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Effect of Waste Foundry Sand on properties of Concrete

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Abstract : Foundry sand consists primarily of silica sand, coated with a thin film of burnt carbon, residual binder (bentonite, sea coal, resins) and dust. Foundry sand can be used in concrete to improve its strength and other durability factors. Foundry Sand can be used as a partial replacement of cement or as a partial replacement of fine aggregates or total replacement of fine aggregate and as supplementary addition to achieve different properties of concrete. In the present work, experimental investigations were performed to evaluate the comparative study of the properties of fresh & hardened concrete containing ferrous & non-ferrous foundry waste sand as fine aggregate replacement and Coal bottom ash as cement replacement. The various strength properties studied consist of compressive strength. The strength development for various percentages (0-20%) replacement of sand with Waste Foundry Sand can easily be equated to the strength development of normal concrete at various ages.

Keywords: Coal bottom ash, Compressive strength, Specific gravity, Water absorption, Waste foundry sand

I. INTRODUCTION

Foundry sand is high quality silica sand with uniform physical characteristics. It is a by-product of ferrous and non-ferrous metal casting industries, where sand has been used for centuries as a molding material because of its thermal conductivity. It is a by-product from the production of both ferrous and non-ferrous metal castings. The physical and chemical characteristics of foundry sand will depend in great part on the type of casting process and the industry sector from which it originates. In modern foundry practice, sand is typically recycled and reused through many production cycles. The automotive industries and its parts are the major generators of foundry sand. Foundries purchase high quality size-specific silica sands for use in their molding and casting operations. The raw sand is normally of a higher quality than the typical bank run or natural sands used in fill construction sites. The sands form the outer shape of the mold cavity. These sands normally rely upon a small amount of bentonite clay to act as the binder material. Chemical binders are also used to create sand "cores". Depending upon the geometry of the casting, sands cores are inserted into the mold cavity to form internal passages for the molten metal. Once the metal has solidified, the casting is separated from the molding and core sands in the shakeout process. In the casting process, molding sands are recycled and reused multiple times. Eventually, however, the recycled sand degrades to the point that it can no longer be reused in the casting process. At that point, the old sand is displaced from the cycle as by-product, new sand is introduced, and the cycle begins again. Although there are other casting methods used, including die casting and permanent mold casting, sand casting is by far most prevalent mold casting technique. Sand is used in two different ways in metal castings as a molding material which focuses the external shape of the cast part and as cores that form internal void spaces in products such as engine blocks. Since sand grains do not naturally adhere to each other so binders must be introduced to cause the sand to stick together and holds its shape during the introduction of molten metal into mold and cooling of casting.

Amritkar and Chandak (2015) studied the effect of waste foundry sand (WFS) on the mechanical properties of concrete with artificial sand as fine aggregate made the observation as compressive strength increases on increase in percentage of waste foundry sand in concrete. Pathariya Saraswati and it all found that application of waste foundry sand for evolution of low- cost concrete P_S cost effective and strength increases with percentage increase of sand.

The continuous reduction of natural resources and the environmental hazards posed by the disposal of waste foundry sand has reached alarming proportion such that the use of waste foundry sand in concrete manufacture is a necessity than a desire. The use of waste foundry sand in normal strength concrete is a new dimension in concrete mix design and if applied on large scale would revolutionize the construction industry, by economizing the construction cost and decreasing the ash content. This paper presents the experimental investigation carried out to study the effect of use of Waste Foundry Sand as a replacement of fine aggregate.

II. MATERIALS AND METHODS

2.1 Materials

ISI mark 53 grade cement (Brand- Ultratech) was used for all concrete mixes. The cement used was fresh and without any lumps. Testing of cement was done as per IS:8112-1989. The sand used for the experimental program was locally procured and conformed to grading zone III as per IS: 383-1970. Crushed stone aggregate with a maximum particle size of 12.5mm and 20mm was obtained from local quarry & was used as coarse aggregate. Normal sand was used as fine aggregate in all concrete mixes. Sieve analysis of all fine aggregates & coarse aggregate was carried in the laboratory. The w/c ratio was kept constant for all the mixes. Mix proportion of M20 grade was used to produce the mixes.

