

Experimental Studies on Strength of Hyposludge Concrete with Polypropylene Fiber

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ABSTRACT: Over million tons of paper wastes are being produced per annum in India. Hypo sludge is the paper industrial waste material generated in mass quantities in forms of slurry and these materials pose problems to environmental and create health hazards. The production of cement also leads to global warming by releasing carbon dioxide into the atmosphere. The use of hypo sludge contributes beneficial properties to the concrete. In this study hypo sludge is used as a replacement for cement in concrete. Polypropylene fibers is synthetic hydrocarbon polymer which is added to increase strength, corrosion resistance, and to reduce cracks extension. This project is concerned with the experimental studies on strength of hypo sludge with polypropylene fiber. The partial replacement of hypo sludge by 10% constant along with polypropylene fibers (0%, 15%, 30%, and 45%). Slump cone and workability tests were conducted immediately after preparing the concrete, later the compression, split tensile and flexural test were tested after 7 and 28 days of curing. Results indicated that workability and slump cone test decreases as the content of polypropylene fiber increases. Maximum strength obtained in combination of 10% hypo sludge and 15% and 30% polypropylene fiber

KEYWORDS: hypo sludge, polypropylene fiber, compressive strength, split tensile strength, flexural strength.

1. INTRODUCTION

Concrete is a composite construction material composed of cement, aggregate generally coarse aggregate made of gravels or crushed rocks such as limestone or granite plus fine aggregate such as sand, water, and/or admixtures. By the inclusion of industrial waste in concrete, the energy and the environment can be saved. To produce Ordinary Portland Cement (OPC), we use earth resources like limestone. During manufacturing of one ton of OPC, an equal amount of carbon-dioxide is released into the atmosphere which is harmful to the environment. So there is a need to choose an alternative. Also, the cost of cement is also steadily increasing day by day. So, there is a great need to use industrial waste products in an appropriate manner. Solid wastes generated during calcium hypo chlorite generation are called hypo sludge. The paper mill sludge consumes a large percentage of area. Hypo sludge contains, low calcium and maximum calcium chloride and minimum amount of silica. Hypo sludge behaves like cement because of silica and magnesium properties. This silica and magnesium improve the setting of the concrete. The use of hypo sludge in concrete can save the paper industry disposal costs and produces a green concrete for construction. Several researchers have studied the individual effect of addition of either hypo sludge or polypropylene fiber on the strength properties of concrete. The information available on the performance with regard to strength and workability of concrete using combinations of hypo sludge as partial replacement of cement and polypropylene fibers as an additive in concrete is limited. Number of studies are going on in India as well as abroad to study the impact of use of these materials.

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II. MATERIAL PROPERTIES

2.1 Materials Used

Material investigation is done to test the various materials that are used in making concrete cubes and cylinders. According to these test results obtained we designed the mix ratios for the materials and prepared the concrete cubes, cylinders and beams. M30 grade concrete is used. The information are given below,

2.2 Cement

The most common cement used is an ordinary Portland cement. Out of the total production, ordinary Portland cement accounts for about 80...90%. Many tests were conducted on cement; some of them are consistency tests, setting tests, soundness tests.

2.3 Fine Aggregate

A fine aggregate obtained from the river is used for experimental purpose. It is of size passed in 4.75 mm sieve.

2.4 Coarse Aggregate

The fractions from 80 mm to 4.75 mm are termed as coarse aggregate. The coarse aggregate is strongest and porous component of concrete.

2.5 Hypo Sludge

The preliminary waste from paper industry is named as hypo sludge. The hypo sludge contains, low calcium, maximum calcium chloride and minimum amount of silica. Hypo sludge behaves like cement because of silica and magnesium properties. This silica improves the setting of the concrete. The table 2.1 will show the properties of Raw Hypo sludge.

Table 2.1 Properties Of Raw Hypo sludge

S.NO	CONSTITUENT	PRESENT IN HYPO SLUDGE, %
1.	Moisture	56.8
2.	Magnesium oxide (MgO)	3.3
3.	Calcium oxide (CaO)	46.2
4.	Loss on ignescent	27.00
5.	Acid insoluble	11.1
6.	Silica (SiO ₂)	9.0

2.6 Polypropylene Fiber

Polypropylene (PP), also known as polypropene, is a thermoplastic polymer used in wide variety of application. Addition of fibers improves the post peak ductility performance, pre-crack tensile strength, fracture strength, toughness, impact resistance, flexural strength resistance, fatigue performance etc. The table 2.2

below will show the properties of polypropylene fiber.

Table 2.2 Properties of Polypropylene Fiber

S.NO	PROPERTY	VALUE
1	Fiber Length	6mm
2	Specific Gravity	0.91 g/cm ²
3	Moisture Absorption	0.05%
4	Elastic Modulus	300-3000Mpa
5	Tensile Strength	300-700N/mm ²

III. MIX DESIGN

3.1 MIX PROPORTIONS

The table 3.1 will show the various mix proportions of different concrete mixes.

MIX	W/C Ratio	Cement	F.A	C.A	Hypo sludge	Polypropylene fiber
M1	0.45	1	1.613	2.65	0.00	0.00
M2	0.45	0.9	1.613	2.65	0.10	0.15
M3	0.45	0.9	1.613	2.65	0.10	0.30
M4	0.45	0.9	1.613	2.65	0.10	0.45

W/C - Water to cement ratio, F.A - Fine Aggregate, C.A - Coarse Aggregate

IV. RESULTS AND DISCUSSION

4.1 Compressive Strength And Spilt Tensile

The compressive strength and spilt tensile strength for all the mixes were obtained after 7 and 28days for the various replacement levels of hypo sludge with polypropylene fiber are mentioned in the table 4.1 below.

4.2 Flexural Strength

The flexural strength for all the mixes were obtained after 7 and 28days for the various replacement levels of hypo sludge with polypropylene fiber are mentioned in the table 4.1 below.

Table 4.1 analysis for variance for various hypo sludge and polypropylene fiber

Mix	Hypo sludge	Polypropylene fiber	Compressive		Spilt Tensile		Flexural
			Strength		Strength		Strength
			7days	28days	7 days	28days	28 days
M1	0%	0%	17.64	25.84	1.56	3.31	4.65
M2	10%	0.15%	18.13	27.51	1.84	3.72	5.16
M3	10%	0.30%	18.97	26.13	1.98	3.46	4.73
M4	10%	0.45%	17.84	25.43	1.31	2.95	4.16

V. CONCLUSION

Based on the experimental investigation on the compressive, spilt tensile and flexural strength of the concrete, the following were observed are Compressive strength , Spilt tensile and Flexural strength of the concrete increases when the 10% replacement of cement by hypo sludge with polypropylene fiber of 0.15% .

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