STRENGTH EVALUATION OF M-SAND WITH PARTIAL REPLACEMENT OF USED AND UNUSED FOUNDRY SAND

Mrs.S.Theerkadharshini. M.E.,
Department of Civil Engineering,
Research Scholar,
Dr.MGR Educational and research institute University
Chennai.
Dr.T.Felixkala M.E.,PhD.,
Department of Civil Engineering
Professor,Dean and Research,
Dr.MGR Educational and research institute University,
Chennai.

Article History: **Received:** 03.11.2022 **Revised:** 15.12.2022 **Accepted:** 1.01.2023

.

Abstract

Foundry sand is a by-product that is produced in metal casting industries at time of casting. It causes environmental issues because of fallacious disposal. Accordingly, its usage in building material, construction and different fields is vital for reduction of environmental troubles. This studies is consists of out to supply a low value and eco-friendly concrete this paper demonstrates the usage of waste foundry sand as a replacement of M-sand in concrete factors and reduce cost of material in construction because of its low-cost availability. An experimental research is executed on a concrete containing waste foundry sand in variety of 20 % and 30 % by using weight of m30 grade concrete. In view that there is polymer chemical resin present chemical take a look at are performed and outcomes are in comparison with M- sand. Varieties of chemical test performed are chloride test and sulphate test. right here there's two styles of foundry sand is used. Material was produced, examined and in comparison with traditional concrete in phrases of workability and strength. The experimental result we conclude that compressive strength increases with will increase in partial substitute of used foundry sand. Intention of the research is to understand the behavior and mechanical properties of concrete after addition of waste foundry sand in different proportion by means of tests like compressive strength, flexural strength and water Absorption. Because of its uniformity and fineness water absorption of the concrete is decreased.

DOI: 10.31838/ecb/2023.12.1.005

I. INTRODUCTION

Foundry sand is a by-product which is produced in metal casting industries at time of casting. It causes environmental troubles because of improper disposal. As a consequence, its usage in constructing material, production and different fields is vital for reduction of environmental issues. This research is incorporates out to supply a low cost and eco-friendly concrete. This paper demonstrates the use of foundry sand as a alternative of M-sand in concrete element and decreases the cost of material in construction because of its low -cost availability.

II. SCOPE AND OBJECTIVE

A. the primary goal of this have a look at is to formulate a low- cost and eco-friendly Concrete.

B. it may be used for other purposes including in construction materials, flow filling, Ceramic, enterprise, bricks & repair, mineral wool merchandise.

C. we will acquire a sustainable disposal of spend foundry sand.

III. MATERIAL COLLECTION

The materials that have been selected for the casting of cubes and beams had been tested preliminary. These preliminary tests are carried out as to whether or not the properties of material are conductive to the respective codes. all of the experiment that has been performed is defined in subcategories.

a. FOUNDRY SAND

Foundry sand is a by-product which is produced in steel casting industries at time of casting. It causes environmental troubles due to wrong disposal.

Used foundry sand: last stage sand in molding sand and it is used for core purpose, and it'll have more compact ability.

Unused foundry sand: it is not used in the molding purpose it remains ordinary as river sand.

b. COARSE AGGREGATE

ordinary granite broken stone aggregates of size more than 12mm are used for the study. Most nominal size of 20 mm is used.

c. CEMENT

The cement that is used is of OPC 53 grade as per the standard specifications of the country. The cement according to the Indian specification must fulfill the IS code IS 12269- 1987 (reaffirmed 1999).

d. M- SAND

For mixture produces concrete aggregate are end products while for concrete manufacturers, aggregates are raw materials for use for concrete manufacturing. The quality of aggregates may be influenced while raw materials, gravel or rock may have characteristics which can’t be modified by the production process. One extremely important component is constant supply of course, fine aggregate. On this regard a course aggregate produced by way of crushing basaltic stone and river sand is the foremost natural supply of fine aggregate in our country. However the intense construction activity is ensuing in growing shortage and price boom of the natural sand within the country in addition the mixture and concrete industry are currently going through a developing public attention related to environmental threats. Therefore, seeking out a possible alternative for natural sand is a must. One alternative used as replacement is the usage of M sand. Due to the forecast shortfall in supply of natural sand and increased construction practices time will come while M sand will play a vast function as an ingredient in concrete manufacturing.

e. REINFORCEMENT BARS

Reinforcement bars is a steel bar or mesh of steel wires used as a tension device in reinforced concrete and reinforced masonry structures to strengthen and hold the concrete in tension. Rebar’s surface is often patterned to form a better bond with the concrete.

