PROPERTIES OF MANUFACTURED SAND

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Abstract:

The present investigation aims to study the Durability properties of concrete in which manufactured sand (M-sand) is used as a partial and full replacement for natural sand. To retain the natural resource such as natural sand an attempt is made in this research by partially replacing the natural sand with M-sand. To study basic durability characteristics of concrete M30 grade were selected. In the durability study the conventional and M-sand concrete is tested by conducting the percentage weight loss for conventional concrete. The present paper focuses on investigating characteristics of M30 concrete with partial replacement of cement with Ground Granulated Blastfurnace Slag (GGBS) and fine aggregate with the Manufactured sand . It is found that by the partial replacement of cement with GGBS and fine aggregate with Manufactured sand helped in improving the durability of the concrete substantially compared to normal mix concrete increased results the durability property of concrete is enchanced by partial replacement of sand with 50% of M-sand for the grade of High Performance Concrete.

Keywords: *Manufactured sand, GGBS, Rapid chloride penetration Test, Acid Attack, Sulphate Attack, Super plasticizers.*

Introduction:

Natural river sand is the most preferred choice as a fine aggregate materials. River sand is a product of natural weathering of rocks over a period of millions of years. It is mined from the river beds and sand mining has disastrous environmental consequences. River sand is becoming a scare commodity and hence exploring alternatives to it has become imminent. Rock crushed to the required grain size distribution is termed as Manufactured sand (M-Sand). In order to arrive at the required grain size distribution the coarser stone aggregates are crushed in a special rock crusher and some of the crushed material is washed to remove fines. This investigation is an attempt to evaluate the characteristics of suing M-sand as fine aggregate. The researchers have done considerable work on replacing the cement with flyash and blast furnace slag without affecting the strength. River sand (Fine aggregate), which is one of the constituents used in the production of concrete, has become expensive and scarce. So there is large demand for alternative materials.

High Performance Concrete to a set of standards above those of the common applications such as high strength, high workability, low permeability and high durability. Concrete is generally a mixture of cement, fine and coarse aggregates. In order to minimize the cost of construction and to utilize the waste product from the iron industry beneficially, cement is replaced with GGBS partially in various Proportions. T thhe present study discuss the replacing the river sand with M-Sand in percentages of 0, 25, 50 &75 together with the replacement of cement by GGBS in Percentages of 0, 5, 10& 15 respectively.

Literature Review:

Shanmugapriya et al. 2012 concluded from experimental researchers that compressive and flexural strength of concrete can be improved by partial replacement of cement by silica fume and manufactured sand for natural fine aggregates. They suggested that optimum replacement of natural sand by manufacturedsand is 50%.

Saeed Ahmaed et al. 2008 have found that compressive strength of various mix ratios increasd from 7% to 33% whereas workability decreased from 11% to 67% with increasing proportion of manufactured sand.

Shyam Prakash et la. 2007 says that manufactured sand satisfies the requirements fine aggregates such as strength, graduation, shape angularity. It is also possible to produce manufactured sand falling into the desired grade. They say that the mechanical properties of manufactured sand depend upon the source of its raw material, i.e., parent rock. Hence the selection of the quarry is very important to quality fine aggregate.

Mahendra R Chitlange et al. 2010 experimentally proved that due to addition of steel fiber to natural sand concrete and manufactured sand concrete there is a consistent increase in flexural and split tensile strength whereas there is only a marginal rise in compressive strength.

Experimental Research:

Materials:

a) **Cement :** The most commonly available Ordinary Portland cement of 53 Grade was used for the investigation. Cement was bought from the same source throughout the research work. While storing cement, all possible contact with moisture was avoided. The specific gravity of cement was found to be 3.15.

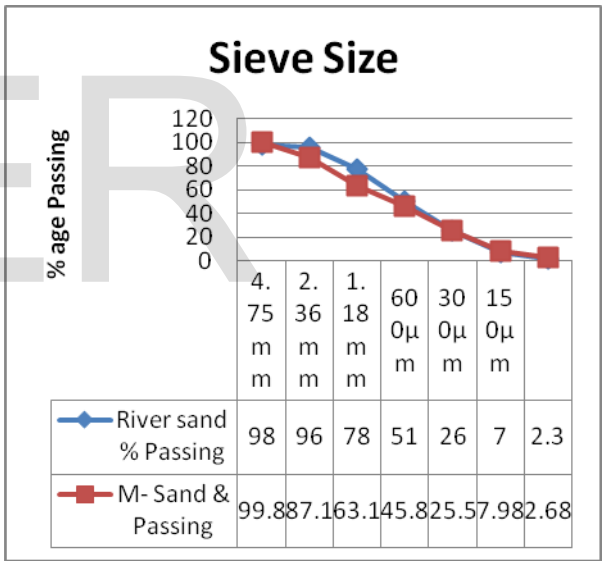
b) **Fine Aggregate**:

Natural Sand: Locally available River Sand having bulk density 1860 kg/m³ was used and the specific gravity is 2.56. The fineness modulus of river sand is 2.64.

