IJCRT.ORG ISSN : 2320-2882
INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

USE OF WASTE FOUNDRY SAND IN INFRASTRUCTURE

[1]Amar Shitole, [2]Pradnya Pradhan,[3]Sujal Haridas, [4]Ashwini Shinde, [5]Aishwarya Taru
[1]Assistant Professor, [2]Student, [3]Student, [4]Student, [5]Student
[1]Department of Civil Engineering,
[1]Pimpri Chinchwad College of Engineering and Research, Pune, India

Abstract: Utilization of industrial waste materials in concrete compensates the lack of natural resources, solving the disposal problem of waste and to find alternative technique to safeguard the nature. There are a number of industrial wastes used as fully or partial replacement of coarse aggregate or fine aggregate. This review carries out a thorough assessment about industrial waste substances, which can be adequately utilized in concrete as fine aggregate substitution. This paper reviewed foundry sand as industrial waste. Basically sand from industrial waste flow through the machines during the sand reclamation process. Experiments have been conducted using waste foundry sand. Crushed sand has been replaced by waste foundry sand which improves compressive strength.

***Index Terms* - Waste Foundry Sand, Compressive Strength, Grade of Concrete.**

I.INTRODUCTION

Foundry sand is a by-product of the ferrous and nonferrous metal casting industry, where sand has been used for centuries as a molding material because of its unique engineering properties. Industry estimates are that approximately 100 million tons of sand are used in production annually. Of that, four to seven million tons are discarded annually and are available to be recycled into other products and industries. Solid wastes generated from manufacturing industries are increasing at an alarming rate and it is consistently increasing. One such industrial solid waste is Used Foundry Sand (UFS). Waste sand is a major problem for Indian Small and medium scale Foundry. Since foundries make intensive use of sand as primary direct material, the regeneration of this sand can be considered as the main factor in environmental performance to achieve sustainable development. Nowadays it is essential to focus on sand regeneration, recycling, re-use and disposal for sustainable development in foundry industries. The option, adopted by some, is to discard and dispose of the used sand altogether after and start with new sand in every cycle. This is not a feasible proposition on economic and environmental consideration. The availability of dumping ground for used chemically bonded sand is becoming difficult day by day. Cost of dumping is also increasing exorbitantly. In addition to non-availability of dumping ground and high dumping cost, the environmental problem is of critical concern. The dumped sand, being toxic, would pollute the atmospheric air as well as the groundwater, having a long lasting effect on the environment and plants. The Government authority is becoming stricter on these issues. On the other hand, availability of new sand is becoming a problem these days. Local authorities are imposing restrictions on mining / extraction of sand altogether. Therefore, supply of new sand to foundries shall be very little or it may even stop altogether. Therefore, they will be compelled to survive on sand obtained by reclaiming used /demolded sand. In addition to above compulsion, there are other good technical reasons for reclamation of chemically bonded sand for re-use.Considering the need to make foundry process “Eco-Friendly”, “Kolhapur foundry and engineering cluster” have installed Thermal Sand Reclamation Plant to reclaim used sand and to make the foundries free of waste generation

II.AIM

To investigate experimentally compressive strength by use of waste Foundry Sand in Concrete with varying proportion of Foundry Sands for M 20 Grade of concrete.

III.OBJECTIVES

- To investigate its further possible uses.
- To develop a new method for cleaning and reusing foundry sand.
- To enhance its strength & utility.
- To keep away contaminated materials from landfills.

