Properties of Concrete Comprising of Waste Foundry Sand (WFS) for Partial Substitution of Fine Aggregates (FA)

Daljeet Kumar[1], Sanjay Kumar Sharma[2]

[1]*Civil Engineering Department, NITTTR, Chandigarh 147004, India*
[2]*Civil Engineering Department, NITTTR, Chandigarh 147004, India*

Abstract - *Increased population and technological developments have resulted in increased generation of waste. Many academicians and engineers throughout the country are thus searching for innovative methods to decrease or better utilise trash as value-added resources. Different industrial waste are intensively examined as a substitute/replacement material for finely aggregated products throughout several decades. This study investigates impacts of the usage of used-foundry sand as a partial substitute for standard (fine) sand. Although used/spent casting sand has not even been adequately studied for material properties for their probable usage in concrete. The data gathered in this study will be used for blending concrete and building applications. The compressive strength is seen to be between 29–32 MPa, splitting tensile strength within 1.8–2.46 MPa and bending resistance within 3.95–4.10 MPa range for replacing fine aggregates between 10% and 50% at the interim of 10%.*

Key Words: Industrial by-products, Waste foundry sand (WFS), Fine aggregates (FA)

1. INTRODUCTION

Concrete is next to the water and also the world's most widely utilized building material. Concrete is a vital aspect of contemporary human civilization in developing architecture and buildings. Cement, water sand, and coarse aggregates play a crucial part in mix design are the major components in contemporary concrete. Since river sand consumption is significant in the fast construction of infrastructure, demand in developing nations is also quite high. As a developing country, India has a strong need for the same thing. As a way of tackling this problem, the substitution of river sand in part or in full is being considered.

Fig -1: Waste foundry sand.

Substituting this component is a major difficulty and even today's needs. The supplemental cementitious materials are previously utilized for waste materials such as recovered demolitions material, slag, recycled glass, calcium carbide residues, fly ash, etc. This industry waste causes environmental difficulties. The utilization of this trash is therefore highly important and has to be highlighted. Foundry sand is one such substance. WFS is a potential resource that may be utilized in concrete as a replacement for natural sand.

2. Literature Review

Several publications comment on the usage of foundry sand on the basis of their reports, little widespread WFS information is collected below in numerous structural applications. Sand-foundry is a by-product of the metal casting industry of ferrous and non-ferrous metals. Foundries reclaim and reuse sand in a foundry numerous times effectively. When the sand cannot be reused in the foundry, it is discarded and is called foundry sand. Foundry sand is silica sand of excellent grade. Since its great heat conductivity, foundry sand was utilized for centuries as a casting medium. Ultimately around 15%, or millions of tons, of sand used by smelters is disposed of. Many foundries in India dump this trash in unoccupied regions, causing environmental problems. Industrial waste causes a lot of ecological hazards. In addition, the environmental impacts of each of the basic concrete components are different. Used in vast amounts across the world, it creates several sustainable development problems. The overuse of natural sand and gravel, which constitute the concrete, is growing. There is an increasing concern as the Building sector has been badly affected by limits on sand extraction from the river which has led to an increase in sand prices. Therefore, the search for alternatives to this problem has become vital.

3. Experimental program

As there is a large-scale production/availability of used/spent foundry sand from foundry industries in the world so this study aims to demonstrate the feasibility of using WFS in concrete as a substitute for FA by evaluating the strength and durability properties of concrete. In the present study such WFS was obtained from mini steel plant. This investigation was directed toward obtaining strength and durability data on concrete incorporating used foundry sands. This experimental investigation was

performed to evaluate the strength and durability properties of M30 grades of concrete mixes, in which natural sand was partial replaced with WFS obtained from a steel production plant in India. This foundry sand was replaced with three percentages (10%, 20%, 30%) of WFS by weight. The properties of material used for making concrete mix are determined in laboratory as per relevant code of practice. Different materials used in present study were cement, coarse aggregates, FA and WFS. Descriptions of various materials of concrete were used in this study.content comes here . Conclusion content comes here

4. Results and discussions

The outcomes of experimental research are reported for different tests to assess the compressive strength (CS), splitting tensile strength (STS), and flexural strength (FS) effects of WFS when utilized as partial substitutions for FA in the proportion of 0, 10, 20, and 30 percent. The average value of 3 specimens for each category at 3 days, 7 days, and 28 days of compressive strength, tensile strength, and flexural strength, together with an increase of concrete mixed with WFS is presented in Table 1.

Table -1: Strengths of concrete mixes with replacement of FA with WFS.

