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Strength Properities of Plain Concrete Using Waste Foundry Sand

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ABSTRACT - An acute shortage of river sand which is generally used as a fine aggregate in concrete has been affecting the construction sector. Foundry Sand can be used as a partial replacement of fine aggregates or total replacement of fine aggregate and as supplementary addition to achieve different properties of concrete. This experimental investigation was performed to evaluate the strength properties of concrete mixtures, in which river sand was partially replaced with Waste Foundry Sand by weight. Compression test was carried out at the age of 28 days of curing. Split tensile test was performed at the age of 28 days. Flexural strength was tested at 28 days of curing.

Test results indicate an increase in compressive strength of plain concrete by inclusion of WFS as a partial replacement of fine aggregate. The maximum strength was achieved at 40% replacement, after which there was loss in compressive strength, split tensile strength

Key Words: Waste Foundry Sand, Compressive Strength, Split Tensile Strength

I. INTRODUCTION

Concrete, in the broadest sense, is any product or mass made by the use of a cementing medium. Generally, this medium is the product of reaction between hydraulic cement and water. As far as the hardened state is considered, the usual requirement is a satisfactory compressive strength. Many properties of concrete are related to its compressive strength such as density, impermeability, durability, resistance to abrasion, resistance to impact, tensile strength, resistance to sulphates.

1.1 Waste Foundry sand:

Solid waste management has become one of the global environmental issues, as there is continuous increase in industrial by-products and waste materials. Due to lack of land filling space and its ever-increasing cost, utilization of waste material and by-products has become an attractive alternative to disposal. Waste foundry sand (WFS) is one of such industrial by-products. Ferrous and non-ferrous metal casting industries produce several million tons of by-product in the world. In India, approximately 2 million tons of waste foundry sand is produced yearly.

1.2 FOUNDRY SAND IN MOLD CASTING:

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. 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.

II. LITERATURE REVIEW:

D.Lawrence and M. Mavroulidou [1] (2009) Found out the properties of concrete containing waste foundry sand. **Rafat Siddique, Geert de Schutter and Albert Noumowec[2]** mechanical properties of concrete mixtures in which fine aggregate (regular sand) was partially replaced with waste foundry sand. **Yogesh Aggarwal, Paratibha Aggarwal, Rafat Siddique, El-Hadj Kadri and Rachid Bennacer [3] (2010)** presented the design of concrete mixes made with waste foundry sand as partial replacement of fine aggregates. **Gurpreet Singh and Rafat Siddique [4] (2011)** carried out an experimental investigation to evaluate the strength and durability properties of concrete mixtures, in which natural sand was partial replaced with (WFS). **Gurpreet Singh and Rafat Siddique [5] (2011)** investigated the abrasion resistance and strength properties of concrete containing waste foundry sand (WFS). **Rafat Siddique and El-Hadj Kadri [6] (2011)** dealt with the effect of foundry sand (FS) and metakaolin (MK)

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Sl. No.	Mix ID	Compressive Strength (MPa)		
		M 20 Grade	M 40 Grade	M 60 Grade
1	WFS0	26.89	48.69	69.76
2	WFS20	30.37	52.76	72.23
3	WFS40	33.86	54.65	73.83
4	WFS60	26.31	45.63	61.62
5	WFS80	21.95	41.57	57.41
6	WFS100	19.77	34.59	43.45

Compressive Strength of Various Concrete Mixes with Replacement of Fine Aggregate over WasteFoundry Sand for Different Grades of Concrete

Sl. No.	Mix ID	Compressive Strength (MPa)		
		M 20 Grade	M 40 Grade	M 60 Grade
1	WFS0	3.26	5.05	7.12
2	WFS20	3.63	5.61	7.88
3	WFS40	4.34	6.37	9.06
4	WFS60	3.16	4.91	6.89
5	WFS80	2.93	4.25	6.28
6	WFS100	2.22	3.82	4.86

Split Tensile Strength of Various Concrete Mixes with Replacement of Fine Aggregate over Waste Foundry Sand for Different Grades of Concrete.

III. TESTING PROGRAM

Compression Test: Compression test is the most common test conducted on hardened concrete, partly because it is an easy test to perform, and partly because most of the desirable characteristic properties of concrete are qualitatively related to its compressive strength. Compressive strength is the capacity of a material or structure to withstand axially directed pushing forces. When the limit of compressive strength is reached, materials are crushed. Concrete can be made to have high compressive strength. Compressive strength is often measured on a universal testing machine; these range from very small table top systems to ones with over 53 MN capacity. Measurements of compressive strength are affected by the specific test method and conditions of measurement. The cube

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specimen was placed in the machine, of 2000kN capacity. The load was applied at a rate of approximately 140 kg/cm^2/min until the resistance of the specimen to the increasing load can be sustained.

