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ARTICLE

EXPERIMENTAL STUDY ON BEHAVIOUR OF PAPER SLUDGE CONCRETE

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ABSTRACT

Concrete is strength and tough material but it is porous material also which interacts with the surrounding environment. The durability of concrete depends largely on the movement of water and gas enters and moves through it. 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 fibers can be used which produces a large amount of solid waste. The innovative use of hypo sludge in concrete formulations as a supplementary cementations material was tested as an alternative to traditional concrete. This research work is concerned with experimental investigation on 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, split tensile strength and flexural strength.

KEY WORDS
Hypo sludge, Compressive strength, Tensile strength, Flexural strength

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INTRODUCTION

In order to diminish nonrenewable material utilization as well as maintaining natural property concepts of recycling and sustainability were globally introduced. Paper sludge mainly consists of cellulose fiber and inorganic materials. The wetness content normally present in paper sludge may vary from 60-75% [1]. Hypo Sludge (HS) is a ravage material produced from paper industry that can used as a cement proxy material in concrete since the lime content in the sludge is huge[2].Paper sludge contains silica and magnesium like cement which develop the setting of the concrete. The capacity of sludge changes from mill to mill. The quantity of sludge generated by a cast-off paper mill is greatly reliant on the nature of unrefined material being used and end product being artificial [3].

The use of paper-mill soft tissue in concrete formulations was investigated as an substitute to landfill dumping. If current tendency continues, with ravage production proposed to rise by 5% every year, landfills would be at filled capacity by 2020 [4]. About 300 kg of sludge is created for each tone of cast-off paper. This is an appealing huge amount of sludge formed every day that makes landfill wasteful as paper mill sludge is massive[5].Hypo sludge is a current arrival amid cementitions materials. It was initially introduced as artificial pozzolana while producing paper the variety of wastes are come out from the various processes in paper industries[6].The problem of hypo sludge utilization is not confined to India alone but is being experienced all over the world. However this problem is particularly acute in India. Where utilization of hypo sludge has not received much attention. Hypo sludge properties make it very suitable for all construction activities including roads, embankments and reclamation of low lying areas [7]

Scope

The scope of this paper is to provide a most economical concrete. It should be easily adopted in field. The wastes from paper production can be converted in useful manner. To reduce the cost of the construction, to promote the low cost housing to the E.W.S. group people, to find the optimum strength of the partial replacement of concrete, minimize the maximum demand for cement, minimize the maximum degradation in environment due to cement and safeguard the ozone layer from greenhouse gases.

MATERIALS USED

Cement

The cement used is OPC (Ordinary Portland Cement). The specific gravity of cement is determined by adopting standard procedure.

Fine aggregates

Aggregate which is passed through 4.75 IS Sieve and retained on 75micron (0.075mm) IS Sieve is termed as fine aggregate. Fine aggregate is added to concrete to assist workability and to bring uniformity in mixture.

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Coarse aggregates

The coarse aggregate for the works is river gravel or crushed stone. Angular shape aggregate of size is 20mm and below. The aggregate which passes through 75mm sieve and retain on 4.75mm are known as coarse aggregate.

Admixture

Retarder

The Retarder is added for slow down chemical process of hydration so that concrete remains plastic and workable for a longer time than concrete without the retarder. They used to accelerating effect of high temperature on setting properties of concrete in hot weather concreting and them delay the setting and hardening of concrete. This is liquid type i.e., GLUCONATES. Colour of retarder is water colour.

Hyposludge

Hyposludge is a solid waste from paper industries. Hyposludge is the primary waste material from the paper industry. It consists of cellulose fibers, calcium carbonate, silica, magnesium, calcium chloride, china clay and residual chemicals along with water. The presence of silica, magnesium and calcium in hyposludge makes it similar to that of cement and hence there is a possibility to replace cement with hyposludge. The Hyposludge can minimize the demand for cement and reduce the cost of construction.

TESTING OF MATERIALS

Specific gravity of cement

The specific gravity of cement is to be found in the laboratory by using pyconometer and other accessories. Value of specific gravity of cement is obtained as 3.05.

