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Experimental study on Partial Replacement of Cement by Hyposludge in Concrete with Chemical Admixture

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***Abstract*— The global cement industry contributes about 9% of greenhouse gas emission to the earth's atmosphere.Paper industry wastes are being produced by 420 million tonnes per annum by chemical process in India. In order to reduce cement manufacturing and disposal problem of paper waste, there is a need to develop alternative binders in construction field. Utilization of industrial waste products as Supplementary Cementitious Material in concrete is very important aspect in view of economical, environmental and technical reasons. It is directed towards developing low cost concrete and light weight concrete from paper industry waste. From the test results,10 % replacement of hyposludge with cement attained good strength and when superplasticizer is added good strength is obtained on 20 % replacement of hyposludge with cement. Hence by replacing hyposludge in the concrete structures that will conserve resources and avoid environmental and ecological damages caused by cement production.**

Keywords*— Cement, hypo sludge, chemical admixture, M30 grade concrete, compressive strength, spilt tensile

I. INTRODUCTION

This work examines by using paper waste (hypo sludge) as partial replacement of cement & it is most essential to develop profitable building materials from hypo sludge. Carbon dioxide is emitted as a by-product of clinker production, a intermediate product in cement manufacture, in which calcium carbonate is calcinated and converted to lime, the primary component of cement. Carbon dioxide is also emitted during cement production by fosil fuel combustion, that causes environmental damages. Concrete is a material which is the most widely used in construction of the buildings in the world.There is an increasing demand for concrete worldwide at low cost, by producing this hyposludge concrete it will reduces the demand of concrete and reduces the emissions of CO2 from cement industry. Hypo sludge is used as a replacement in producing concrete and was investigated on its physical and mechanical properties. There is an increasing demand for concrete worldwide at low cost, by producing this concrete it will reduces the demand of concrete and reduces the emissions of CO2 from cement industry. This project concisely explains the technical and environmental benefits of supplementary cementitious materials use and study the deign parameters of concrete on inclusion of paper waste as partial replacement of cement with and without using superplasticizers.

II. MATERIALS AND PROPERTIES

A. *Cement*

Cement is formed by grinding calcined limestone and clay into a very fine, grey powder. Cement is one of the binding agent in this project. The cement and water forms a paste and binds the other materials together. The Ordinary Portland Cement (53 grade) conforming to IS:8112-1989 is being used. Tests were conducted on cement.

TABLE I. PROPERTY OF 53 GRADE CEMENT

S.no.	Property	Result
1.	Specific gravity	3.15
2.	Consistency	33%
3.	Initial setting time	30 min
4.	Final setting time	600 min

B. *Fine Aggregate*

Fine aggregate is the essential ingredient in concrete that consists of natural sand or crushed stone.Fine aggregate used throughout the work comprised of M-sand with maximum size of 4.75mm conforming to Zone I as per IS 383-1970. The physical properties of fine aggregate like specifc gravity and water absorption are tested in accordance with IS:2386.

TABLE II. PROPERTY OF FINE AGGREGATE

S.no.	Property	Result
1.	Specific gravity	2.6
2.	Water absorption	2%

C. *Coarse Aggregate*

Coarse aggregate consists of crushed granite or basalt rock,conforming to IS:383. Coarse aggregate are used in the size of 20mm.The physical properties of coarse aggregate like specific gravity, impact strength and crushing strength are tested in accordance with IS:2386.

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TABLE III. PROPERTY OF COARSE AGGREGATE

S.no.	Property	Result
1.	Specific gravity	2.45
2.	Impact strength	26.75%
3.	Crushing strength	28%

D. Hyposludge

Hyposludge is a waste material collected from the paper industry. Hyposludge is used in concrete with the replacement of cement of 10%,20%, and 30% by using superplasticizers and also in absence of superplasticizers. The compressive strength and spilt tensile strength was determined in 7 and 28days.

