IMPACT OF QUARRY DUST PARTICLE SIZE ON THE COMPRESSIVE STRENGTH OF BACTERIAL-ENHANCED MORTAR

K S Padhma[1] S Gunasekaran[2]K.B.Shoba[3] Mageswari[4]

[1]Research scholar,St. Peter's Institute of Higher Education & Research, Chennai, Tamilnadu, India
Email: narayanan.sunilkumar@yahoo.in

[2]Dean and Head,R & D,St. Peter's Institute of Higher Education & Research, Chennai, Tamilnadu, India
Email: deanresearchspu@gmail.com

[3]Associate Professor,Department of civil Engineering,St. Peter's Institute of Higher Education & Research, Chennai, Tamilnadu, India
Email: haridrab002@gmail.com

[4]Professor and Head, Department of civil Engineering, Panimalar Engineering college, Poonamallee, Tamilnadu, India.

Corresponding author: narayanan.sunilkumar@yahoo.in

ABSTRACT

River sand has been historically the preferred choice, for the fine aggregate component of concrete, however its excessive use has raised environmental concern this study examine[s the impact of varying the finenessmodulus of quarry dust on the comprehensive strength of mortar when it is partially replaces river sand mortar cubes specimens were tested to determine comprehensive strength two basic mixes M20 and M30. The results reveal a relationship between the fineness of quarry dust and variations in compressive strength.

Keyword: Compressive Strength, Quarry dust, Bacteria, Fineness modulus.

1. Introduction

Concrete is the most used material now days. Concrete consist of coarse aggregate, fine aggregate, binding material and water. The rapid growth in construction building activities has cost a shortage of conventional construction supplies. Overuse of the materials has raised environmental issues in proper sand management disrupts the marine ecosystem and hinders natural sand replenishment. Due to limited natural sand sources and an effort to minimise concrete production costs, there is a rising demand for substitute materials like fine aggregates to replace sand. Concrete costs can be reduced by lowering the individual materials within the matrix. Using locally accessible materials can help to reduce expenditure.Many countries struggled to supplythe high global demand for fine aggregate in concrete manufacturing, leading to the use of alternative materials quarry dust a by-product of crushing during quarrying is a cost effective and abundant resource,they typically provide 1% quarry waste fine aggregate, produced from mining and processing of rocks into tiny particles less than 4.75 mm is an environmental challenge due to disposal issues. Using quarry waste fine aggregate in concrete reduces the need for sand while reducing environmental impact due to the use of natural sand.

2. Literature review

This paper investigated the impact of a more typical axenic bacteria culture(B. subtilis bacteria) and a culture produced from an impure (non-axenic) soil sample on three binder compositions: ordinary portland cement (OPC cement), an OPC-fly ash mixture, and a (Calcium sulphoaluminate (CSA) cement using compressive strengths, sorptivity, ultrasonic pulse velocity, thermo gravimetric analysis, and visual observations. They discovered that both bacteria repaired 0.35 mm fissures and enhanced absorption. When compared to OPC, OPC-fly ash and CSA cement combinations resulted in increased sustainability, higher cell survival, and superior microstructure and fracture healing over time.[13]

This study discusses the benefit of bacteria that reduces water penetration and chloride ion permeability. The results of the current review research suggest that with the ‘‘microbial concrete” can be an substitute and premium quality concrete which heals the cracks that is cost effective, environmentally friendly and ultimately go in front to improved durability of building materials. Finally, he concluded that, Bacillus Pasteuri and bacillus subtilis are most effective useful bacteria to heal the cracks in concrete [11].

