is weak in tension. That is why steel reinforcement bars are embedded in the material to be able to build structures. The steel bars take over the load when the concrete cracks in tension. The concrete on other hand protects the steel bars for attacks from the environment and prevent corrosion to take place. However, the cracks in the concrete form a problem. Here the ingress of water and ions take place and deterioration of the structure starts with the corrosion of the steel. To increase the durability of the structure either the cracks that are formed are repaired later or in the design phase extra reinforcement is placed in the structure to ensure that the crack width stays within a certain limit. This extra reinforcement is then only needed for durability reasons (to keep the crack width small) and not for structural capacity. Especially with current steel prices this extra steel is not desirable. Durability is one reason to prevent cracks or limit crack widths. Other reasons are water tightness of structures, loss of stiffness and aesthetic reasons. If in some way a reliable method could be developed that repairs cracks in concrete automatically, this would increase and ensure durability and functionality developed that repair cracks in concrete enormously. On the other hand it would save a lot of money. Of course repair cracks of cracks that develop in concrete structures would go down. But also the extra steel that is used to limit crack widths could probably be saved to a large extent. Cracks widths in concrete structure should be limited, mainly for durability reasons. If cracks widths are too large the cracks need to be repaired or extra reinforcement is needed already in the design If a method could be developed to automatically repair cracks in concrete this would save an enormous amount of money, both on the costs of injection fluids for cracks and also on the extra steel that is put in structures only to limit crack widths. For structural reasons this extra steel has no meaning. A reliable self-healing method for concrete would lead to a new way of designing durable concrete structures, which is beneficial for national and global economy. The "Bacterial Concrete" can be made by embedding bacteria in the concrete that are able to constantly precipitate calcite. This phenomenon is called microbiologically induced calcite precipitation. Calcium carbonate precipitation, a widespread phenomenon among bacteria, has been investigated due to its wide range of scientific and technological implications. Calcite formation by Bacillus subtilis is a model laboratory bacterium, which can produce calcite precipitates on suitable media supplemented with a calcium source. A common soil bacterium, Bacillus subtilis, was used to induce CaCO3 precipitation. The basic principles for this application are that the microbial urease hydrolyzes urea to produce ammonia and carbon dioxide, and the ammonia released in surroundings subsequently increases pH, leading to accumulation of insoluble CaCO3. The favorable conditions do not directly exist in a concrete but have to be created. A main part of the research will focus on this topic. How can the right conditions are created for the bacteria not only to survive in the concrete but also to feel happy and produce as much calcite as needed to repair cracks. Furthermore the bacteria should be suspended in a certain concentration in a certain medium before they are mixed through the concrete ingredients. Optimization is needed here, which involves experimental testing. Furthur we investigate the

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 09 | Sep 2020 www.irjet.net p-ISSN: 2395-0072

project by replacing M- sand with of foundry sand because, now a days good quality natural river sand is not readily available, it is to be transportated from a long distance. These resources are also exhausting very rapidly. So there is a need to find alternative to natural river sand. Natural river sand takes millions of years for its formation and is not renewable. As a substitute to natural sand, artificial sand is used as a complete replacement. In this project the behaviour of concrete is assured by partially replacing the natural sand with foundry sand which is a waste product from machine industries. The experimental work is mainly concern with the study of mechanical properties like compressive strength, split tensile strength and as well as flexural strength of concrete by partial replacement of artificial sand by foundry sand as fine aggregate. Tests over carried out on cubes, cylinders to studies the mechanical properties of bacterial concrete using foundry sand and compare with bacterial concrete with natural sand as fine aggregate.

2. METHODOLOGY

Methodology is the overall approach that underpins the project. In this chapter the methods followed to complete the project is discussed. The following representation shows the methodology being used.