TABLE IV. PROPERTY OF HYPOSLUDGE

S.no.	Property	Result
1.	Consistency	31%
2.	Initial setting time	36 miin
3.	Final setting time	595 min

E.Chemical Admixture

Admixtures are ingredients other than basic ingredients cement, water and aggregates that are added to concrete batch immediately before or during mixing to modify one or more of the specific properties of concrete in fresh and hardened state.Added in small quantity in liquid form. Dr. Fixit Pidiproof LW+ was used. It is used as an additive for cement concrete.It makes concrete cohesive and prevents segregation.

F.Water

Water is the essential ingredient to mix all the components in concrete. The pH of water used should be from a range of 6.0 to 8.5.Water is required for preparation of cement mix and curing work.

III. DESIGN MIX METHODOLOGY

The concrete mix design was proposed by using IS10262:2009.The grade of concrete used was M30 with water to cement ratio 0.45. Superplasticizer was added about 4 % of cement.The mix design proportions for $1m^3$of concrete were tabulated.

TABLE V. MIX DESIGN PROPORTIONS

Hypo sludge(%)	W/C ratio	Cement (Kg/m^3)	F.A (Kg/m^3)	C.A (Kg/m^3)
0	0.45	440	717	1130
10	0.45	390	717	1130
20	0.45	354	717	1130
30	0.45	310	717	1130

IV. EXPERIMENTAL INVESTIGATION

A. Test on Fresh Concrete

Slump cone test determines the workability and consistency of various concrete mixes.By using a metallic slump mould,The difference in level between the height of the mould and that of the highest point of the subsided concrete is measured.

B. Casting of moulds

Casting of conventional concrete of M30 mix ratio and also casting of 10%,15%,20%,25% and 30% replacement of cement by hypo sludge. We casted conventional concrete with M30 mix design, we casted 24 cubes and 24 cyclinders of around for conventional concrete of cube size 150mm×150mm×150mm.and cylinder size 150mmϕ ×300 mm has been casted for the determination of compressive strength and spilt tensile strength respectively. The concrete specimens were cured under normal conditions as per IS 516-1979 and were tested at 7 days and 28 days for determining compressive strength and spiltting tensile strength.

C. Compressive strength Test

In this test, the cubes are subjected to compressive force in a compression testing machine and the ultimate load at which the failure occurs is noted.Then the compressive stress is ultimate load by area exposed to load and stress value is obtained in N/mm^2.

Fig 1. Compressive strength test

TABLE VI. COMPRESSIVE STRENGTH TEST RESULTS

S.no	Hypo Sludge (%)	Compressive Strength at 7 days (N/mm^2)	Compressive Strength at 28 days (N/mm^2)
1.	0%	24.3	35.7
2.	10%	25.6	37.6
4.	20%	26	38.1
6.	30%	21.9	29.7

D. Split Tensile strength test

In this test,the cylindrical specimen is placed horizontally between the loading surface of a compression-testing machine and the load is applied until failure of cylinder occurs along the vertical diameter. The split tensile strength is given by the formula 2P/ (ΠDL) and the stress value is obtained in N/mm^2.

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Fig 2. Split tensile strength test

TABLE VII.SPLIT TENSILE STRENGTH TEST RESULTS

S.no	Hypo Sludge (%)	Split tensile Strength at 7 days (N/mm^2)	Split tensile Strength at 28 days (N/mm^2)
1.	0%	2.15	2.56
2.	10%	1.8	2.61
4.	20%	1.37	1.62
6.	30%	1.1	1.9

V. CONCLUSION

we conclude our project with various mixes with curing periods of 7 and 28 days by partial replacement of cement with hypo sludge.Testing of cubes and cylinder in compression testing machine with capacity of 1000 kN were carried out.The compressive strength of concrete increases as the curing period for M30 grade concrete and the replacement of hypo sludge is done from 0%,10%,20%, and 30%.The maximum compressive strength for 7 days and 28 days is achieved for 20% replacement of cement with use of superplasticizers and starts decreasing on 30%.

The maximum strength of concrete is attained in 20% replacement of hyposludge with cement as compared to Conventional concrete.

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