IV. LITERATURE REVIEW

Sustainable use of industrial-waste as partial replacement of fine aggregate for preparation of concrete – A review Manoj Kumar Dash a,1, Sanjaya Kumar Patro b, Ashoke Kumar Rath a,2 Concrete the most broadly used construction material (Prabhu et al., 2014), aggregate makes 70% of its volume is the principal component material in concrete production and consumes globally 8–12 million tons of natural aggregate annually (Devi and Gnanavel, 2014; Al-Jabri et al., 2009). The aggregate classifications used are course aggregate with 4.75 mm particle size or more and fine aggregate with 4.75 mm particle size or less. Fine aggregate (Sand) is a significant material utilized for the composition of mortar and concrete and assumes a most essential part in design mix. Sand is a major component of concrete and properties of a specific concrete mix will be determined by the proportion and type of sand used to formulate concrete. It has significant impact on the workability, durability, strength, weight, and shrinkage of concrete. Sand is usually a larger component of the mix than cement. Sand can fill up the pores or voids in the concrete, which is also a contributing factor for the strength of concrete. Sand reduces volume changes resulting from setting and hardening process and provides a mass of particles which are suitable to resist the action of applied loads and show better durability than cement paste alone. Hence sand has a major role for concrete to solidify to give the necessary strength. According to the report of Singh (2012), Singh and Siddique (2012a,b), partial supplanting of sand with waste foundry sand up to 15% increases compressive strength, splitting tensile strength, modulus of elasticity and abrasion resistance of concrete mixtures with the increment of waste foundry sand as replacement for fine aggregate. Siddique et al. (2009, 2015) assess the properties of concrete in which sand was partially supplanted with three different percentages (10%, 20%, 30%) of used foundry sand as partial substitution (Siddique et al., 2009) and studied two grades of concrete M-20 & M-30 incorporating waste foundry sand as partial substitution with five percentages (0%, 10%, 15%, 20%) Siddique et al., 2015. They inferred that with the rate of increment of foundry sand content in concrete, the compressive strength, splitting tensile strength, modulus of rupture and modulus of elasticity of concrete mixes increased. Saha, Suman, C. Rajasekaran, and Ajinkya P. More. "Use of foundry sand as partial replacement of natural fine aggregate for the production of concrete." In Sustainable Construction and Building Materials, pp. 61-71. Springer, Singapore, 2019.

In this paper, it explains the scarcity of natural fine aggregate becomes prominent in the present scenario due to high consumption of natural fine aggregate as the demand for concrete is increasing day by day. As a result, environmental degradation also becomes very significant. In this experimental study, an effort has been made to study the feasibility of using foundry sand as partial replacement for natural fine aggregate to produce concrete with desired properties. Physical and mechanical properties of the produced concrete were studied by incorporating foundry sand, 10, 20, 30, and 40% of the mass of total fine aggregate in the mixes. For achieving the desired strength of concrete mixes, 30% replacement of natural fine aggregates by foundry sand was observed in this work to be considered for the production of fresh concrete. Use of a certain percentage of foundry sand as an alternative for natural fine aggregate to produce concrete will lead to protect the natural resources, save the environmental system, and promote sustainability in concrete industries.

V Methodology

➢ Casting process

➢ Reclamations of Sand

A series of 36 cubes specimens and 3 conventional concrete cubes are cast and tested for compressive strength. To accomplish the aim and objectives, a methodology developed is as follows:

1. Casting of the cube and check for Compressive Strength with conventional concrete for mix M20 is carried out.
2. The Casting of the cube with replacement of Fine Aggregate with waste Foundry Sand for mix M20 with varying percentage is done.
3. Cube specimens of 150 mm x 150 mm x 150 mm are casted.
4. Testing of the above said cube at 7, 14 & 28 days for compressive strength is done respectively.
5. Compressive Strength result tests are compared with that of the conventional concrete strength

VI Material to be Used

1. Cement: Ordinary Portland cement of 53 grade is used in this experimentation conforming to I.S- 8112- 1989.
2. Fine Aggregate: Fine aggregates are the second ingredient of the aggregate phase in concrete. Sand is the most commonly used fine aggregate in concrete. Fine aggregates that pass from 4.75 mm (No.4) sieve but are retained on 75um (No.200) sieve.
3. Coarse Aggregate: The coarse aggregates used for the concrete are 20 mm passing and retained on a 4.75mm.
4. Water: Potable water is used for the experimentation.
5. Foundry Sand: It is obtained from Reclamation Sand process, types of sand used Core Sand, Reclaimed Sand, Raw Black Sand Menon Kagal, Raw Black Sand Vikram Nagar. The Material is brought from “Kolhapur foundry and engineering cluster”. They have installed Thermal Sand Reclamation Plant to reclaim used sand.

