Eco - Friendly and Cost - Effective Self Compacting Concrete Using Foundry Sand

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ABSTRACT

The way waste foundry sand is disposed of in industry presents serious environmental problems. particularly in the foundry sector, To address this issue, an experimental investigation was conducted and evaluate the effects on Using leftover foundry sand in concrete to partially substitute natural sand, specifically targeting M30 grade concrete, which design is to achieve compressive strength of 30 MPa in 28 days. In the study, percentage (0%,25%,50%,100%) of the foundry sand was replaced with fine aggregate. The performance in both conventional concrete and concrete with WFS was assessed through various tests, including compressive strength, using the weight loss method in cement mortar (CM).The results revealed a slight improvement in strength and durability. Notably, the benefits were more pronounced in MM 10 grade cement mortar. This research highlights the potential of utilizing industrial by-products like WFS in construction, contributing to waste reduction and promoting sustainable practices in the concrete industry.

Keywords: Compression test, Mortar , Foundry sand, Strength and durability, Waste management.

INTRODUCTION

Using waste products in building and lowering construction costs are two of the issues facing civil engineers today. For many years, natural resources like river sand have been used in construction. it is the outcome of huge expenses. Low-cost construction could be achieved by overcoming the use of natural resources and waste materials, such as foundry sand in concrete. Aggregate makes up roughly 60% to 80% of the volume of concrete. The building sector has seen an alarming rise in the use of sand . The industry is facing difficulty in the supply of The industry is having trouble finding natural river sand. The building industry has found solutions, such as synthetic sand, rock dust, etc., to get around this problem. Using waste materials in concrete is an additional option. Sand is recycled and used repeatedly in the foundry industry for casting. Waste foundry sand (WFS) is the word for the material that is disposed of as waste after it has been used for a long time. By using such material in concrete, waste foundry sand disposal issues can be lessened and concrete production becomes more cost-effective. aggregate in MM 10 grade as a partial substitute.

Sand is removed from the foundry and referred to as "FOUNDRY SAND" when it can no longer be utilized there. These days, we partially replace MM 10 grade concrete with this fine aggregate.

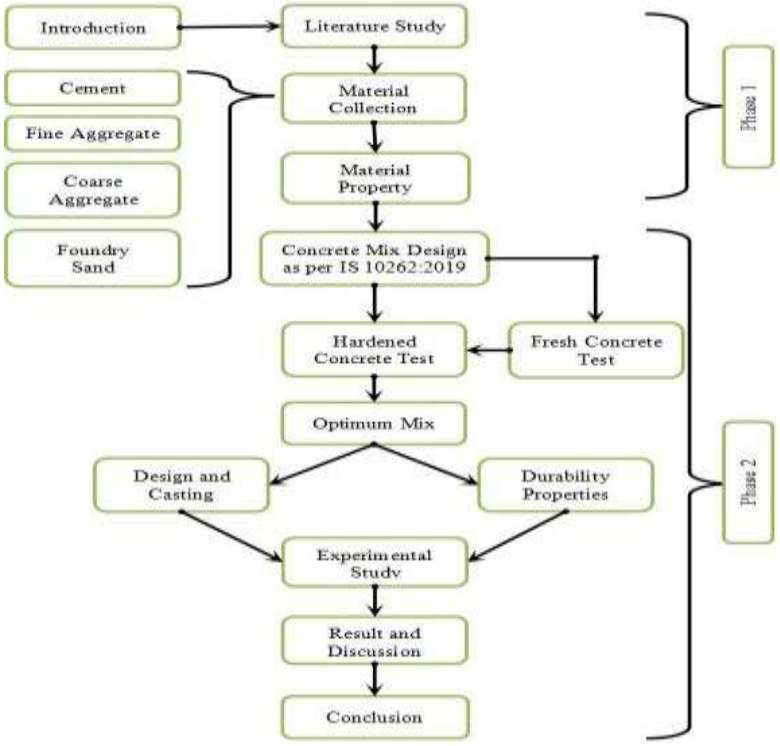
1.1 OBJECTIVES

- To investigate how foundry sand affects the characteristics of both fresh and hardened concrete..
- To conduct a comparative analysis to identify differences between foundry sand mix and Self compacting concrete.
- Foundry sand can be substituted for sand in percentages of 0%, 25%, 50%, and 100%.
- Split tensile strength is used to compare compressive strength.

1.2 SCOPE OF STUDY

- Utilization the foundry sand and reduce the environmental problem of foundry sand.
- low-cost and eco-friendly concrete.
- To check strength and property in mortar.
- Reduce the construction cost

2. METHODOLOGY



MATERIAL AND PROPERTIES

2.1 CEMENT PROPERTIES

In a factory, the raw materials are combined, heated, and crushed to create ordinary Portland cement (OPC). According to BIS specification IS:12269 1987, OPC 53 Grade Cement must have a minimum strength of 53 MPa, or 530 kg/sq.cm, for 28 days..

