Utilization of Waste Foundry Sand As Partial Replacement of Fine Aggregate For Low

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Abstract- *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. Use of foundry sand in various Engineering application scan solve the problem of disposal of foundry sand and other purposes. 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 and as supplementary addition to achieve different properties of concrete. In the present study, effect of foundry sand as fine aggregate replacement on the compressive strength, split tensile strength and modulus of elasticity of concrete having mix proportions of 1:2.05:3. 45 was investigated Fine aggregates were replaced with two percentages of foundry sand. Tests were performed for compressive strength, split tensile strength and modulus of elasticity for all replacement levels of foundry sand at different curing periods. Test results showed that there is some increase in compressive strength, split tensile strength and modulus of elasticity after replacing the fine aggregates with certain percentage of foundry sand so foundry sand can be safely used in concrete for durability and strength purposes.*

Keywords- Foundry sand, Portland Pozzolana cement (PPC), water cement ratio, compressive strength, split tensile strength, flexural strength

I. INTRODUCTION

Foundry sand is high quality silica sand with uniform physical characteristics. It is a byproduct of ferrous and nonferrous 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 both ferrous and nonferrous metal castings. The physical and chemical characteristics of foundry sand will depend in great part on the type of casting process and the industry sector from which it originates. In modern foundry practice, sand is typically recycled and reused through many production cycles. Industry estimates that approximately 100 million tons of sand are used in production annually of that 6 10 million tons are discarded annually and are available to be recycled into other products and in industry. The automotive industries and its parts are the major generators of foundry sand. Foundries purchase nigh quality size-specific silica sands for use in their moulding and casting operations. The raw sand is normally of a higher quality than the typical bank run or natural sands used in fill construction sites. The sands form the outer shape of the mould cavity. These sands normally rely upon a small amount of betonies clay to act as the binder material. Chemical binders are also used to create sand "cores". Depending upon the geometry of the casting, sands cores are inserted into the mould cavity to form internal passages for the molten metal. Once the metal has the solidified casting is separated from the moulding and core sands in the shakeout process. In the casting process moulding sands are recycled and reused multiple times. Eventually, however the recycled sand degrades to the point that it can no longer be reused n the casting process.

A. Objective

- To economize the cost of construction without compromising with quality.
- To investigate the utilization of Used Foundry Sand as Fine aggregate and influence of UFS on the Strength on concrete made with different replacement levels.
- To check the effect of Used Foundry Sand in concrete on properties of fresh concrete & compressive strength.
- To check the suitability of Used Foundry Sand as an alternative construction material.
- To effectively utilize the waste material from the Foundries.
- To reduce the problem of disposal of Foundry Waste.
- To prove that the Foundry waste from Foundries can be a replacement for fine aggregate.
- To study the physical properties of Foundries waste and are the ingredients in concrete.
- To replace the fine aggregate by Foundry waste in different ratio such as 10%, 20%, 30%, 40% in M20 mix concrete.

- To determine the compressive strength and compare it with the conventional concrete.

II. STATE OF DEVELOPMENT

This article summarizes previous studies on the reasons that contribute to the usage or avoidance of Retrofitting.

American Foundry men's Society(1991).The applications of flow able fill are numerous and include restoration of utility cuts in county roads, backfilling structures, filling abandoned wels, filing voids under existing pavements, and pipe embedment's. The specifications in most jurisdictions for flow able fill materials require that aggregates satisfy ASTM C33.(9) While spent foundry sand may not satisfy the graduation requirements of ASTM C33 for fine aggregates, the uniform, spherical nature of the particles produces a relatively free-flowing mixture.

Tarun R. Naik(1994).The physical and chemical characteristics of foundry sand will depend in great part on the type of casting process in modern foundry practice, sand is typically recycled and reused through many production cycles. Industry estimates that approximately 100 million tons of sand are used in production annually of that 6 10 million tons are discarded annually and are available to be recycled into other products and in industry. The automotive industries and its parts are the major generators of foundry sand. Foundries purchase nigh quality size-specific silica sands for use in their moulding and casting operations

Vema Reddy(2015).The experimental work is mainly concern with the study of mechanical properties like compressive strength, split tensile strength and as well as flexural strength of concrete by partial replacement of artificial sand by foundry sad as fine aggregate. Tests over carried out on cubes, cylinders to studies the mechanical properties o concrete using foundries and compare with concrete with natural sand as fine aggregate. Artificial sand was replaced with five percentages (0%, 5%, 10%, 15%& 20%) of Waste Foundry Sand by weight. A total of five concrete mix proportions are made with and without foundry sand. Compression test, splitting tensile strength test and flexural strength test were carried out to evaluate the strength properties of concrete at the age of 7 &28 days. Test results showed a nominal increasing strength and durability properties of concrete by the addition of waste foundry sand as a partial replacement of natural.