Manufactured sand: M- Sand was used as partial replacement of fine aggregate. The bulk density of manufactured sand was 1860 kg/m³, specific gravity and fineness modulus was found to be 2.56 and 3.10 respectively.

Table 1 . *Sieve analysis of River sand & M – Sand*

Sieve Size	River sand % Passing	M- Sand & Passing
4.75mm	98	99.78
2.36mm	96	87.14
1.18mm	78	63.12
600µm	51	45.75
300µm	26	25.50
150µm	7	7.98
Fineness Modulus	2.30	2.68



c)Coarse Aggregate : Crushed angular aggregate with maximum grain size of 12.5mm and down graded was used and having bulk density 1691kg/m³. The specific gravity and fineness modulus was found to be 2.89 and 2.75 respectively.

d) Super Plasticizer: In order to improve the workability to high performance concrete, superplasticizer in the form of Sulphonated Napthalene Polymers complies with IS 516 – 1959 and ASTM C 642 type F as a high range water reducing admixture (VARAPLAST PC 100) was

used . This had 40% active solids in solution. The specific gravity is 1.22. It is a liquid instantly dispensable in water.

e) ggbs: GGBS is obtained by quenching molten iron slag from a blast furnance in water or steam, to producea glassy, granular product that is then dried and ground into a fine powder. GGBS is used to make durable concrete structures in combination with ordinary port land cement and other pozzolanic materials. The fineness modulus of GGBS using blaine' fineness is 320m²/kg and other properties of GGBS.

f) Water: Water is an important ingredient of concrete as it actually participates in the chemical reaction with cement. In general, water fit for drinking is suitable for mixing concrete. Impuritiew in the water may affect setting time, strength, shrinkage of concrete or promote corrosion of reinforcement. Locally available drinking water was in the present work.

Test Specimens and Test procedure:

Rapid chloride penetration Test: The concrete cubes of 150mmx150mm size, were casted and cured for a period of 21 days used as test specimens. A sample of dia 100mm and thickness 50mm are subjected to a direct current of 60 volts across two faces. The concrete for the both cases i.e. normal concrete and modified concrete. The ingredients of concrete were thoroughly mixed till uniform consistency was achieved. The current passing through the specimen, the specimen is monitored regularly hours. The total charge that the passed through the specimen is calculated and is the value of product of time in seconds and current in amperes and unit is "coulomb".

Acid Attack Test: The acid resistivity of concrete was studied by immersing the specimens in acid solution. The test has been conducted for the conventional concrete and concrete specimens replacing fine aggregate with0,25,50,&75% of M-sand. The specimens of size 150x150x150mm were casting and cured in water for 28days. The initial weights were measured and the specimens were immersed in 5% sulphuric acid solution for the next 28 days of acid exposure, specimens were tested for compressive strength and compared with the strength of concrete specimens which were not exposed to acid attack.

Sulphate attack test: Specimens replacing fine aggregate with 0,25,50, &75% of M-sand. The Specimens of size 150x150x150mm were casted andcured in water for 28 days. The initial weights were measured and the specimens were immersed in 5% magnesium sulphate solution for the next 28 days of sulphate exposure, specimens were tested for compressive specimens which were not exposed to acid environment.

Table 2. *Rapid Chloride Permeability Testof the conventional concrete are presented in Table for M30 Grade of concrete.*

S. No	Grade of Concrete	Replacement of M-Sand	% of GGBS	Charges passed coulombs(RCPT Value)	Chloride ion	Permeability Per ASTM C1202
1.	M30	0%	0%	842	1000-2000	Low
2.	M30	25%	5%	1514	1000-2000	Low
3.	M30	50%	10 %	2174	2000-4000	Moderate
4.	M30	75%	15 %	2153	2000-4000	Moderate

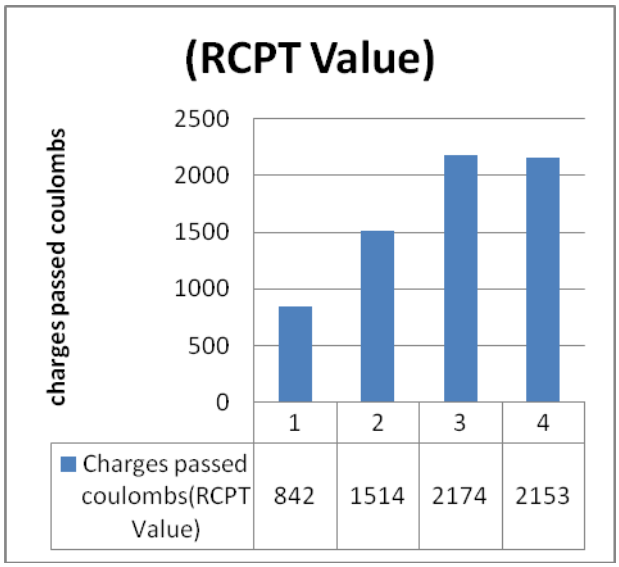


Table 3. *Acid Attack Testof the conventional concrete are presented in Table for M30 Grade of concrete.*

