PERFORMANCE EVALUATION OF ECOLOGICAL CONCRETE USING FOUNDRY SAND

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Abstract: Generation of waste foundry sand as a by-product of metal casting industries causes environmental problems such as infertility of land, unsightly, awful smell etc. because of its improper disposal. Thus, its usage in building material and in other fields is essential for reduction of these environmental problems. This research is carryout to produce a low-cost concrete. An experimental investigation is carry out on a concrete containing waste foundry sand in the range of 0%, 10%, 20% and 30% by weight for M-40 grade concrete. The concrete containing foundry sand is to be test and compare with conventional concrete in terms of workability, compressive strength, split tensile strength and flexural strength. Cubes will be cast and compression test will be performance on 7^{th}, 14^{th}, 21^{th} and 28^{th} days. Cylinder and beam will be cast and test be performance on 7^{th} and 28^{th} days. The aim of this research is to know the mechanical properties of concrete after adding optimum quantity of waste Foundry sand in different proportion.

Keywords- Waste foundry sand; Concrete; Mix design; Casting and Testing; Compressive strength; Split tensile strength; Flexural strength.

I. INTRODUCTION

The industrial byproducts which have been disposed earlier are now being considered for beneficial use. Beneficial use can reduce our nation's carbon production and consumption of virgin material and result in economic gains. It is important component of nation's solid waste management hierarchy that first promotes source reduction and waste prevention followed by reuse, recycling, energy recovery and disposal. Researches all over the world today are focusing on ways of utilizing either industrial or agricultural wastes as a source of raw materials for the industry.

These wastes utilization would not only be economical, but may also result to foreign exchange earnings and environmental pollution control. The utilization of industrial and agricultural waste produced by industrial process has been the focus of waste reduction research for economical, environmental and technical reasons. This is because over 300 million tons of industrial wastes are being produced per annual by agricultural and industrial process in India. The problem arising from continuous technological and industrial development is the disposal of waste material. If some of the waste materials are found suitable in concrete making not only cost of construction can be cut down, but also safe disposal of waste material can be achieved.

The compressive strength, split tensile strength and flexural strength of conventional concrete and fine aggregate replaced concrete are compared and the results are tabulated. The most critical problem we are facing now a day is the deficiency of artificial resources for the construction purpose. The reason behind this is the ban of on extraction of sand ordered by government. To solve this problem, we are using solid waste from industries as a replacement material for fine aggregate i.e. used foundry sand. The foundry industry is diverse and complex. Although there are differences in some specific operations, the foundry processes vary only slightly from one foundry to another. The main foundry process produces metal or alloy castings by pouring molten metal into molds.

The molds may be made of molding sand and core sand or may be of a permanent type made of metal and a refractory lining. After hardening, the castings are removed from the molds, processed and finished. The raw materials (sands) used for making foundry molds are usually recycled. However, after multiple uses, they lose their characteristics, thereby becoming unsuitable for further use in manufacturing processes, and all the raw materials are then discarded as waste. Used Foundry sand (UFS) is a discarded material coming from ferrous and nonferrous metal-casting industry. It's a mixture of high-quality size-specific silica sand, few -amount of impurity of ferrous and nonferrous by-products from the metal casting process itself and a variety of binders. It can be reused several times in foundries but, after a certain period, cannot be used further and becomes waste material, referred to as used or spent foundry sand (UFS or SFS).

II. SIGNIFICANCE OF THE WORK

- To evaluate the strength of concrete with the use of Waste foundry sand.
- To review available literature for Waste foundry sand and on the base of that to do some experiments.
- To investigate the various proportion of Waste foundry sand in the mix design.
- To compare results of various proportion of Waste foundry sand in the mix design by following test
  a. Compressive Strength Test (at 7, 14 and 28 days),
  b. Flexural test (at 7 and 28 days)

c. Split Tensile Test (at 7 and 28 days).

III. EXPERIMENTAL INVESTIGATION

[1] Material Used:

Cement -Cement is one of the important elements of mortar it is the binding material in mortar which is used for all building elements. Most important value is the faster rate of development of strength. Ordinary Portland cement 53 grade is used for casting the mortar cubes. Cement properties are evaluated as per the IS methods.

Fine Aggregate -Natural river sand well graded passing over 4.75 mm sieve is will be used. Fine aggregate followed to Indian Standard Specifications IS: 383-1970.

Table 1 Property of fine aggregate

Sr No.	Property	Test Results
1	Specific gravity	2.48
2	Water absorption	1.01%
3	Moisture content	0.1%

Coarse Aggregate -Uncrushed gravel or stone which is the result of natural breakdown and crushed gravel or stone are usually called the "Coarse Aggregates". As stated earlier, coarse aggregates are stones that are retained on 4.75mm sieve. Nearly all natural aggregates make from bed rocks. Fine aggregate properties are calculated as per the IS 2386-1963 methods.

