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EFFECT OF WASTE FOUNDRY SAND ON THE DIFFERENT PROPERTIES OF CONCRETE

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ABSTRACT

Used-foundry sand is a by-product of ferrous and nonferrous metal casting industries. Foundries successfully recycle and reusable 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 waste foundry sand. In an effort to utilization waste foundry sand in large volume, research is being carried out for its possible large-scale utilization in making concrete as partially replacement of fine aggregate. This paper presents the results of an experimental investigation carried out to evaluate the different properties of concrete mixtures in which fine aggregate (regular sand) was partially replaced with waste-foundry sand (WFS). Fine aggregate was replaced with five percentages (5%,10%,15%, 20%, and 25%) of WFS by weight. Tests were performed for the properties of fresh concrete. Compressive strength, splitting- tensile strength, flexural strength andnon-destructive test were determined at3, 7and 28 days. Test results indicated a marginal increase in the strength properties of plain concrete by the inclusion of WFS as partial replacement of fine aggregate (natural sand) and that can be effective used in creating good quality concrete and construction materials.

KEYWORDS: Industrial waste, waste-foundry sand, Compressive strength.

1. INTRODUCTION

Concrete is the most widely used construction material in the construction industry and offers a number of advantages, including most of mechanical and durability properties, low cost, and high rigidity. River sand is one of the main ingredients in production of concrete and it is mostly 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. 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.

Ferrous and non-ferrous metal casting industries produce several million tons of by-product in the world. WFS is major byproduct of metal casting industry and successfully used as a land filling material for many years. 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 Foundry industry produces a large amount of by-product material during casting process. The ferrous metal casts in foundry are cast iron and steel, nonferrous metal are aluminum, copper, brass and bronze. Over 70% of the total by-product material consists of sand because moulds consist usually of molding sand, which is easily available, inexpensive, resistance to heat damage and easily bonded with binder and other organic material in would. Foundry industry use high quality specific size silica sand for their molding and casting process. These WFS is black in color and contain large amount of fines.

2. OBJECTIVES OF INVESTIGATION

- To know the behavior of compressive and split tensile strength of foundry sand.
- Utilization of foundry sand will reduce the disposal problem of foundry sand.

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3. MATERIALS AND METHODS

Cement
Ordinary Portland cement (Ultra tech cement 53 grade) of confirming to IS: 12269-1987 was used. All properties of cement are tested as per IS: 12269.Specific gravity of cement was 3.15

Fine Aggregate
The locally available river sand was used as fine aggregate 4.75 mm size confirming to zone II with specific gravity 2.6. The testing of sand was conducted as per IS: 383-1970.Water absorption and fineness modulus of fine aggregate was 1.23% and 2.671 respectively.

Coarse Aggregate
Coarse aggregate used was 20mm and less size with specific gravity 2.75. Testing of coarse aggregate was conducted as per IS: 383-1970. Water absorption and fineness modulus of coarse aggregate was 0.63% and 6.013 respectively.

Waste Foundry Sand
Waste foundry sand was found locally. Waste foundry sand can be found from KSB Company near the Ahmednagar. The waste foundry sand was used as partial replacement of fine aggregate (natural sand). The physical and chemical properties are same about that the natural sand.

Fig.1 crushed waste foundry sand

TABLE NO. 1 physical properties of waste foundry sand

Sr. No.	Physical Property of Waste Foundry Sand	Value
1	Color	Grey (Blackish)
2	Specific Gravity	2.49
3	Bulk relative Density	2592 kg/m^3
4	Water Absorption	0.45%
5	Moisture contain	0.13%

Water
Locally available water used for mixing and curing which is potable and is free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete.

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4. PREPARATION OF MIX

Mix design carried out for M25 grade of concrete by IS 10262:2009, having mix proportion of 1:1.52:2.64 with water cement ratio of 0.45. The partial replacement of fine aggregate by 5% to 25% at an increment of 5% each. Chemical admixtures are not used in the work.

