Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 04, April-2019

Experimental Investigation of Foundry Sand in Concrete

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***Abstract*—it is necessary to seek the possibility of recycling them, once their durability is expired. The recycled materials can be used effectively in architectural and civil engineering fields. They can stand close to the concept of green concrete which is in compatible with the environment. Foundry sand from casting industries is a waste material which is dumped extensively and in this study an attempt has been made to evaluate the usage of this waste material in concrete. The constant depletion of sand beds at all major sources of availability is a major concern and thus efforts are taken in order to replace sand in construction activities. In this study, effect of foundry sand as fine aggregate replacement on the compressive strength, flexural strength and split tensile strength of concrete with a grade of concrete M30 & The over exploitation of non-renewable materials is becoming a threat and therefore water cement ratio of 0.45 was investigated at different limited curing periods (7,14 and 28 days). The percentage of foundry sand used for replacement were 0%, 10%, 20% , 30%, and 40% by weight of fine aggregate. Test showed impressive results, showing capability of foundry sand for being a component in concrete for imparting strength. Making concrete from recycled materials saves energy and conserves resources which lead to a safe sustainable environment.**

Keywords- Foundry sand, Replacement of sand, Compressive strength and Waste materials.

I INTRODUCTION

Waste foundry sand (WFS) is a by-product from the production of both ferrous and nonferrous metal castings. It is high quality silica sand. Foundries use high quality size-specific silica sands for use in their moulding and casting operations. Normally raw sand is of a higher quality than the typical bank run or natural sands used in fill construction sites. In the casting process, moulding sands are recycled and reused many times. Eventually, when, recycled sand degrades to a level that it can be no longer is reused in the casting process. When it is not possible to further reuse sand in the foundry, it is removed from the foundry and is termed as waste foundry sand. The physical and chemical characteristics of foundry sand depend upon the type of casting process and the type of industries.

Classification of foundry sands depends upon the type of binder systems used in metal casting. Two types of binder systems are generally used, and on the basis of that foundry sands are categorized as: clay-bonded sands (green sand) and chemically bonded sands. Clay-bonded (Green) sand is composed of naturally occurring materials which are blended together; high quality silica sand (85–95%), bentonite clay (4–10%) as a binder, a carbonaceous additive (2–10%) to improve the casting surface finish and water (2–5%). It is black in colour due to carbon content. Green sand is the most commonly used moulding media by foundries. The silica sand is the bulk medium that resists high temperatures while the coating of clay binds the sand together. The water adds plasticity. The carbonaceous additives prevent the "burn-on" or fusing of sand onto the casting surface. Green sands also contain trace chemicals such as MgO, K2O, and TiO2. The green sand used in the process constitutes upwards of 90% of the moulding materials used.

Chemically bonded sands are used both in core making where high strengths are necessary to withstand the heat of molten metal, and in mould making. Chemically bonded sand consists of 93–99% silica and 1–3% chemical binder. Silica sand is thoroughly mixed with the chemicals; a catalyst initiates the reaction that cures and hardens the mass. There are various types of chemical binder systems used in the foundry industry. The most common chemical binder systems used are phenolic-urethanes, epoxy-resins, furfyl alcohol, and sodium silicates. Chemically bonded sands are generally light in colour and in texture than clay bonded sands.

Waste foundry sand (WFS) is also referred as spent foundry sand (SFS) or used foundry sand (UFS)

II LITERATURE REVIEW

Dr.M.Palani Vel, S.Vignesh et al were described "UTILIZATION OF FOUNDRY SOLID WASTE (SLAG) FOR M20 CONCRETE MIX PROPORTIONS" **2015,** Journal of environmental science, Toxicology the specimens were casted by M20 % grade of concrete. They studied the effect of different proportion of foundry slag (16.67%, 33.33%, 50%, 66.66%, 83.33%, and 100%) in concrete. From the test results, the Compressive strength was increased by 16.67%,33.33%,50% of foundry slag for the standard value of 20N/mm and 66.66%, 83.33%, 100% at 7 days respectively and also 28 days was increased by 83.07%,99.07% and 100% respectively.

