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USE OF FOUNDRY SAND FOR DEVELOPMENT OF ECOFRIENDLY CONCRETE

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Abstract: Concrete is the most indisputable material being used in infrastructure development throughout the world. It is a globally accepted construction material in all types of Civil Engineering structures. Natural sand is a prime material used for the preparation of concrete and also plays an important role in Mix Design. Now a day's we find deficiency of river sand. The reduction in the sources of natural sand and the requirement for reduction in the cost of concrete production has resulted in the increased need to find new alternative materials to replace river sand so that excess river erosion is prevented and high strength concrete is obtained at lower cost. Partial or full replacement of natural sand by the other alternative materials like quarry dust, foundry sand and others are being researched from past two decades, in view of conserving the ecological balance. The use of used foundry sand in concrete matrix as a fine aggregate replacement material was tested as an alternative to normal concrete. In this work fine aggregate has been replaced by used foundry sand by the of 0%, 10%, 20%& 30% by weight of natural sand for M-20 grade concrete.

Keywords: Industrial Waste Used Foundry Sand, Eco-Friendly, Cost, And Compressive Strength.

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INTRODUCTION

Now-a-days the construction sector is developing rapidly on a greater scale and also involves new techniques for rapid and comfort works on the field. The consumption of natural n Resources as an ingredient of concrete, costs high as well as it are on verge of extent. These problems force us to recover the natural resources or to find an alternative option to overcome this problem. Presently, the production of waste foundry sand as a by-product of metal casting industries causes various environmental problems. Usage of this waste in building material would help in reduction of stress on environment. Metal industries use foundry sand which is uniform sized, high quality silica sand that is bound to form a mound for casting of ferrous and non-ferrous metal. Finer sand than normal sand is used in metal casting process. The burnt sand after the casting process of metal is reuse for many times but when it cannot be longer used it is removed from foundry as a waste for disposal known as "Waste foundry sand".

Use of waste foundry sand as a partial replacement or total replacement by fine aggregate in concrete leads in production of economic, light weight and high strength concrete. Concrete is a material which is composed of coarse aggregate, fine aggregate, cement, admixtures and water these each material in concrete contributes its strength. So, by partial or percentage replacing of material affects different properties of concrete. By using such waste material which harms the environment can be used for the development of low cost and eco-friendly building materials. In this study an experimental investigation is carried out by varying percentage of fine aggregate with used foundry sand to produce low cost and eco-friendly concrete.

II. EXPERIMENTAL PROGRAM:

A) Material:

i) Foundry sand:

Most of the metal industries prefer sand casting system. In this system mould made of uniform sized, clean, high silica sand is used. After casting process foundries recycle and reuse the sand several times but after sometime it is discarded from the foundries known as waste foundry sand. The application of waste foundry sand to various engineering sector can solve the problems of its disposal and harmful effect to environment.

Foundry sand consists primarily of silica sand, coated with a thin film of burnt carbon, residual binder (betonies, sea coal, and resins) and dust. Foundry sand can be used in concrete to improve its strength and other durability factors. Foundry Sand can be used as a partial replacement of fine aggregates and as supplementary addition to achieve different properties of concrete.

Fig:1. Foundry sand

Properties Of Foundry Sand:

Table no.1: Chemical composition

constituent	Value (%)
SiO_2	87.91
Al_2O_3	4.70

Fe_2O_3	0.94
CaO	0.14
MgO	0.10
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

ii) Cement:

The most common cement used is an ordinary Portland cement. The Ordinary Portland Cement of 53 grade (Birla cement OPC) conforming to IS: 8112-1989 is be use. Many tests were conducted on cement; some of them are consistency tests, setting tests, soundness tests, etc.

