



“Effects Of Waste Foundry Sand On The Properties Of Concrete”

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Abstract: The construction industry and concrete manufacturers have realized that they will need to use available aggregate rather than search for the perfect aggregate to make an ideal concrete suitable for all purposes. Simultaneously significant increase in the other construction materials production like steel will produce a lot of industrial waste such as used foundry sand. This can be used in the production of concrete for specific purposes. In this work, effects of utilization of used-foundry sand as partial replacement for regular sand (fine aggregate) in concrete were investigated. The data obtained in this investigation will be used to establish mixture proportions for concrete and construction applications.

Keywords: waste foundry sand, compressive strength, water absorption

I. INTRODUCTION

Concrete is the most widely used construction material in the construction industry and offers a number of advantages including good mechanical and durability properties, low cost and high rigidity. Over the past several decades the demand for concrete has been increasing rapidly due to growth in infrastructure development. River sand is one of the main ingredients in concrete production and it is used as a fine aggregate.

The heavy demand for concrete has resulted in the over-exploitation of river sand in the river bed and this has led to a range of harmful consequences, including increased river bed depth, water table lowering and the intrusion of salinity into rivers. The restriction in the extraction of sand from the river increases the price of sand and has severely affected the stability of the construction industry. As such finding an alternative material to river sand has become imperative.

Over the past several decades an enormous amount of research has been carried on the use of industrial waste as a substitute/replacement material for fine aggregate. The research findings revealed that the substitution of an alternative material in concrete could improve both the mechanical and durability properties and the practice led to the sustainable concrete development. Foundry Sand (FS) is a by-product

from the metal alloys casting industry with high silica content. Silica sand is bonded with clay or chemicals, and is used for the material casting process.

Foundries recycle the sand many times and when the sand is no longer recyclable, it is disposed of this is called foundry sand. About 15% of sand used by foundries is ultimately disposed of amounting to millions of tons. In India many foundries dump this waste in nearby vacant areas. Which creates an environmental problem? With increased restrictions on disposal in nearby areas industries are constrained to find alternative ways to reuse waste. Past few decades FS have been utilized in highway applications but the amount of waste re-utilized in this way is still negligible. For this reason there is a need to utilize FS in other ways become very imperative. Recently research has been carried out on the utilization of FS in concrete and concrete related products.

Waste Foundry Sand (WFS) is a byproduct from the production of both ferrous and nonferrous metal castings. It is high quality silica sand. Foundries use high quality size-specific silica sands for use in their molding and casting operations. Normally raw sand is of a higher quality than the typical bank run or natural sands used in fill construction sites. In the casting process, molding sands are recycled and reused many times. When recycled sand degrades to a level that it can be no longer is reused in the casting process. When it is not possible to further reuse sand in the foundry it is removed from the foundry and is termed as waste foundry sand.

The physical and chemical characteristics of foundry sand depend upon the type of casting process and the type of industries. Classification of foundry sands depends upon the type of binder systems used in metal casting. Two types of binder systems are generally used and on the basis of that foundry sands are categorized as clay-bonded sands (green sand) and chemically bonded sands. Clay-bonded (Green) sand is composed of naturally occurring materials which are blended together high quality silica sand(85–95%), bentonite clay (4–10%) as a binder, a carbonaceous additive(2–10%) to improve the casting surface finish and water (2–5%). It is black in color due to carbon content.

II. Green sand is the most commonly used molding media by foundries. The silica sand is the bulk medium that resists high temperatures while the coating of clay binds the sand together. The water adds plasticity. The carbonaceous additives prevent the “burn-on” or fusing of sand onto the casting surface. Green sands also contain trace chemicals such as MgO, K₂O and TiO₂. The green sand used in the process constitutes upwards of 90% of the molding materials used.

III. Chemically bonded sands are used both in core making where high strengths are necessary to withstand the heat of molten metal and in mold making. Chemically bonded sand consists of 93–99% silica and 1–3% chemical binder. Silica sand is thoroughly mixed with the chemicals a catalyst initiates the reaction that cures and hardens the mass. There are various types of chemical binder systems used in the foundry industry. The most common chemical binder systems used are phenol-urethanes, epoxy-resins and sodium silicates. Chemically bonded sands are generally light in color and in texture than clay bonded sands. Waste Foundry Sand (WFS) is also referred as Spent Foundry Sand (SFS) or Used Foundry Sand (UFS).

II.METHODOLOGY

Material used:

The materials used in this present work are foundry sand, Ordinary Portland cement (53 grade), coarse aggregates and fine aggregates.

Table No. 3.1 Observation table for fineness modulus of waste foundry sand

Sieve Size	Mass retained (gms)	Cumulative mass Retained (gms)	Cumulative percentages retained (%)	Cumulative percentages passing (%)
4.75 mm	7	7	1.4	98.6
2.36 mm	4	11	2.2	97.8
1.18 mm	6	17	3.4	96.6
600 μ	15	32	6.4	93.6
300 μ	235	267	52.4	47.6
150 μ	201	468	93.6	6.4