Amitkumar D.Raval et al were described "FOUNDRY SAND -UTILISATION AS A PARTIAL REPLACEMENT OF FINE AGGREGATE FOR ESTABLISHING SUSTAINABLE CONCRETE" 2015, International journal of Engineering Sciences & Research technology, In this study , effect of foundry sand as fine aggregate replacement with M25(1:1.10:3.38) mix proportion & w/c ratio(0.48) also the percentage of foundry sand used for replacement were (0%,10%, 20%, 30%,40%,50%)by weight of fine aggregate.

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Based on the test results they concluded that, the Compressive strength increases up to 30% of replacement & decreases suddenly at40% replacement when compared to ordinary mix without foundry sand at 28 days. The replacement of natural sand with used foundry sand up to 30% is desirable, as cost effective.

III MATERIALS AND TESTING

The following are the materials to be used in the proposed investigation

a) Foundry Sand
b) Cement OPC 43 Grade
c) Coarse Aggregate (Crushed Angular Aggregate)
d) Fine Aggregate(River sand)

FOUNDRY SAND

Most of the metal industries prefer sand casting system. In this system mould made of uniform sized, clean, high silica sand is used. After casting process foundries recycle and reuse the sand several times but after sometime it is discarded from the foundries known as **foundry sand**. The application of waste foundry sand to various engineering sector can solve the problems of its disposal and harmful effect to environment. Foundry sand is clean, uniformly sized, high-quality silica sand that is bounded to form moulds for ferrous (iron and steel) and non-ferrous (copper, aluminum, brass) metals. Type of foundry sand depends on the casting process in foundries. Foundry sand is generally of two types: Green sand, chemically bounded sand. Additive in sand depends on type of metal casting. Use of waste foundry sand full or partial replacement by fine aggregate helps to achieve different properties or behavior of concrete.

CEMENT

The fresh cement is used for research work having grade of cement is 43grade (OPC) all properties of cement are tested by conforming IS -12269-1987 to be use.

FINE AGGREGATE

Aggregates are important constituent of concrete. Ordinary river sand was used as fine aggregate. It is used for the experimental program is locally procured and conformed to grading zone II as per IS: 383-1970. The sand is first sieved through 4.75 mm sieve to remove any particles greater than 4.75 mm. Fine Aggregate passing through 4.75 mm was used in the concrete mixes

COARSE AGGREGATE

The aggregate having size more than 4.75 mm is termed as coarse aggregate. The graded coarse aggregate is described by its nominal size i.e. 40mm, 20mm, 16mm, 12.5mm etc. In this project we using the maximum size of coarse aggregate is 20mm.Testing of aggregate is done as per IS 383-1970.

IV RESULT AND DISCUSSION

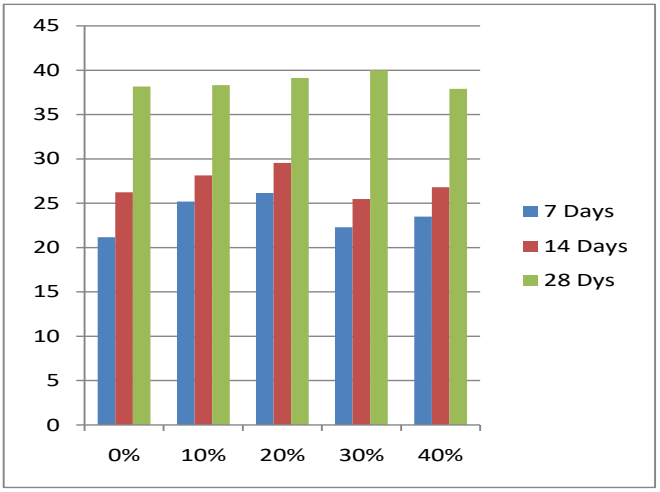
The specimens casted will be tested for compressive strength,split tensile strength ,and flexural strength of plain cement concrete with replacement of fineaggrgate by foundry sand with various percentages.

COMPRESSIVE STRENGTH TEST

The test was carried out conforming to IS 516-1965 to obtain compressive strength of concrete at the age of 7, 14, 28 days. The cubes were tested using compression testing machine (CTM) 2000 kN. From the test results, it was observed that the strength of foundry sand concrete is greater than that of conventional concrete.

