

Effect of Characteristic Compressive Strength of Concrete by Replacing Cement Partially with Hypo Sludge

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ABSTRACT: Hypo Sludge is a waste produced in the paper manufacturing industry. Paper mills generate more than 4 million tons of sludge each year for disposal. Hypo Sludge is known to contain useful fibers and chemicals, as my project to get good results by adding of ferrous oxide to the hypo sludge to the fly ash improve the strength, durability, and life span of concrete structures exposed to weather. 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. It means that the broken, low-quality paper fibers are separated out to become waste sludge. This research work describes the feasibility of using the Hypo Sludge in concrete production as replacement of cement by weight. The use of Hypo Sludge in concrete formulations as a supplementary cementations material was tested as an alternative to conventional concrete. The mix has been replaced by Hypo Sludge accordingly in the range of 0% (without Hypo Sludge), 10%, 20%, 30% and 40% by weight of cement for M-40 mix. Concrete mixtures were produced, tested and compared in terms of compressive strength for 28 days.

KEY WORDS: Hypo Sludge, Fibers, Ferrous oxide, Cement, Compressive strength.

I. INTRODUCTION

Paper mill sludge is a major economic and environmental problem for the paper and board industry. The material is a by-product of the de-inking and re-pulping of paper. The total quantity of paper mill sludge produced in the world is many million tones. The main recycling and disposal routes for paper sludge are land-spreading as agricultural fertilizer, producing paper sludge ash, or disposal to landfill. In functional terms, paper sludge consists of cellulose fibers, fillers such as calcium carbonate and china clay and residual chemicals bound up with water. The moisture content is typically up to 40%. The material is viscous, sticky and hard to dry and can vary in viscosity and lumpiness. It has an energy content that makes it a useful candidate as an alternative fuel for the manufacture of Portland cement. Paper production is a highly capital and labour intensive activity. Wood pulp is the fibrous material that results when wood is separated into its constituent fibers by chemical or mechanical means. Waste paper is composed of previously discarded paper or paperboard products. So, by using this paper waste we can solve the disposal problem. In urban cities, Solid waste management is one of the most challenging issues, which are facing a serious pollution problem due to the generation of huge quantities of solid waste. In this paper presents making hypo sludge from paper waste, which is use as a construction material.

This paper mill sludge consumes a large percentage of local landfill space for each and every year. To reduce disposal and pollution problems emanating from these industrial wastes, it is most essential to develop profitable building materials from them. The quantity of sludge varies from mill to mill. The amount of sludge generated by a recycled paper mill is greatly dependent on the type of furnish being used and end product being manufactured. This study

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includes different concrete mixtures to determine the influence of hypo sludge derived from Rayalaseema paper mill Pvt.Ltd, plant near the northern bank of river Tungabhadra near Kurnool town Gondiparlla village in the State of A.P.

II. RELATED WORK

Experimental investigations in developing low cost concrete from paper industry waste R. Srinivasan, *K. Sathiya and M. Palanisamy, 2010 Over 300 million tones of industrial wastes are being produced per annum by chemical and agricultural process in India. These materials pose problems of disposal and health hazards. The wastes like phosphogypsum, fluorogypsum and red mud contain obnoxious impurities which adversely affect the strength and other properties of building materials based on them

Utilization of waste paper pulp by partial replacement of cement in concrete Sumit A Balwaik; S P Raut, ISSN: 2248-9622 The use of paper-mill pulp in concrete formulations was investigated as an alternative to landfill disposal. The cement has been replaced by waste paper sludge accordingly in the range of 5% to 20% by weight for M-20 and M-30 mix. By using adequate amount of the waste paper pulp and water, concrete mixtures were produced and compared in terms of slump and strength with the conventional concrete.

III. EXPERIMENTAL PROCEDURE

A. MATERIALS

Materials used in the experimental work are as follows

- Cement
- Hypo sludge
- Fine Aggregate
- Coarse Aggregate
- Ferrous oxide
- Water

B. MATERIALS DESCRIPTION AND THEIR PROPERTIES

a. CEMENT

Cement is a fine powdered adhesive and cohesive substance which when mixed with fine aggregate, coarse aggregate and water form a paste which on curing turns in to hard stone like substance. In this study, Portland cement conforming to IS: 4031-1988 is being used. The properties of cement are shown below.

TABLE1. PROPERTIES OF CEMENT

S. No	CHARACTERISTICS	VALUE
1	SEPECIFIC GRAVITY	3.15
2	NORMAL CONSISTENCY	32%
3	INITIAL SETTING TIME	83minutes
4	FINAL SETTING TIME	205minutes

b. HYPO SLUDGE

Hypo sludge produced in a large amount as by product of paper industry. It contains low calcium and minimum amount of silica and it's due to presence of silica and magnesium properties that it behaves like cement. In this study hypo sludge is derived from Rayalaseema paper mill Pvt.Ltd, plant near the northern bank of river Tungabhadra near Kurnool town Gondiparlla village in the State of A.P.

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Fig 1. Hypo Sludge

TABLE 2. PROPERTIES OF HYPO SLUDGE

S. NO	CONSTITUENT	PRESENTAGE
1	MOISTURE	56.8
2	MAGNESIUM OXIDE(MgO)	3.3
3	CALCIUM OXIDE(CaO)	46.2
4	LOSS ON IGNESENT	27.00
5	ACID INSOLUBLE	11.1
6	SILLICA(SiO ₂)	9.0
7	R ₂ O ₃	3.6

c. FINE AGGREGATE

The sand used in the present investigation belongs to Zone II, and is free from any undesirable matter which affects the strength of concrete. The following are the properties of fine aggregate.

