Experimental Investigation on Replacement of M-Sand with Foundry Sand and prosofis juliflora ash with cement

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Abstract - **The depletion of natural resources and the environmental concerns related to their extraction have caused a growing interest in sustainable construction materials, Foundry sand, a byproduct of metal casting processes, and Prosopis juliflora ash, formed from the combustion of the invasive plant species, both provide interesting alternatives to traditional construction materials. The study focuses on determining the flexural behavior of reinforced concrete beams that incorporate these alternate materials. The study intends to examine the impacts of foundry sand and Prosopis juliflora ash on the strength, durability, and sustainability of the concrete mixtures. This study uses Prosopis Juliflora ash and foundry sand in place of traditional materials to examine the flexural behavior of reinforced concrete (RC) beams. Fine aggregate is substituted with foundry sand, and cement is substituted with Prosopis Juliflora ash in different amounts (10%, 20%, and 30% for foundry sand, and 2.5%, 5%, and 7.5% for Prosopis Juliflora ash) in M35 mix design. The study assesses the Compressive strength of cubes and the flexural performance of RC beams by experimental casting and testing. The results show that there are notable differences in stiffness, flexural strength, and cracking behavior between the various degrees of Prosopis Juliflora ash and foundry sand substitution. The Rapid chloride penetration test is taken to analyze the durability of the specimen. The results provide information about the viability and efficiency of employing these substitute materials in the manufacturing of concrete**

INTRODUCTION

As metal is cast, a byproduct called foundry sand is formed in the casting process. The incorrect disposal of it results in environmental issues. Its use in construction, building materials, and other areas is therefore crucial to lowering environmental issues. The goal of this research is to create environmentally friendly, inexpensive concrete. This study illustrates how foundry sand can be used in place of M-sand in concrete components, lowering the cost of materials used in construction due to their inexpensive availability.

Concrete's mechanical and durability qualities have been proven to increase when substitute materials are used, and this approach can promote the development of sustainable concrete. One such intriguing substance that needs more research is waste foundry sand (WFS), which could be used in place of fine particles in concrete. It is a byproduct of the casting of both ferrous and non-ferrous metals, with ferrous foundries creating the majority of the sand.

SCOPE AND OBJECTIVE:

A. This study's primary goal is to create an inexpensive, environmentally friendly concrete.
B. It can be used for other purposes such as in construction materials, flow filling, ceramic, industry, bricks & repair, and mineral wool products.
C. We can achieve sustainable disposal of spent foundry sand.
D. To reduce maximum usage of cement by ash

MATERIAL COLLECTION:

The materials selected for casting cubes and beams have been tested preliminary. These preliminary tests are conducted as to whether the properties of the material are conducive to the respective codes. All of the experiment that has been performed is explained in subcategories.

FOUNDRY SAND:

foundry sand is sand that when moistened and compressed or oiled or heated tends to pack well and hold its shape. It is used in the process of sand casting for preparing the mold cavity

PROSOFIS JULIFLORA ASH:

Ash for Prosofis juliflora is obtained as a waste material from biomass waste power plants. Strength development is not solely attributable to Prosofis juliflora ash's cementitious properties.

COARSE AGGREGATE:

Ordinary granite broken stone aggregates size greater than 12mm are used for the study. A maximum nominal size of 20 mm is used.

CEMENT:

The cement used is of OPC 53 grade as per the Standard Specifications of the country. The cement according to the Indian specification must satisfy the IS code IS 12269- 1987 (reaffirmed 1999).

M- SAND:

Aggregates are the finished product for companies that create aggregates, while for companies that make concrete, aggregates are the raw materials needed to make concrete. While raw materials, gravel, or rock may have properties that the production process cannot change, the quality of aggregates can. Fine aggregate supply stability is, of course, a crucial component. In this sense, the primary natural source of fine aggregate in our nation is a coarse aggregate made from crushed basaltic stone and river sand. However, the country's natural sand supply is becoming more scarce and more expensive due to the strong construction activity. In addition, the aggregate and concrete industries are currently dealing with a growing public awareness of environmental hazards. Thus, seeking a viable alternative to natural sand is a must. One alternative used as a replacement is the use of M sand. Due to the forecast shortfall in supply of natural sand and increased construction practices time will come when M sand will be a crucial component in the creation of concrete.