By replacing of river sand by equal weight of foundry sand in concrete, the strength increases with increase of foundry sand in concrete upto the level of 20% of replacement, after that the strength decreases at 30% of replacement of foundry sand in concrete in various curing periods. Below listed tables and graphs shows the relationships between the no of days and its mean compressive strength values.

MIXTURESS	*7DAYS N/mm²*	*14 DAYS N/mm²*	*28 DAYS N/mm²*
0%	x	26.22	38.16
10%	25.20	28.15	38.31
20%	26.16	29.55	39.14
30%	22.29	25.47	39.98
40%	23.50	26.80	37.90



SPLIT TENSILE STRENGTH

The test was carried out conforming to IS 516-1959 to obtain split tensile strength of concrete at the age of 28 days. The cylinders were tested using compression testing machine (CTM) of capacity 2000KN.

By replacing of river sand by equal weight of foundry sand in concrete, the strength increases with increase o foundry sand in concrete up to the level of 20% of replacement, after that the strength decreases at 30% of replacement of foundry sand in concrete in various curing periods.

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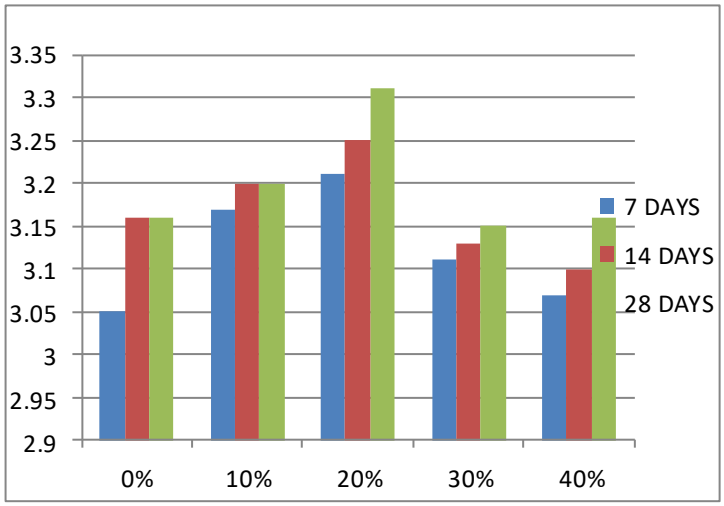
MIXTURESS	*7DAYS N/mm²*	*14 DAYS N/mm2*	*28 DAYS N/mm²*
0%	3.05	3.16	3.16
10%	3.17	3.20	3.20
20%	3.21	3.25	3.31
30%	3.13	3.13	3.15
40%	3.07	3.10	3.16



V CONCLUSION

Based on the above investigations the following observations are made regarding the properties and behavior of concrete on partial replacement of fine aggregate by waste foundry sand:

1. fresh concrete shows that the addition of foundry sands gives low slump values mainly due to the presence of very fine binders, so these mixtures require high superplastizer dosage in order to maintain a good workability.

2.Compressive strength, Split tensile strength, flexural strength increases on increase in percentage of waste foundry sand as compare to the conventional mix.

3.By the results, max compressive strength, tensile strength, flexure strength is obtained at 30% replacement of fine aggregate by foundry sand.

The increase in strength parameters may be due to fineness of foundry sand. Fineness is higher than fine aggregate & reduce the porous nature in concrete thereby increasing density and strength.

4.Based on the results, The replacement of natural sand with used foundry sand up to 30 % is desirable. as it is cost effective, reduce the amount of fine aggregate.

5.Use of waste foundry sand in concrete reduces the production of waste through metal industries; it is an eco friendly building material.

REFERENCES

[1] Abichou T.Benson, C. Edil (1998) 'Database on beneficial reuse of foundry byproducts', Recycled materials in geotechnical applications Geotech. Spec. Publ.No.79, C. Vipulanandan and D.Elton, eds., ASCE, Reston, Va., 210-223.

[2] Bemben.S.M, Shulze, D.A. (1993). The influences of selected testing procedures on soil/geomembrane shear strength measurements. Proc., Geosynthetics '93, Industrial Fabrics Association International, St.Paul, Minn., 619-631.

