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[ijrset@gmail.com](mailto:ijrset@gmail.com)

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# Eco-Friendly Foundry Sand Used in Construction Material

**Audumbar Bobade, Yashraj Bhadale, Prathmesh Nade, Sakshi Kamble, Om Chavan, Mr. N.R.More**

Department of Civil Engineering, Jayawantrao Sawant Polytechnic College, Hadapsar, Pune, India

Professor, Department of Civil Engineering, Jayawantrao Sawant Polytechnic College, Hadapsar, Pune, India

**ABSTRACT:** As fine aggregate replacement on the compressive strength, split tensile strength and modulus of elasticity of concrete having mix proportions of M 20 grade was investigated. Fine aggregates were replaced with six percentages of foundry sand. The percentages of replacements were 0%, 10%, 20%, 30%, 40% and 50% by weight of fine aggregate. Tests were performed for compressive strength, and split tensile strength Metal foundries use large amounts of the metalcasting process. 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 the foundry. This study presents information about the civil engineering applications of foundry sand, which is technically sound and environmentally safe. The use of foundry sand in various engineering applications can solve the problem of disposal of foundry sand and other purposes.

Foundry sand consists primarily of silica sand, coated with a thin film of burnt carbon, residual binder (bentonite, sea coal, resins), and dust. Foundry sand can be used in concrete to improve its strength and other durability factors. Foundry Sand can be used as a partial replacement of cement as a partial replacement of fine aggregates or a total replacement of fine aggregate and as a supplementary addition to achieve different properties of concrete.

In the present study, the effect of foundry sand and modulus of elasticity for all replacement levels of foundry sand at different curing periods (7 days & 28 days). Test results showed that there is some increase in compressive strength, splittensile strength, and modulus of elasticity after replacing the fine aggregates with a certain percentage of foundry sand so foundry sand can be safely used in concrete for durability and strength.

**KEYWORDS:** Foundry waste, Foundry sand, Concrete, Strength, Industrial waste, Utilization

## I. INTRODUCTION

The industrial byproducts which were disposed of earlier are now being considered for beneficial use. Beneficial use can reduce our nation's carbon production and consumption of virgin material and result in economic gains. It is an important component of the nation's solid waste management hierarchy that first promotes source reduction and waste prevention followed by reuse, recycling, energy recovery, and disposal. Researchers all over the world today are focusing on ways of utilizing either industrial or agricultural waste as a source of raw materials for the industry. This waste utilization would not only be economical but may also result in foreign exchange earnings and environmental pollution control.

The utilization of industrial and agricultural waste produced by industrial processes has been the focus of waste reduction research for economic, environmental, and technical reasons. This is because over 300 million tons of industrial waste are being produced per annum by agricultural and industrial processes in India. The problem arising from continuous technological and industrial development is the disposal of waste material. If some of the waste materials are found suitable for concrete making not only the cost of construction can be cut down, but also safe disposal of waste material can be achieved.

The cement of high-strength concrete is generally high which often leads to higher shrinkage and greater evaluation of neat of hydration besides increase in cost. A partial substitution of cement for industrial waste is not only economical but also improves the properties of fresh and hardened concrete and enhances the durability characteristics besides the safe disposal of waste material thereby protecting the environment from pollution This paper deals with the partial replacement of fine aggregate with the industrial waste from China Clay industries. The compressive strength, split tensile strength, and flexural strength of conventional concrete and fine aggregate replaced concrete are compared and

the results are tabulated.

**II. LITERATURE REVIEW**

NO.	Paper Title	Author Name	Year of Publication	Remark
1	Effect of use of waste foundry sand in concrete.	S.N.Ghadge	2022	This paper is clear that the compressive strength of foundry sand concrete increased up to a replacement level of 40% and beyond that there was a decline in strength. The foundry sand fractions are finer than fine aggregate.
2	Capillarity of concrete incorporating waste of foundry sand.	J.M. Khatib, B.A.Herki, S.Kenai.	2020	This paper shows the amount of water absorbed per unit area for concrete containing different amounts of waste foundry sand. [WFS] versus square root of time at the age of 1, 7, 28, and 90 days of curing.