2.2 Mixing and test procedures

A careful procedure was adopted in the batching, mixing and casting operations. The concrete mixture was prepared by rotating drum concrete mixer and hand mixing. The proportions of fine aggregates were fed into the drum first and mixed thoroughly. After that coarse aggregate were added to it. Then water was added carefully so that no water was lost during mixing. Cubical moulds of size 150mm*150mm*150mm were casted for compression strength test was used. The moulds were cleaned & oiled properly before every pouring. The concrete was filled in the moulds in three layers, each layer being tamped with tamping rod. Also the vibrations were given by putting the cubes on the chasis of the mier. The specimens were allowed to remain in the steel mould for the first 24 hours at ambient condition and were covered with plastic sheet to prevent moisture loss due to evaporation. After that these were demoulded with care so that no edges were broken and were placed in the curing tank at the ambient temperature for curing. At the end of every curing period, the samples were taken out of curing tank and were tested.

III. EXPERIMENTAL RESULTS &DISCUSSIONS

3.1 General

Various properties of concrete incorporating foundry sand at various replacement levels with fine aggregate were studied, results were compared and checked for compressive strength, & water absorption of foundry sand mix with ordinary mix.

3.2 Concrete properties

Table1. shows the compressive strength of concrete with partial replacement of sand by WFS. Water absorption & Specific gravity are important indicators for the durability of hardened concrete. Reduction of water absorption, Fineness Modulus & porosity can greatly enhance the long term performance & service life of concrete in aggressive service environments. Decreased porosity also benefits the compressive & flexural strengths of concrete, as a fundamental relationship exists between porosity and strength of solids.

PHYSICAL PROPERTIES OF WFS:

- Sp. Gravity = 2.63
- Fineness Modulus = 1.89

PHYSICAL PROPERTIES OF SAND:

- Sp. Gravity = 2.45

- Fineness Modulus = 3.92
- Water absorption = 0.51 %

PHYSICAL PROPERTIES OF AGGREGATE:

- Sp. Gravity = 2.84
- Fineness Modulus = 6.21
- Water Absorption = 0.95%

TABLE 1.COMPRESSIVE STRENGTH TEST RESULTS

SR.NO	MATERIAL	Compressive strength (N/mm^2)		
		7DAYS	14DAYS	28DAYS
1.	Cement+Sand+Aggregate (0% WFS)	24.73	25.47	27.85
2.	Cement+Sand+Aggregate (2% WFS)	25.32	22.80	33.60
3.	Cement+Sand+Aggregate (4% WFS)	26.89	25.99	34.81
4.	Cement+Sand+Aggregate (6% WFS)	29.99	30.22	38.50
5.	Cement+Sand+Aggregate (8% WFS)	26.81	30.07	31.50
6.	Cement+Sand+Aggregate (10% WFS)	27.10	29.18	30.15

In this research the values of compressive strength for different replacement levels of waste foundry sand contents (0%, 2%,4%,6%,8%,10%) at the end of different curing periods (7 ,14 & 28 days) are plotted in fig. 1, which show the variation of compressive strength with fine aggregate replacements at different curing ages. It is evident from Fig. 1 that compressive strength of concrete mixtures with 2%, 4% and 10 % of foundry sand as sand replacement was higher than the control mixture at 7, 14 & 28 days age and the strength was maximum at 6 % replacement level for both types of sands.

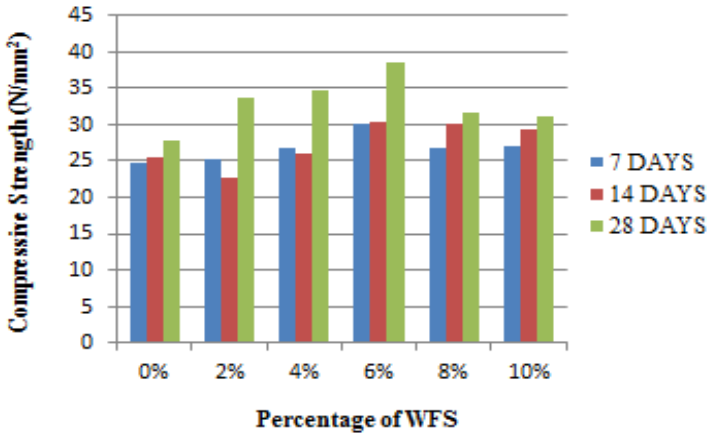

Fig.1. Variation of compressive strength with fine aggregate replacements at different curing ages.

IV. CONCLUSION

As we have conducted multiple practices on Concrete by adding different percentage of material i.e. Waste Foundry Sand (WFS), we concluded

- The Compressive strength of Conventional concrete improves by replacing Sand with Waste Foundry Sand with 6%.
- During practices we found that the strength of conventional concrete goes on increasing till a certain percentage of replacement of Sand with WFS.
- As we keep increasing the percentage of replacement of Sand with WFS, the compressive strength of concrete get reduced.
- Maximum compressive strength of concrete is obtained at 6% replacement of sand with WFS.

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