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A STUDY ON COMPRESSIVE STRENGTH OF CONCRETE BY PARTIAL REPLACEMENT OF SAND WITH WASTE FOUNDRY SAND

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Abstract – *Conservation of natural resources and preservation of environment is the essence of any development. The problem arising from continuous technological and industrial development is the disposal of waste material. If some of the materials are found suitable in concrete making not only cost of construction can be put down, but also safe disposal of waste materials can be achieved. Metal foundries successfully recycle and reuse the sand many times in a foundry. When the sand can no longer be reused in the foundry, it is removed from the foundry and is termed "foundry sand". Foundry sand consists primarily of silica sand, coated with a thin film of burnt carbon, residual binder 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 as supplementary addition to achieve different properties of concrete.*

Key Words: **Waste Foundry sand, concrete, Mix Design, Compressive Strength, Partial Replacement,**

1. INTRODUCTION

Concrete is a composite material composed of gravels or crushed stones (coarse aggregate), sand (fine aggregate) and hydrated cement (binder). It has been in use for over a century in all construction works. A variety of new materials in the field of concrete technology have been developed during the recent past with the ongoing demand of construction industries to meet the functional, strength ,economical and durability requirements. The worldwide consumption of sand as fine aggregate in concrete production is very high and several developing countries have encountered some strain in the supply of natural sand in order to meet the increasing needs of infrastructural development in recent years. To overcome the stress and demand of river sand, researchers and practitioners in the construction industries have identified some alternatives. Concrete is a mixture comprised of cement (10-15 percent), coarse and fine aggregates (60-75 percent) and water (15-20 percent) by volume. Foundry sand can be used as a fine aggregate substitute in PCC concrete. Ferrous and no ferrous metal casting industries produce several million tons of by-product in the world. But use of waste foundry sand for land filling is becoming a problem due to rapid increase in disposal cost. In an effort to use the WFS in large volume, research has being carried out for its possible large scale utilization in making concrete as partial replacement of fine aggregate The ferrous metal casts in foundry are cast iron and steel, non-ferrous metal are aluminium, copper, brass and bronze. Over 70% of the total by-product material consists of sand because moulds consist usually of moulding sand, which is easily available, inexpensive, resistance to heat damage and easily bonded with binder and other organic material in mould. These WFS is black in colour and contain large amount of fines. The typical physical and chemical property of WFS is dependent upon the type of metal being poured, casting process, technology employed, type of furnaces (induction, electric arc and cupola) and type of finishing process (grinding, blast cleaning and coating). The Compressive test is conducted for 25%, 50% and 75% replacement of foundry and natural sand.

1.1 Foundry Sand

Foundry sand consists primarily of clean, uniformly sized, high-quality silica sand or lake sand that is bonded to form molds for ferrous (iron and steel) and nonferrous (copper, aluminum, brass) metal castings. Although these sands are clean prior to use, after casting they may contain Ferrous (iron and steel) industries account for approximately 95 percent of foundry sand used for castings. The automotive industry and its parts suppliers are the major generators of foundry sand. WFS was used as a partial replacement of fine aggregate (natural river sand). 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 moulding material because of its thermal conductivity. It is a by-product from the production of both ferrous and non-ferrous metal castings.

Fig-1 Foundry Sand

TABLE-1 Constituent of Foundry sand

Constituent	Value (%)
SiO_2	87.91
Al_2O_3	4.70
Fe_2O_3	0.94
CaO	0.14
MgO	0.30
SO_3	0.09
Na_2O	0.19
K_2O	0.25
TiO_2	0.15
P_2O_5	0.00
Mn_2O_3	0.02
SrO	0.03
LOI	5.15
TOTAL	99.87

2. MATERIALS USED

Cement: The most common cement used is an ordinary Portland cement. The Ordinary Portland Cement of 43 grade (JYOTHI cement OPC) conforming to IS: 8112-1989 is be use. Many tests were conducted on cement.

Fine aggregate: Those fractions from 4.75 mm to 150 micron are termed as fine aggregate. The river sand and crushed sand is be used in combination as fine aggregate conforming to the requirements of IS: 383. The river sand is wash and screen, to eliminate deleterious materials and over size particles.

Coarse Aggregate: The fractions from 20 mm to 4.75 mm are used as coarse aggregate. The Coarse Aggregates from crushed Basalt rock, conforming to IS: 383 is being use.