Properties of Cement:

Table no.2:

Sr.no.	Physical properties of Birla OPC-53 cement	Result	Requirement as per IS:8112-1989
1	Specific Gravity	3.15	3.10-3.15
2	Standard Consistancy(%)	31.5%	30-35
3	Initial setting Tim	91 min.	30 minimum
4	Final Setting Time	211 min.	600 maximum
5	Compressive Strength (N/mm^2) At 28 Day's	58 N/mm^2	53 N/mm^2 maximum

iii) Coarse Aggregate:

The fractions from 20 mm to 4.75 mm are used as coarse aggregate. The coarse aggregates from locally available source have been used confirming to IS 383:1970

Table No.3: Physical properties of CA

Sr.No	Physical properties	Result Obtained
1	Fineness Modulus	4.80
2	Specific Gravity	3.02

iv) Fine Aggregate:

In this study fine aggregates are confirm to IS: 383-1970 zone I

Table No.4: Physical properties of Natural sand

Sr.No	Physical properties	Result Obtained
1	Fineness Modulus	3.50
2	Specific Gravity	2.70

B) Mix Design:

As per IS: 10262-2009 mix design was prepared for M20 grade and same design was used in preparation of test samples.TABLE-3 shows mix design proportion.

For that 1:1.77:2.97 this mix proportion ratio is used, with w/c ratio **0.48**.

Table no.3 (a): For 3 cube of each proportion:

Sr.no.	% of Foundry Sand Replace by Natural sand	Cement (kg)	Water (kg)	Coarse Aggregate (kg)	Fine Aggregate (kg)	Foundry Sand (kg)
1	00	5.043	2.43	15	8.940	0
2	10	5.043	2.43	15	8.046	0.894
3	20	5.043	2.43	15	7.152	1.788
4	30	5.043	2.43	15	6.258	2.682

Table no.3(b) For 3 Cylinder of each proportion-

Sr.no.	% of Foundry Sand Replace by Natural sand	Cement (kg)	Water (kg)	Coarse Aggregate (kg)	Fine Aggregate (kg)	Foundry Sand (kg)
1	00	7.95	3.81	23.64	14.1	0
2	10	7.95	3.81	23.64	12.69	1.41
3	20	7.95	3.81	23.64	11.28	2.82
4	30	7.95	3.81	23.64	9.87	4.23

C) Testing:

i) Test on Foundry Sand:

Table no. 4(a):

Sr.no	Test perform on Foundry Sand	Result
1	Fineness Modulus	2.83
2	Specific Gravity	2.72
3	Moisture content	1%

ii) Workability Test On Concrete:

Table no.4(b):

Sr no.	% Replacement of Foundry Sand	Slump cone test (mm)	Compaction Factor test	Flow table Test(%)
1	00	40	0.85	48
2	10	175	0.94	52
3	20	80	0.92	40
4	30	45	0.90	12

ii) Compressive strength test On Cubes:

Test specimens are tested at the age 7 and 28 days of curing under CTM.

Table no.4(c):

Sr.no.	% Replacement of Foundry Sand	Compressive strength@ 7 days (Mpa)	Compressive strength@ 28 days (Mpa)
1	00	18.74	30.77
2	10	21.62	29.33
3	20	23.03	30.44
4	30	22.74	37.00

III. CONCLUSIONS:

Based on above study the following conclusions are made regarding the properties and behavior of concrete on partial replacement of fine aggregate by waste foundry sand.

(1) Compressive strength increases on increase in percentage of waste foundry sand as compare to traditional concrete upto 20% replacement, after that it is gradually decreased.

(2)In this study, maximum compressive strength is obtained at 20% replacement of fine aggregate by waste foundry sand and increment is 23% at 7 days and v 20.24% for 30% replacement at 28 days.

(3)From this study it is concluded that workability of concrete made with 10% replacement of foundry sand is on higher side than other percentages.

(4) Use of waste foundry sand in concrete reduces the production of waste through metal industries; i.e. it's an eco-friendly building material.

(5)Use of foundry sand in concrete replenish the properties of concrete and make it ecofriendly.

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