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STUDY On M-SAND AS A PARTIAL REPLACEMENT OF FINE AGGREGATE IN CONCRETE

Y. Boopathi[1] and J.Doraikkannan[2]
[1] Assistant Professor, Department of Civil Engineering, mahendra Engineering College,Namakal
[2] Assistant Professor, Department of Civil Engineering, Pavaai Engineering college, Namakkal.
E mail: y.boopathi@gmail.com, doraikkannan07@gmail.com

***Abstract*—** Sand is the one of main constituents of concrete making about 42 % of volume of concrete used in construction industry. Natural sand is mainly excavated from river beds and always contains high percentages of inorganic materials, chlorides, sulphates, silt and clay that adversely affecting the strength and durability of concrete and reinforcing steel there by reducing the life of structure. Digging sand, from river bed, in access quantity is hazardous to environment. So, it is time to find an alternative material for natural river sand. In order to fulfill the requirement of fine aggregates, an alternative material like manufactured sand can be used in concrete. Manufactured sand is defined as a purpose-made crushed fine aggregate produced from a suitable source material. Production generally involves crushing, screening and possibly washing. In this paper, natural river sand is replaced by manufactured sand by various proportions such as 0%, 20%, 40%, 60% and 80%. For these various replacement percentages, a suitable proportion is selected for a particular grade of concrete to get optimum strength. Hardened concrete tests such as Compressive strength test and Split tensile strength test were performed. The test results showed that there is a gradual increase in strength when using manufactured sand up to 60%
Keywords: M-sand, quarry rock dust, specific gravity, strength properties of concrete.

I. INTRODUCTION

Currently India has facing a great demand to natural river sand due to its excessive cost and depletion of these natural sources causes major environmental problems. Nowadays in the construction industry, major projects such as construction of power plants, silos, dams, bridges, highway projects etc., meet more demand in the building materials. The utilization of manufactured sand has been accepted as one of the building material. The above study presents the usage of manufactured sand in concrete at various replacement proportions for two water cement ratios of 0.5 and 0.48.

II. OBJECTIVE

1. To Study the properties of the M-Sand.
2. To study the compressive and split tensile strength of the specimens which is replaced by the M-Sand upto 40%
3. Comparing the water cement ratio of 0.48 and 0.50

III. SCOPE

1. The mechanical strength of the concrete is enhanced in the partial replacement of the M-Sand.
2. Analyzing the water cement ratio between 0.5 to 0.48.

IV. METHODOLOGY

MATERIALS USED

The materials used in this study are Portland Pozzolano Cement (PPC), Natural River Sand, Manufactured sand, coarse aggregate of size 20mm. The Manufactured sand obtained from SRC Projects (P) Ltd., Salem was used to cast cubes, cylinders and beams. Initially, quarry blasting is done for rock extraction. These rock particles are crushed by using the primary crusher and secondary crusher. After screening, using Vertical shaft impactor (VSI) and Horizontal shaft impactor (HSI) these particles are grained into smaller particles of size below 4.75mm which is known as Manufactured sand. The five types of fine aggregate used are shown in table 1.

Table 1**:** Types of fine aggregates

Description	Natural	Manufactured
0 MS	100%	0%
20 MS	70%	30%
40 MS	60%	40%
60 MS	40%	60%
80 MS	20%	80%

PROPERTIES OF MATERIALS

The properties of materials such as cement, fine aggregate, quarry rock dust and coarse aggregate are shown in table 2.

Table 2: Material properties

Material	Material property	
	Specific gravity	Fineness modulus
Cement	3.15	6.30
Natural river sand	2.62	2.58
Quarry rock dust	2.59	2.52
Coarse aggregate	2.70	1.29

DETAILS OF THE SPECIMEN

Cube, cylinder and beam specimen were cast for studying the variation in strength properties due the replacement of 0MS, 20MS, 40MS, 60MS and 80MS. For these various proportions, water cement ratios of 0.5 and 0.48 are adopted and the specimens are casted. The dimensions and the number of specimens used for this study are listed in the table 3. As per IS 10262:2009 Mix design was obtained for M30 grade concrete.