Foundry sand: Metal foundries use large amounts of the metal casting process. Foundries successfully recycle and reuse the sand many times in a foundry and the remaining sand that is termed as foundry sand is removed from foundry. This study presents the information about the civil engineering applications of foundry sand, which is technically sound and is environmentally safe. Use of foundry sand in various engineering applications can solve the problem of disposal of foundry sand and other purposes. We used foundry sand from mechanical department KLS's VDRIT, Haliyal.

Water: Water is an important ingredient of concrete as it actually participates in the chemical reaction with cement. Since it helps to from the strength giving cement gel, the quantity and quality of water is required to be looked into very carefully.

3. MATERIALS PROPERTIES

1. Water absorption test on coarse aggregate= 4%
2. Specific gravity of fine aggregate = 2.66
3. Specific gravity of coarse aggregate = 2.8
4. Specific gravity of cement= 3.17

4. EXPERIMENTAL PROGRAM

- A careful procedure was adopted in the batching, mixing and casting operations for M_{25}.
- The coarse aggregates and fine aggregates were weighed first with an accuracy of 0.5 grams.
- The concrete mixture was prepared by rotating drum concrete mixer. The proportions of fine aggregates were fed into the drum first and mixed thoroughly.
- After that coarse aggregates 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 testing and 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 vibrator.
- 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 de moulded with care so that no edges were broken and were placed in the curing tank at the ambient temperature for curing.
- Compressive strength test is conducted for 7days and 28days in Compressive testing machine

Fig-2 Mixing

TABLE – 1 MIX PROPORTION OF CONCRETE WITH FOUNDRY SAND (20 CUBES)

% REPLACEMENT	FOUNDRY SAND(kg)	CEMENT(kg)	F A (kg)	C A (kg)	WATER (kg)
CONVENTION	0	33.24	51.19	69.04	13.29
25%	12.79	33.24	38.4	69.04	13.29
50%	25.6	33.24	25.6	69.04	13.29
75%	38.39	33.24	12.79	69.04	13.29

5 RESULTS

TABLE -2 COMPRESSIVE STRENGTH OF CONCRETE ON 7 DAYS

SAMPLE NO.	CONVENTIONAL	25% REPLACEMENT OF FOUNDARY SAND	50% REPLACEMENT OF FOUNDRY SAND	75% REPLACEMENT OF FOUNDRY SAND
1.	18.9	8.88	16.44	13.43
2.	16.96	6.65	16.89	12.35
3.	17.8	10.33	17.23	12.44
AVERAGE	17.88	8.62	16.85	12.74

TABLE – 3 COMPRESSIVE STRENGTH OF CONCRETE ON 28 DAYS

SAMPLE NO.	CONVENTIONAL	25% REPLACEMENT OF FOUNDARY SAND	50% REPLACEMENT OF FOUNDRY SAND	75% REPLACEMENT OF FOUNDRY SAND
1.	23.43	14.74	23.58	26.67
2.	20.94	16.56	24.97	23.55
3.	25.61	15.91	27.48	24.39
AVERAGE	23.32	15.73	25.34	24.87

COMPRESSIVE STRENGTH GRAPH

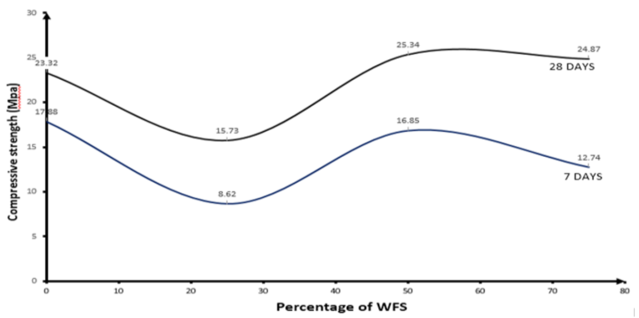

Fig-3 Compressive Strength Vs % Replacement Of Foundry Sand

6. CONCLUSIONS AND SCOPE

- The maximum compressive strength was achieved with 50% replacement of fine aggregate with waste foundry sand.
- Optimum replacement of foundry sand is 50% in our context and further replacement reduces the compressive strength of concrete.
- A suitable recycling of the discarded foundry sand as building construction material could be suggested.
- Waste foundry sand can be effectively used as fine aggregate in place of conventional natural sand in concrete.
- Environmental effects from wastes and disposal problems of waste can be reduced through this project.
- Compressive strength of concrete can increase by using non-ferrous foundry sand with replacement of natural sand.

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