Khatib, Jamal(2017).The review paper summarizes the conclusion on the basis of test conducted for various properties of concrete like strength , durability etc. the paper review shows the positive as well as negative changes in the properties of concrete on the partial replacement of fine sand by waste foundry sand. from the past researches and the conclusion made by us shows the positive change in the utilization of waste foundry sand in construction field. As this results gives the great potential towards the development on environment friendly and strengthen cementitious concrete.

III. PROBLEM STATEMENT

To find out effect of foundry sand as fine aggregate replacement on the mechanical properties of concrete(Compressive strength, flexural strength, splitting tensile strength and modulus of elasticity. the percentage of replacement is 0%,10%,20%,30% by weight of fine aggregate.

IV. RESULT AND DISCUSSION

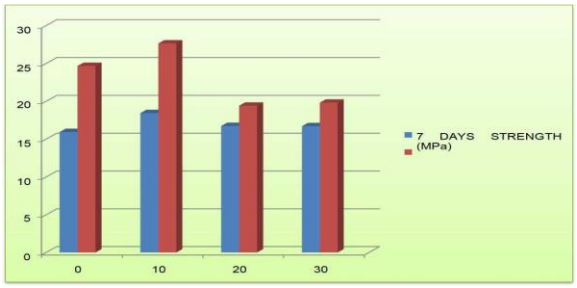
Various properties at concrete incorporating foundry sand at various replacement levels with fine aggregate were studied, results were compared and checked for compressive strength, split tensile strength and modulus of elasticity of foundry sand mix with ordinary mix

A. Compressive Strength

Fig.1 Compressive Strength Test

Table 1 Average Compressive strength

Foundry sand content,%	Designation (N/mm ^{2})	
	7 days	28days
0	15.94	24.672
10	18.443	27.644
20	16.74	19.416
30	16.711	19.822



Graph 1compressive Strengths comparison Chart

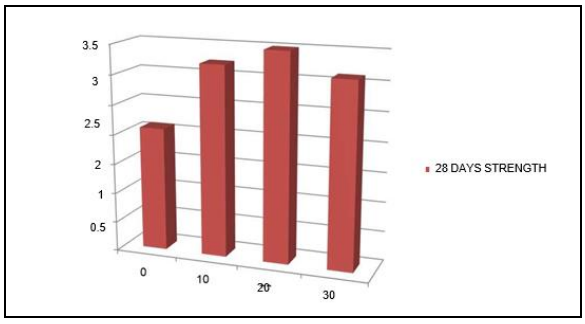
It is evident that compressive strength of concrete mixtures with 0%, 10%, 20%, 30%, of foundry sand as sand replacement was higher than the control. Mixture (MIX-1) at all ages and that the strength of all mixtures continued to increase with the age. Compressive strength for different replacement levels is increases by 13.27%, 5.72%, 5.39%, for 28 days strength.

B. Split tensile strength

Fig. 2 Splitting Tensile Strength Test

Table 2 Average splitting tensile strength

Foundry sand content,%	Designation (N/mm^2)
	28 Days
0	2.093
10	3.22
20	3.498
30	3.177



Graph 2 Splitting Tensile Strengths comparison Chart

It was found that split tensile strength of concrete incorporating foundry sand (using. 10 %, 20 % and 30 % replacement levels with fine aggregate and a w/c of 0.52) depended on the Percentage of foundry sand used the variation of split tensile strength was shown in Tableshows the variation of split tensile strength with replacements of foundry sand at various levels of fine aggregate at 28-days.in .Graph shows that split tensile strength increases with the increase in replacement of percentage of sand with foundry sand at 28-days. For control mix, split tensile strength was increase by 12%, 14%, and 20% with respect to different. Replacement levels of sand with foundry sand at 28 days. The split tensile strength of concrete increases by 5.78%, 3.03% and 1.65% for 28 days strength

