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AN EXPERIMENTAL INVESTIGATION ON CONCRETE WITH OF PARTIAL REPLACEMENT OF CEMENT BY HYPO SLUDGE

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Abstract - *To produce low cost concrete by blending various ratios of cement with hypo sludge & to reduce disposal and pollution problems due to hypo sludge it is most essential to develop profitable building materials from hypo sludge. To make good quality paper limited number of times recycled Paper Fiber can be used which produces a large amount of solid waste. This 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. So Hypo sludge may be used as partially replacement of cement. So we can use Hypo sludge as a partial replacement of cement in pervious concrete. In this research study the (OPC) cement has been replaced by hypo sludge accordingly in the range of 5 % 10% and 15% by weight of cement for 0.30, 0.35, and 0.40 water/cement ratio. The compressive strength test and flexural strength test was carried out for 7 and 28 days to measure the compressive strength and flexural strength of concrete.*

Key Words: ***Hypo Sludge, split tensile strength, Compressive Strength, Flexural Strength.***

1. INTRODUCTION

Masonry is a globally accepted construction material in all types of civil engineering structures. Stone and Brick masonry construction very much prefers one for load bearing structures and high rise buildings, especially in the developing and under developed countries because of its ease of construction and economy. It has been used for the construction of a number of historical and traditional buildings. Though this masonry is not much understood in the aspect of strength and other parameters, because of its non-homogeneity. Most of the walls of buildings and residential houses are masonry walls, made of stones, bricks or concrete blocks, with rendering on both sides. Even though mortar makes up as little as 7% of the total volume of a masonry wall, it plays a crucial role in the performance of the structure. Due to the environmental concern and the need to conserve energy, various research efforts have been directed toward the utilization of waste materials. The cost of cement is also steadily increasing. With ever-increasing environmental problems because of industrial waste products comes a great need to use these products in an appropriate manner to reduce health and environmental problems. For this purpose, experimental investigation is carried out to develop the data on the compressive strength development of mortar with time and with different percent replacement of Hypo Sludge.

1.1 Source of hypo sludge

Hypo sludge is formed as waste by-product is purely a chemical wastes and do not contain any bio-degradable element. Most of the paper mills in India prepare bleach liquor (calcium hypochlorite) using lime and elemental chlorine. Six mills among eight mills are using ClO2 as bleaching agent either as partial substitution of elemental chlorine or in final stage of bleaching to attain desired brightness level. its behaves like cement because of silica and magnesium properties. This silica and magnesium improve the setting of the concrete.

Literature Review

In 2013, Jayesh kumar Pitroda et al focused on investigation of strength of concrete and optimum percentage of the partial replacement by replacing cement via 10%, 20%, 30%, and 40% of Hypo Sludge. Keeping all this view, the aim of investigation is the behavior of concrete while adding of waste with different proportions of Hypo sludge in concrete by using tests like compression strength and split strength.[2]

In 2014, Ritesh Patil and M.Jamnu study the various mechanical properties of concrete containing hypo sludge. Hypo sludge was used as a replacement to cement. Replacement percentages used during the present study were 10%, 15%, 20%, 25%. Compressive strength of cubes were found on 3days, 7days, and 28days. The 28th day flexural strength and split tensile strength of the specimens was found on the respectively beams and cylinders. It is found that replacement of hypo sludge have beneficial effects on the mechanical properties of concrete.

In 2014, Abdullah Shahbaz Khan et al present dissertation work is directed towards developing low cost concrete from paper industry waste. Dissertation work is carried out with M20 & M30 grade concrete with W/c ratio of 0.55 & 0.45 respectively as a control specimen and hypo sludge is replaced in different percentages such as 10%, 20%, and 30% by weight of cement. Test was conducted to study the mechanical properties of concrete, such as compressive strength, split tensile strength and flexural strength. The curing period should be 3, 7 and 28 days.[1]

In 2014, R. Balamurugan and R. Karthick raja produce low cost concrete by blending various ratios of cement with hypo sludge. Work is concerned with experimental investigation

on strength of concrete and optimum percentage of the partial replacement by replacing cement via 5%, 10%, 15%, and 20% of Hypo Sludge.

Materials and properties

A. Materials

1. Hypo Sludge,
2. Cement
3. Coarse Aggregate
4. Fine Aggregate
5. Water

1) *Hypo Sludge*

This hypo sludge contains low calcium and maximum calcium chloride and minimum amount of silica. The hypo sludge behave like cement because of silica and magnesium properties. A silica and magnesium improve the setting time of concrete.

2) *Cement*

Cement that is used of OPC 43 grade as per the standard specification of the country. The cement according to the Indian specification must satisfy the IS code 12269 – 1987.

3) *Coarse Aggregate*

The strength of aggregates, and hence its influence on the concrete, is primarily dependent on its mineralogy. Beyond this, a smaller sized aggregate may have strength advantages in that internal weak planes may be less likely to exist or would be smaller and discontinuous

4) *Fine Aggregate*

Sand is primarily filler for the voids in concrete. Increasing the proportion of sand in the total mix increases cement demand because of the relatively very large surface area that needs to be coated by cement paste. Flow ability and mobility of concrete is enhanced with larger sand proportion but increases cement demand.

Mix Design

A mix M30 grade was designed by most of the researchers as per IS 10262:2009 and the same was used to prepare the test samples.

