

Influence of Foundry Sand and Hypo Sludge in Concrete

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ABSTRACT: Concrete is always valuable product in construction industry. The concrete ingredients are cement, coarse aggregate, and water. Nowadays the concrete materials are reduced in earth surface so we are in need to find out the alternative materials to concrete. In this situation we should utilize the larger amount of waste products in ground surface. For example plastic wastages, agriculture wastages, rice husk ash etc.

The aim of present investigation is to study the effect of used foundry sand as replacement of fine aggregates and hypo sludge as cement in various percentages in concrete.

150 mm cubes, 300 mm x 150 mm cylinders, and 500 x 100 x 100 prism were prepared with Concrete specimens were prepared with various replacement levels of 10%, 20%, 30% , 40% by foundry sand with sand and 10%, 20%, 30% by Hypo Sludge with cement in M20 grade of concrete. Fresh concrete properties and hard concrete properties are investigated such as Compressive strength, Flexural strength and Split-tensile strength at 7, 14, 28 days.

KEYWORDS: Waste products, Replacement, Foundry sand, hypo sludge

I. INTRODUCTION

Concrete is one of the most used construction materials in the construction industry and it has become an excellent and important construction material in the infrastructure and industrial development due to its various advantages like

- ✓ Good mechanical properties
- ✓ Highly durable
- ✓ Economical

Last few decades the utilization of concrete becomes very prominent and due to the recent growth in the construction industry, the demand for concrete is escalating rapidly. As a result, the concrete industry is facing with a declining availability of natural resources used as raw and construction materials, i.e. cement and aggregate.

River sand has been the most widely fine aggregate in concrete and over-exploitation of river sand has led to various harmful consequences. So that finding a new alternative material for river sand becomes imperative in the construction industry.

Foundry Sand

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.

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Foundry Sand can be used as a partial replacement of cement or as a partial replacement of fine aggregates or total replacement of fine aggregate and as supplementary addition to achieve different properties of concrete.

Two general types of binder systems are used in metal casting depending upon which the Foundry sands are classified as:

- Clay bonded systems (Green sand)
- Chemically-bonded systems.



Fig. a - Foundry Sand

II. LITERATURE REVIEW

M. Ranjitham., et al (2014) were studied the High performance concrete appears to be a better choice for a strong and durable structure. In this project, investigations were carried out on strength properties such as compressive strength, split tensile strength and flexural strength of M75 grade of HPC mixes with different replacement levels such as 10%, 20%, and 30% of foundry sand with fine aggregate and 10%, 20%, 30% and replacing cement by mineral admixtures such as fly ash and ground granulated blast furnace slag by adopting water-binder ratio of 0.3. Conplast SP430 is based on Sulphonated Naphthalene Polymers can be used as a super plasticiser for better workability for high performance concrete.

They conclude that adding optimum super plasticizer dosage the workability is reached. So that the required slump value can be obtained for HPC. The slump value for M75 grade using foundry sand and fly ash is reduced. For 30% fly ash and 30% GGBS replacement, the fresh properties observed were good as compared to 10%, 20% replacement. Hence fly ash replacement is effective for HPC in order to attain high strength. Compare to ordinary concrete M75 grade concrete attain good strength by using lower water/binder ratio. Hence segregation and bleeding occurs in the concrete can be reduced. Foundry sand substitution generally results in favourable outcomes and is highly recommended for all HPC mixes. The strength of concrete structures using foundry sand is always similar to conventional concrete. The presence of foundry sand and mineral admixtures increasing the compressive strength and also withstanding the maximum load. Compare to fly ash GGBS attains good strength as cement replacement.

Dushyant R. Bhimani., et al (2013) were studied the produce of low cost concrete by blending various ratios of fine aggregate and cement with used foundry sand and Pozzocrete to reduce disposal and pollution problems due to used foundry sand and Pozzocrete. Pozzocrete P60 is a processed quality assured fly ash, investigated for its use as a partial replacement for cement in concrete (1:1.48:3.21).