Specific gravity of coarse aggregate

The specific gravity of the coarse aggregate is to be found in the laboratory by using pyconometer and other accessories. Value of specific gravity of coarse aggregate is found to be 2.81 [Table 1].

Table 1: Specific Gravity test for Coarse Aggregate

Description	Sample
Wt of empty pycnometer(gm)	673
Wt of pycnometer + coarse aggregate (gm)	1537
Wt of pycnometer +Water+ coarse aggregate (gm)	2085
Wt of pyconometer + Water	1550
Specific Gravity	2.74

Specific gravity of fine aggregates

The specific gravity of sand is to be found in the laboratory by using pyconometer and other accessories. Value of specific gravity of sand is 2.63.

Bulk density for coarse aggregate

Table 2: Bulk Density of Coarse Aggregate

Description	Sample
Wt of empty cylinder w1 (kg)	110.024
Wt of cylinder +coarse aggregate w2(kg)	118.9
Net wt of the aggregate w2-w1 (kg)	88.276
Bulk density, V (kg/litre)	11.65

Water absorption of coarse aggregates

The water absorption of aggregate is determined by measuring the increase in weight of a dry sample when immersed in water for 24 hours. The ratio of the increase in weight to the weight of dry sample expressed as percentage is known as absorption of aggregate. The water absorption of aggregate is to be found in the laboratory. Values of water absorbing capacity of coarse aggregate are 0.5%.

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Abrasion value of coarse aggregates

The abrasion value is to be found in the laboratory by using Deval's abrasion machine and other accessories. Abrasion value of coarse aggregate is 8.6%.

Properties of cement

The properties of cement tested were listed below in [Table 3]

Table 3: Properties of Cement

Sl.No	Particulars	Values
1	Specific gravity	3.05
2	Initial setting time	30min
3	Final setting time	5hrs 10min

Properties of coarse aggregates

The properties of coarse aggregate tested were listed below in [Table 4]

Table 4: Properties of Coarse Aggregates

Sl. No	Particulars	Values
1	Specific gravity	2.81
2	Water absorption	0.5%
3	Deval's abrasion	8.6%
4	Fineness modulus	7.12
5	Bulk density	1.42 x 10^3 Kg/m^3
6	% of voids	50 %

Properties of fine aggregates

The properties of fine aggregate tested were listed below in [Table 5]

Table 5: Properties of Fine Aggregates

Sl.no	Particulars	Values
1	Specific gravity	2.63
2	Bulk density	1.21 x 10^3 Kg/m^3
3	Fineness modulus	2.46
4	% of voids	54 %
5	Water absorption	1.0 %
6	Moisture content	1.4 %

Properties of Hyposludge

The properties of hyposludge tested were listed below in [Table 6]

Table 6: Properties of Hyposludge

Sl.No	Particulars	%
1	Lime	49
2	Silica	5.5
3	Alumina	2
4	Magnesium	1.4
5	Sodium oxide	1.6

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TEST ON HARDENED CONCRETE

Compression test

The compressive strength of concrete is defined as the load which causes the failure of specimen, per unit area of cross-section in uniaxial compression under given rate of loading. The strength of concrete is expressed as N/mm^2.

For structural design the compressive strength is taken as the criterion of quality of concrete and working stress are prescribed as per codes in terms of percentages of the compressive strength as determined by standard tests. The specimens are cured for 7 days and 28 days, for 7 days testing and 28 days testing with water cement ratio of 0.5 [Table 7]. The Fig.1 depicts the compressive strength of concrete for 7 days and 28 days with various percentage of sludge.

Split tensile test

The specimens are cured for 28 days and tested with water cement ratio of 0.5[Table 8]. The Fig.2 depicts the tensile strength of concrete for 28 days with various percentage of sludge.