Table 3.1 Cement Properties

Cement Propertie	Values
Fineness of Cement	2.26%
Grade of Cement	53
Specific Gravity	3.16
Initial Setting Time Final Setting Time	17 mins 35 mins





2.2 FINE AGGREGATE PROPERTIES

Fine aggregate is occasionally used to describe aggregate that is smaller than 4.75 mm. A natural substance fills the spaces between the coarse aggregate. Sands collected from the land or the sea make up fine aggregate. Natural sand or broken stone make up the majority of the particles in fine aggregates, which typically flow through a 9.5mm screen.

Table 3.2 Fine aggregate Properties

FineAggregate Property	**Values**
SpecificGravity	2.73
Finess Modulus	2.75

2.3 FOUNDRY SAND PROPERTIES

Disposal of waste foundry sand in industry called WFS

Table 3.3 Foundry sand Properties

FineAggregate Property	**Values**
SpecificGravity	2.64
Finess Modulus	2.83

3.3 CHEMICAL COMPOSITION

Al_2O_3	45%
SiO_2	48%
Fe_2O_3	2.5%
TiO_2	3.5%
alkalies	0.30%
LOI	0.70%

Foundry sand before heat treatment

Foundry sand after 2 h heat treatment at 600 °C

To assess suitability as foundry/moulding sand and as a partial replacement for fine aggregate in concrete/mortar, with focus on LOI reduction and bonding behaviour.

Initial (supplier / tentative composition – bulk oxide basis)

Al2O3	45%
SiO2	48%
Fe2O3	2.5%
TiO2	3.5%
Alkalies (CaO, K2O, MgO, Na2O)	0.30%
LOI	0.70%

This corresponds to a high-alumina, high-silica sand with very low LOI, suitable for direct use as moulding sand and as fine aggregate replacement up to about 25–30% in concrete without pretreatment.

EDX – before heat treatment

Major elements in wt.% (normalised); minor K, As, Zn.

O	39.4
Si	18.3
C	23.8
Al	10.7
Fe	3.3
Ti	1.6

When converted to oxides, the EDX sample shows:

SiO2	39–40%
Al2O3	20%
Fe oxides	4–5%
TiO2	2–3%
Effective LOI (associated mainly with C)	23–24%.

EDX – after heat treatment

Major elements in wt.% (normalised)