5. EXPERIMENTAL WORK

Destructive test conducted on Concrete

In present study cube compression test, flexural test on beams and Cylindrical split tensile test on self-compacting concrete with constant fraction of steel fiber were carried out.

Compressive Strength Test:

Compression test on the 150 mm x 150 mm x 150 mm cube specimens were conduct on the 1000 KN compressive testing machine. The specimens were cured in water for 28-days. The cube compressive strength is calculated as crushing load per unit area.

$$f_{cu} = P_c / A$$

Where

P_c = Failure load in compression, KN

A = Loaded area of cube, mm^2

Flexural Strength

Flexural strength test on the100x100x700mm were casted and cured for 28 days. The flexural strength is determined by the Formula:

$fcr = P_f L / bd^2$

Where,

fcr = Flexural strength, MPa

P_f = Central load through two-point loading system, N

L = Span of beam, mm

b = Width of beam, mm

d = Depth of beam, mm

Split Tensile Test:

The split tensile strength test is carried on diameter 150 mm and length 300 mm were casted and cured for 28 days. The split tensile strength of cylinder is calculated by the following formula:

$$f_t = 2P / \pi LD$$

Where,

f_t = Tensile strength, MPa

P = Load at failure, N

L = Length of cylinder, mm

D = Diameter of cylinder, mm

Workability Test

Slump Cone test was conducted for investigation of workability of fresh concrete. Natural sand partially replaced with 0%, 5%, 10%, 15%, 20% & 25% waste foundry sand with a constant water cement ratio 0.45.

Pull Out Test

The Pull Out test is partially destructive test. The pullout test dealings the force required to pull an embedded metal insert with an enlarged head from a concrete specimen or a structure.The bond strength was carried out according to IS 2770. A 16mm diameter deformed steel reinforced bar was embedded into the concrete cube at the center up to depth of 150mm.

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Rebound Hammer Test

Rebound hammer test is used to be find the compressive strength of concrete members. It consistsfor every rebound of spring control hammer that slides on a plunger within a tubular housing. After impact the hammer rebounds. The distance traveled by mass, is called as rebound number

6. RESULTS AND DISCUSSION

The results obtained from the experimental investigations are tabulated in tables. The results have been analyzed and the graphs showing the strength variations are plotted. The effect of partial replace of sand with waste foundry sand.

TABLE NO. 2 compressive strength of concrete with partially replacement of foundry sand

Serial No.	% of replacement	3 days Strength	7 days Strength	28 days Strength
1	M1 (0)	9.56	18.23	38.85
2	M2 (5)	9.82	18.64	40.90
3	M3 (10)	10.11	18.93	40.36
4	M4 (15)	10.27	20.85	41.15
5	M5 (20)	9.94	18.90	38.39
6	M6 (25)	8.93	18.18	38.09

TABLE NO. 3 Flexural strength of concrete with partially replacement of foundry sand

Serial No.	% of replacement	28 days Strength
1	M1 (0)	13.02
2	M2 (5)	13.18
3	M3 (10)	13.23
4	M4 (15)	13.94
5	M5 (20)	13.12
6	M6 (25)	12.57

TABLE NO. 4split tensile strength of concrete with partially replacement of foundry sand

Serial No.	% of replacement	28 days Strength
1	M1 (0)	3.76
2	M2 (5)	3.90
3	M3 (10)	3.99
4	M4 (15)	4.06
5	M5 (20)	3.67
6	M6 (25)	3.52

TABLE NO. 5slump value of concrete with partially replacement of foundry sand

Serial No.	% of replacement	Slump value in mm
1	M1 (0)	70
2	M2 (5)	68
3	M3 (10)	62
4	M4 (15)	60
5	M5 (20)	60
6	M6 (25)	56