REINFORCEMENT BARS:

In reinforced concrete and reinforced masonry constructions, a reinforcement bar is a steel bar or a mesh of steel wires used as a tension device to strengthen and keep the concrete in tension. The surface of rebar is frequently textured to improve its bonding properties with concrete.

MATERIAL TESTING AND CHARACTERISTICS

SPECIFIC GRAVITY:

The density bottle was used to determine the specific gravity of the cement. The bottle was cleaned and dried.

FINENESS :

The fineness of the sand has been found by the sieve analysis method.

MOISTURE CONTENT :

100 g of aggregate was taken and their weight was determined, say $W_{1.}$ The sample was then kept in the oven for 24 hours. It was taken out and the Dry weight W_2 difference gives moisture.

WATER ABSORPTION:

100 g of aggregate was taken and weighed as $W_{1.}$ The sample was immersed in water for 24 hours. It was taken out and drained and its weight was determined say as W_2 difference between them gives absorption of the sample.

PROPERTIES OF CEMENT:

S.NO	DESCRIPTION	RESULT
1.	Specific gravity	3.11
2.	fineness	2%
3.	consistency	31%
4.	Initial Setting time	110 minutes

PROPERTIES OF COARSE AGGREGATE:

S.NO	DESCRIPTION	RESULT
1.	Specific gravity	2.80
2.	fineness	7.53
3.	Surface moisture	0.08%
4.	Water absorption	1.36%

PROPERTIES OF M- SAND :

S.NO	DESCRIPTION	RESULT
1.	specific gravity	2.53
2.	Fineness modulus	5.4
3.	moisture content	9.0 %
4.	water absorption	7.0%

FOUNDRY SAND :

S.NO	DESCRIPTION	RESULT
1.	specific gravity	2.42
2.	Fineness modulus	2.25
3.	moisture content	0.7%
4.	water absorption	0.40%

CHEMICAL PROPERTIES OF FOUNDRY SAND:

CHEMICAL PROPERTIES	%
Content of SiO2	86.93%
Content of Al2O3	5.71%
Content of Fe2O3	0.82%
Content of CaO	0.26%
Content of MgO	0.33%
Content of SO3	0.09%
Content of Na2O3	0.2%
Content of K2O	0.27%
Content of TiO2	0.17%
Content of P2O5	0%
Content of Mn2O3	0.03%
Content of SrO	0.04%
Content of LOI	5.1%

MIX DESIGN

DEFINITION:

Mix design is selecting suitable ingredients of concrete and determining their relative proportions with the object of certain minimum strength and durability as economically as possible.

OBJECTIVE OF MIX DESIGN :

- Achieving the required minimum strength is the primary goal
- producing concrete as cheaply as possible is the second.

FACTORS TO BE CONSIDERED IN MIX DESIGN :

1. Grade of concrete
2. Type of cement
3. Type & size of aggregate
4. Type of mixing and curing
5. Water/cement ratio
6. Degree of workability.
7. Air content.

DESIGN STIPULATIONS:

Grade designation : M_{35}
Type of cement used : OPC-53
Maximum size of aggregate : 20 mm
Maximum water content : 0.43
Minimum water content : 300 kg/m^3
Specific gravity of cement : 2.88
The specific gravity of coarse aggregate : 7.57
The specific gravity of fine aggregate : 2.53

MIX DESIGN:

CEMENT	FINE AGGREGATE	COARSE AGGREGATE	WATER
400	642	1165	172

SUPER PLASTICICIZER: chemical admixture

CUBES AND PRISM:

EXPERIMENTAL PROCEDURES

CONSTITUENT MATERIALS USED:

The materials usually used in the concrete mix are cement, M-Sand, coarse aggregate and foundry sand,prosofis juliflora ash.

EXPERIMENTAL METHODOLOGY:

Mix design was done for M35concrete as per the Indian standard code specifications (IS 10262-2007). Initial tests on all the ingredients of concrete were done and the results were tabulated. Experimental test is carried out on a concrete containing foundry sand in range of 10%,20%, 30% replaced by fine aggregate and 2.5%,5%,7.5% prosofis juliflora ash replaced by cement weight of M-35 concrete. The tests were carried in cube of 150*150*150 for 7, 14 and 28 days. and prism of `500*100*100 for 28 days.