VII Concrete Mix Proportions & Preparation of Mix Design.

Concrete for M20 grade is prepared. A mixed proportion of 1.36: 2.03: 4.35 with water-cement ratio less than 0.45 to get a characteristic strength of M20. Three sets of mix design were prepared with the use of different substituents such as follows:

1. Cement + fine aggregate + 20 mm coarse aggregate + water.
2. Cement + (Foundry Sand 10%+ Fine aggregate 90%) + coarse aggregate + Water
3. Cement + (Foundry Sand 15%+ Fine aggregate 85%) + coarse aggregate + Water

These concretes were prepared and cast in 150mm concrete mould to take the compressive test. After 24 hours these moulds were De-moulded and set for curing in a water tank. The compressive tests were taken in 7, 14 & 28 days respectively to check the results.

Sample 0: Plain Concrete Block

Sample 1: Core Sand

Sample 2: Reclaimed Sand

Sample 3: Raw Black Sand Menon Kagal

Sample 4: Raw Black Sand Vikram Nagar

Table 1.Material Required For 1 Cube

Sr. No.	% WFS	Cement (Kg)	C.A (Kg)	F.A (Kg)	WFS (Kg)
1	0	1.36	4.7	2.03	0
2	10	1.36	4.7	1.83	0.2
3	15	1.36	4.7	1.73	0.305

VIII Material Testing

Cement, Fine aggregate and coarse aggregates are tested before the experiments and checked for conformity with relevant Indian standards. Specific gravity test Silt Content and Sieve Analysis test of Fine aggregates are conducted as per IS: 2720 (Part II)1973.

Elongation and Flakiness Index test of Coarse aggregate are conducted as per IS: 2386 (Part III)1963. Consistency, Initial and Final Setting Time, Soundness Test, Fineness Of Cement are the test conducted on cement as per IS 4031: 1988, 2000, IS 650:1960 IS 269: 1989 (OPC)

IX Testing

Compression test is to be conducted on cubes on proposed experimentation work.

- Compression Test:

The Compression test is the most common test conducted on concrete. The test is easy to perform and gets most of the desirable characteristics properties of concrete which is related to its compressive strength. The compression test is carried out in the cube of the size 150 x 150 x 150 mm. The cubes are filled with 0%, 10%, and 15% with Foundry Sand. Each layer is compacted by hand compaction. After the top layer has been compacted the surface of the concrete is brought to the finished level with the top of the mold, using a trowel. After 24 hours the cubes are remoulded and are shifted to a curing tank wherein, they are allowed to cure for 7, 14 & 28 days. After 7, 14 & 28 days of curing the cubes, are tested on a digital compression testing machine as per I.S. 5161959.

The failure load is noted. The compressive strength is calculated as follows:
Compressive strength (MPa) = Failure load divided by cross-sectional area = F/A.