C	21.8
O	38.4
Al	11.6
Si	22.2
Ca	0.9
Ti	0.7

Fe	3.8
Cu ≈ 0.5	
Mg, Cl traces	

4 MIXDESIGN

4.1 MIX PROPORTION FOR 1 CUM

1) Cement = 1 kg

2) Water = 158 kg

3) Fine aggregate = 1 kg

M-Sand = 250 g/m^3 25% F.aggregate

N-Foundry sand = 750g/m^3 50 % F.aggregate

4) Water-cement ratio = 0.45

4.2 MIX DESING RATIO

Mix proportion (Cement : Fine aggregate) = 1 : 1

5 RESULTANDDISCUSSION

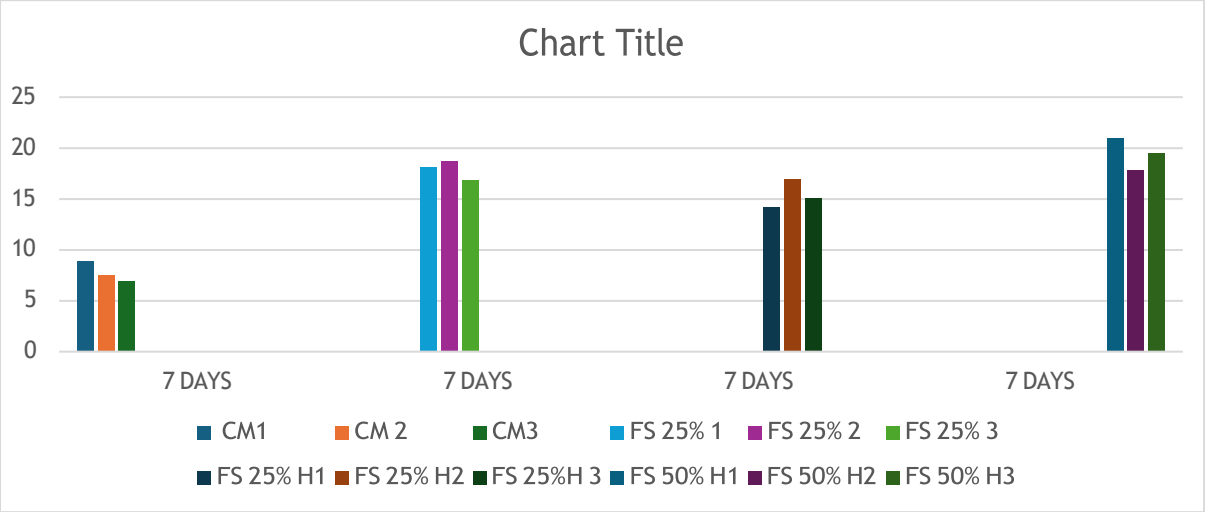
5.1 COMPRESSION TEST



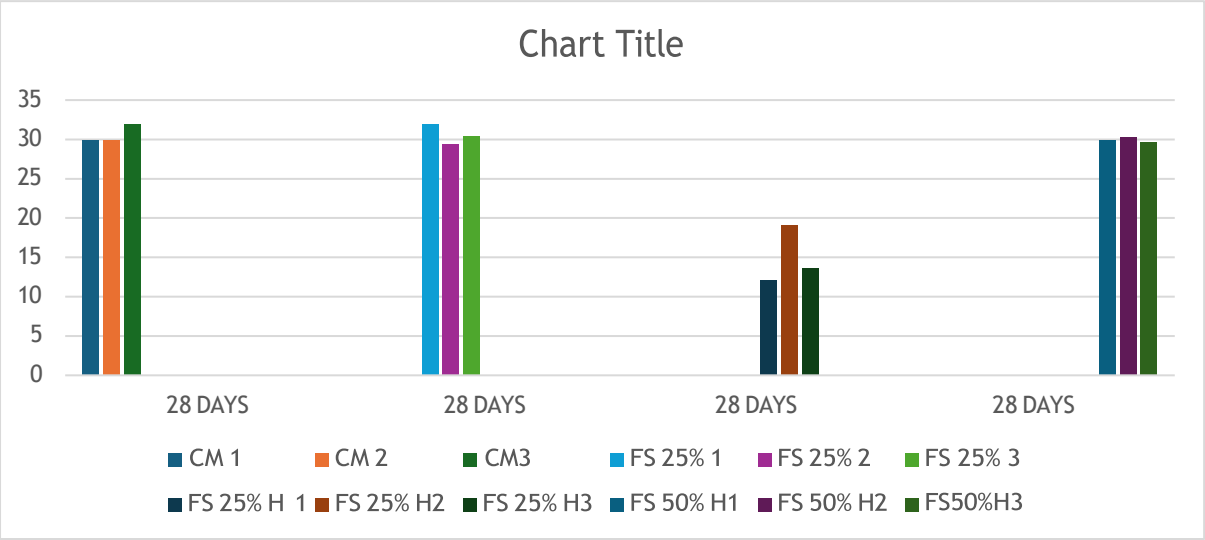
Fig.no: 5.1 Compression test Table 5.1 Compression test result

S.NO	MIX PROPORTIONS	COMPRESSIVE STRENGHT (N/mm²) 7 days	COMPRESSIVE STRENGHT (N/mm²) 28 days
1	CM 1:1	8.89	29.85
2	CM 1:1	7.46	29.85
3	CM 1:1	6.93	32.0
1	FS 25% without heat	18.13	32.0
2	FS 25% without heat	18.69	29.34
3	FS 25%without heat	16.88	30.4
1	FS 25% with heat	14.23	12.08
2	FS 25% with heat	16.89	19.02
3	FS 25% with heat	15.12	13.68
1	FS 50%	20.99	29.86
2	FS 50%	17.78	30.28
3	FS 50%	19.56	29.68

Compression test result 7 Days chart



Compression test result 28 Days chart



FIGURES

















CONCLUSION

- The present study examined the physical and chemical characteristics of waste foundry sand (WFS). The compressive strength of concrete was evaluated using both untreated and reclaimed WFS as partial replacements for natural sand at proportions of 25%, 50%, 75%, and 100%. Based on the experimental findings, the following conclusions were drawn.
- From the tests conducted on the six concrete mixtures, it was observed that at all curing ages, the strength of concrete containing up to 25% WFS and reclaimed WFS was nearly comparable to that of the conventional mix (CM). However, mixtures with 25% to 50% replacement levels showed a slight reduction in compressive strength. At 28 days, the decrease was approximately 1.6% and 5.7%, respectively, compared to the conventional mix.
- It shows the 25% and 50% of Partial replacement of foundry sand concrete is best one compare to cc.
- The results indicate that waste foundry sand (WFS) and reclaimed WFS can be effectively used as partial replacements for fine aggregate up to 25% and 50%. At these replacement levels, good quality concrete can be produced without compromising the required standards.

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