The utilization of Pozzocrete P60 as cement replacement material in concrete or as additive in cement introduces many benefits from economical, technical and environmental points of view. The innovative use of used foundry sand in concrete formulations as a fine aggregate replacement material was tested as an alternative to traditional concrete. This paper presents the results of the concrete of mix proportion 1:1.48:3.21 in which cement is partially replaced with

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Pozzocrete P60 as 10% by weight of cement, and fine aggregate is partially replaced with used foundry sand as 10%, 30% and 50% by weight of fine aggregate.

From that study, they conclude that the results presented in this paper, indicate that the incorporation of a 10% Pozzocrete P60 mixed cement is feasible for strength. Pozzocrete P60 and foundry sand can be used in concrete to improve strength. Partial replacement of the Portland cement with Pozzocrete P60 and Partial replacement of fine aggregate with used foundry sand improve strength. The results indicate that the % change in cost reduce up to 5.17 for 50% replacement of used foundry sand plus 10% replacement of pozzocrete.

Dushyant Rameshbhai Bhimani1., et al (2013) were studied the produce low cost concrete by blending various ratios of fine aggregate with used foundry sand & to reduce disposal and pollution problems due to used foundry sand. It is most essential to develop profitable building materials from foundry sand. The innovative use of used foundry sand in concrete formulations as a fine aggregate replacement material was tested as an alternative to traditional concrete. The fine aggregate has been replaced by used foundry sand accordingly in the range of 0%, 10%, 30% & 50% by weight for M-20 grade concrete.

Concrete mixtures were produced, tested and compared in terms of workability and strength with the conventional concrete. These tests were carried out to evaluate the mechanical properties for 7, 14 and 28 days. As a result, the compressive increased up to 50% addition of used foundry sand. They conclude that Based on limited experimental investigation concerning the water absorption and compressive strength of concrete, the following observations are made regarding the resistance of partially replaced foundry sand:

- The water absorption decreased up to 50% replacement of fine aggregate by used foundry sand.
- Compressive strength increase when replacement of used foundry sand percentage increases when compare to traditional concrete. From this test, replacement of fine aggregate with this used foundry sand material provides maximum compressive strength at 50% replacement.
- The results indicate that the % change in cost reduce up to 3.39 for 50% replacement of used foundry sand.

III. EXPERIMENTAL STUDY

Materials Used:

- **Cement:** Ordinary Portland cement, 53 Grade conforming to IS 12269 – 1987.
- **Fine aggregate:** Locally available river sand, conforming to Grading zone II of IS 383 –1970.
- **Coarse aggregate:** Locally available crushed blue granite stones conforming to graded aggregate of nominal size 12.5 mm as per IS 383 – 1970.
- **Foundry Sand:** Foundry sand is high quality silica sand with uniform physical characteristics. It is a by-product of ferrous and non-ferrous metal casting industries, where sand has been used for centuries as a moulding material because of its thermal conductivity. It is a by-product from the production of both ferrous and non-ferrous metal castings. Physical properties of Foundry sand are in Table 1.

Table 1 - Physical Properties of foundry sand as per ASTM

Property	Results	Test Method
Specific Gravity	2.39 - 270	ASTM D854-06
Bulk Relative Density, lb/ft ³	160.0	AASHTO T 084
Absorption, %	0.76 - 6.20	ASTM C128-07a
Moisture Content, %	0.1 - 15.0	ASTM D2216-05
Clay Lumps and Friable Particles	1 - 44	ASTM C142-97 AASHTO T 112
Plastic Index	No plastic to 12	ASTM D4318-05 AASHTO T 090

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- Hypo Sludge: Paper making generally produces a large amount of solid waste. Paper fibers can be recycled only a limited number of times before they become too short or weak to make high quality paper.

Chemical Properties of Materials:

The raw materials used for the manufacture of cement consist mainly of lime, silica, alumina and iron oxide. The properties of Raw materials are tabulated in Table 2.

Table 2 - Chemical Property – Results of the Materials

Elements	% of Oxides in Cement	% of Oxides in hypo sludge	% of Oxides in foundry sand
O	50.84	39.69	49.23
Ca	33.96	11.62	39.86
C	-	5.69	6.18
Si	12.25	21.22	4.53
Mg	0.48	5.26	-
Fe	0.84	12.47	-
Al	1.64	4.06	-

IV. RESULTS AND DISCUSSION

Various properties of concrete incorporating foundry sand fine aggregate and hypo sludge with cement at various replacement levels were studied. Test was conducted for fresh concrete properties are,

Test on fresh concrete:

The **concrete slump test** measures the consistency of fresh concrete before it sets. It is performed to check the workability of freshly made concrete, and therefore the ease with which concrete flows.