Flexural strength test

Concrete as we know is relatively strong in compression and weak in tension. In reinforced members, little dependence is placed on the tensile strength of concrete. The value of the modulus of rupture depends on the dimension of the beam and manner of loading. The system of loading used in finding out the flexural tension is central point loading and three points loading. In central point loading, maximum fiber stress will come below the point of loading where the bending moment a maximum.

This ensures that top and bottom surfaces of the beam are parallel so that loading is uniform across the width. Loading is applied through 2 rollers, each at a distance of L/3 from the supports on either side. Apply the loading without shock and increase at a constant stroke rate (0.02mm/min) with water cement ratio of 0.5 [Table 9]. The Fig.3 depicts the flexural strength of concrete for 28 days with various percentage of sludge.

RESULTS

Table 7: Compressive Strength of Concrete Cubes

Sl. No	Partial Replacement In (%)	Ultimate Compressive strength(KN)	
		7 days	28 days
1.	0	16.30	28.12
2.	10	18.55	30.33
3.	20	19.11	31.19
4.	30	19.870	28.12
5.	40	17.90	36.33

Table 8: Tensile Strength of Concrete Cylinders

Sl.No	Partial Replacement In (%)	Ultimate Tensile strength (KN) (28 days)
1.	0	3.21
2.	10	3.00
3.	20	2.90
4.	30	2.77
5.	40	2.48

Table 9: Flexural Strength of Concrete Beams

Sl.No	Partial Replacement In (%)	Ultimate Flexural strength (KN) (28 days)
1.	0	1.21
2.	10	2.60

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3.	20	2.95
4.	30	3.57
5.	40	2.88

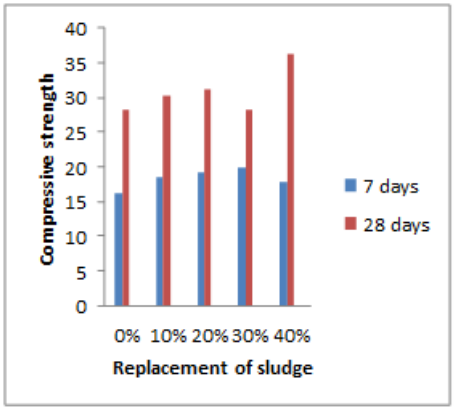

Fig. 1: Compressive strength of concrete.

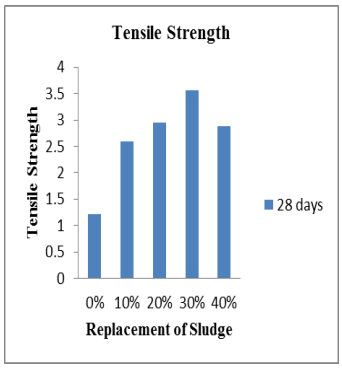

Fig. 2: Tensile strength of concrete.

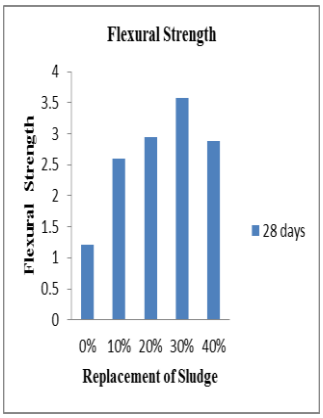

Fig. 3: Flexural strength of concrete.

CONCLUSION

The following conclusions could be drawn from the study, Hyposludge as waste product from paper industry available in India could be used as mineral admixtures in concrete. Its use in concrete could save as much as 40% of cement as binding material, while providing the same strength. Under certain

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conditions, replacement of cement by hyposludge appears to increase the strength of concrete.The compressive strength and sulphate attack of cement mortar cubes results indicated that increased with curing period but above 30% replacement, decreased with increasing hyposludge percentage. Partial replacement of Ordinary Portland Cement with about 30% Hyposludge in concrete gives more strength compared to conventional concrete. The 40% replacement slightly equal to the conventional concrete. Here we can conclude 30% hypo sludge with cement will give good strength, so it is considered as optimum content.

CONFLICT OF INTEREST

There is no conflict of interest.

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None

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