IV. PHYSICAL AND CHEMICAL PROPERTIES OF MATERIALS

TABLE: 1 Properties of 53 grade Cement

S.NO	DESCRIPTION	RESULT
1.	Specific gravity	3.16
2.	Fineness	2%
3.	Consistency	31%
4.	Initial Setting time	110 minutes

TABLE:2 PROPERTIES OF 20MM SIZE COARSE AGGREGATE

S.NO	DESCRIPTION	RESULT
1.	Specific gravity	2.73
2.	fineness	7.80
3.	Surface moisture	0.08%
4.	Water absorption	1.36%

TABLE: 3 Properties of M- Sand

S.NO	DESCRIPTION	RESULT
1.	specific gravity	2.67
2.	Fineness modulus	5.4
3.	moisture content	9.0 %
4.	water absorption	7.0%

TABLE: 4 Properties of used foundry sand

S.NO	DESCRIPTION	RESULT
1.	specific gravity	2.42
2.	Fineness modulus	2.25
3.	moisture content	0.7%
4.	water absorption	o.45%

TABLE: 5 Properties Of Unused Foundry Sand

S.NO	DESCRIPTION	RESULT
1.	specific gravity	2.42
2.	Fineness modulus	2.1
3.	moisture content	0.5%
4.	water absorption	0.45%

TABLE: 6 Chemical Properties Of Foundry Sand

CHEMICAL PROPERTIES	%

Loss on ignition	8.90%
Water soluble matter	0.03%
Acid soluble matter	8.50%
Content of SiO2	0.50%
Content of Ai2O2	2.67%
Content of Fe203	0.59%
Content of Cao	2.65%

TABLE: 7 Properties of Reinforcement

DESCRIPTION	**SIZE**
Size of main bars	16mm in diameter
Size of secondary bars	16mm in diameter
Cover thickness provided	25mm
Spacing between tie bars	150mmc/c

V. MIX DESIGN OF M30 GRADE CONCRETE

a. OBJECTIVE OF MIX DESIGN

- The first objective is to achieve the stipulated minimum strength.
- The second objective is to make the concrete in most economical manner.

b. FACTORS TO BE CONSIDERD IN MIX DESIGN

1. Grade of concrete
2. Type of cement
3. Type & size of aggregate
4. Type of mixing and curing
5. Water/cement ratio
6. Degree of workability.
7. Air content.

c. DESIGN STIPULATIONS

Grade designation: M_{30}

Type of cement used: OPC-53

Maximum nominal size of aggregate: 20 mm

Maximum water content : 0.55

Minimum water content : 300 kg/m

Specific gravity of cement : 3.16

Specific gravity of coarse aggregate: 7.80

Specific gravity of fine aggregate: 2.5

TABLE: 8 MATERIAL REQUIREMENTS FOR CUBE OF SIZE 150 X 150 X 150 mm

(%)	WATER (lit)	CEMENT	FINE AGGREGRATE (Kg)	FOUNDRY SAND (Kg)	COARSE AGGREGATE (Kg)
0	0.47	2.5	2	0	3.8
20	0.47	2.5	1.6	0.4	3.8
30	0.47	2.5	1.4	0.6	3.8

VI. EXPERIMENTAL METHODOLOGY

Mix design was done for M30 concrete as per the Indian standard code specifications (IS 10262-2007). Initial tests on all the ingredients of concrete were done and the results were tabulated. Experimental test is carried out on a concrete containing foundry sand in range of 20%, 30% by weight of M-30 concrete. The tests were carried in cube of 150x150x150 and reinforced beam of 750x150x150 for 7, 14 and 28 days.

a. Cube Compressive Strength

The compressive strength, as one of the most important properties of hardened concrete, in general is the characteristic material value for classification of concrete. 28 days cube compressive strength is tested on cubes of size 150mmx150mmx150mm and 28 days compressive strength is tested.

