"COMPARATIVE STUDY ON STRENGTH OF MORTAR (REPLACING SAND WITH CINDER SAND)"

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ABSTRACT

Cinder being a highly pyroclastic material possesses mass less than that of the incentive aggregate. Apart from being vitric in nature. Cinder dust can be a replacement for fine aggregates for both construction industries as well as for road construction. The availability of natural river sand is becoming less in the environment hence there is a necessity to find replacement for natural river sand. This can be achieved by compensating the industrial wastes such as slag, cinder & manufacturing sand. Here in this research, natural sand is replaced partially with cinder as fine aggregates, in this regard, the replacement is so done to enhance the desired property of mortar. Commonly the natural sand is replaced by cinder sand but no emphasis on the size of the fine aggregate (fineness modulus) is taken into consideration which is based on the theory that property of the material changes due to variation in the size The properties of cinder sand is compared with natural river sands per IS 383. In this research sample cubes of standard size 70.6mm x 70.6mm x 70.6mm specimens have been casted for 1:3 proportion with replacement of sand with cinder by weight. The resultant samples have been tested for their strength and quality parameters to check the suitability of application of the above-mentioned replacement of natural aggregate with cinder to cement sand mortar.

KEYWORDS: Cinder, Natural River Sand, Replacement, Strength

INTRODUCTION

There is a need for conserving resources, environment and for proper utilization of energy. Hence, there has been a prominence on the use of waste and industrial byproducts in all areas including construction industries. Recently the growing trend towards the use of subsidiary materials is emphasized, for cement mortar because of shortage of materials. In this study the performance of cement mortar mix, applicable for casting of the replacement of sand with cinder is scrutinized. Cement mortars of mix proportion 1:2 & 1:3, W/C 0.45, 0.55, 0.65 with incorporating various percentage of cinder. The mortar performance is studied in terms of compressive strength and unit weight. The type of light weight aggregate, its physical characteristics and particle strength are stated to be limiting factors in controlling the achievable mortar strength. However, the strength of light weight aggregate is also reported to be highly influenced by the other factors like bulking of fine aggregate, cement content, inclusion of mineral admixtures method and period of the water binder ratio. This experimental study is aimed to investigate the Compressive strength and unit weight of mortar by incorporating different dosage of Cinder material obtained from local steel industries as partial replacement of sand. Our objective is based on the use of cinder as fine aggregate taking the size and fineness modulus into consideration, and showing whether the basic properties of mortar increases with decrease in size or vice versa. In the present-day construction, it is used as a bottom or sub grade aggregate in floorings as well as washrooms in buildings and pavement construction. The present investigations involve the use of cinder aggregate in making conventional concrete by replacing the conventional granite and fine aggregate in partial or full amounts. Cinder aggregates being light in weight, the dead loads of the structure are significantly reduced. Cinder is one among the best alternatives for coarse and fine aggregates for making conventional concrete in respect of the properties like density and workability, though the strength development is low at different replacement levels. Many industries such as paper mills use coal as a fuel for firing boilers to generate steam. After the coal is as burnt in the boilers, it leaves a residue known as "coal ash, or coal cinder". It's basically the power or pieces from burned or unburned coal that is nor reduced to ashes but is incapable of further reduction. Coal cinder is an inorganic waste produced in the combustion black coal in the boiler house. This by product can be a valuable resource, becoming an alternative to natural fines used in bricks and concrete.

MATERIALS AND METHODS

Infrastructure forms the backbone of modern world and as such its improvement to enhance its properties and to make it sustainable is important. Cementitious materials lie at the heart of infrastructural development. In this research, following materials were used for experimental procedures: • Portland pozzolana cement • Fine aggregate • Fine cinder sand • Water

Mix was prepared as per specifications of IS 383. Samples were prepared in proportions as shown below:

• Cement sand ratio was kept at 1:3 • Water cement ratio was set up at 0.4 • Cinder samples were made by addition of 10%, 20% 30% and 40% of cinder sand in replacement of river sand. • Samples were casted by using cinder sand of different fineness modulus as replacement. • Cubes of standard size of 70.6 mm x 70.6 mm x 70.6 mm have been casted. • Control samples were prepared without replacement of cinder sand.

In this research, a total of 117 samples were made for testing compressive strength at 7 days, 14 days and 28 days.3 samples were casted of each percentage of cinder sand of particular fineness modulus for each phase of testing. After 24 hours the specimens were remoulded. It was guaranteed that the size and shape of remoulded blocks did not get disturbed in the process, curing period was done in accordance with IS 456-2000 and was kept for 14 days. Sieve test was done in accordance with IS 4031(1)-1996 and was conducted to find fineness of cement. Standard consistency test was conducted in lab with the help of vicat's apparatus in accordance with IS 4031(1)-1988 (part 5). To determine setting time of cement vicat's apparatus was used and at that time room temperature was about 22-28 degree Celsius.

RESULTS AND DISCUSSION

1.FINENESS OF CEMENT (PPC)

To check the fineness of the cement, sieve test was conducted; by sieving 100g of cement through IS sieve No.9 (90 micron) on three different samples as prescribed in code. The fineness test details are shown in Table 1. It was found that average weight of residue left on sieve was 7.3% which is less than 10% hence it can be claimed that cement is fit to use.