This article describes how to construct self-healing concrete and discusses howthe addition of bacteria increases the concrete's properties and makes it superior to normal concrete in many ways. In this study, theauthor analysed various bacterial species that can be applied to concrete fracture repair. Concrete cracks are repaired in part by bacteria-creating calcium carbonate crystals that block and seal the cracks. Numerous researchers have studied the self-healing properties of concrete and have discovered the following findings: microorganisms enhance the properties of ordinary concrete, increasing its strength by 13.75% in 3 days, 14.28% in 7 days, and 18.35% in 28 days. As is common knowledge, repairs, and upkeep cost a lot of money.[12]

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This work understands the use of urease-producing bacteria isolates, such as Bacillus subtilis, Bacillus Pasteuri species in the healing of cracks in concrete. The study has reviewed different types of bacteria that can be used for healing cracks and has also identified that bacteria has a positive effect on the compressive strength of Portland cement mortar cubes and concrete, how the use ofbacteria decreases water penetration and chloride ion permeability. The present study results recommend that using the ‘‘microbial concrete” can be an alternative and high-quality concrete sealant which is cost-effective, environmentally friendly, and eventually leads to improvement in the durability of building materials [10]

In the present study attempted to arrest the cracks in concrete using bacteria and calcium lactate. The percentages of bacteria selected for the study are 3.5% and 5% by weight of cement. In addition, calcium lactate was used at 5% and 10% replacement of cement by weight. Bacteria produce calcium carbonate crystals which blocks the micro cracks and pores in the concrete after reacting with calcium lactate. The bacterial selection depends upon the alkaline environment, where bacteria have to survive. He showed that this bacterial concrete improves the compressive strength of concrete through his experimental study. Bacillus pasteurii is adopted for this study. Various tests such as compressive strength, elastic modulus and fracture of concrete were analyzed in this study.[13]

This paper reviewed how introducing the bacteria into the concrete makes it very beneficial it improves the property of the concrete which is more than the conventional concrete. [15]

3.Objective of the study:

The main objective of the study is to determine the effect of quarry dust fineness, on the compressive strength of concrete additionally the study aims to examine the influence of quarry dust grading on compressive strength of the bacterial mortar.

4. MATERIAL USED:

In the current study ordinary Portland cement 53 grade (OPC) was utilized for investigation. Physical and Mechanical properties of the cement utilized in the study are presented in the table I

Table 1: Properties of cement

Sl.No	Description	Value
1	Standard Consistency	31.5%
2	Initial setting time	92

3	Final setting time	210
4	Specific gravity	3.15
5	7 days strength	34 MPa
6	14 days strength	45 MPa
7	28 days strength	54 MPa

Table 2 Properties of sand

Sl.No	Description	Value
1	Specific gravity	2.6
2	Grading Zone	Zone II
3	Fineness Modulus	2.66

Table 3: Sieve analysis of River sand

Sieve analysis of fine aggregates		
1000gms		
Seive size	Weight retained in gms	Cumulative % Passing
10 mm	2	99.89
4.75 mm	24	97.4
2.36 mm	34	93
1.18 mm	120	81
600µ	382	42.8
300µ	282	15.3
150µ	146	1
pan	10	0
Fineness Modulus 2.55		

This investigation utilized quarry dust from local quarries with fineness modulustables 2 and 3 provide sieve analysis results and physical attributes of Quarry dust. (2.952, 3.254)

Table 4: Sieve analysis of Quarry dust.

The sieve analysis of quarry dust with the fineness of 2.952.

Sieve analysis of fine aggregates		
1000gms		
Seive size	Weight retained in gms	Cumulative % Passing

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10 mm	1	99.89
4.75 mm	11	98.797
2.36 mm	126	85.97
1.18 mm	168	68.178
600µ	295	39.579
300µ	290	9.919
150µ	85	1.3
Pan	13	0
Fineness Modulus 2.949		

Table 5: Sieve analysis of Quarry dust.

The sieve analysis of quarry dust with the fineness of 3.254.

Sieve analysis of fine aggregates		
1000gms		
Seive size	Weight retained in gms	Cumulative % Passing
10 mm	0	99.89
4.75 mm	29	98.797
2.36 mm	157	85.97
1.18 mm	270	68.178
600µ	220	39.579
300µ	212	9.919
150µ	85	1.3
Pan	14	0
Fineness Modulus 3.25		

Water:

Portable water which is ordinary drinking water available in construction laboratory, was used for casting all specimens in this investigation. Water facilitates the even dispersion of cement,ensuring that every particle of aggregates thoroughly coated and mixed with other ingredients, it chemically reads with the cement promoting setting and hardening water also lubricates the mix and improves its compactness.it is free of impurities like oil and organic materials.