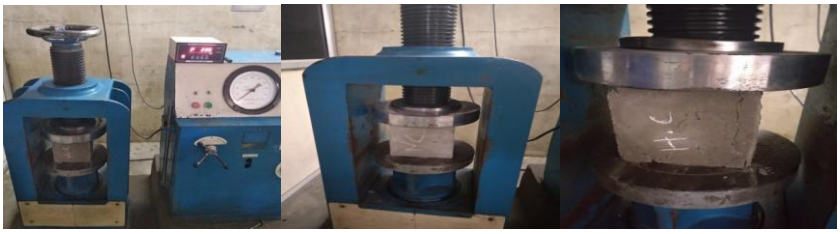

FIGURE:1 Testing of Cube for compressive strength

(i) TEST ON USED FOUNDRY SAND

TABLE:9 Used Foundry Sand - 20 %

SI.NO	DAYS OF CURING	LOAD (KN)	COMPRESSION STRENGTH (N/MM^2)
1	7 Days	501	28.3
2	14 Days	715	31.8
3	28 Days	807	35.9

TABLE:10 Used Foundry Sand - 30 %

SI.NO	DAYS OF CURING	LOAD (KN)	COMPRESSION STRENGTH (N/MM^2)
1	7 Days	549	24.4
2	14 Days	753	33.5
3	28 Days	870	38.7

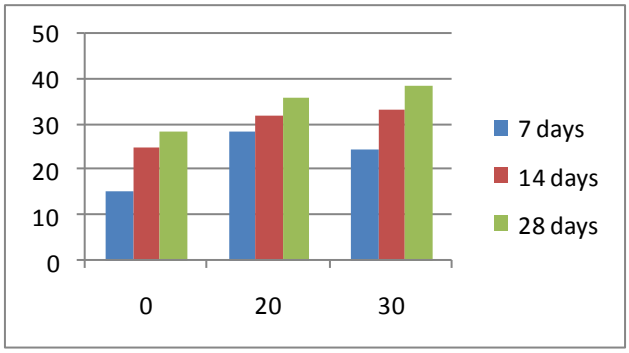

FIGURE: 2 Used Foundry Sand compressive strength Graph

(ii) TEST ON UNUSED FOUNDRY SAND TEST

TABLE: 11 - Unused Foundry Sand – 20%

SI.NO	DAYS OF CURING	LOAD (KN)	COMPRESSION STRENGTH (N/MM^2)
1	7 Days	492	21.9
2	14 Days	726	32.3
3	28 Days	816	36.3

TABLE: 12 UNUSED FOUNDRY SAND – 30%

SI.NO	DAYS OF CURING	LOAD (KN)	COMPRESSION STRENGTH (N/MM^2)
1	7 Days	555	24.7
2	14 Days	767	34.1
3	28 Days	897	39.9

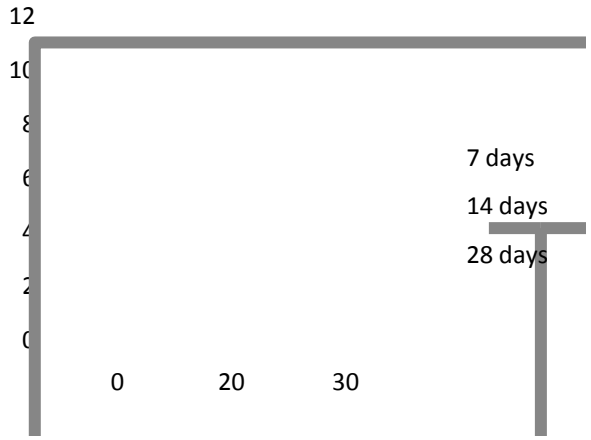

FIGURE:3 Unused Foundry Sand compressive strength Graph

b. FLEXURAL STRENGTH TEST

Tests are carried out on 150mmx150mmx750mm beams conforming to IS 516: 1959 to obtain the flexural strength at the age of 28 days. In the flexural test a standard plain concrete beam of rectangular cross section is simply supported and subjected to central point loading until failure.