Mix		M0	M1	M2	M3
% of WFS Replacement		0	10	20	30
% of Fine Aggregate		100	90	80	70
Compressive Strength	3 Days	12.09	13.84	14.19	14.9
	7 Days	19.56	20.63	21.31	21.87
	28 Days	28.41	29.09	29.67	30.84
Tensile Strength	3 Days	1.01	1.14	1.34	1.56
	7 Days	1.83	1.94	2.06	2.47
	28 Days	2.76	2.81	2.97	3.48
Flexural Strength	3 Days	1.31	1.62	1.93	2.13
	7 Days	2.23	2.32	2.41	2.54
	28 Days	3.35	3.46	3.57	3.62

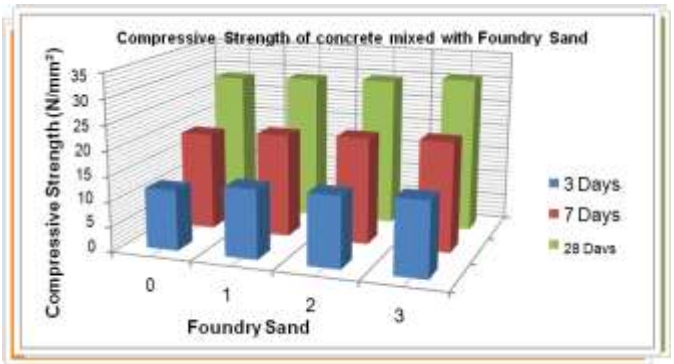

Fig -2: Compressive strength of concrete mixes with replacement of FA with WFS at3, 7 & 28 days.

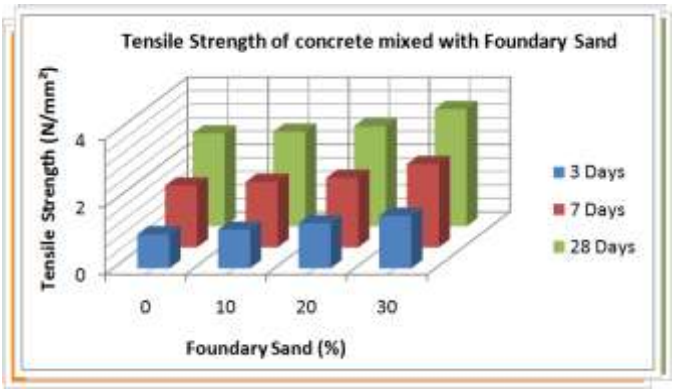

Fig -3: Tensile strength of concrete mixes with replacement of FA with WFS at 28 days.

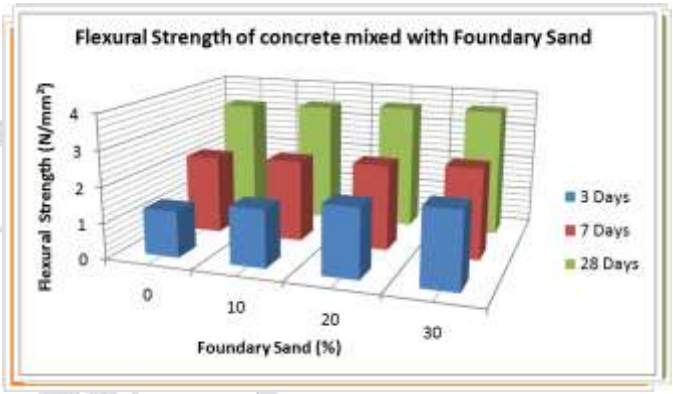

Fig -4: Flexural strength of concrete mixes with replacement of FA with WFS at 28 days.

From figure 2 it can be seen that curing time period along with increase in the percentage of WFS has significant effect on compressive strength increase. Compressive strength increased with increase in age of WFS. The compressive development of WFS and concrete mixes was higher as compared to concrete mixes having no WFS. From figure 3 it can be seen that curing time period along with increase in the percentage of WFS has significant effect on tensile strength increase. Tensile strength increased with increase in age of WFS. The tensile development of WFS and concrete mixes was higher as compared to concrete mixes having no WFS. From figure 4 it can be seen that curing time period along with increase in the percentage of WFS has significant effect on flexural strength increase. Flexural strength increased with increase in age of WFS. The flexural development of WFS and concrete mixes was higher as compared to concrete mixes having no WFS.

Thus from Figure 2, Figure 3 and Figure 4, it is seen that at 30% replacement, WFS showed considerable improvement on strength properties (compressive strength, splitting tensile strength and flexural strength) of concrete and on the basis of these results from the present study, conclusions are drawn.

5. CONCLUSIONS

The following findings are drawn on the basis of the trials undertaken:

- 8.55% increment in the CS was found at 30% substitution of FA with WFS at 28 days correlated to normal concrete.

- 8.55% increment in the TS was found at 30% substitution of FA with WFS at 28 days compared to normal concrete.
- Replacement of FA with WFS showed an improvement in the STS of concrete up to 30%.
- 8.55% increment in the TS was found at 30% replacement of FA with WFS at 28 days compared to normal concrete.
- CS, STS, and FS of concrete mixtures increased with age for all the foundry sand contents.

The findings of the survey indicated that WFS utilized for use in the production of high-grade concrete and building materials might be useful in making good quality concrete.

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