X Result

Table 2

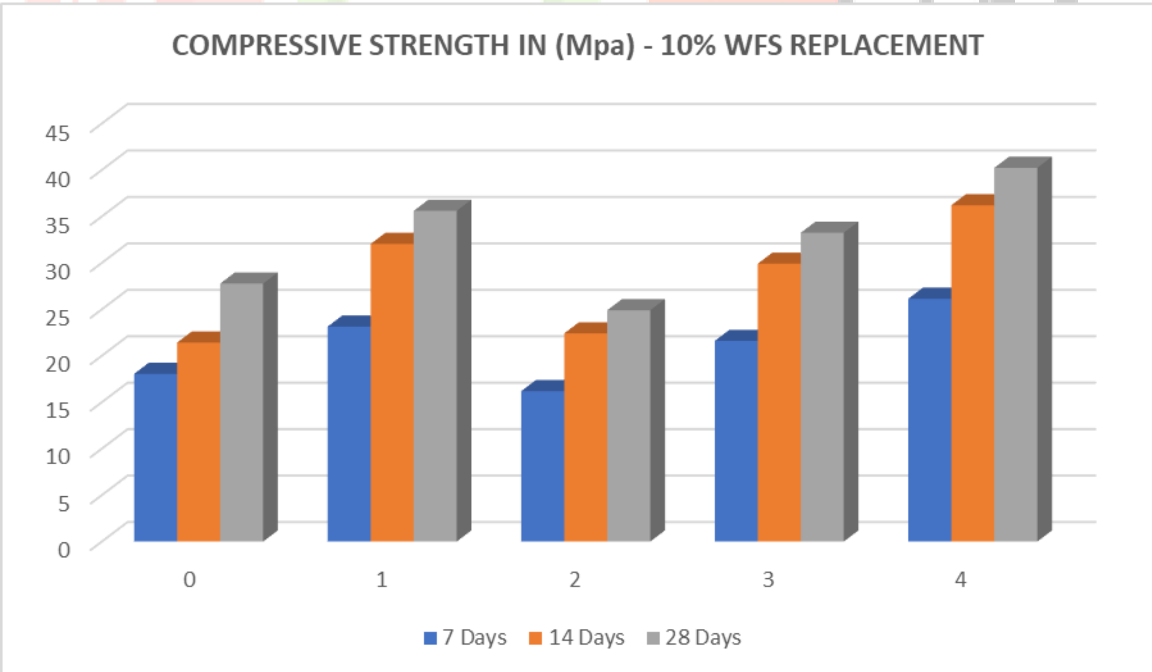
COMPRESSIVE STRENGTH OF CONCRETE BLOCK In (Mpa)				
Sr. No	% of WFS	7 Days	14 Days	28 Days
1	0	18.05	21.42	27.77

