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EXPERIMENTAL INVESTIGATION ON THE STRENGTH CHARACTERISTICS OF CONCRETE USING MANUFACTURED SAND

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ABSTRACT

The most widely used material in this world is concrete. After water, concrete is placed in second position. The use of natural sand in conventional concrete has become of vital importance which is scarce to obtain. Sand is basic concrete making construction material required in large quantities. Manufactured sand is one among such materials to replace river sand which can be used as an alternative fine aggregate in mortars and concrete. In general concrete is a combination of cement, fine and coarse aggregate. These days, natural river sand is difficult to acquire and extraction of sand from river has represented an awesome threat to environment. An attempt had been made in the present investigation to discuss the properties of concrete such as workability and strength of concrete which is prepared by replacing natural sand with M-sand at different replacement levels (0%, 10%, 20%, 30%, 40% and 50%) for M30 Grade of concrete.

KEY WORDS: M-sand, Strength, workability, workability, River sand

1.1 INTRODUCTION:

For a long time concrete was considered to be very durable material requiring. We build concrete structures in highly polluted urban and industrial areas, aggressive marine environments, harmful sub-soil water in area and many other hostile conditions where other materials of construction are found be non –durable. Since the use of concrete in recent years have spread to highly harsh and hostile conditions, the earlier impression that concrete is a very durable material is being threatened, particularly on account of premature failures of number of structures.

MANUFACTURED SANDS

Due to the increased levels of construction expected in India in the forthcoming years it is expected that fine aggregate suitable for use in concrete will become scarce or uneconomical to produce. With the expected shortfall in natural sands manufactured sands offer a viable alternative to natural sand, if the problems associated with the use of manufactured sands can be resolved and its poor reputation in the industry overcome.

Manufactured sands are made by crushing aggregate to a size appropriate for use as a fine aggregate (<2.36mm). The crushing process however generates large amounts of materials <75microns as well as causing the manufactured sand to have an irregular particle shape. These fine particles and irregular shape of the aggregate have detrimental effects on the workability and finish of the concrete. These negative effects have given manufactured sands a poor reputation in the construction industry. However recent studies show that these fine particles may be able to be utilized to increase the compressive and flexural strengths of concrete.

1. It does not have the presence of impurities such as clay, dust and silt coatings, increase water requirement as in the case of river sand which impair bond between cement paste and aggregate. Thus, increased quality and durability of concrete.
2. M-Sand is obtained from specific hard rock (granite) using the state-of-the-art international technology; thus, the required property of sand is obtained.
3. M-Sand is cubical in shape and is manufactured using technology like High Carbon steel hit rock and then ROCK ON ROCK process which is synonymous to that of natural process undergoing in river sand information.
4. Modern and imported machines are used to produce M-Sand to ensure required grading zone for the sand.

1.2 OBJECTIVES OF THE STUDY:

1. Determine the workability, the overall strength, as well as the rate of strength gain for varying water cement ratios of concrete containing manufactured sand.
2. Compare the results of the manufactured sand concrete to a conventional mix containing natural sand.
3. From the data collected in the previous objective choose a water cement ratio with poor workability and determine the required amount of superplasticizer to achieve a good workability.
4. Also determine the overall strength, as well as the rate of strength gain of the concrete after the addition of a super-plasticizer
5. Determine compressive strength, split tensile strength and flexural strength and Durability of concrete containing manufactured sand.

2.0 LITERATURE REVIEW

Evertsson (2000) reported that knowledge gained from research should be used by quarry operators to optimize the performance of their equipment and to achieve lower quantities of quarry fines.

Jeffrey et al (2003) found that the generation of quarry fines is due to the extraction and processing operations in a quarry. There are several parameters that influence the production of fines, which are relevant to the rock characteristics and the involved processes. However, careful design and optimization of extraction and processing could minimize the fines production.

Petavratzi (2006) investigated that the large amount of dust fraction below 75 m generated from various ores and found that the different types of rock produced different amounts of fines with different physical properties.

Mitchell and Benn (2007) replaced a HSI with a cone crusher. For 20mm aggregate size, the production increased from 250 to 300 tonnes per hour for the same feed rate i.e. 20% increase in production and the proportion of fines have been decreased from 38 to 30% i.e. 21% decrease in fines.

The University of Leeds (2007c) explored that the quarry fines are produced from various activities, but the stages of blasting are considered as the most liable in generating such fines. The amount of dust produced during blasting is estimated to be as high as 20%.

3.0 METHODOLOGY

Table 1: Physical properties of cement

S. No	Property	Test results
1	Normal consistency	32%
2	Specific gravity	3.15
3	Initial setting time	60 minutes
4	Final setting time	460 minutes

Table 2: Physical properties of fine aggregat

S. No	Property	Value
1	Specific gravity	2.7
2	Fineness modulus	3.09

Table 3: Physical properties of coarse aggregate

S. No	Property	Value
1	Specific gravity	2.8
2	Fineness modulus	4.9

Table 4: Physical properties of water

S. No	Property	Value
1	pH	7.1

4.0. MIX DESIGN OF M30 GRADE CONCRETE

Final trial mix for M30 grade concrete is 1:1.86:2.89 at w/c of 0.50

Cement = 394 kg/m3

Water = 197 kg/m3

Fine aggregates = 732 kg/m^3

Coarse aggregate = 1139 kg/m^3

Water-cement ratio = 0.50

5.0 TESTS ON CONCRETE

5.1. Slump cone test Results

Table 1: Slump cone test Results

S.no	% M Sand	Slump in mm
1	0%	80
2	10%	70
3	20%	60
4	30%	50
5	40%	40
6	50%	40

5.2. Compaction factor test

S.no	% M Sand	Compaction factor
1	0%	0.94
2	10%	0.90
3	20%	0.84
4	30%	0.82
5	40%	0.84