TABLE:13 Flexural Strength test Result

Percentage	Flexural strength @ 7days (N/mm^2)	Flexural strength @ 14days (N/mm^2)	Flexural strength @ 28 days (N/mm^2)
0	4.1	6.3	8.2
20	4.7	7.1	9.1
30	5.2	8	10.3

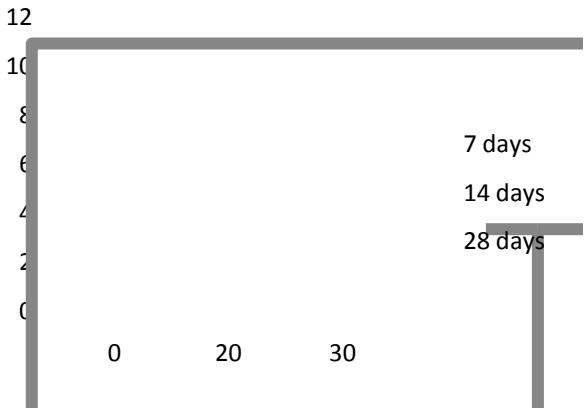

FIGURE: 4 Flexural Strength Result Graph

VII.CONCLUSION

It could be noted that the effects of concrete containing foundry sand is unique, as the foundry sand changes its physical and chemical properties and also its manufacturing process.

- There is improvement in the compressive strength of the concrete by partial replacement of foundry with M-SAND.
- There is improvement in the flexural strength of the concrete by partial replacement up to 30% of foundry sand with M-SAND.
  Here we get the similar difference b/w used and un used foundry sand, so we use USED foundry sand for beam because of it easy availability and free cost.
- Application of this study leads to development in construction sector and innovative building material.

- Use of waste foundry sand in concrete reduces the production of waste through metal industries i.e. it's an eco friendly building material.

REFERENCE

[1] LAVANYA PRABHA, S., GOPALAKRISHNAN, M., NEELAMEGAM, M., : Development of high-strength nano-cementitious composites using copper slag, ACI Materials Journal, 117(4), 37–46 (2020).

[2] S. LAVANAYA PRABHA, A. MOHAN, G. VELRAJKUMAR, A. MOHAMMEDHAROONZUBAIR., Study On Structural Behaviour Of Ductile High-Performance Concrete Under Impact And Penetration Loads ., Journal of Environmental Protection and Ecology 23, No 6, 2380–2388 (2022)

[3] MOHAN, A , VIJAYAN, D.S. , REVATHY, J., PARTHIBAN, D., VARATHARAJAN, R. :Evaluation of the impact of thermal performance on various building bricks and blocks: A review, Environmental Technology and Innovation, 23, 101577 (2021).

[4] M. THOLKAPIYAN, A.MOHAN, VIJAYAN.D.S, :A survey of recent studies on chlorophyll variation in Indian coastal waters, IOP Conf. Series: Materials Science and Engineering 993 , 012041, 1-6 (2020).

[5] GOPALAKRISHNAN, R., MOHAN, A., SANKAR, L. P., & VIJAYAN, D. S. : Characterisation On Toughness Property Of Self-Compacting Fibre Reinforced Concrete. In Journal of Environmental Protection and Ecology , 21(6), 2153–2163.

[6] M. THOLKAPIYAN , A. MOHAN, D. S. VIJAYAN.,VARIABILITY OF SEA SURFACE TEMPERATURE IN COASTAL WATERS OF GULF OF MANNER, INDIA, Oxidation Communications 45, No 3, 562–569 (2022) .

[7] MOHAN, A., TABISH HAYAT, M. :Characterization of mechanical properties by preferential supplant of cement with GGBS and silica fume in concrete, Materials Today: Proceedings, 43, 1179–1189 (2020).

[8] DHARMAR, S., GOPALAKRISHNAN, R., MOHAN, A. :Environmental effect of denitrification of structural glass by coating TiO2, Materials Today: Proceedings, 45, 6454–6458 (2020).

[9] MOHAN, A., PRABHA, G., BALAPRIYA, B., DEEPIKA, M., HEMANTHIMEKALA, B. Tribological Investigations on the Properties of Concrete Containing Recycled Plastic Aggregate, Journal of Balkan Tribological Association, 27(6), pp. 1010–1020 (2021).