S.No	Grade of Concrete	Replacement of M-Sand	% of GGBS	% Weight loss	% Comp Strength loss
1.	M30	0%	0%	2.65	9.73
2.	M30	25%	5%	2.01	9.19
3.	M30	50%	10%	2.26	9.44
4.	M30	75%	15%	2.22	9.41

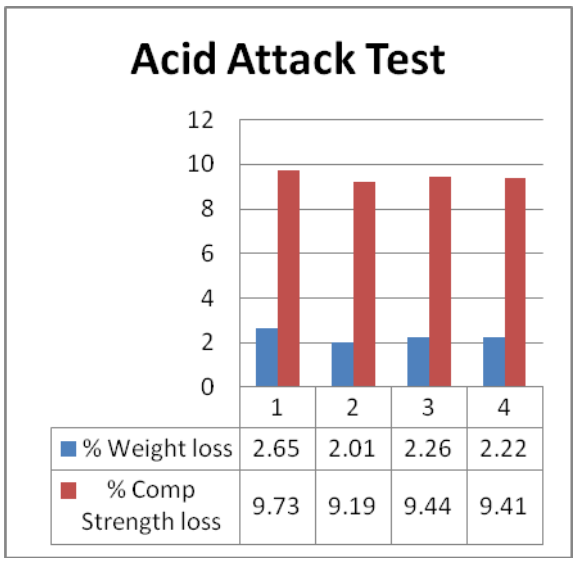
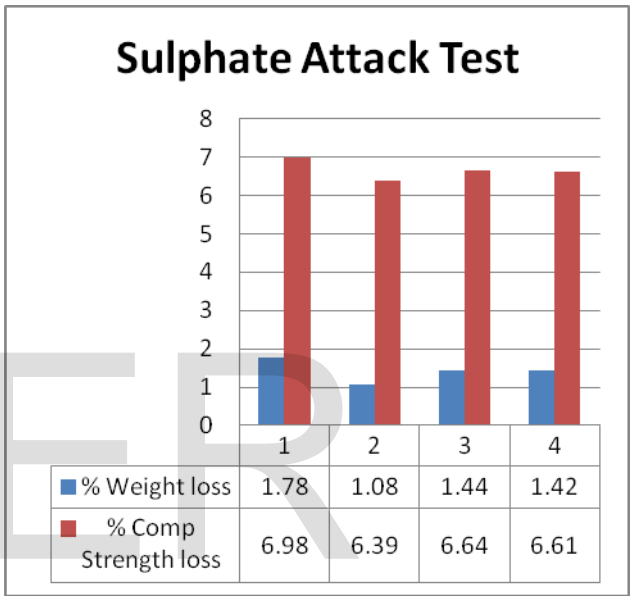


Table 5. Sulphate Attack Testof the conventional concrete are presented in Table for M30 Grade of concrete.

S.No	Grade of Concrete	Replacement of M-Sand	% of GGBS	% Weight loss	% Comp Strength loss
1.	M30	0%	0%	1.78	6.98
2.	M30	25%	5%	1.08	6.39
3.	M30	50%	10%	1.44	6.64
4.	M30	75%	15%	1.42	6.61



Conclusion:

- The concrete can be improved by partial replacement of GGBS for cement and M – Sand for Fine Aggregate.
- The concrete can be improved by using Super Plasticizers.
- From the above experimental results it is proved that, M – Sand can be used as alternative material for the fine aggregate i.e.sand. Based on the results RCPT , Acid & Sulphate attack Test are increased as the percentages of M – Sand increased.
- The present experimental programme indicated that the durability properties of the concrete could enchance the effect of utilization of M-Sand ontained from the place of river sand in concrete .
- Results of the experimental studies show that resistance to penetration of water as

proved by Rapid Chloride Penetration Test , is increased with increasing proportion of M-Sand Concrete.

- GGBS can be used as one of the alternative material for the cement.
- From the experimental results 50% of cement can be replaced with GGBS.
- The percentage Weight loss due to Sulphate Attack Test is 1.8% for Conventional concrete and 1% by replacing 10% of cement with GGBS and 50% of fine aggregate with M – Sand.
- The percentages Weight loss due to Acid Attack Test is 2.65% for Conventional Concrete and 2% by replacing 10% of cement with GGBS and 50% of fine aggregate with M – Sand.
- When the percentage of replacement of M-sand goes beyond 50%, the strength is considerably reduced.
- The durability of M – sand concrete under acid & sulphate attack is higher inferior to that of conventional concrete.
- The use of M-Sand in the Construction Industry helps to prevent unnecessary damages to the environment and provide optimum exploitation of the resources.

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