COMPARATIVE STUDY ON THE PARTIAL REPLACEMENT OF CEMENT USING HYPO SLUDGE AND FLY ASH

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ABSTRACT:

In this research study on partial replacement of cement using hypo sludge and fly ash was studied. Basically, fly ash is the waste material from hydroelectric power station and hypo sludge is the waste from paper sludge industry. This replacement can help to reduce emission of CO_2 and help to improve concrete properties up to certain extent. The mix proportion are calculated by using Indian standard code design of mix for M25 grade concrete. 0%, 10%, 20%, 40% replacement of hypo sludge is done. Cubes and cylinders are casted and 7 & 28 days curing is done. Compressive strength test and split tensile strength test are carried out. Due the replacement of cement with hypo sludge up to certain extent properties of concrete enhanced. Comparative studies are carried out between the properties of normal concrete and replaced concrete. Replacement of cement with hypo sludge gives better environment friendly solution for durable concrete. It proves cost effective as compared to the normal concrete and also disposal problem of hypo sludge can be reduced.

Keywords: Hypo sludge, Fly ash, Compressive strength, plit tensile strength, Cost effective, environment friendly

INTRODUCTION:

Now a days there is a low availability of natural resources, Ordinary Portland Cement (OPC) are rapidly used throughout the world like in industries, residential buildings, power plants, transportation works, etc…So Production and utilization of concrete has rapidly increased. This results in increased consumption of natural aggregates.

The production of Hypo sludge is estimated about 35% of the daily production in the paper industries. These wastes are used as an ingredient of cement manufacturing in wet process. But present days we use dry process for manufacturing of cement so hypo sludge are not useful for manufacturing of cement. The paper industries are dumped these waste nearby any pit or waste land. It leads to effects the environmental issues.

Hypo sludge produced in a large amount as by product of paper industry. It is a by-product obtained by deinking and re pulping of paper and its disposal is in the form of land spreading. Hypo sludge mainly contains low calcium and maximum calcium chloride and minimum

amount of silica. Lime sludge behaves like cement because of silica and magnesium properties. It is a major economic and environmental problem for the paper and board industry. Hyposludge is purely chemical waste and requires large space for disposal. We can use it as a partial replacement material in cement concrete. Use of hypo sludge in cement concrete not only solve the disposal problem but also make concrete economical by replacing cement partially. Hyposludge will also improve construction functionality and ecological sustainability and results in low life cycle cost.

1.1Materials

1.1.1 Cement

OPC 53 cement with a characteristic of compressive strength of 53 MPa after 28 days of curing process. It has widely used in construction because to its high strength and durability, making it suitable for various applications including construction of high-rise buildings, bridges, and dams, etc. OPC 53 cement has excellent strength and durability, its production can have high energy consumption and carbon dioxide emissions, raising environmental concerns.

1.1.2 Hypo Sludge

Hypo sludge contains low calcium and maximum calcium chloride and minimum amount of silica. Because of silica and magnesium properties it behaves like Cement as a binding material. The hardening of the concrete can be improved by silica and magnesium. Hypo sludge is purely chemical waste obtain from paper sludge industry and requires large space for disposal. Use of hypo sludge in cement concrete not only solve the disposal problem but also make concrete economical. Hypo sludge will improve ecological sustainability and results in low life-cycle cost.

1.1.3 Fly Ash

Using fly ash in concrete reduces cracking and bleeding, it creates a dense, high-durability concrete that is resistant to sulphates and alkali-aggregate reactions. This concrete mix also requires less water and causes less shrinking.

Fly ash is not environmentally friendly. It is a waste byproduct of combusted coal obtained from industrial boilers, and it is generally considered an environmental hazard. However, by reusing or recycling the fly ash to make concrete products, the impact of fly ash on the environment can be reduced, instead of simply sending this hazardous waste to the landfill.