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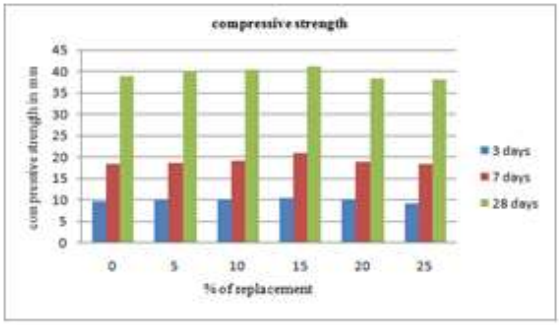
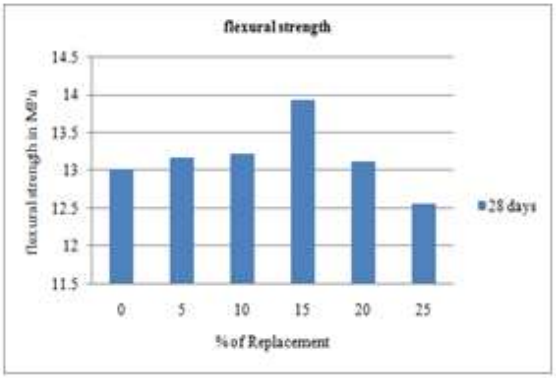
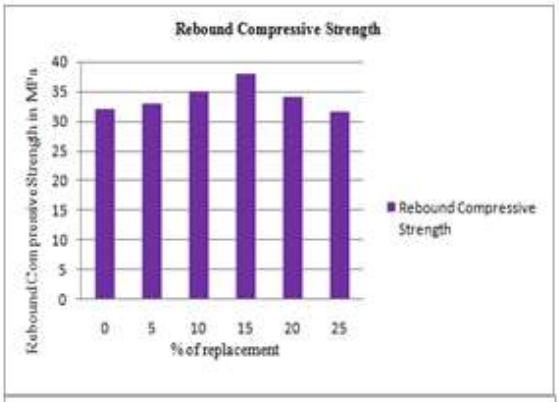
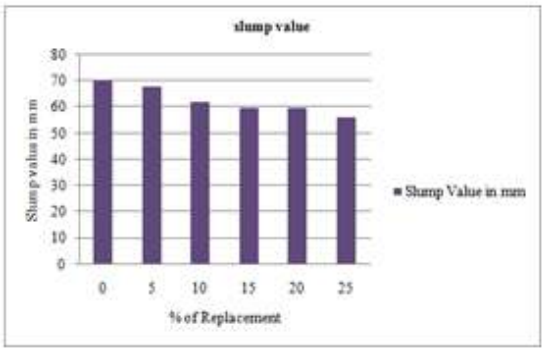
TABLE NO. 6 rebound compressive strength of concrete with partially replacement of foundry sand

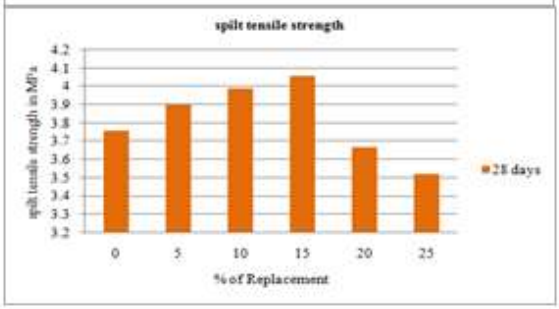
Serial No.	% of replacement	Rebound number	Rebound Compressive Strength
1	M1 (0)	34	32
2	M2 (5)	36	33
3	M3 (10)	38	35
4	M4 (15)	39	38
5	M5 (20)	37	34
6	M6 (25)	35	32











7. CONCLUSION

- Natural sand can be possibly replaced partially waste foundry sand in concrete.
- The compressive strength of concrete from 0% to 15% replacement of sand by waste foundry sand is satisfactory.
- Replacement of natural sand with waste foundry sand showed increases in the split tensile strength and

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flexural strength up to the 15% replacement then after split tensile strength reduced.

- Use of foundry sand in concrete will be minimize the disposed problem of waste foundry sand and it's an ecofriendly

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