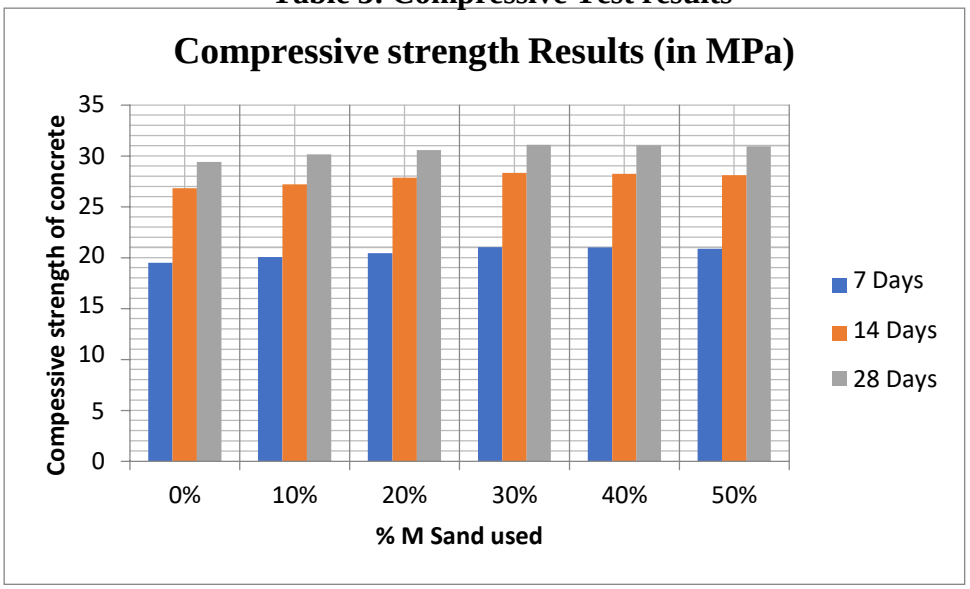
6	50%	0.80

Table 2: Compaction Factor Test results

5.3. COMPRESSIVE STRENGTH OF CONCRETE

S.no	% M Sand used	Compressive strength of in MPa		
		7 Days	14 Days	28 Days
1	0%	19.5	26.80	29.40
2	10%	20.06	27.18	30.14
3	20%	20.44	27.86	30.56
4	30%	21.04	28.32	31.10
5	40%	20.98	28.24	31.02
6	50%	20.86	28.10	30.92

Table 3: Compressive Test results

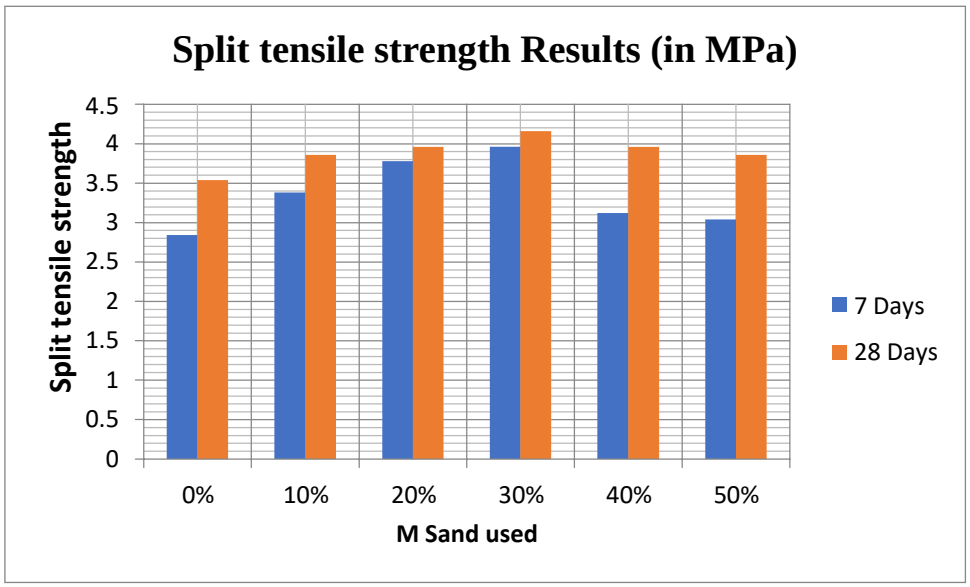


Graph 1: Compressive Test results

5.4. SPLIT TENSILE STRENGTH OF CONCRETE

S.no	% M Sand used	Split tensile strength in MPa	
		7 Days	28 Days
1	0%	2.84	3.54
2	10%	3.38	3.86
3	20%	3.78	3.96
4	30%	3.96	4.16
5	40%	3.12	3.96
6	50%	3.04	3.86

Table 4: Split Tensile Test results



Graph 2: Split Tensile Test results

6.0 CONCLUSIONS

From the above study the following conclusions were made

1. The value of slump for the concrete decreases with increasing the percentage of M Sand for concrete.
2. The value of compaction factor for the concrete decreases with increasing the percentage of M Sand for concrete.
3. Compressive strength for 7days, 14days, 28days for the concrete increases initially up to 30% M Sand than decreases with increasing the percentage of M Sand. The optimum value for the compressive strength was obtained at 30% M Sand.
4. Split tensile strength and flexural strength for 7days, and 28days for the concrete increases initially up to 30% M Sand than decreases with increasing the percentage of M Sand. The optimum value for the compressive strength was obtained at 30% M Sand.
5. The addition of M-sand significantly increased the compressive, tensile and flexural strengths of concrete with maximum strengths in each case being achieved at 30% M- sand.

So, the replacement of 30% of M Sand is generally useful for better strength values in M30 grade of concrete.

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