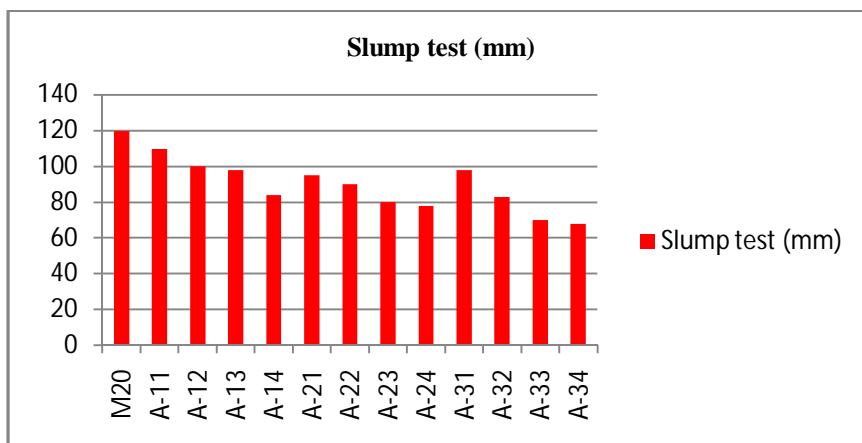


Fig. b - Bar Chart for Slump test

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Compacting factor of fresh concrete is done to determine the workability of fresh concrete by compacting factor test as per IS: 1199 – 1959. The apparatus used is Compacting factor apparatus. The test results are shown in below chart,

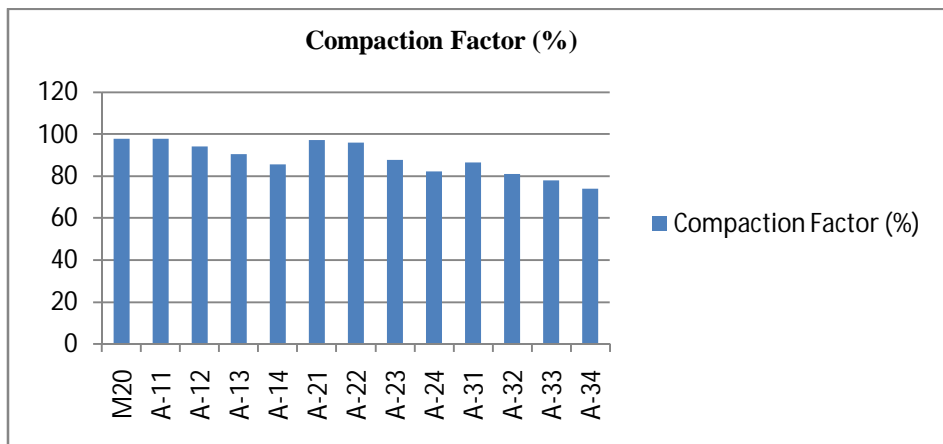


Fig. c - Bar Chart for Compaction factor test

Test on Hardened concrete:

Various properties of hardened concrete incorporating foundry sand as fine aggregate and hypo sludge as cement at various replacement levels were studied.

The **compressive strength** is calculated by dividing the failure load with the area of application of load, usually after 28 days of curing. The strength of concrete is controlled by the proportioning of cement, coarse and fine aggregates, water, and various admixtures. Test Results for Compressive Strength of concrete at 7 & 14 days are shown in Fig. d