2. MIX PROPORTIONS

2.1 Mix Proportion 1

Material	6 Cubes	1 Cylinder
Cement (kg)	5.67	1.484
Fly ash (kg)	1.62	0.424
Hyposludge (kg)	0.81	0.212
Water (kg)	3.11	0.8162
CA (kg)	23.59	6.1745
FA (kg)	16.40	4.293

Table 1 : mix proportion 1

2.2 Mix Proportion 2

Material	6 Cubes	Cylinder
Cement (kg)	4.86	1.272
Fly ash (kg)	1.62	0.424
Hyposludge (kg)	1.62	0.424
Water (kg)	3.11	0.8162
CA (kg)	23.59	6.1745
FA (kg)	16.40	4.293

Table 2 : mix proportion 2

2.3 Mix Proportion 3

Material	6 Cubes	Cylinder
Cement (kg)	3.24	0.954
Fly ash (kg)	1.62	0.424
Hyposludge (kg)	3.24	0.636
Water (kg)	3.11	0.8162
CA (kg)	23.59	6.1745
FA (kg)	16.40	4.293

Table 3 : mix proportion 3

3. RESULTS

3.1 Compressive Strength Test Results

3.1.1 Test result for 7 days curing

Sr No	Cement Replacement In Percentage	Specimen Designation	Age Of Concrete In Days	Compressive Strength In N/mm^2	Average Strength In N/mm^2
1	0	C1	7	17.33	16.57
		C2	7	16.24	
		C3	7	16.14	
2	10	C1	7	17.54	17.07
		C2	7	16.45	
		C3	7	17.22	
3	20	C1	7	17.78	17.49
		C2	7	16.68	
		C3	7	18.01	
4	40	C1	7	17.15	16.98
		C2	7	16.33	
		C3	7	17.46	

Table 4 : Test Result Of Cube Specimen Of 7 Days Curing

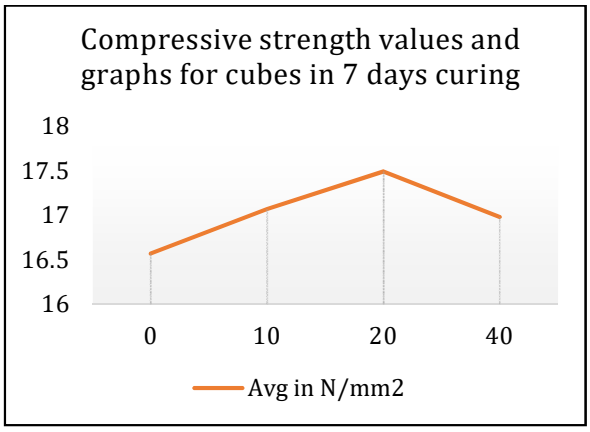

Chart 1 : Test Results Of Cube Specimen In 7 Days Curing

3.1.2 Test result for 7 days curing

Sr No	Cement Replacement In Percentage	Specimen Designation	Age Of Concrete In Days	Compressive Strength In N/mm²	Average Strength In N/mm²
1	0	C1	28	26.24	
		C2	28	26.67	26.07
		C3	28	25.30	
2	10	C1	28	26.87	
		C2	28	26.52	26.62
		C3	28	26.47	
3	20	C1	28	26.73	
		C2	28	26.43	26.45
		C3	28	26.19	
4	40	C1	28	26.63	
		C2	28	26.25	25.98
		C3	28	25.06	