**III. METHODOLOGY**

1. Collection of raw material
  - (i) Foundry sand (ii) Course aggregate (iii) Fine aggregate (iv) Cement
2. Testing of physical properties of foundry sand and fine aggregate
  - (i) Sieve Analysis (ii) Specific Gravity
3. Preparation of concrete for M20 grade
4. Replacement of Fine Aggregate by Foundry Sand by 0%, 10%, 20%, 30%, 40%, 50%
5. Preparation of mould (36 Mould) Mould size = 150X150X150mm
6. Curing a blocks
7. Compression testing of block at 7Days and 28Days
8. Water absorption test of block (0%, 10%, 20%, 30%, 40%, 50%)
9. Result and Discussion
10. Conclusion



**Curing Tank**

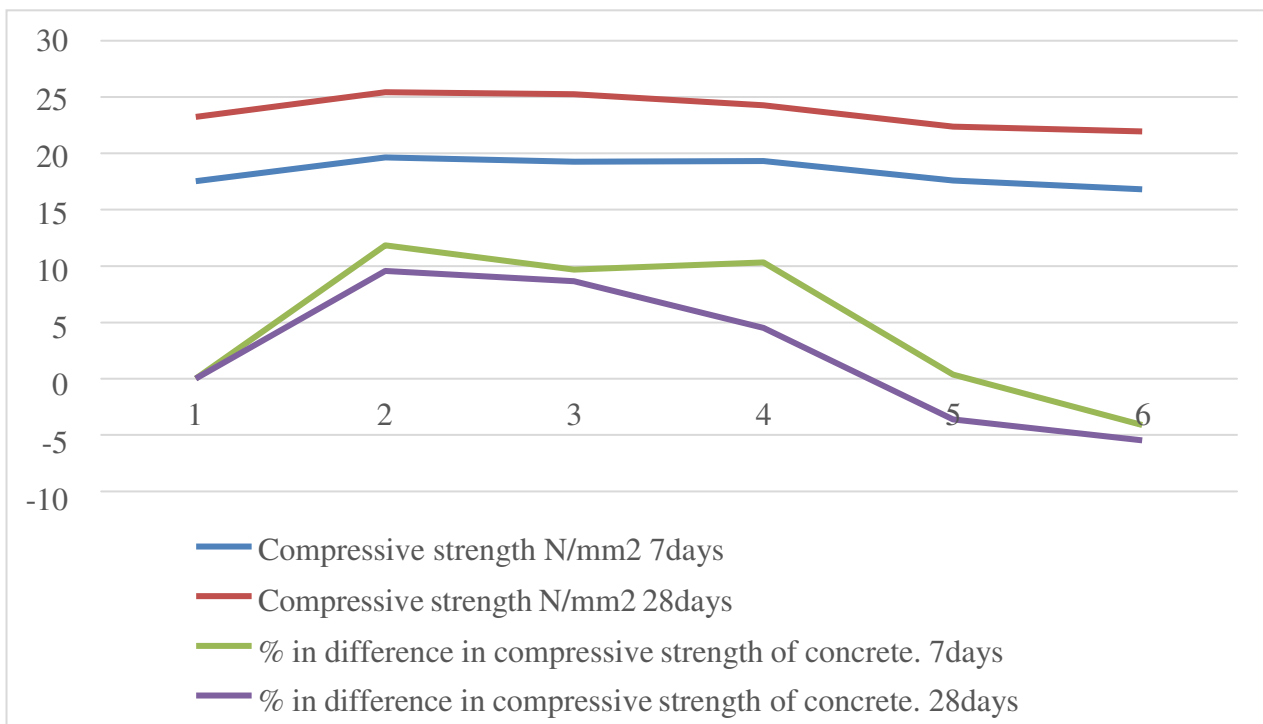


IV. EXPERIMENTAL RESULTS

The experimental results regarding the utilization of foundry sand in construction materials demonstrate promising outcomes. Through rigorous testing and analysis, it has been observed that incorporating foundry sand into various construction materials, such as concrete, asphalt, and bricks, yields favourable mechanical properties and structural performance. These experiments have shown that foundry sand can effectively replace traditional aggregates or supplementary cementations materials within specified limits, without compromising the integrity or functionality of the final product. Additionally, investigations into the environmental impacts, such as reachability and emissions, have indicated satisfactory outcomes, affirming the feasibility and sustainability of using foundry sand in construction materials. Overall, the experimental findings underscore the potential of foundry sand as a viable alternative resource in construction applications, offering both technical and environmental benefits.

Foundry sand replacement (%)	Compressive strength N/mm <sup>2</sup>		% in difference in compressive strength of concrete.	
	7days	28days	7days	28days
0	17.52	23.20	0	0
10	19.63	25.42	+11.84	+9.56
20	19.22	25.21	+9.70	+8.66
30	19.33	24.25	+ 10.33	+4.52
40	17.58	22.36	+ 0.34	-3.62
50	16.80	21.93	- 4.10	-5.47

Table 5.1:- Avg. compressive strength of concrete for different % of replacement of foundry sand of 7 days & 28 days.





