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AN EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF MUCKING SAND AS FINE AGGREGATE IN CONCRETE

Vinoth Kumar R[1] and Anne Mary J[2]

[1]Quality Control Engineer, Afcons Infrastructure Ltd, Jammu & Kashmir
[2]Asst Prof, Department of Civil Engineering, VeltechDr.RR& Dr.SR University. Technology, Chennai.
3Assistant Professor, Dept. of Civil Engineering, SreeSastha Institute of Engineering and Technology, Chennai.

ABSTRACT

In the construction industry, there is a high demand for natural river sand/Crusher sand, especially in the production of concrete, which creates major sustainability issues. The best way to deal with these environmental concerns is to use waste or recycled material, as substitute for natural river sand/Crusher sand. This paper deals with replacement of sand used in concrete as fine aggregates by the waste generated by the Mucking particles. This study has made an attempt to partially replace mucking dust in place of sand in M30 grade concrete. On experimentation, it was found that the partial replacement of sand with 40% of mucking dust has given the optimum results. Therefore, this study recommends that if partial replacement of sand with mucking dust up to 40% in M30 grade of concrete is done, the effective waste management can contribute towards saving of our environment. Tests were conducted on cubes to study the strength of concrete made of Mucking Dust and the results were compared with the crusher sand Concrete. It is found that the compressive strength of concrete made of Mucking Dust are nearly 25% more than the conventional concrete Similar studies may be done with other concrete mix ratios and also for self compacting concrete.

Keywords **:** Mucking sand, Fine Aggregate, Optimum replacement

I. INTRODUCTION

Concrete is the most widely used composite material today. The constituents of concrete are coarse aggregate, fine aggregate, binding material and water. Rapid increase in construction activities leads to acute shortage of conventional construction materials. It is conventional that sand is being used as fine aggregate in concrete. For the past two years, the escalation in cost of sand due to administrative restrictions in India, demands comparatively greater cost at around two to three times the cost for crusher waste.

The function of the fine aggregate is to assist in producing workability and uniformity in the mixture. The river deposits are the most common source of fine aggregate. Now-a-days the natural river sand has become scarce and very costly. Hence we are forced to think of alternative materials. The Mucking materials may be used in the place of river sand fully or partly. A comparatively good strength is expected when sand is replaced partially or fully with or without concrete admixtures. It is proposed to study the possibility of replacing sand with locally available crusher waste without sacrificing the strength and workability of concrete.

2. MATERIALS USED

2.1 Cement

Ordinary Portland Cement (OPC) of 53 grade confirming to IS 12269-1987 was used for this study. The specific gravity and Blaine specific surface area of PC were 3.12 and 2250 cm2/gm respectively.

2.2. Aggregates

Dry and clean, locally available river sand conforming to grading zone-II as per IS: 383-1970 was used in concrete mixture. Its specific gravity was 2.65 with 1% absorption. Mucking sand is replaced for fine aggregate in prescribed below mix proportion. Locally available coarse aggregate from quarry was used and they are rather rounded in shape with a maximum size of 20 mm size. The specific gravity and water absorption of coarse aggregate were 2.79 and 0.3% respectively.

2.3. Water

Water conforming to the requirements of IS: 456-2000 is found to be satisfactory for making concrete. It is generally stated that water fit for drinking is suitable for making concrete. For the present research, potable water free from salts is used for concrete mixing and curing.

2.4. Mix Proportion and Mix details

The mix proportions were made for a control mix of slump 80 mm for M20, grade of concrete for w/c ratio of 0.50 respectively by using IS10262-2009 method of mix design. For each grade of concrete, total five mixes were made by replacing normal Mucking dust has been proposed as an alternative to crusher sand that gives additional benefit to concrete. Mucking dust is known to increase the strength of concrete over concrete made with equal quantities of crusher sand, but it causes a reduction in the

workability of concrete. Mucking dust is a kind of waste material that is generated from the tunnel. The present study is an attempt to experiment on use of mucking dust to replace crusher sand in concrete.

3. EXPERIMENTAL INVESTIGATION

Step:1 Gradation has carried out in mucking and found that too much of flakiness and oversize has found. If we can remove the oversize particles in mucking than we can use that one as sand.

I.S. SIEVE SIZE in mm	Retained Weight in(gm)	Cumulative Retained w.t in (gm)	Percentage Cumulative Wt Retained	Percentage of Passing	Permissible Limit
10	0	0	0	100	100
4.75	532	532	38.49	61.51	90-100
2.36	176	708	51.23	48.77	60-95
1.18	252	960	69.46	30.54	30-70
0.600	96	1056	76.41	23.59	15-34
0.300	102	1158	83.79	16.21	5-20
0.150	138	1296	93.78	6.22	0-10
PAN	86	1382	100.00	0.00	
TOTAL	1382				
FINENESS MODULUS			4.13		

The above result we have obtained is not satisfied.