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Bacteria-genus bacillus

These specious are known for diverse roles in various environments ranging from soil health to industrial applications.different types of bacillus bacteria utilized in self healing bio-concrete are:

Subtilis	megaterium	Cohnii	Pasterii	Spaericus

Bacillus subtilis is a rod-shaped gram-positive soil-based bacterium is used in this project.

Result and Discussion.

FIG.1 MORTAR CUBE

CuringAfter preparing the cubes they were immediately submerged in clean, fresh water in a curing tank. Once the curing period was completed the specimens were removed, and placed in shade to dry, the cubes were then tested for compressive strength 7 days, 14 days and 28 days in compression testing machine.

Compressive Strength Test

Compressive Strength testing is a curial evaluation method used assess ability of concrete to withstand compressive loads, this testing process involves subjecting concrete specimens typically cubes or cylinders, to gradually increasing compressive forces until failure occurs. The test is conducted using specialized machine known as

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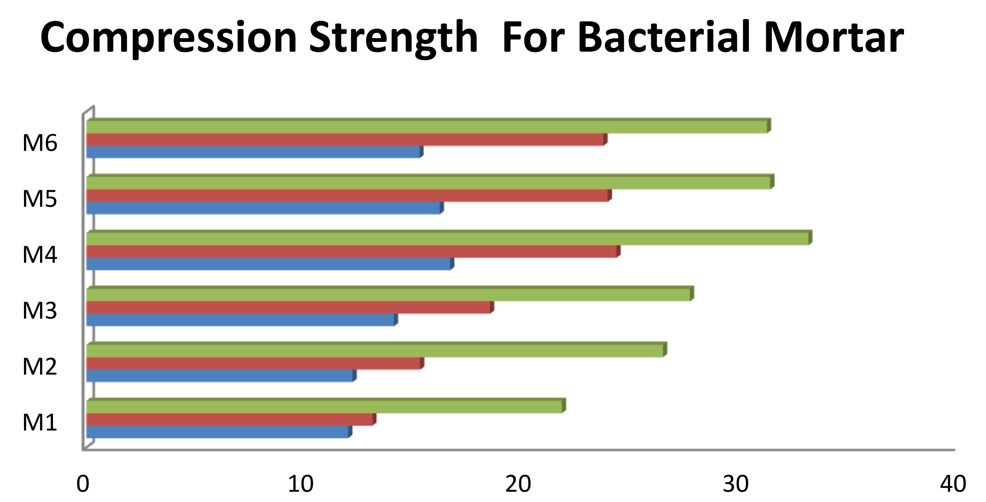
a compressive testing machine, which applies the force uniformly all over the cube and measures the resistance offered by the concrete.

The 50x50x50 cubes are carefully positioned in the testing machine with the load applied to the opposite side from where they were cast. The load is incrementally increased until the specimen fails. The formula used to calculate the compressive strength is

Compressive strength = Total failure Load/Area of the Cube

Fig.2 **Compression Strength For Bacterial Mortar**



	M1	M2	M3	M4	M5	M6
28 days	21.8	26.43	27.67	33.1	31.35	31.2
14 days	13.11	15.3	18.5	24.3	23.9	23.7
7 days	12	12.2	14.1	16.67	16.2	15.27

Conclusion:

- Bacillus subtilis can form a tough protective endospore enabling it to withstand extreme environmental conditions. Laboratory culture bacteria are used for this study.
- Introducing bacteria into concrete facilitate crack repair by producing calcium carbonate crystals which effectively block and mend cracks.
- The formation of these crystals reduces water permeability, shrinking crack widths from 0.5mm to 0.35mm.
- Regular concrete instructions are less necessary due to the self-healing capabilities imparted by these materials thereby extending concrete’s life span when compared to conventional concrete.

- This approach enhances durability and strength surpassing that of normal concrete.
- The efficiency and compressive strength were maximum when 15ml of bacteria was added to the concrete.

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