**A. COMPRESSIVE STRENGTH FOR 7DAYS FOR DIFFERENT % OF SAND REPLACEMENT.**

1. Compressive strength for 0%foundry sand replacement (7days)

Cube no.	Compressive load (KN)	Strength (N/mm2)	Avg. strength N/mm2
1	362.70	16.12	17.52
2	416.10	18.49	
3	103.9	17.95	

2. Compressive strength for 10% sand replacement (7days)

Cube no.	Compressive load (KN)	Strength (N/mm2)	Avg. strength N/mm2
1	399.90	17.77	19.63
2	456.30	20.28	
3	463.90	20.84	

3. Compressive strength for 20% sand replacement (7days)

Cube no.	Compressive load (KN)	Strength (N/mm2)	Avg. strength N/mm2
1	411.75	18.30	19.22
2	477.90	21.24	
3	407.70	18.12	

4. Compressive strength for 30% sand replacement (7days)

Cube no.	Compressive load (KN)	Strength (N/mm2)	Avg. strength N/mm2
1	419.40	18.64	19.33
2	491.60	21.85	
3	393.75	17.50	



5. Compressive strength for 40% sand replacement (7days)

Cube no.	Compressive load (KN)	Strength (N/mm <sup>2</sup> )	Avg. strength N/mm <sup>2</sup>
1	354.15	15.74	17.58
2	386.80	17.19	
3	445.70	19.81	

6. Compressive strength for 30% sand replacement (7days)

Cube no.	Compressive load (KN)	Strength (N/mm <sup>2</sup> )	Avg. strength N/mm <sup>2</sup>
1	412.45	18.33	16.80
2	353.50	15.71	
3	368.10	16.36	

B. COMPRESSIVE STRENGTH FOR 28DAYS FOR DIFFERENT % OF SAND REPLACEMENT.

1. Compressive strength for 0%foundry sand replacement (28days)

Cube no.	Compressive load (KN)	Strength (N/mm <sup>2</sup> )	Avg. strength N/mm <sup>2</sup>
1	568.35	25.26	23.20
2	533.70	23.72	
3	463.95	20.62	

2. Compressive strength for 10% sand replacement (28days)

Cube no.	Compressive load (KN)	Strength (N/mm <sup>2</sup> )	Avg. strength N/mm <sup>2</sup>
1	533.00	23.69	25.42
2	564.30	25.08	
3	618.50	27.49	



3. Compressive strength for 20% sand replacement (28days)

Cube no.	Compressive load (KN)	Strength (N/mm <sup>2</sup> )	Avg. strength N/mm <sup>2</sup>
1	575.30	25.57	25.21
2	557.80	24.79	
3	568.60	25.27	

4. Compressive strength for 30%foundry sand replacement (28days)

Cube no.	Compressive load (KN)	Strength (N/mm <sup>2</sup> )	Avg. strength N/mm <sup>2</sup>
1	578.25	26.10	24.25
2	561.60	24.96	
3	488.00	21.69	

5. Compressive strength for 40% sand replacement (28days)

Cube no.	Compressive load (KN)	Strength (N/mm <sup>2</sup> )	Avg. strength N/mm <sup>2</sup>
1	465.00	20.67	22.36
2	514.15	22.85	
3	530.10	23.56	

6. Compressive strength for 50% sand replacement (28days)

Cube no.	Compressive load (KN)	Strength (N/mm <sup>2</sup> )	Avg. strength N/mm <sup>2</sup>
1	456.70	20.12	21.93
2	528.00	23.47	
3	499.50	22.20	



#### V. CONCLUSION

1. The compressive strength of concrete mix at 7 days with 10%, 20%, 30%, and 40%. Foundry sand has increased as compared to concrete mixed with sand. The % increase in the range of 0.34% to 11.84% as compared to concrete mix with natural sand.
2. At 10% replacement of sand with foundry sand gives maximum compressive strength within 7 days. i.e. 19.63 N/mm<sup>2</sup>.
3. The compressive strength of concrete mix at 28 days with 10%, 20%, and 30% foundry sand has increased as compared to concrete. From the graph of 28 days of compressive strength, it can be seen that the compressive mix with sand. The % increase in the range of 4.52% to 9.56% as compared to concrete mix with natural sand.
4. At 10% replacement of sand with foundry sand gives maximum compressive strength with 28 days. i.e. 25.42 N/mm<sup>2</sup>.

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