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Property of the specimen	Type of the specimen	Dimension of the specimen	Total number of specimens casted for each W/C ratio
7 days-Compressive strength	Cube	150mm×150mm×150mm	20
28 days-Compressive strength	Cube	150mm×150mm×150mm	20
28 days-Split tensile strength	Cylinder	Diameter - 150mm Height - 300mm	10
28 days-Flexural strength	Beam	1100mm×150mm×100mm	6

CASTING DETAILS

The specimens were cast for M30 grade concrete. The materials required are batched and weighed and mixed thoroughly using a mixer machine. The workability of fresh concrete was measured in terms of slump cone test and Vee Bee consistometer test. The cubes and cylinders were compacted using the vibrating table. The specimens are shown in the following figures

Fig 1: Cubes casted with 0% M- Sand

Fig 2: Cubes casted with 60% M-Sand

Fig 3: Cylinder casted with 0% M- Sand

RESULTS AND DISCUSSION

1. COMPRESSION STRENGTH TEST

The compressive strength of specimens with various replacement proportions of natural river sand by manufactured sand for different water cement ratios are shown in the following tables.

Table 4: Compressive strength results of M30 grade concrete of W/C= 0.5

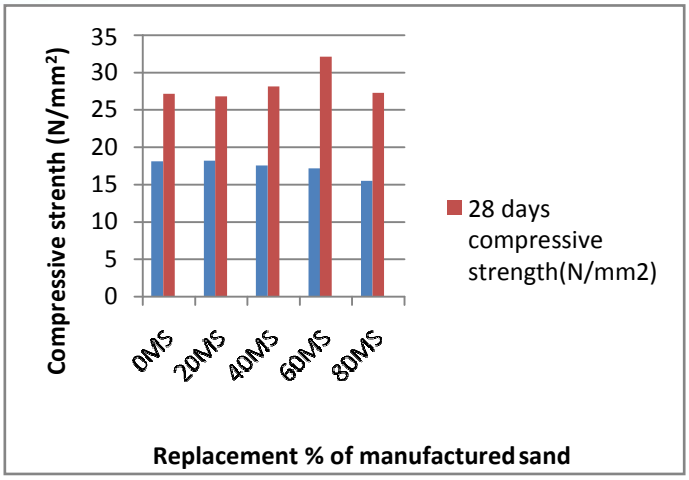

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Figure 6: Average Compressive strength of cubical specimen with various replacement proportions of manufactured sand (W/C = 0.5)

Types of fine aggregate	Mix proportion (Cement: river sand: M-sand: coarse aggregate)	Sample no.	7 days results		28 days results	
			Compressive strength (N/mm^2)	Average Compressive strength (N/mm^2)	Compressive strength (N/mm^2)	Average Compressive strength (N/mm^2)
0MS	1: 1.83: 0: 2.79	1	18.65	18.13	27.11	27.18
		2	16.87		24.67	
		3	18.87		29.77	
20MS	1: 1.46: 0.36: 2.79	1	19.54	18.20	18.44	26.81
		2	19.10		21.55	
		3	16.00		40.44	
40MS	1: 1.09: .73: 2.79	1	18.66	17.55	34.00	28.14
		2	16.01		33.33	
		3	18.03		17.11	
60MS	1: 0.73: 1.09: 2.79	1	17.77	17.18	32.67	32.13
		2	16.00		32.00	
		3	17.77		31.77	
80MS	1: 0.36: 1.46: 2.79	1	15.11	15.55	28.03	27.25
		2	16.00		29.11	
		3	15.55		24.67	