[3] Bemben.S.M, Shulze, D.A. (1995).The influence of testing procedures on Clay/geomembrane shear strength measurements. Proc. Geosynthetics '95, IFAI, St.Paul, Minn., 1043-1056.

[4] Fredlund.D.G, Morgenstern.N.R, Widger.R.A (1978). Shear strength of unsaturated soils.Can.Geotech.J, Ottawa, 15(3), 313-321.

[5] Javed.S, Lovell.C. (1994). Use of Waste foundry sandin construction.Rep.JHRP/INDOT/FHWA-94/2J, Final REP., Purdue School of Engg., West Lafayette, Ind.

[6] Javed.S, Lovell.C (1994). Use of waste foundry sand in civil engineering. Transp. Res. Rec. 1486, Transportation Research Board, Washington, D.C., 109–113.

[7] Kleven.J.R, Edil.T.B, Benson.C.H, 2000. Evaluation of excess foundry system sands for use as sub base material. Transp.Res.Rec. 1714, Transportation Research Board, Washington, D.C., 40–48.

[8] Mitchell, J. K., 1993. Fundamentals of soil behavior, Wiley, New York. Naik.T.R. and Singh.S.S (1997).

[9] Permeability of flowable slurry materials containing foundry sand and fly ash. J. Geotech. and Geoenvir. Engg. ASCE.

[10] Naik.T.R and Singh.S.S (1997b). Flowable slurry containing foundry sands. J. Mat. In Civil. Engg. ASCE, 9(2), 93–102.

[11] Naik.T.R, Singh.S.Shiw, and Ramme.W.Bruce, (April, 2001). Performance and Leaching Assessment of Flowable Slurry. Journals of Environmental Engg. V.127, No. 4, pp 359-368.

[12] Naik.T.R.Kraus, N.Rudolph, Chun Yoon-moon, Ramme.W.Bruce and Singh S.Shiw, August 2003.Properties of Field Manufactured Cast-Concrete Products Utilizing Recycled Materials. Journals of Materials in Civil Engg. V.15, No. 4, pp 400-407.

[13] Naik.T.R, Kraus.N.Rudolph, Chun Yoon-moon, Ramme.W.Bruce and Siddique Rafat, May-June2004.Precast Concrete Products Using Industrial By-Products. ACI Materials Journal. 101, No. 3, pp 199-206.

[14] Reddi.N.Lakshmi, Rieck, P.George, Schwab.A. P, Chou.S.T and Fan.L.T. (May 1995). Stabilization of Phenolic in foundry sand using cementious materials. Journals of Hazardous Materials, V. 45, pp 89-106.

[15] Stark.T, Eid.H. (1994). Drained residual strength of cohesive soils. J. Geotech. Engg, ASCE, 120(5), 856–871.

[16] Takasumi, D. L., Green, K. R., Holtz, R. D., 1991.Soil-geosynthetics interface strength characteristics: A review of state-of-the-attesting procedures. Proc., Geosynthetics '91, Industrial Fabrics Association International, St. Paul, Minn., 87–100.

[17] Tikalsky, J. Paul, Smith, Earl and Regan, W. Raymond, December 1998. Proportioning Spent-Casting Sand in Controlled Low-Strength Materials. ACI Material Journal, V.95, No.6, pp 740-746.

[18] Tikalsky, J. Paul, Gaffney Mike and Regan, W. Raymond, December 2000. Properties of Controlled Low-Strength Materials Containing Foundry Sand. ACI Materials Journal, V.97, No.6, pp 698-702

[19] IS: 8112-1989, Specifications for 43-Grade Portland cement, Bureau of Indian Standards, New Delhi, India.

[20] IS: 383-1970, Specifications for coarse and fine aggregates from natural sources for concrete, Bureau of Indian Standards, New Delhi, India.

[21] IS: 10262-1982, recommended guidelines for concrete mix design, Bureau of Indian Standards, New Delhi, India.

[22] IS: 1199-1959, Indian standard methods of sampling and analysis of concrete, Bureau of Indian Standards, New Delhi, India

[23] IS: 516-1959, Indian standard code of practice- methods of test for strength of concrete, Bureau of Indian Standards, New Delhi, India.