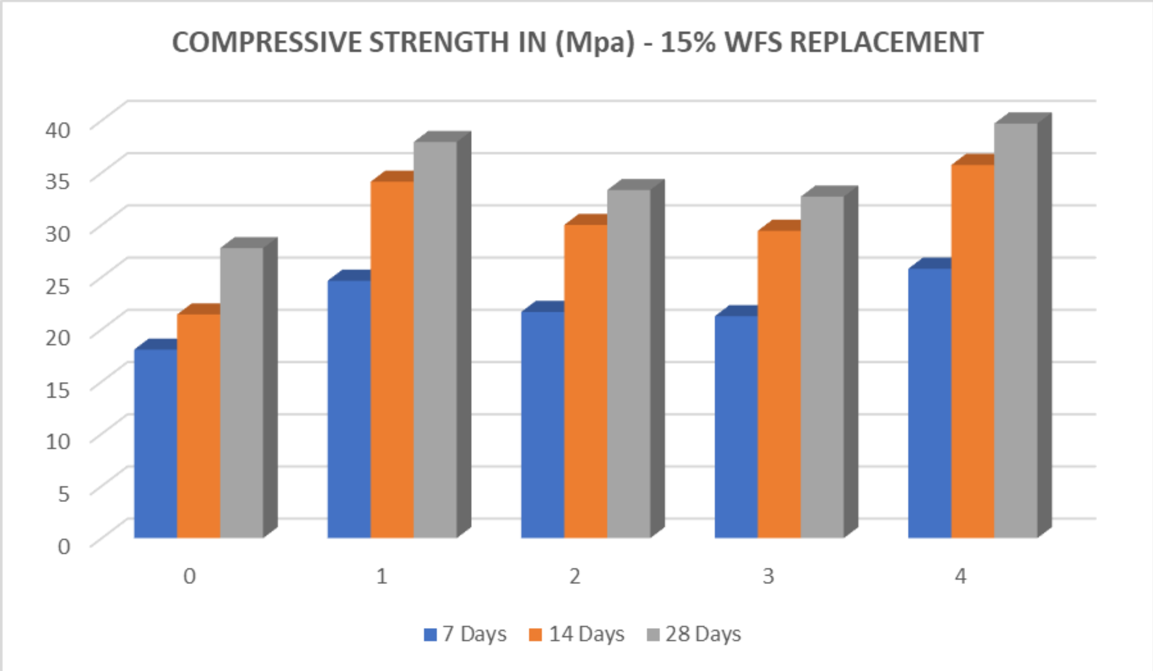
Table 3

COMPRESSIVE STRENGTH IN (Mpa) – 10% WFS REPLACEMENT			
Sr. No	7 Days	14 Days	28 Days
1	23.14	32.04	35.6
2	16.19	22.41	24.9
3	21.6	29.91	33.24
4	26.14	36.2	40.23

Table 4

COMPRESSIVE STRENGTH IN (Mpa) – 15% WFS REPLACEMENT			
Sr. No	7 Days	14 Days	28 Days
1	24.65	34.13	37.93
2	21.66	29.99	33.33
3	21.25	29.43	32.70
4	25.80	35.73	39.70





XI Conclusion

The paper presented a comprehensive parametric study on a wide range of properties and durability characteristics of concrete , on which there is little information. Use of waste foundry sand in concrete reduces the production of waste through metal industries i.e. WFS is eco-friendly building material The problems of disposal and maintenance cost of land filling is reduced. Application of this study leads to develop in construction sector and innovative building material. Compressive strength increases on increase in percentage of waste foundry sand as compare to traditional concrete. In this study, maximum compressive strength is obtained at 15%replacement of fine aggregate by waste foundry sand

XII References

- Saha, S., &Rajasekaran, C. (2016). Mechanical properties of recycled aggregate concrete produced with Portland Pozzolana Cement. Advances in Concrete Construction, An International Journal, 4(1), 27–35.
- Saha, S., Rajasekaran, C., & Vinay, K. (2017). Use of concrete wastes as the partial replacement of natural fine aggregates in the production of concrete. In Global Civil Engineering Conferences (GCEC-2017), Lecture Notes in Civil Engineering (Vol. 9). Singapore
- Monosi S, Tittarelli F, Giosue C, Ruello ML (2013) Effect of two different sources and washing treatment on the properties of UFS by-products for mortar and concrete production. Constr Build Mater 44:260–266
- Torres A, Bartlett L, Pilgrim C (2017) Effect of foundry waste on the mechanical properties of Portland Cement Concrete. Construction Build Mater 135:674–681 • M.C. Zanetti and S. Fiore, Foundry waste recycling in moulding operations and in the ceramic industry, Waste. Manag. Res., 21(3), 2003, 235–242.
- R Siddiquea, G. Kaur, and A. Rajor, Waste foundry sand and its leachate characteristics. Resour. Conserv. Recycl. , 54(12), 2010, 1027–1036.
- ABIFA (2015). Brazilian Casting Association – Brazilian Association of the Foundry Industry, ABIFA yearbook 2015, ABIFA foundry guide. June 201522–25.
- Kumar Sunil,” Utilization of Fal-G bricks and blocks”, Construction and Building Materials
- N. Gurumoorthy K. Arunachalam “Durability Studies on Concrete Containing Treated Used Foundry Sand”, January 2019
- IS: 1918 - 1966 “METHODS OF PHYSICAL TESTS FOR FOUNDRY SANDS”
- Huan-Lin Luo, Deng-Fong Lin, Mei-Ling Chung and Lisa Y. Chen “Waste Foundry Sand Reused as Clay Replacement for Tile Manufacture”
- S. Rubini, C.S. Suganya “Fractional restoration of foundry soil in brick manufacturing”