Sample NO.	Weight of cement sample (g) W	Weight of residue (g) W1	Fineness (W1/W)100	Average fineness
1	100	7.2	7.2	7.3
2	100	7.7	7.7	
3	100	6.9	6.9	

Table 1

2.STANDARD CONSISTENCY OF CEMENT

The standard consistency of cement is that consistency, which allows the vicat's plunger to penetrate to a point 5 to 7mm from bottom of the vicat mould when tested. This test was conducted on 5 different samples of 400g each, at 5 different percentages of water. The complete observation has been compiled in Table 2.

S.no.	1	2	3	4	5
Weight of cement(g)	400	400	400	400	400
%age water added by weight of cement	25	27	29	31	32
Weight of water added (g)	100	108	116	124	128
Penetration of plunger (mm)	20	26	30	32	34
Standard consistency in %age	32				

Table 2

3.SPECIFIC GRAVITY

Specific gravity also called relative density is the ratio of a substance to the density of a reference substance.

The specific gravity of soil particles is determined using the relation:

$$G = D / C - (A - B)$$

Where;

D = Weight of oven dried sample

C = Weight of sample

A = Weight of sand + water + pycnometer

B = Weight of pycnometer filled with water only.

Observation and calculation for specific gravity of soil are shown in table 3:

S.no.	Description	Sample no.	
		1	2
1	C	500	500
2	A	1818	1810
3	B	1500	1501
4	D	498	498
Specific gravity of sand		2.64	

Table 3

Observation and calculation for specific gravity of cinder are shown in table 4:

S.no.	Description	Sample no.	
		1	2
1	C	500	500
2	A	1740	1736
3	B	1500	1497
4	D	497	495
Specific gravity of sand		1.9	

Table 4

4. INITIAL SETTING TIME AND FINAL SETTING TIME

The setting behaviour of cement is assessed by two time periods known as initial setting time and final setting time. Different types of cement have different setting times. Hence it is mandatory to find these parameters. With the help of vicat's apparatus these tests were carried out in lab, and the results obtained in laboratory were compared with the standard values of cement; where it was found that results are under permissible limits.

Initial setting time: 39 minutes

Final setting time: 496 minutes

CONCLUSION

It may be concluded that usage of cinder, industrial waste aggregate to some extent (80%) along with natural aggregate (20%) in industrial waste admixtures such as Super plasticizer has proved to be quite satisfactory with respect to various strengths studied. Based on the above experimental investigation the usage of light weight industrial waste aggregate such as cinder to some extent (80%) along with natural sand (20%) and industrial waste admixture. With the increase of cinder sand, the percentage of compressive strength will increase by 2% initially with small replacement then with the increase of cinder sand the compressive strength decreases up to 7% and also with the increase of cinder sand, the compressive strength decreases but smaller the fineness modulus higher the strength as compared to that of higher fineness modulus

REFERENCES

Bryan, Dennis. S. P, "Occurrence and uses of natural lightweight aggregate in the western United States", Lightweight aggregate in Western United States, January 1989, pp. 89-193.

P.S. Raghu prasad, R. Satish, D.B. Nirmala, A.V. Pradeep Kumar, "Experimental investigation on solid concrete blocks with partial replacement of coarse aggregate with Cinder aggregate".

M. A. Calderone and R. G. Burg, "Development of very low density structural lightweight concrete", ACI journal, vol. 218, February 2004, pp. 177-188.

Watkins, J. and Liu, K.L.W., "A Finite Element Study of Short Beam Test Specimens under Mode-II loading", The International Journal of Cement Composites and Light Weight Concrete, Vol.7, No.1, Feb.1985, pp.39-47.

Owens, P.L. (1993). "Light weight aggregates for structural concrete," Structural Light weight Aggregate Concrete, Chapman & Hall, London, pp.1-18.

N. Siva lingaRao, G. VenkataRamana, V. Bhaskar Desai, B. L.P. Swamy, "Properties of lightweight aggregate concrete with cinder and silica fume admixture", International Journal of Earth Sciences and Engineering, Vol. 4, No. 6, October 2011, pp. 907-912.

Dr.V. Bhaskar Desai, A. Satyam,'Some studies on strength properties of Light weight cinder aggregate concrete', "volume 4 issue 2, feb 2014

A text book of "concrete Technology" by M.S. Shetty.

Sivakumar and Prakash M "Characteristic studies on the mechanical properties of quarry dust addition in conventional concrete" in the Journal of Civil Engineering and Construction Technology Vol. 2(10), pp. 218-235.

IS: 383:1970 Indian standard institution, Specifications of coarse and fine aggregates from natural sources of concrete.

Singh S., Nagar R., and Agarwal, V." A review on properties of sustainable concrete using granite dust as a replacement for river sand". Journal of cleaner production, Vol.126, pp.74-87, (2016).

Silvia Smeu, Andrei Gal and Catalin Badea, "Environmental Friendly Building Materials: Unfired Clay Bricks" Journal of Environment, Vol. 03, Issue 03, pp. 47-50, (2014).

IS: 12269-2013, physical requirement for 53 Grade ordinary Portland cement.

IS 3495(Part 1)-1992, Testing of Bricks: Compressive strength test.

IS 3495(Part 2)-1992, testing of bricks: Water absorption test.