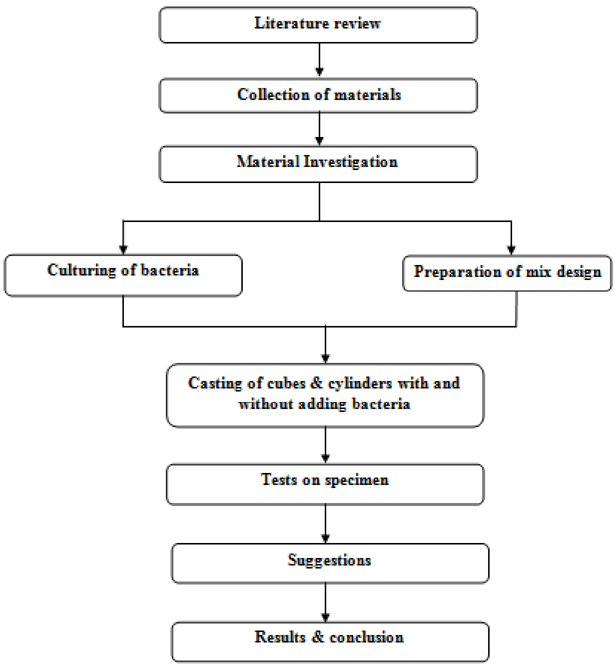

Fig-1 Methodology

3. EXPERIMENTAL INVESTIGATIONS

3.1 Compressive Strength Test

The compressive strength is the capacity of a material or structure to withstand loads tending to reduce size. It can be measured by plotting applied force against deformation in a testing machine. Some materials fracture at their compressive strength limit; others deform irreversibly, so a given amount of deformation may be considered as the limit for compressive load compressive strength is a key value for design of structures. Compressive strength is often measured on universal testing machine, this range from very small table-top systems to ones with over 2000Kn capacity. Measurements of compressive strength are affected by the specific test method and conditions of measurement. Compressive strength are usually reported in relationship to a specific technical standard. Concrete mixtures can be designed to provide a wide range of mechanical and durability properties to meet the design requirements of a structure. The compressive strength of concrete is the most common performance measure used by the engineer in designing buildings and other structures. The compressive strength is calculated from the failure load divided by the cross-sectional area resisting the load and reported in units of N/mm2. Following results are observed in compressive strength when natural aggregates were replaced with demolition concrete waste aggregates. However a decrease in compressive strength was observed when natural aggregates were replaced with those replacing materials but characteristic strength was achieved successfully. Values of compressive strength for various percentages of recycled concrete wastes were reported in Table and variation of compressive strength with age of concrete is shown in chart

Table 1 – Compressive Strength test result

Table 7.1 compressive strength of conventional concrete

CUBE	7 DAYS	14 DAYS	28 DAYS
1	17.11	28	28.88
2	18.88	23.55	30.14
3	20	24.88	29.33
Average	18.66	25.18	29.43

Table 2- compressive strength of 20% replacement concrete using foundry sand and adding 10ml of bacteria

CUBE	7 DAYS	14 DAYS	28 DAYS
1	20.33	26.45	28.54
2	18.83	28.34	31.62
3	18.98	25.38	30.11
Average	19.21	26.72	29.89

Table 3- compressive strength of 20% replacement concrete using foundry sand and adding 15ml of bacteria

CUBE	7 DAYS	14 DAYS	28 DAYS
1	21.36	26.65	28.83
2	20.75	27.77	31.85
3	22.12	28.52	29.86
Average	21.41	27.64	30.17

Table 4- compressive strength of 20% replacement concrete using foundry sand and adding 20ml of bacteria

CUBE	7 DAYS	14 DAYS	28 DAYS
1	17.86	24.87	26.78
2	19.47	26.97	29.65
3	18.85	24.82	28.33
Average	18.72	25.55	28.48

Table 5 - comparison of compressive strength of bacterial concrete

CUBE	7 DAYS	14 DAYS	28 DAYS
0ml	18.66	25.18	29.43
10ml	19.21	26.72	29.89
15ml	21.41	27.64	30.17
20ml	18.72	25.55	28.48

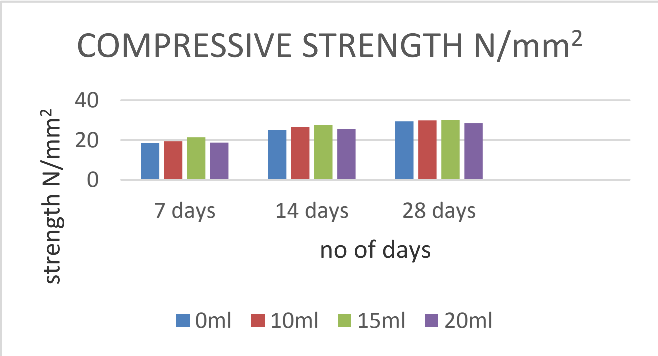

Fig -2 compressive strength

COMPARISON

The Compressive Strength of Bacterial Concrete is more than 11.80% of the Conventional Concrete for 28 days curing.

3.2 SPLIT TENSILE STRENGTH TEST

This is an indirect test to determine the tensile strength of cylindrical specimens. Splitting tensile strength tests were carried out an cylinder specimens of size 150 mm diameter and 300mm length at the age of 7 days and 28 days curing for the ultimate result using AIML compression testing machine of 2000Kn capacity as per BIS;5816-1970.