Step:2 Gradation conducted in crusher sand + mucking sand in the ratio of 60:40

I.S. SIEVE SIZE in mm	Retained Weight in(gm)	Cumulative Retained w.t in (gm)	Percentage Cumulative Wt Retained	Percentage of Passing	Permissible Limit
10	0	0	0	100	100
4.75	166	166	16.97	83.03	90-100
2.36	66	232	23.72	76.28	75-100
1.18	120	352	35.99	64.01	55-90
0.600	90	442	45.19	54.81	35-59
0.300	290	732	74.85	25.15	8-30
0.150	154	886	90.59	9.41	0-10
PAN	92	978	100.00	0.00	
TOTAL	978				
FINENESS MODULUS			2.87		

Now we are getting in limits as we required, one thing found here also 16% oversize found if possible to control the oversize I make sure that we can use this as sand.

Step:3 Specific gravity and Water absorption

The Specific gravity of the aggregates that are used is tested by following the Indian Standards specification by following IS 2386 (Part III) – 1963. The specific gravity is one of the important factor that everything depends on the design mix also depends on the specific gravity of the materials that we use. As the particle size is less we will use pycnometer for sand. The empty weight of the pycnometer is measured and then it is filled with sand up to a mark and the weight is measured. Then water is filled with water and the weight is measured. Then weight of the pycnometer only with water is measured and the specific gravity of the fine aggregates used is calculated.

The same method is used for determining the specific gravity of the mucking dust.

Property	Mucking sand	Crusher Sand	Test method
Specific Gravity	2.8 - 2.92	2.680	IS2386(Part III)- 1963
Absorption (%)	3.0-3.2	2.70	IS2386(Part III)- 1963
Moisture Content (%)	Nil	Nil	IS2386(Part III)- 1963
Fine Particles Less than 0.075 mm (%)	12-15	10-12	IS2386(Part III)- 1963
Sieve analysis	Zone-II/ZoneI	Zone-II/ZoneI	IS 383- 1970

Step:4 Control Trail Mix

In this study, M30 concrete mix has been used with Ordinary Port-land Cement (OPC 53 Grade) with specific gravity of 3.15, conform-in to IS 12269: 1987 [14]. The maximum nominal size of coarse aggregates was 20 mm, and the sieve specifications conform to Table 2 of IS 383:1970 [15].

Based on the design mix for M30 in line with IS 456:2000 [16] and IS 10262:2009 [17], the mix ratio has been arrived at 1:2:3.6(cement:sand:coarseagg) with a water-cement ratio of 0.45.Adopting the above design-mix ratio, the control specimens Crusher sand 60% and Mucking sand 40% have been cast. The mix proportions were determined by conducting slump tests and using the mix ratio derived

Workability:

The workability is one of the physical parameters of concrete which affects the strength and durability and the appearance of the finished surface. The workability of concrete depends on the water cement ratio and the water absorption capacity of the aggregates. If the water added is more which will lead to bleeding or segregation of aggregates. The test for the workability of concrete is given by the Indian Standard IS 1199-1959 which gives the test procedure using various equipments. In our case we have used slump cone test for measuring the workability of concrete. We have measured the height of the fall of the cone of concrete for various water-cement ratios and recorded the values for ordinary concrete. Then the same procedure is

done with the concrete having the partial replacement of sand with raw quarry dust at various percentages.

Compressive strength*:*

Concrete has relatively higher compressive strength, but very poor in tensile strength. The different mix of concrete gives various strength, according to the IS10262: 1982 gives the characteristic and design strength values for various grades of concrete. The strength attained by the mix must be tested by its compressive strength of the samples which are made in the standard mould of size 150mm X 150mm X 150mm and then the cubes are kept for curing and the compressive strength test was done according to IS 516: 1959 for 7days, 28days for the partial replaced samples

Compression test

The cube specimens were tested for compressive strength at the end of 7 days and 28 days. The specimens were tested after surface of the specimen dried. The load was applied on the smooth sides without shock and increased continuously until the failure of the specimen. The maximum load withstand by the specimens is noted, mean compressive strength is determined.

The results show that there is an increase in the compressive strength of the concrete which the increment is about 60% to 80% depending on the replacement. The workability of the concrete is decreasing when the replacement percentage of the mucking sand is increasing gradually, so as to increase the workability small quantity of the fly-ash is replaced in place of cement to increase the workability.

This show that the fly ash and mucking sand replacement showed the desirable results which can suggest the usage of the mucking sand as replacement of crusher sand.

Compressive strength in N/mm2			
Days	Ordinary mix	30%	40%
7	27.5	33.6	43.26
28	36	48.2	58.6

4. CONCLUSION:

1. The Replacement of the crusher sand with mucking shows an improved in the compressive strength of the concrete.
2. As the replacement of the crusher sand with mucking increases the workability of the concrete is decreasing due to the absorption of the water by the mucking sand.

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