Split Tensile Test: The load was applied at a rate of approximately 140 kg/cm^2/min until failure of the specimen. The maximum load applied was recorded at failure. Assuming concrete specimen behaves as an elastic body. A uniform lateral tensile stress of acting along the vertical plane causes the failure of the specimen.

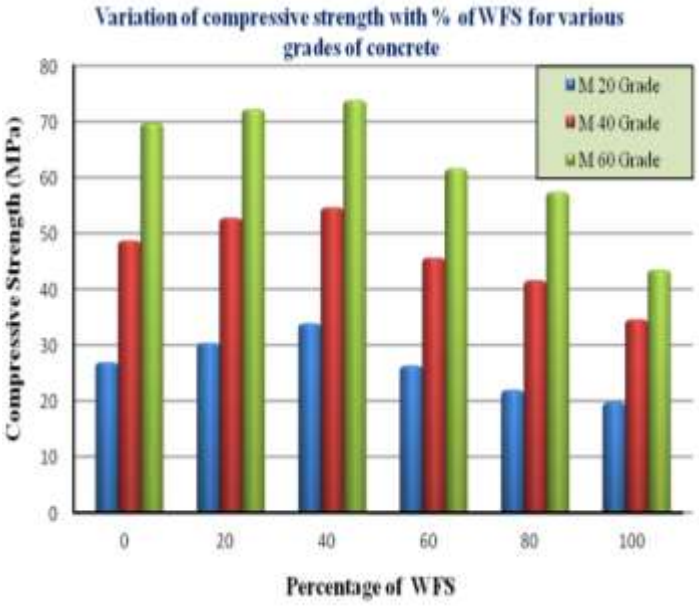

Chart -1: **Compressive Strength of Various Concrete Mixes with Replacement of Fine Aggregate over Waste Foundry Sand for Different Grades of concrete.**

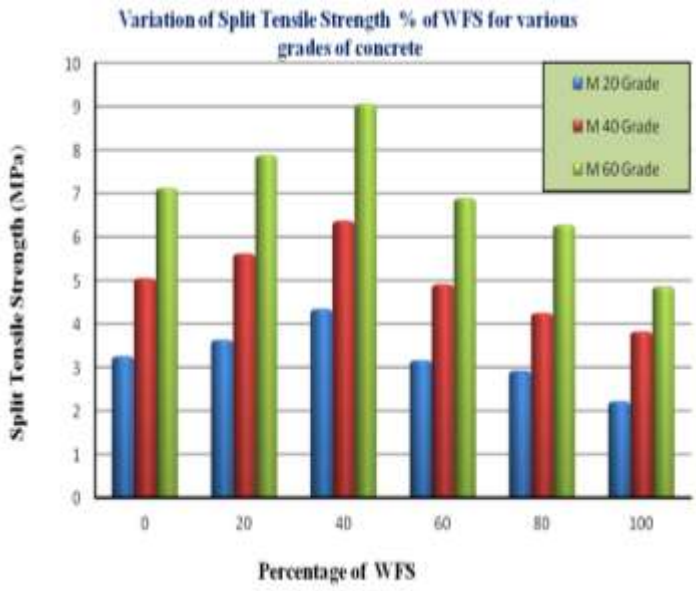

Chart 2: Split Tensile Strength of Various Concrete Mixes with Replacement of Fine Aggregate over Waste Foundry Sand for Different Grades of Concrete

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Fig -1: **Curing of Test Specimens**

IV. CONCLUSIONS

- Increase in compressive strength of the concrete with increases in waste foundry sand up to 40% and the maximum compressive strength is achieved at 40% replacement of natural fine aggregate with waste foundry sand which comes to be 33.86 MPa for (M20 grade), 54.65 MPa for (M40 grade) and 73.83 MPa for (M60 grade) respectively and then there was a considerable decrease in the strength.
- Replacement of fine aggregate with waste foundry sand showed increase in the split tensile strength of plain concrete of grade M20, M40 and M60 up to 40% and then there was a considerable decrease in the strength. Maximum strength was achieved at 40% i.e., 4.34 MPa, 6.37 MPa and 9.06 MPa respectively.
- When percentage of waste foundry sand was increased beyond 40% the mix started losing its workability.
- Use of foundry sand in concrete can save the ferrous and non-ferrous metal industries disposal, cost and produce a 'greener' concrete for construction.
- Environmental effects from wastes and disposal problems of waste can be reduced through this research.
- A better measure by an innovative Construction Material is formed through this research.
- The used foundry sand can be innovative Construction Material but judicious decisions are to be taken by engineers.

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