C. Flexural tensile strength

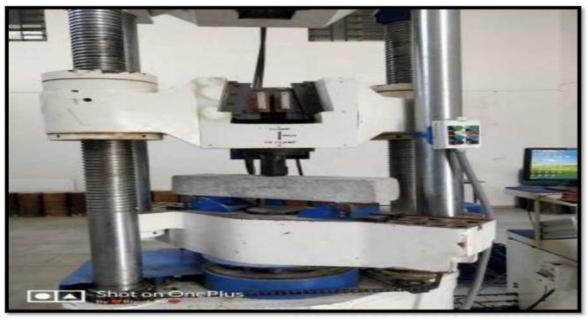
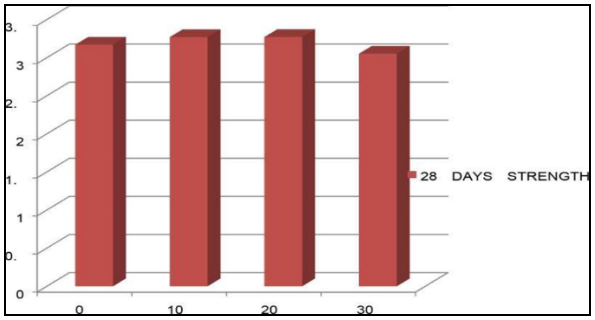


Fig 3 Flexural tensile strength

Table 3 Average flexural tensile strength

Foundry sand content,%	Designation (N/mm^2)
	28 Days
0	3.17
10	3.27
20	3.271
30	3.052



Graph 3 Flexural Tensile Strengths comparison

As we know concrete is relatively strong in compression and weak in tension tensile stress are developed due to drying shrinkage rusting of steel and temperature gradient and many more. So knowledge of tensile strength in

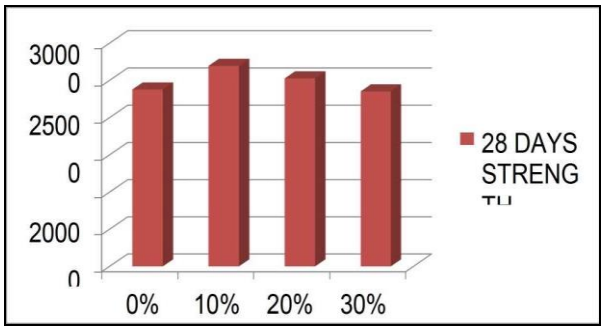
concrete is important. The value of modulus of rupture depends on dimension of beam and manner of loading. Maximum fibre stress will come below point on loading when bending moment is maximum. The flexural strength of specimen is expressed as modulus of rupture, fb= (P x l)/b x d^2 Flexural permissible strength, fck= 0.7 x Vfck (N/mm^2) The values for flexural tensile strength are greater than permissible value. The value for 20% replacement is very good.

D. Modulus of Elasticity

Fig. 4 Modulus of Elasticity

Table 4 Average Modulus of Elasticity

Foundry sand Content %	Modulus of elasticity MPa
	28 days
0	$23.78x10^3$
10	$26.95x10^3$
20	$25.27x10^3$
30	$23.53x10^3$



Graph 4 Modulus of Elasticity comparison chart

In this investigation, the modulus of elasticity of concrete mixtures were determined at the age of 7 & 28 days at various levels of replacement of fine aggregates with foundry sand with w/c ratio of 0.52.At 28-days, control mix M-1 (with 0% replacement level of foundry sand) achieved modulus of elasticity of 23.78 GPa, whereas mixtures M-2 (10% foundry sand), M- 3 1 (20% foundry sand), and M-4 (30% foundry sand) achieved modulus of elasticity of 26.95 GPa, 25.27GPa and 23.53 GPa respectively. So the results show that modulus of elasticity increase with age as well as replacement of foundry sand. Table-15 shows the results for modulus of elasticity of concrete for various levels of replacement of Foundry Sand. Variation of Modulus of Elasticity at various replacement levels of foundry sand is shown in graph

V. CONCLUSION

- Based on test results, it showed a very good replacement for 10% of used foundry sand. Further investigation showed those replacements after 20% to 30% causing small loss in compressive strength, modulus of elasticity.
- The compressive strength for different replacement levels is increases by 13.27%, 5.72% and 5.39% for 28 days strength.
- The split tensile strength of concrete increases by 3.03%, 5.78%, and 1.65% for 28 days strength.
- The values for flexural tensile strength are greater than permissible value. The value for 20% replacement is very good.
- The values for modulus of elasticity are good for 10 % replacement.

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