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EFFECT OF WASTE FOUNDRY SAND ON FLEXURAL STRENGTH AND WATER ABSORPTION OF CONCRETE

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ABSTRACT
Presently, the construction industry is constantly expanding on a huge scale and incorporating new techniques for quick and comfortable field labor. Concrete, being a construction material, plays a significant part in this industry. The cost of using natural resources as concrete materials is significant, and it is on the edge of becoming exorbitant. These issues urge us to either restore natural resources or discover another way to solve the situation. Waste foundry sand, which is produced as a byproduct of the metal casting industry, currently creates a variety of environmental issues. The use of this waste as a building material might help to reduce environmental stress.
An experimental examination is carried out in this work by altering the percent of fine aggregate with foundry sand to generate low-cost and environmentally friendly concrete. In India, waste foundry sand is an industrial waste material that is used for a variety of uses. WFS is a waste management system that is utilised in landfills. It's utilised as a sub-base for highways. Several states have approved the use of foundry sand without requiring encapsulation. It is now employed in the production of hot mix asphalt. Because foundry sand is made up of more than 80% fine homogeneous silica sand, it can be utilised as a substitute for natural fine aggregate. Foundry sand is being used in Portland cement and Portland cement concrete combinations, which is a new application.There are again various trends where the WFS is used but these previously mentioned trends are brought in actual practice and are giving satisfactory results. The utilization of WFS and is also reducing the environmental problems due to WFS. Hence, WFS is proving to be eco-friendly.

Keywords: eco-friendly, waste foundry sand, Compressive strength, split tensile strength.

INTRODUCTION

Now-a-days the construction sector is exploring rapidly on a large scale and also involves new technique for rapid and comfort works on the field. Concrete as a building material plays an important role in this sector. The consumption of natural resources as ingredients of concrete cost high as well as it is on verge of extent. These problem 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 byproduct of metal casting industries causes various environmental problem. 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 mould for casting of ferrous and non-ferrous metal. Finer sand than normal sand is used in metal casting process of metal is reused for many times but when it cannot longer have 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 by fine aggregate in concrete leads in production of economic, light weight and strength concrete.

Concrete is a material which is composed of coarse aggregate, Fine aggregate, cement, Admixtures and Water these each material in concrete contribute 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 % of fine aggregate with used foundry sand to produced low cost and eco-friendly concrete.

LITERATURE REVIEW

Jaychandra ,Shashi Kumar, A. Sanjith J. DG Narayan,(2015),(7)Presented Paper on Strength Behaviour Of Foundry Sand On Modified High Strength Concrete Concluded That: The main constituent of foundry sand are high quality silica of uniformly sized or the lake sand obtained by mould of ferrous and nonferrous metal casting. Initially the sand will be clean before casting, but after castingit will be reached in ferrous content of about 95% of its own volume. The type and volume of materials used for moulds depend upon the type of metal being casted in the mould. But usually the green sand owning the 90% of about ingredients is used in large scale.It could be noted that the effect of concrete containing foundry sand is unique, as the foundry sand changes its physical and chemical properties and also its manufacturing process. Instead of using it for landfilling it can be used more effectively and efficiently for construction. The intrusion of foundry sand reduces workability and also required more water to form a homogenious mix. Annexation of foundry sand helps in enhancing the hardened properties of concrete to a margine of 25%.

C. G. Konapure, D. J. Ghanate,(2015),(8)Presented Paper On Effect Of Industrial Waste Foundry Sand As Fine Aggregate On Concrete Concluded that: Now-a-days huge production waste material from metal industries used foundry sand as byproduct of metal industries causes various environmental problems. To use these waste of product in building material can help in reduction of stress on environment. Sand is used for metal casting industries, finer than normal sand natural sand. After the metal casting processes burnt sand is cannot be longer used it is removed from foundry as a waste for disposal known as "waste foundry sand". The used waste foundry sand as a partial substitutes or total substitutes by fine aggregate in concrete leads in production of economic, light weight, high strength of concrete. Each material in concrete contributes its strength or durability of so, by partial or material which harms the environment can be used for the development of low cost & eco-friendly building material in the research work to study the various percentage of fine aggregate with used foundry sand. In this paper gives to use the foundry sand as a partial replacement by the fine aggregate in concrete, a research work is carried out on a concrete containing foundry sand in range 0%, 10%, 20%, 30%, by weight for M20 7 M30 grade of concrete.