Table 2 Property of coarse aggregate

Sr No.	Property	Test Results
1	Specific gravity	2.51
2	Water absorption	1.38%
3	Moisture content	0%

Waste foundry sand -Waste foundry sand obtained locally. It is used as a replacement (0%,10%,20%, & 30%) to the fine aggregate. The tests are conducted on WFS for its physical properties.

Table 3 Property of Waste foundry sand

Sr No.	Property	Test Results
1	Specific gravity	2.35
2	Water absorption	1.01%
3	Moisture content	0%

Water -Fresh and clean water is utilized for throwing the examples in the present investigation. The water is generally free from natural issue, sediment, oil, sugar, chloride and acidic material and so forth according to Indian standard. The pH esteem at the very least 6.

[2] Mixing Proportion:

Following table showing mix design of M40 and M70 with replacement of fine aggregate. The fine aggregate replacement with WFS with different level like 0%,10%,20% and 30%.

Table 4 Mix Proportion(M40)

Cement (kg/m^3)	F.A (kg/m^3)	C.A (kg/m^3)	Water (Lt/m^3)	Admixture (Lt/m^3)
518.84	668.29	922.58	197.16	3.2

Table 5 Partial Replacement of WFS

Replacement % of WFS	Fine aggregate (kg/m^3)	WFS (kg/m^3)
0%	735.07	0
10%	668.29	66.78
20%	601.51	133.56
30%	534.73	200.34

IV. Results and Discussion:

[1] Compressive strength:

Concrete cubes of size 150×150×150mm were casted and tested for compressive strength of 7th, 14th ,28th days for 0%, 10%, 20% and 30% replacement of Fine aggregate by WFS.

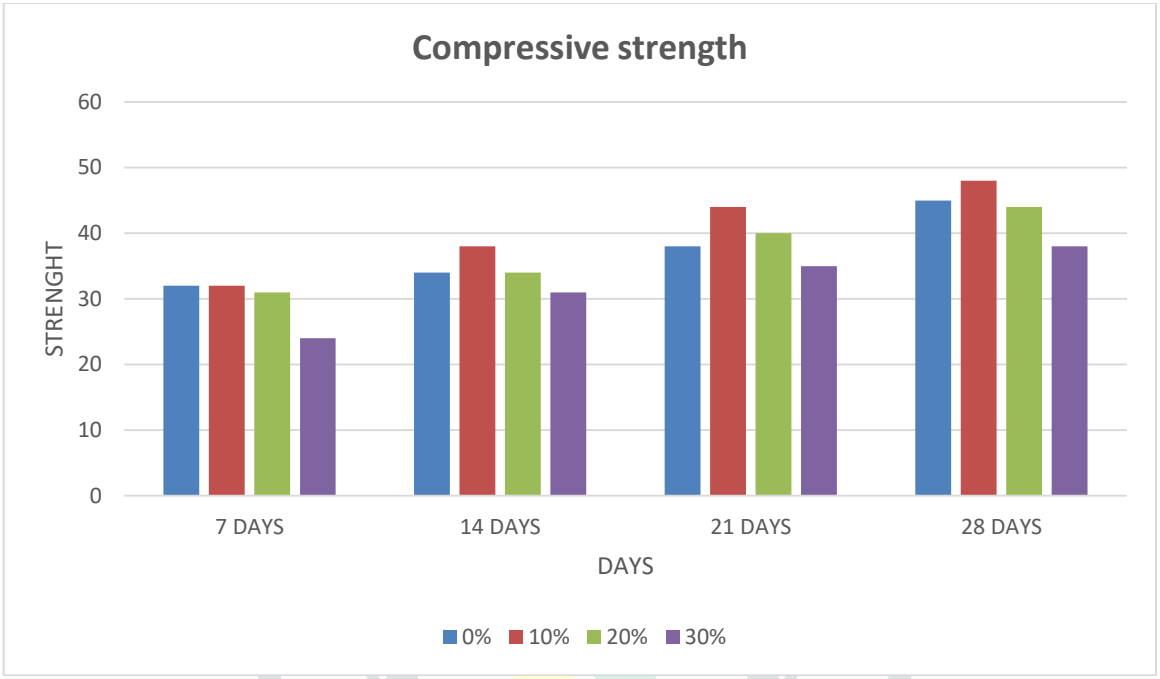

Figure 1 compression test results

[2] Split Tensile strength:

Figure 2 shows tensile strength results for mix with different percentage of Waste foundry sand.