Table 6 split tensile strength of conventional concrete

CUBE	7 DAYS	14 DAYS	28 DAYS
1	1.75	1.45	2.38
2	1.95	1.65	2.56

3	1.54	1.54	2.54
Average	1.85	1.54	2.39

Table 7 split tensile strength of 20% of replacement concrete using foundry sand and adding 10ml of bacteria

CYLINDER	7 DAYS	14 DAYS	28 DAYS
1	1.73	1.93	2.65
2	1.57	2.22	2.88
3	1.81	2.05	2.97
Average	1.67	2.16	2.72

Table 8 split tensile strength of 20% of replacement concrete using foundry sand and adding 15ml of bacteria

CYLINDER	7 DAYS	7 DAYS	28 DAYS
1	1.93	1.86	2.42
2	1.86	1.75	2.79
3	1.91	1.96	2.12
Average	1.92	1.86	2.44

Table 9 split tensile strength of 20% of replacement concrete using foundry sand and adding 20ml of bacteria

CYLINDER	7 DAYS	14 DAYS	28 DAYS
1	1.68	1.98	2.64
2	1.91	2.01	2.47
3	1.83	1.95	2.67
Average	1.75	1.98	2.59

Table 10 comparison of split tensile strength of bacterial concrete

CUBE	7 DAYS	14 DAYS	28 DAYS
0ml	1.75	1.54	2.39
10ml	1.67	2.16	2.72
15ml	1.92	1.86	2.44
20ml	1.75	1.98	2.59

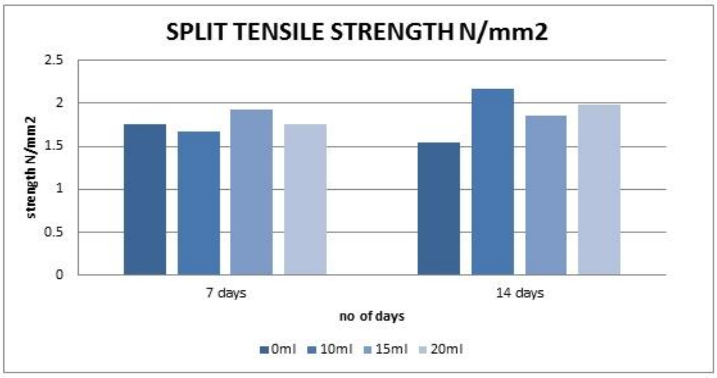

Fig 3 spilt tensile strength

5. CONCLUSIONS

- From the obtained split tensile strength and compressive strength results the incorporation of high numbers of bacteria in the concrete mix, result in a significant gain of strength due to self-healing property of bacteria's.
- Due to the inclusion of bacteria in concrete, we achieved approximately 10% of increase in compressive strength and also 30% increase in tensile strength. From the results.
- It can be concluded that easily cultured *Bacillus Subtilis* can be safely used in improving the performance and characteristics of concrete.
- Waste foundry sand can be efficacious used as fine aggregate in place of regularly river sand in concrete.
- Compressive strength increases on increase in percentage of waste foundry sand as compare to traditional concrete.
- In this study, more compressive strength is obtained at 40% replacement of fine aggregate by waste foundry sand. Split tensile strength increases with increase in some percentage of waste foundry sand and there after it decreases.
- Use of waste foundry sand in concrete reduces the production of waste through metal industries i.e. it's an eco-friendly building material.
- Application of this study guide to develop in construction sector and inventive building material.
- The result for 40% replacement of waste foundry sand shows that the concrete produce is an economical, sustainable and high strength concrete. And Hence we can effectively use the Bacterial concrete in the structures, to get more strength and durability.

REFERENCES

[1] A detailed study on partial replacement of fine aggregate with brick debris" R.veerakumar(volum:9; march:2018;IAME publication)
[2] Salmabanu Luhar, Suthar Gourav, A Review paper on self healing concrete, Journal of Civil Engineering Research, S.5(3), 2015, pp 53-58.
[3] Filipe Bravo da Silva, Nele De Belie, Nico Boon and Willy Verstraete, Production of non-axenic ureolytic spores for self healing concrete applications, Construction and Building Materials, S.93, 2015, pp 1034-1041.
[4] Aliko-Benitez, M. Doblare, J. A. Sanz-Herrera, Chemical-defusive modeling of self healing behavior in concrete, International Journal of Solids and Structure, S.69-70, 2015, pp 392-402.
[5] Daquan Sun, Tianban Lin, Xingyi Zhu, Linchui Cao, Calculation and evaluation of activation energy as a self-healing indication of asphalt mastic, Construction and Building Materials, S. 95, 2015, PP 431-436.