Deepak Chaurasiya, KiranKoli, SurajChaudhari, Vardan More, P. C. Satpute, (2016),(9)Presented Paper On Utilization Of Foundry Sand : An Art to Replace Fine Sand With Foundry Sand Concluded That Foundry industry use high quality specific size silica sand for their molding and casting process. This is high quality sand than the typical bank run or natural sand. Foundries successfully recycle and reuse the sand many times in foundry. When it can no longer be reused in the foundry, it is removed from the industry and it is termed as waste foundry sand. Currently very limited literature is available on the use of these byproducts in the concrete. Waste foundry sand is one of the major issues in the management of foundry waste. WFS are blank in colour and contain large amount of fines. The typical physical and chemical properties of WFS is dependent upon the type of metal being poured, casting process, technology employed, type of furnance (induction, electric arc, and cupola) and type of finishing process (grinding, blast cleaning and coating).

Pranitabhandari, Dr. K. M. tajne,(2016),(10)Presented Paper on Use Of Foundry Sand in Conventional Concrete Concluded that foundry sand normally rely upon a small amount of bentonite clay to act as the binder material. Two general types of binder systems are used in metal casting depending upon which the foundry sands are classified as: 1) clay bounded system (green sand) 2) chemically bounded systems. Both types of sands are suitable for beneficial use but they have different physical and environmental characteristics. Green sand is the most commonly used recycled foundry sand for beneficial reuse. It is composed of naturally occurring material which are blended together ; high quality silica sand (85-95%), bentonite clay (4-10%) as a binder. Carbonaceous additive (2-10%) to improve the casting surface finished and water (2-5%). It is black in colour, due to carbon content, has a clay content that results in % of material that passes a 200 sieve and adherstogethere due to and water.

S.S. Jadhav, S. N. Tande, A.C. Dubai,(2017),(11)Presented Paper On Beneficial Reuse Of Waste Foundry Sand In Concrete Concluded That the industrial byproduct which have been disposed earlier are now being considered for beneficial use. Beneficial use can reduce our nations carbon productionand consumption of virgin material and result in economic gains. It is important component of nations solid Waste management hierarchy first promotes source reduction and waste prevention followed by reused, recycling, energy recovery and disposal. Researches all over the world today are focusing on ways of utilization either industrial or agricultural waste as a source of raw materials for the industries. These waste utilization would not only be economical, but may also result in foreign exchange earnings and environmental pollution control. The foundry industry is diverse and complex. The present work concerns the investigation UFS utilization effects on both morters and concrete. In particular, the performance of conglomerates, at different w/c ratios, are investigated. The aims is to be establish the amount of used foundry sand that can be add admixtures without to heavy penalization, principally in terms workability, mechanical performances and drying shrinkage.

Vemma Reddy, S.Shridhar, Etal,(2017),(12)Presented Paper On International research of engineering and technology and Concluded That: The performance of fresh and hardened properties of concrete containing discarded foundry sand in place of fine aggregate. They have performed the test on the cubes and cylinders having 20%-100% replacement of foundry sand. They have concluded that the slump of the concrete decreases with increase in the % of foundry sand. The compressive strength of the concrete has increased by 13.42% by the replacement of 20% of foundry sand over normal sand. Their result have concluded that upto 60% of foundry sand gives rise to the compressive strength of concrete. The split tensile strength increase upto 60% replacement of foundry sand after that decrease till 100%

OBJECTIVES OF INVESTIGATION

➢ The purpose of this research is to see how leftover foundry sand affects concrete.
➢ The use of waste foundry sand in the building industry to improve the characteristics of concrete also helped to alleviate the problem of waste foundry sand disposal.
➢ To study the effect on Flexural strength and water absorption due to replacement of waste foundry sand in concrete with the normal concrete.