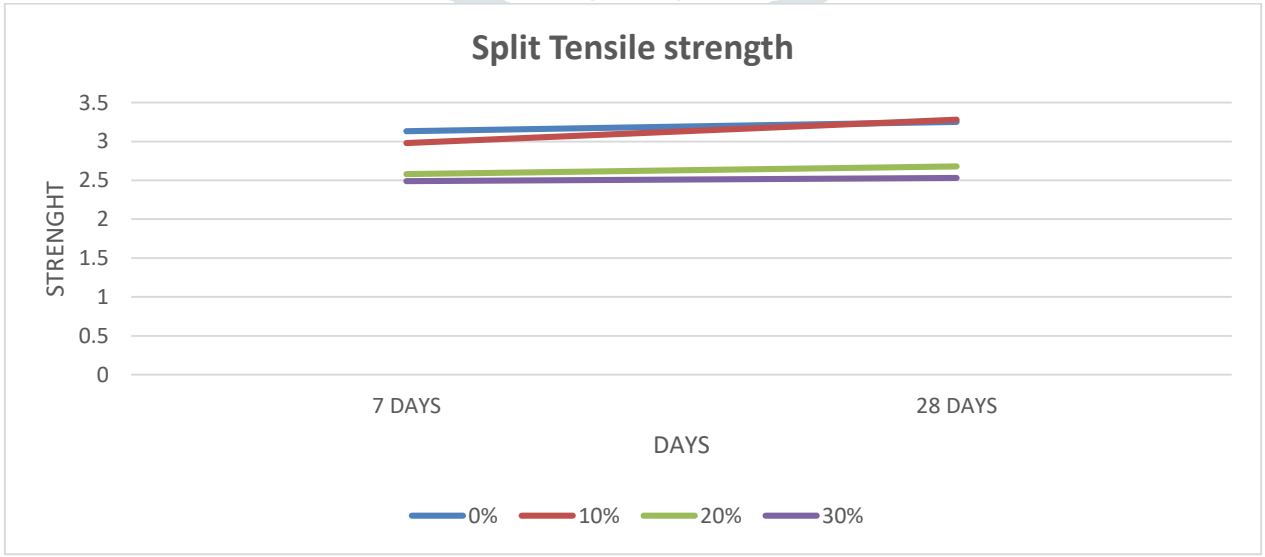

Figure 2 Split tensile test results

[3] Flexural strength:

Figure 3 shows Flexural strength results for mix with different percentage of Waste foundry sand.

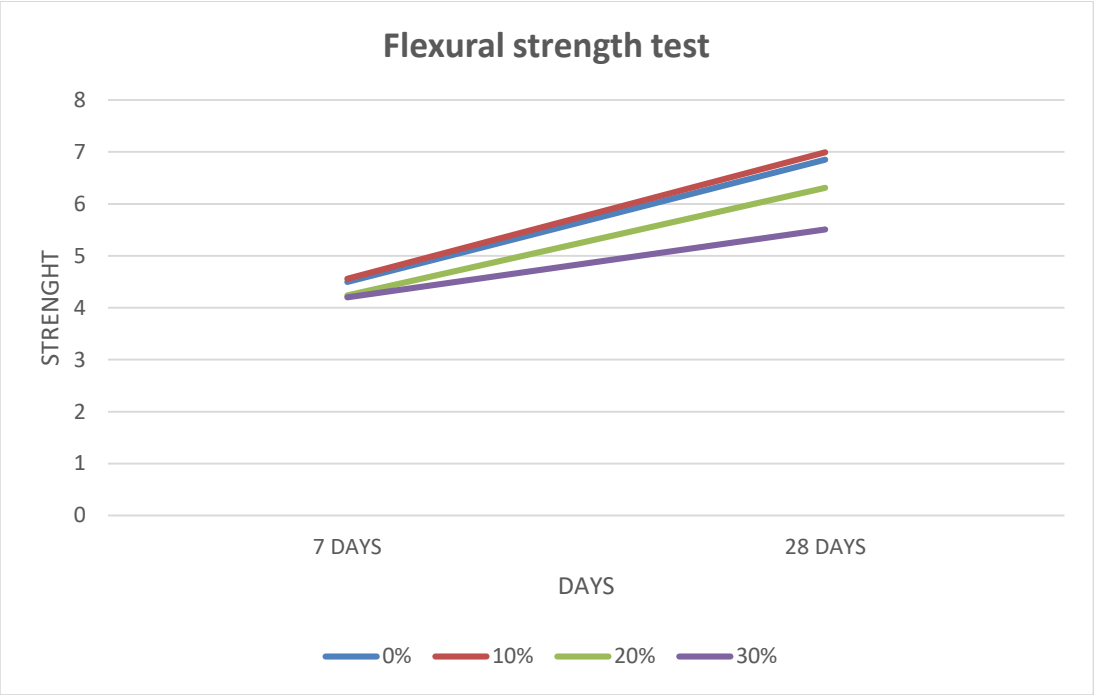

Figure 3 Flexural strength test results

V. CONCLUSION

1. The compressive strengths were increased with increase in the foundry sand in the concrete mix up to 20% and will decrease after 20%.
2. The split tensile strengths were increased with increase in the foundry sand in the concrete mix up to 10% and will decrease after 10%.
3. The Flexural strengths were increased with increase in the foundry sand in the concrete mix up to 10% and will decrease after 10%.

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