Table 5: Compressive strength results of M30 grade concrete of W/C =0.48

Types of fine aggregate	Mix proportion (Cement: river sand: M-sand: coarse aggregate)	Sample no.	7 days results		28 days results	
			Compressive strength (N/mm^2)	Average Compressive strength (N/mm^2)	Compressive strength (N/mm^2)	Average Compressive strength (N/mm^2)
0MS	1: 1.66: 0: 2.64	1	19.55	19.4	32.00	32.36
		2	16.88		33.33	
		3	21.77		31.77	
20MS	1: 1.328: 0.332: 2.64	1	20.44	20.14	25.11	29.62
		2	18.66		32.44	
		3	21.33		31.33	
40MS	1: 0.996: 0.664: 2.64	1	21.77	20.58	29.33	31.1
		2	19.77		32.22	
		3	20.22		32.00	
60MS	1: 0.664: 0.996: 2.64	1	22.11	20.96	34.22	35.00
		2	20.22		34.67	
		3	20.55		36.00	
80MS	1: 0.33: 1.32: 2.64	1	18.66	18.9	29.33	29.9
		2	16.88		28.88	
		3	21.33		31.55	

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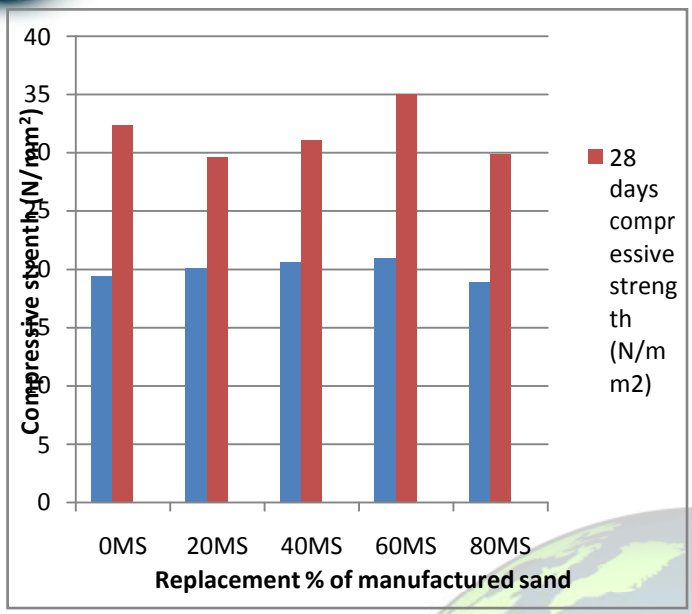

Figure 7: Average Compressive strength of cubical specimen with various replacement proportions of manufactured sand (W/C = 0.48)

SPLIT TENSILE STRENGTH TEST

The Split tensile strength of concrete specimens with various replacement proportions of natural river sand by manufactured sand for water cement ratio 0.48 is shown in the following table.

Table 6: Split tensile strength results of M30 grade concrete of W/C =0.48

Types of fine aggregate	Mix proportion (Cement: river sand: M-sand: coarse aggregate)	28 days Split tensile strength (N/mm^2)
0MS	1: 1.66: 0: 2.64	3.91
20MS	1: 1.328: 0.332: 2.64	2.32
40MS	1: 0.996: 0.664: 2.64	2.45
60MS	1: 0.664: 0.996: 2.64	2.49
80MS	1: 0.33: 1.32: 2.64	2.30

CONCLUSION

From the above study, the following conclusions are drawn:

1. Based on the compressive strength results of cubes, natural river sand is replaced by manufactured sand. The optimum replacement percentage of M-sand is 60% without the usage of any super-plasticizer.
2. By the comparison of Split tensile strength results, the strength of the concrete reduces up to 40% replacement of natural river sand by manufactured sand and the strength increases gradually beyond 40%.
3. Comparing the water cement ratio of 0.48 and 0.50, it is concluded that when the water cement ratio increases, the replacement percentage of manufactured sand and strength properties decreases.

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