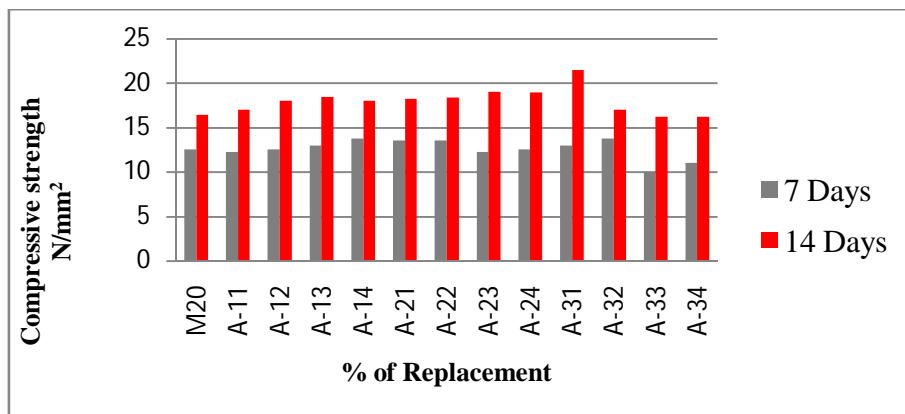


Fig. d - Bar Chart for Compressive Strength of Cubes for 7 and 14 Days

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Test Results for Compressive Strength of concrete at 28 & 56 days are shown in Fig. e

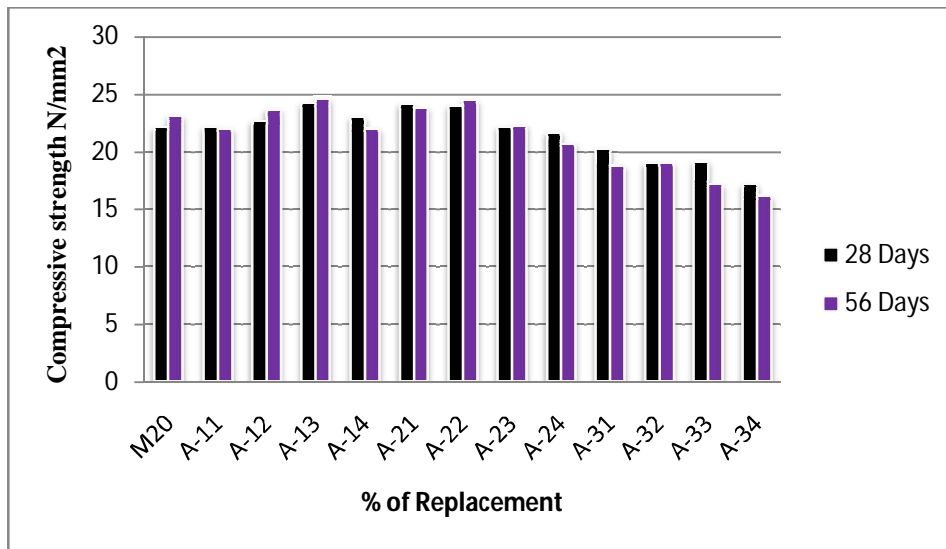


Fig. e - Bar Chart for Compressive Strength of Cubes for 28 and 56 Days

The **tensile strength** of concrete is one of the basic and important properties. Splitting tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete. The concrete is very weak in tension due to its brittle nature and is not expected to resist the direct tension. The concrete develops cracks when subjected to tensile forces. Thus, it is necessary to determine the tensile strength of concrete to determine the load at which the concrete members may crack. Test Results for Split Tensile Strength of concrete at 7 & 14 days are shown in Fig. f