Table 5 : Test Result Of Cube Specimen Of 28 Days Curing

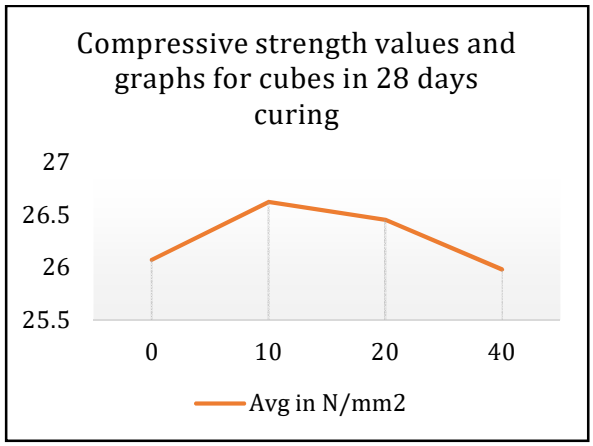

Chart 2 : Test Results Of Cube Specimen In 28 Days Curing

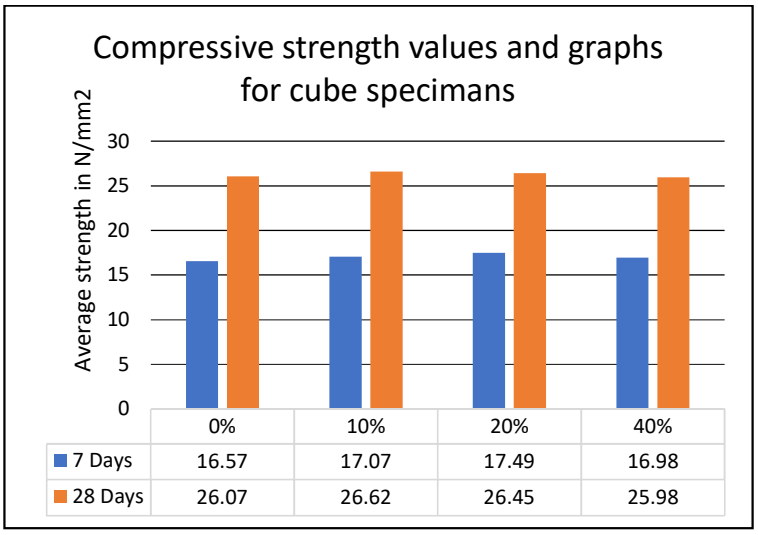

Chart 3 : Comparison Test Results Of Cube Specimen In 7 And 28 Days Curing

3.2 Split Tensile Test Results

Sr No	Cement Replacement In Percentage	Specimen Designation	Age Of Concrete In Days	Average Compressive Strength In N/mm^2
1	0	T1	28	3.87
2	10	T1	28	3.39
3	20	T1	28	2.94
4	40	T1	28	2.53

Table 6 : Test Result Of Cylinder Specimen Of 28 Days Curing

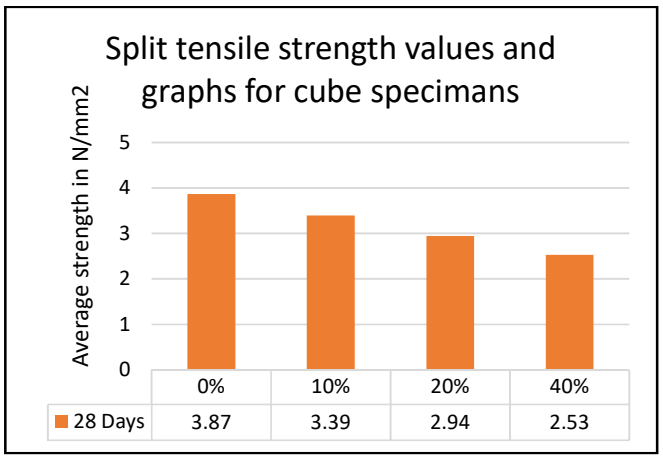

Chart 4 : Test Results Of Cylinder Specimen In 28 Days Curing

4. CONCLUSION

Replacement of cement with hyposludge upto 10% is feasible but more than 10% gives the reverse result as compared to the normal concrete mix after 28 days.

Hence use of hyposludge in concrete can save disposal cost of paper industry waste and produces green concrete for construction. The hazardous environmental effects of paper industrial waste can be reduced upto some extend.

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