MATERIALS

1. Cement: Cement is a phrase that refers to powdered materials that, when mixed with water, create strong adhesive properties. The cement utilised in the study was Ordinary Portland Cement 53 Grade
2. Fine aggregate: As a fine aggregate, river sand is employed. The most important attribute of fine aggregate is its grading, which is one of many. Coarser sand may be desired since finer sand increases the water requirement of concrete, and extremely fine sand may not be required in fine aggregate because it typically contains more fine particles in the form of cement and mineral admixtures such fly ash and silica fume. The sand particles should also pack tightly in order to achieve a low void ratio. To develop a dense fine aggregate mix with the best cement content and the least amount of mixing water, properties including gradation, specific gravity, and water absorption must be evaluated. The fine aggregate was river sand, which conformed to zone 2.
3. Water: Water is a crucial component of concrete since it actively participates in the mixing process. From a mix design standpoint, compatibility between supplied cement and chemical mineral admixtures, as well as the water used for mixing, is critical. The chemical interaction of water with cement is frequently stated in concrete codes and in the literature. The hydrated cement gel's binding activity is what gives cement concrete its strength. Excess water would simply result in the production of undesired spaces (and/or capillaries) in the hardened cement paste in concrete, hence the water need should be decreased to that required for chemical reaction of a hydrated cement. According to IS 456:2000, potable water is utilised for mixing and curing.
4. Waste Foundry Sand:The majority of waste foundry sand is natural and material. It has qualities that are similar to those of real or synthetic sand. As a result, it can usually be used in place of sand. The majority of metal industry prefer the casting method. This technique employs a mould consisting of uniformly sized, clean, high silica sand. After the casting process, foundries recycled and reused the sand multiple times, but it was eventually thrown as "waste Foundry Sand." Foundry sand is divided into two types:

- Green sand
- Chemically bounded sand

METHODOLOGY

Testing Of Concrete: Research Work is divided into 2 parts:

a) Test on fresh concrete state:

1. Slump Flow Test
2. Flow table test (IS: 1199- 1959)

b) Test On Hardened Concrete State

1. Flexural Test
2. Water Absorption Test

TESTING PROGRAM

Flexural strength test: For flexural strength test beam specimens of dimension 100x100x500 mm were cast. The specimens were de-molded after 24 hours of casting and were transferred to curing. These flexural strength specimens were tested under two point loading as per I.S. 516-1959, on 14 th& 28th days over an effective span of 400 mm on Flexural testing machine. Load and corresponding deflections were noted up to failure. In each category three beams were tested and their average value is reported.

The flexural strength was determined by the formula

$fcr = P_f L / bd^2$ or $3P_f a / bd^2$

Where,

fcr= Flexural strength

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

a = distance between line of fracture to the nearest support, mm.

Where,

L = Centre to center distance between the support = 400 mm,

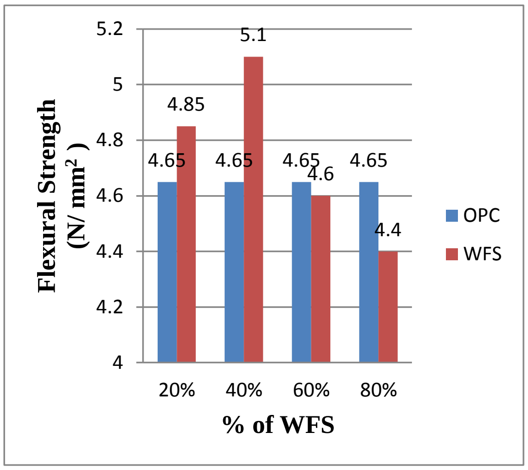
b = width of specimen=100 mm

d = depth of specimen= 100.

Fig. 1 - Flexural Test Setup

Table No. 1: Flexure Test of at the End of 28 Days

Sr. No	Notation	Flexural Strength (N/mm^2)	Water Absorption
1	OPC	4.65	4.64
2	WFS 20	4.85	4.42
3	WFS 40	5.10	4.10
4	WFS 60	4.60	3.80
5	WFS 80	4.40	3.56



Graph No. 1 –Flexure strength 28 Days

Water Absorption Test:

The test specimen shall be completely immersed in water at room temperature for 24 * 2 h. The specimen then shall be removed from the water and allowed to drain for 1 min by placing them on a 10mm or coarser wire -mesh. 'Visible water on the specimens shall be removed with a damp cloth. The specimen shall be immediately weighed and the weight for each specimen noted in N to the nearest 0.01 N.

Subsequent to saturation, the specimens shall be dried in a ventilated oven at 107 + 7°C for not less than 24 h and until two successive weighing at intervals of 2 h show an increment of loss not greater than 0.2 percent of the previously determined mass of the specimen. The dry weight of each specimenshall be recorded in N to the nearest 0.01 N.