Fineness modulus = sum of cumulative % of mass retained on the sieve / 100

$$= 159.4 / 100$$

$$= 1.59$$

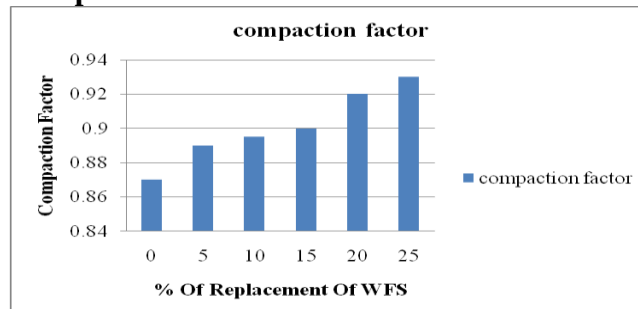
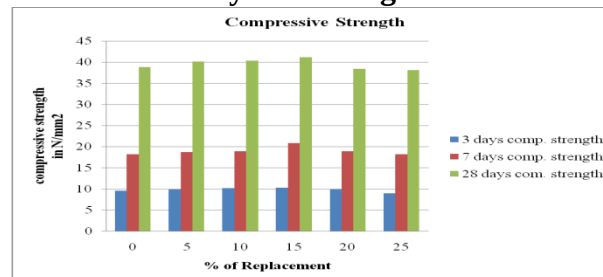
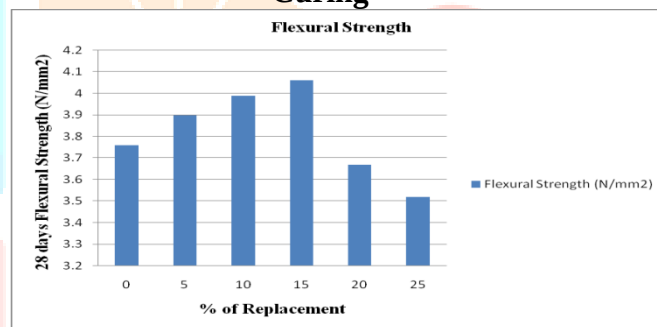
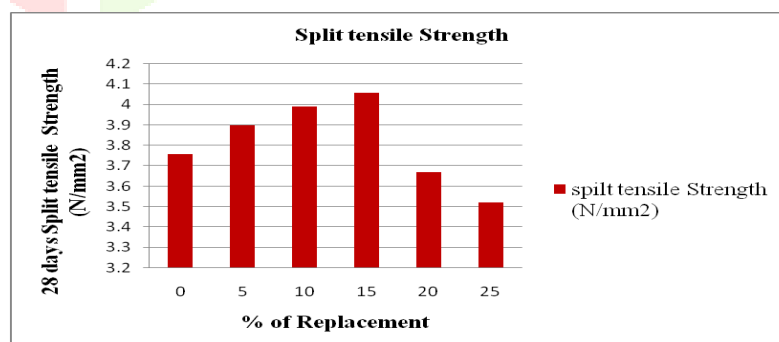
Table 2- Physical properties of Waste Foundry Sand

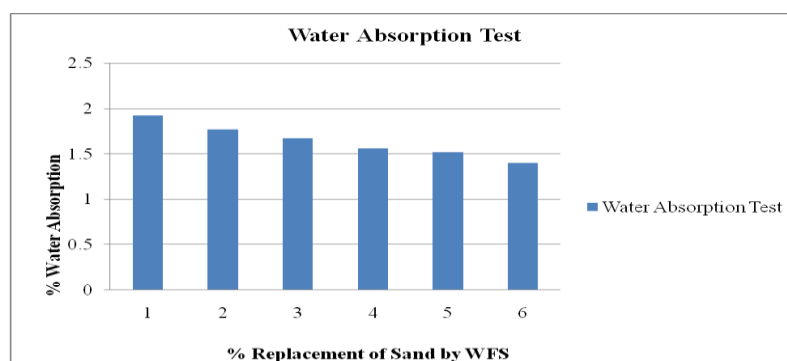
Characteristics	Value
Color	Grey(Blackish)
Specific Gravity	02.49
Water Absorption	1.16 %
Fineness Modulus	1.59 %

Table 3.3 - Chemical properties of Waste Foundry Sand and fine Aggregate

Constituents	WFS % by Weight	Fine Aggregate
Silica (SiO ₂)	78.81–95.10	80.78
Iron Oxide (Fe ₂ O ₃)	0.94–5.39	1.75
Alumina (Al ₂ O ₃)	0.81–10.41	10.52
Calcium Oxide (CaO)	0.14–1.88	3.21
Magnesium oxide (MgO)	0.30–1.97	0.77
Titanium Dioxide (TiO ₂)	0.04–0.22	Nil
Sodium Oxide (Na ₂ O)	0.19–0.87	1.37
Potassium Oxide (K ₂ O)	0.25–1.14	1.23

IV. RESULT AND DISCUSSION

Graph 1: Comparative Compaction Factor values of concrete with sand replacement WFS.**Graph no.2. Conventional concrete using waste foundry sand Compressive Strength after 3, 7 & 28 Days of Curing****Graph no.3. Conventional concrete using waste foundry sand Flexural Strength after 28 Days of Curing****Graph No.4. Conventional concrete using waste foundry sand Split tensile Strength after 28 Days of Curing.**

Graph No.5: Comparative water absorption of concrete with Sand replacement with WFS for 28 days**V. CONCLUSION**

The present experimental research work was carried out to evaluate the suitability of waste foundry sand as a partial replacement of river sand in concrete. Experiment was conducted by replacing river sand with waste foundry sand in varying percentages in concrete. Based on the analysis of test results we can conclude.

- 1) Natural sand can be possibly replaced partially waste foundry sand in concrete.
- 2) Replacement of natural sand with waste foundry sand showed increases in the split tensile strength and flexural strength up to the 15% replacement then after split tensile strength reduced.
- 3) Water absorption of concrete reduces as the percentage of waste foundry sand in concrete increases. As voids in the concrete reduce water absorption goes on reducing. Also unit weight of concrete goes on reducing with the replacement of cement due to lower specific gravity of WFS.
- 4) Use of foundry sand in concrete will be minimizing the disposed problem of waste foundry sand and it's an eco-friendly.
- 5) Waste foundry sand is more available than any other raw material thus the cost of waste foundry sand is considerable lower than that of similar material.

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