	Cement	Fine aggregate	Coarse aggregate	Water
By weight (Kg/m^3)	432.55	508.95	1206.93	186
By ratio	1	1.17	2.79	0.43

1. compressive strength

The important property of concrete is its strength in compression. The aim of these experimental tests is to determine the maximum load carrying capacity of test specimen. Cubes of size 150 x 150 x 150 mm were cast. Three numbers of specimens were tested for 7 and 28 days. The specimens are casted for M30 grade concrete with different proportions of hypo sludge and tested.

Figure 1: compression testing machine

Table 1 *: COMPRESSIVE STRENGTH AT 7DAYS*

	Compressive load (N)	Compressive strength (N/mm^2)	Compressive strength (N/mm^2)
Conventional Concrete	$560X10^3$	24.88	22.45
	$460 X 10^3$	20.44	
	$520 X 10^3$	23.11	
5% of Hypo Sludge	$400 X 10^3$	17.778	18.32
	$430 X 10^3$	18.667	
	$420 X 10^3$	20	
10% of Hypo Sludge	$350 X 10^3$	15.55	15.35
	$375 X 10^3$	16.66	
	$365 X 10^3$	16.22	
15% of Hypo Sludge	$300 X 10^3$	13.33	13.88
	$310 X 10^3$	14	
	$315 X 10^3$	13.77	

***Table 2** : COMPRESSIVE STRENGTH AT 28DAYS*

	Compressive load (N)	Compressive strength (N/mm^2)	Compressive strength (N/mm^2)
Conventional concrete	660 X 10^3	29.33	30.43
	680 X 10^3	30.22	
	720 X 10^3	32	
5% of Hypo Sludge	455 X 10^3	20.22	20.22
	450X 10^3	20	
	480 X 10^3	21.33	
10% of Hypo Sludge	430 X 10^3	19.11	19.00
	430 X 10^3	19.11	
	425 X 10^3	18.88	
15% of Hypo Sludge	390 X 10^3	17.33	16.28
	360 X 10^3	16	
	335 X 10^3	14.88	

2. Flexural strength

Prism size of 100 x 100 x 500 mm. Three numbers of specimens were tested for 7 and 28 days. The specimens are casted for M30 grade concrete with different proportions of hypo sludge and tested.

figure 2 : Flexural testing machine

figure 3:Flexural testing machine

***Table 3 :** Flexural Strength At 7Days*

	Load (N)	Flexural Strength (N/mm^2)	Avg. Flexural Strength (N/mm^2)
Conventional Concrete	28 X 10^3	14	15.5
	30 X 10^3	15	
	29 X 10^3	14.5	
5% Of Hypo Sludge	20.8 X 10^3	10.4	11.2
	19 X 10^3	9.5	
	21.4 X 10^3	10.7	
10% Of Hypo Sludge	20.6 X 10^3	10.3	10
	19.8 X 10^3	10	
	19 X 10^3	9.5	
15% Of Hypo Sludge	19.5 X 10^3	9.75	9.3
	18 X 10^3	9	
	18.2 X 10^3	9.1	

***Table 4 :** Flexural Strength At 28Days*

	Load (N)	Flexural Strength (N/mm^2)	Avg. Flexural Strength (N/mm^2)
Conventional concrete	45 X 10^3	22.5	24
	49 X 10^3	24.5	
	50 X 10^3	25	
5% Of Hypo Sludge	21.4 X 10^3	10.7	11.33
	22.6 X 10^3	11.3	
	24 X 10^3	12	
10% Of Hypo Sludge	21.8 X 10^3	10.9	11.6
	24 X 10^3	12	
	23.8 X 10^3	11.9	
15% Of Hypo Sludge	19 X 10^3	9.5	9.76
	19.6 X 10^3	9.8	
	20 X 10^3	10	

3. Split Tensile strength

Cylinders of size 150 mm diameters and 300 mm diameter were cast. Three numbers of specimens were tested for 7 and 28 days. The specimens are casted for M30 grade concrete with different proportions of hypo sludge and tested.

Figure 4 : Compression testing machine

***Table 5** : SPLIT TENSILE STRENGTH AT 7DAYS*

	Load (N)	Split Tensile Strength (N/mm^2)	Avg. Split Tensile Strength (N/mm^2)
Conventional Concrete	140X 10^3	1.98	1.744
	110X 10^3	1.556	
	120X 10^3	1.697	
5% Of Hypo Sludge	100X 10^3	1.414	1.485
	110X 10^3	1.556	
	105X 10^3	1.485	
10% Of Hypo Sludge	110X 10^3	1.556	1.579
	115X 10^3	1.626	
	110X 10^3	1.556	
15% Of Hypo Sludge	95X 10^3	1.343	1.414
	100X 10^3	1.414	
	105X 10^3	1.485	

***Table 6 :** SPLIT TENSILE STRENGTH AT 28DAYS*

	Load (N)	Split Tensile Strength (N/mm^2)	Avg. Split Tensile Strength (N/mm^2)
Conventional Concrete	160X 10^3	2.26	2.42
	170X 10^3	2.40	
	185X 10^3	2.55	
5% Of Hypo Sludge	150X 10^3	2.12	2.16
	160X 10^3	2.26	
	150X 10^3	2.12	
10% Of Hypo Sludge	145X 10^3	2.05	2.00
	140X 10^3	1.98	
	140X 10^3	1.98	
15% Of Hypo Sludge	135X 10^3	1.91	1.82
	125X 10^3	1.77	
	137X 10^3	1.94	

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