Percent Water Absorption (Percent),

W percent = $\frac{(Ww - Wd)}{Wd} X 100$

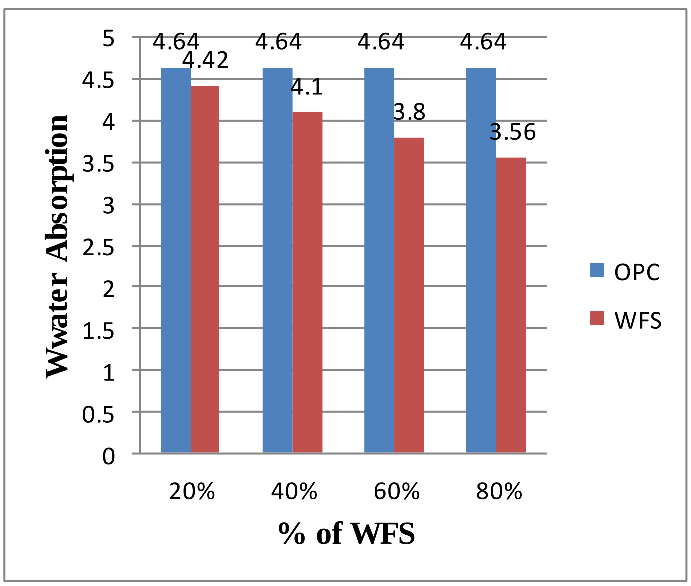
Ww = Weight of wet (saturated) block.

Wd = weight of block after complete drying.

Fig. 2 – Water Absorption test

Table No. 2: Water absorption test

Sr. No	Notation	Water Absorption
1	OPC	4.64
2	WFS 20	4.42
3	WFS 40	4.10
4	WFS 60	3.80
5	WFS 80	3.56



Graph No. 2 –Water absorption test

CONCLUSIONS

➢ The use of leftover foundry sand in concrete helps to mitigate the issue of manufacturing of foundry sand. Furthermore, it alleviates the problem of land filling disposal and maintenance costs.

➢ It was concluded that there was increase in flexural strength of concrete upto 40% replacement. Flexural strength of concrete decreased after 50% compared to the plain concrete. The minimum flexural strength as observed at 80% replacement.

➢ It was found that the water absorption of concrete containing WFS is decreasing with increase in percentage addition of WFS and shows an increase in value further.

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REFERENCES

2. Naveen Arsu, S. Vivek, J. Robinson T. Thilak, Ranjeeth, Etal., “Exprimental Analysis Of Waste Foundry Sand In Partial Replacement Of Fine Aggregate In Concrete” International Research, Vol-10, ISSN 0974-4290,(2017).
3. Pendhari Ankush R, Demse Dhananjay G.,Nikum Madhuri E., Karpe Balraj E, Khairnar Promod R, Suryawanshi Priyanka R., “Partial Replacement Of Sand By Waste Foundry Sand In Partial Replacement Of Sand By Waste Foundry Sand” International Research Journal Of Engineering And Technology Vol-4 issue-5, ISSN 2395-56,(2017).
4. Scoot Seiter, Dominique M. Pittenger, Etal “State Of the Partial Literature Scan For Waste Foundry Sand” Olkhama Department Of Transportation,(2017).
5. Neslihan dogan-saglamtimur, Etal., “Waste Foundry Sand Usage For Building Material Production: A First Geopolymer Record in Material Reused” Research Article On Advanced In Civil Engineering, Article ID 1927135,(2018).
6. Ramnivas, Etal., “ A Literature Review On Foundry Sand Concrete” International Journal Of All Research Eduaction And Scientific Method, Vol-6, issue-8, ISSN 2455-6211,(2018).
7. Shrinivas raw, Gurpreet singh, Etal., “An Elobrate Research Foray On The Strength Parameters Of Concrete Using Glass Powder, Waste Foundry Sand And Copper Slag”International Journal Of Innovative Technology And Exploring Engg, Vol-8, ISSN 2278-3075,(2019).
8. D. PRADEEP KUMAR*a, P. ESWARAMOORTHIb A study on the strengthof green concrete structural element using foundry sand Journal of the Balkan Tribological Association Vol. 24, No 4, 826–837 (2018).
9. Keval Mehta,Prof. (Mrs) Reshma L. Patel,, Dr. Jayeshkumar Pitroda, WaterAbsorption and Sorptivity of Sustainable Mortar Made With Used Foundry Sand and Hypo Sludge.
10. Devinder Sharma, Sanjay Sharma, Ajay Goyal Prediction of High Compressive Strength of Concrete using Waste Foundry Slag and Alccofine by NDT. International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181.