Cube Compressive Strength :

Compressive strength, one of the most important properties of hardened concrete, is the characteristic material value for concrete classification. 28 days cube compressive strength is tested on cubes of size 150mmx150mmx150mm and 28 days compressive strength is tested.

Conventional concrete cube

SI.NO	DAYS OF CURING	LOAD (KN)	COMPRESSION STRENGTH (N/MM^2)
1	7 Days	550	22.3
2	14 Days	753	33.4
3	28 Days	930	41.33

REPLACEMENT OF FOUNDRY SAND 10% 2.5% PROSOFIS JULIFLORA ASH

SI.NO	DAYS OF CURING	LOAD (KN)	COMPRESSION STRENGTH (N/MM^2)
1	7 Days	563	22.3
2	14 Days	770	34.2
3	28 Days	932	41.4

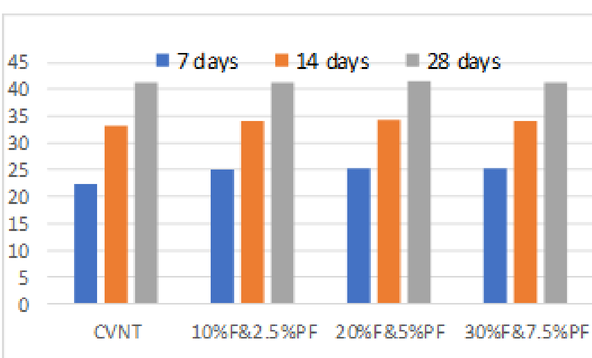
REPLACEMENT OF FOUNDRY SAND 20% AND 5% PROSOFIS JULIFLORA ASH

SI.NO	DAYS OF CURING	LOAD (KN)	COMPRESSION STRENGTH (N/MM^2)
1	7 Days	570	25.3
2	14 Days	774	34.4
3	28 Days	935	41.5

REPLACEMENT OF FOUNDRY SAND 30% AND 7.5% PROSOFIS JULIFLORA ASH

SI.NO	DAYS OF CURING	LOAD (KN)	COMPRESSION STRENGTH (N/MM^2)
1	7 Days	562	24.9
2	14 Days	773	34.2
3	28 Days	929	41.2

COMPARISON GRAPH



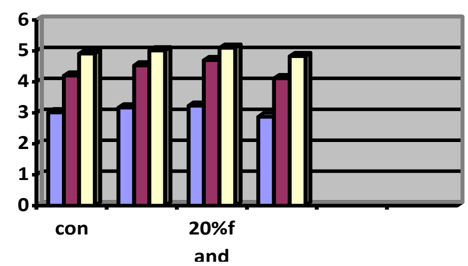
FLEXURAL STRENGTH TEST:

Tests are carried out on 100mmx100mmx500mm Prism conforming to IS 516: 1959 to obtain flexural strength at the curing of 28 days. In the flexural test, a standard plain concrete beam of a rectangular cross-section is simply supported and subjected to central point loading until failure.

CRACK PATTERN

Flexural strength of prism replacing foundry sand with fine aggregate and prosofis juliflora ash with cement

Foundry sand %	Prosofis juliflora ash %	Flexural strength@ 7 days	Flexural strength@ 14 days	Flexural strength@ 28 days
0	0	3.02	4.2	4.91
10	2.5	3.17	4.53	5.02
20	5	3.23	4.7	5.1
30	7.5	2.88	4.12	4.83



CONCLUSION

It is noted that the effects of concrete containing foundry sand is unique, as the foundry sand changes its physical and chemical properties and also its manufacturing process. And ash content acts on cement to make effective

[1] Improvement in concrete's compressive strength by partially replacing the foundry with M-sand.

[2] There is improvement in the flexural strength of the concrete by partial replacement of up to 20% of foundry sand with fine aggregate and 5% prosofis juliflora ash with cement

[3] Application of this study leads to development in the construction sector and innovative building materials.

[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.

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