[10] AYYASAMY, L.R., MOHAN, A., REX, L.K., ...VIJAYAN, D.S.: Enhanced Thermal Characteristics Of Cuo

Embedded Lauric Acid Phase Change Material, Thermal Science, 26(2), pp. 1615–1621 (2022).

[11] THOLKAPIYAN, M., MOHAN, A., VIJAYAN, D.S.: Tracking The Chlorophyll Changes Using Sentinel-2A/B Over The Gulf Of Manner, India, Oxidation Communications, 45(1), pp. 93–102 (2022).

[12] Dr.G.VELRAJKUMAR, R.MURALIKRISHNAN, A.MOHAN, R.BALA THIRUMAL, P.NAVEEN JOHN: Performance of GGBFS and silica fume on self compacting geopolymer concrete using partial replacements of R-Sand, materials today : proceedings, Volume 59, Part 1, Pages 909-917 (2022).

[13] D. S. VIJAYAN , A. MOHAN , C. NIVETHA , VIDHYALAKSHMI SIVAKUMAR , PARTHIBAN DEVARAJAN , A. PAULMAKESH , AND S. ARVINDAN: Treatment of Pharma Effluent using Anaerobic Packed Bed Reactor, Journal of Environmental and Public Health, Volume 2022, Article ID 4657628, 6 pages (2022).

[14] AYYASAMY, L.R., MOHAN, A., VIJAYAN, D.S., ...DEVARAJAN, P., SIVASURIYAN, A.: Finite element analysis of behavior and ultimate strength of composite column , Science and Engineering of Composite Materials, 29(1), pp. 176–182, (2022).

[15] GOPALAKRISHNAN, R., MOHAN, A., SANKAR, L. P., & VIJAYAN, D. S , Characterisation of Toughness Property of Self-Compacting Fibre Reinforced Concrete. In Journal of Environmental Protection and Ecology 21(6) 2153 (2020)

[16] MOHAN, A., SARAVANAN, J.., Characterization Of Geopolymer Concrete By Partial Replacement Of Construction And Demolition Waste – A Review., Journal of the Balkan Tribological Association, 2022, 28(4), pp. 550–558.

[17] SRIVIDHYA K , MOHAN A, THOLKAPIYAN M, ARUNRAJ A, “Earth Quake Mitigation (EQDM) Through Engineering Design”, Materials Today : Proceedings, Volume 22, 1074-1077, (2020).

[18] MOHAN, A, Experimental Investigation on the Ecofriendly External Wrapping of Glass Fiber Reinforced Polymer in Concrete Columns, Advances in Materials Science and Engineering, Volume 2021, Article ID 2909033, 12 pages .

[19] KARTHIKA, V.S. , MOHAN, A. , KUMAR, R.D. , JAMES, Sustainable consideration by characterization of concrete through partial replacement of fine aggregate using granite powder and iron powder, Journal of Green Engineering, 9 (4), 514-525, 2020.

[20] A JOTHILAKSHMI, M. , CHANDRAKANTHAMMA, L. , DHAYA CHANDHRAN, K.S. , MOHAN Flood control and water management at basin level-at orathur of Kanchipuram district International Journal of Engineering and Advanced Technology, 2019, 8 , International Journal of Engineering and

Advanced Technology 8 (6), 1418-1421

[21] THOLKAPIYAN, M., MOHAN, A., VIJAYAN, D.S., TRACKING THE CHLOROPHYLL CHANGES USING SENTINEL-2A/B OVER THE GULF OF MANNER, INDIA, Oxidation Communications, 2022, 45(1), pp. 93–102.

[22] A MOHAN, K. S. DHAYA CHANDHRAN, M. JOTHILAKSHMI, L. CHANDHRKANTHAMMA, Thermal Insulation and R- Value Analysis for Wall Insulated with PCM, International Journal of Innovative Technology and Exploring Engineering volume 12 S, 912-921, 2019.

[23] THOLKAPIYAN, M., MOHAN, A., VIJAYAN, D.S. Spatial And Temporal Changes Of Sea Surface Phytoplankton Pigment Concentration Over Gulf Of Manner, India Oxidation Communications, 2021, 44(4), pp. 790–799