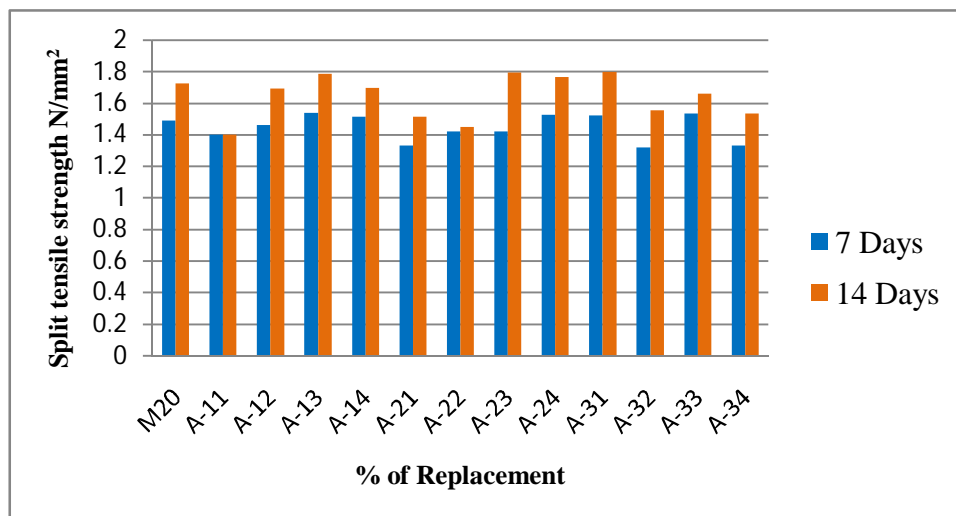


Fig. f - Bar Chart for Tensile Strength of Cylinder for 7, 14 and 28 Days

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Flexural strength is one measure of the tensile strength of concrete. It is a measure of an unreinforced concrete beam or slab to resist failure in bending. It is measured by loading concrete beams with a span length of at least three times the depth. The flexural strength is expressed as Modulus of Rupture. Test Results for Flexural Strength of concrete at 7, 14 & 28 days are shown in Fig. g

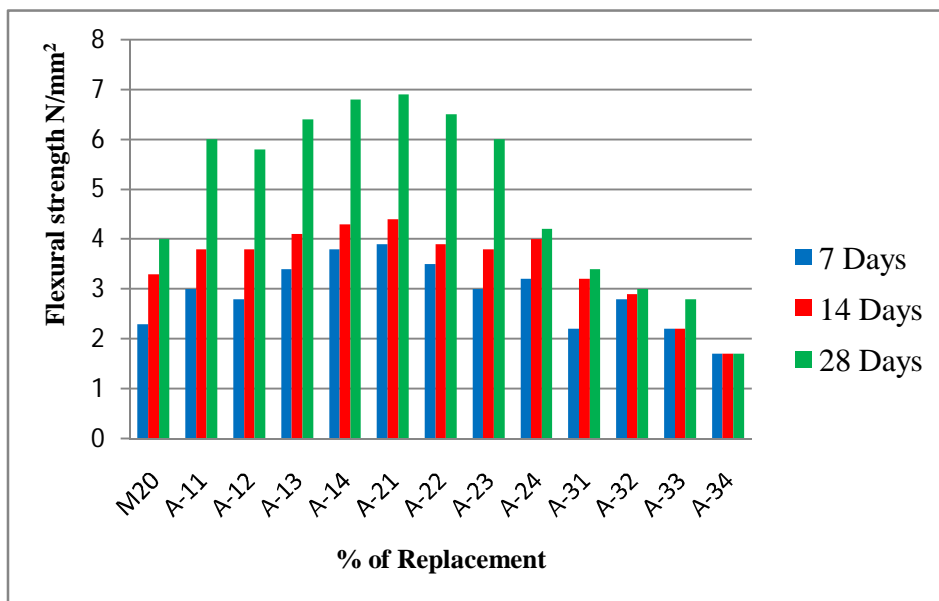


Fig. g - Bar Chart for Flexural Strength of Beam for 7, 14 and 28 Days

V. CONCLUSION

- ✓ Based on limited experimental investigation on the compressive, flexural and split tensile strength of concrete, the following observations are made regarding the resistance of partially replaced foundry sand and hypo sludge.
- ✓ Compressive strength of the concrete is increased at the percentage of replacement of 20% of hypo sludge and 30% of foundry sand.
- ✓ In this study, maximum compressive strength is obtained at 20% of hypo sludge and 30% of foundry sand.
- ✓ Replacement of cement with this waste of hypo sludge and replacement of sand with used foundry sand increasing in split tensile strength at 20% of hypo sludge and 30% of foundry sand.
- ✓ Replacement of cement with this waste of hypo sludge and replacement of sand with used foundry sand increasing in flexural strength at 20% of hypo sludge and 40% of foundry sand.
- ✓ Use of waste foundry sand in concrete reduces the production of waste through metal industries i.e. it's an eco-friendly building material.
- ✓ Waste foundry sand can be effectively used as fine aggregate in place of conventional river sand, in concrete.
- ✓ The problems of disposal and maintenance cost of land filling is reduced.
- ✓ Cost of cement should become low from this project and Amount of waste foundry sand used properly in concrete.
- ✓ Environment effects from wastes and maximum amount of cement manufacturing is reduced through this project.
- ✓ A better measure by an innovative Construction Material is formed through this research.

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