TABLE 3. PROPERTIES OF FINE AGGREGATE

S. No	CHARACTERISTICS	VALUE
1	ZONE	II
2	SPECIFIC GRAVITY	2.57
3	DENSITY	14kN/m ³

d. COARSE AGGREGATE

It is well known fact that coarse aggregate occupies about 70% of concrete. Here coarse aggregate of 20mm size are used and other properties are described below.

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TABLE 4. PROPERTIES OF COARSE AGGREGATE

S. No	CHARACTERISTICS	VALUE
1	NOMINAL MAXIMUM SIZE	20mm
2	SPECIFIC GRAVITY	2..78
3	DENSITY	1625.83kg/m3

e. FERROUS OXIDE

Iron oxide or ferrous oxide is the inorganic compound with the formula FeO. The following are its properties.

TABLE 5. PROPERTIES OF FERROUS OXIDE

Formula	FeO
Molar mass	71.844 g/mol
Melting point	1,377 °C
Density	5.74 g/cm ³
Boiling point	3,414 °C
Appearance	black crystals

IV. RESULTS AND DISCUSSIONS

A. COMPRESSIVE STRENGTH TEST RESULT

150 mm × 150 x 150 mm concrete cubes were casting using M20 grade concrete. Specimens with mixing of hypo sludge, fly ash and adding of mix with ferrous oxide at 10%, 20%, 30%, and 40% levels were cast. During casting the cubes were mechanically vibrated by using a table.

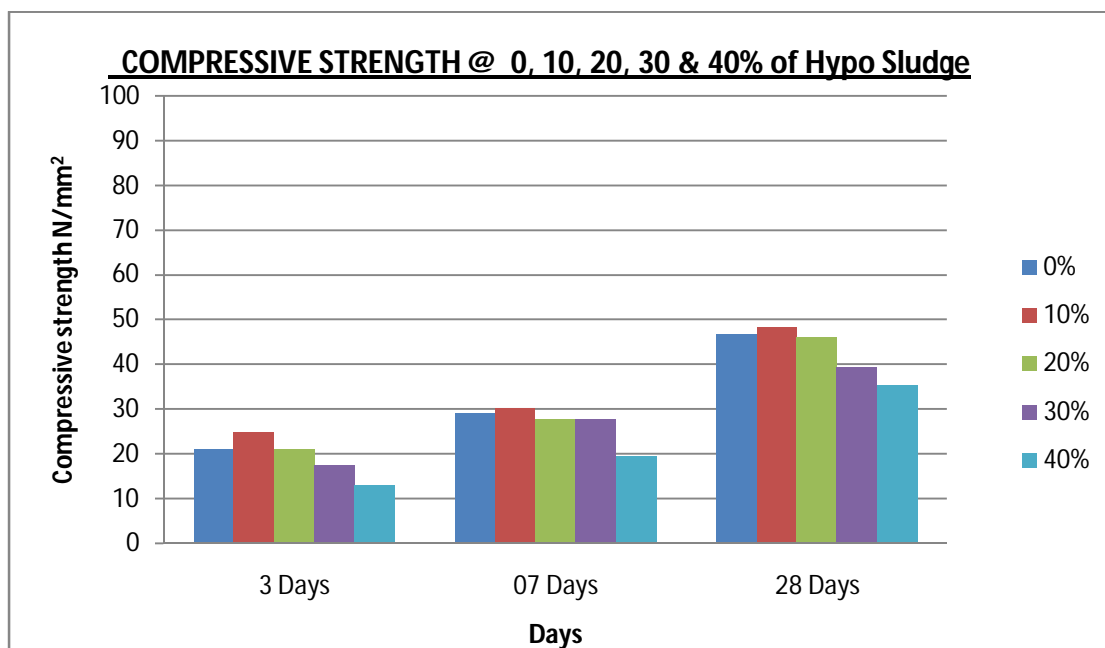
TABLE 6. COMPRESSIVE STRENGTH AT 0, 10, 20, 30 & 40% OF HYPO SLUDGE

Days	Comp. strength	Comp. strength	Comp. strength	Comp. strength	Comp. strength
	0%	10%	20%	30%	40%
3	21.05	24.80	21.12	17.43	13.07
7	29.12	30.17	27.82	27.82	19.44
28	46.83	48.28	45.93	39.22	35.20

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The graph shows the compressive strength results of various mixes of Hypo Sludge tested at 3, 7 and 28 days of curing. It is clear that at 30% of replacement there is maximum compressive strength i.e. 39.22 N/mm².

IV. CONCLUSION

Based on limited experimental investigations concerning the compressive strength, the following conclusions are drawn:

1. The 0% replacement of cement in M₄₀ grade of concrete gives compressive strength of 46.83 N/mm² 28 days.
2. The 10% replacement of cement by hypo sludge in M₄₀ grade of concrete gives compressive strength of 48.28 N/mm² for 28 days.
3. The 20% replacement of cement by hypo sludge in M₂₀ grade of concrete gives compressive strength of 45.93 N/mm² for 28 days.
4. The 30% replacement of cement by hypo sludge in M₂₀ grade of concrete gives compressive strength of 39.22 N/mm² for 28 days.

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