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STRUCTURAL PERFORMANCE OF CONCRETE BY PARTIAL REPLACEMENT OF CEMENT WITH HYPO SLUDGE

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ABSTRACT

Concrete is strength and tough material but it also porous whichinteracts within the surrounding environment. The durability of concrete depends on the movement of gas and water enters and moves through it. To produce low cost concrete by blending various ratio of cement with hypo sludge and to reduce disposal and pollution problems due to hypo sludge it is most essential to development of profitable building materials from hypo sludge. To make good quality paper limited number of times for recycled paperfibrecan be used which produce a large amount of solid wastes. Hyposludge is used in concrete formulation as a supplementary cementatious material was tested as an alternative concrete into traditional concrete. These test were carried out to evaluate the mechanical properties like compressive strength and split tensile strength up to 28 days. As a result, the compressive and tensile increased up to 20% addition of hypo sludge and further increase in hypo sludge reduces the strength gradually. Thisproject is concerned with experimental investigation on strength of concrete and optimum percentage of partial replacement by replacing cement 5%, 10%, 15%, and 20% of Hypo Sludge. In this project view, the aim of investigation is the behaviour of concrete while adding of waste with different proportions of Hypo sludge in concrete by using tests like compressive strength and split strength.

The mix design was carried out for M25 grade concrete as per IS: 10262-2009.

***Keywords*—Cement; Hyposludge; Paper Waste; OPC**

I.INTRODUCTON:

Industrial wastes are being produced per annum byagricultural and agricultural process in India. These materials possess problems of disposal, health hazards and aesthetic problem. Paper fibers can be recycled only a limited number of times before they become too short or weak to make high quality paper. It means that the broken, low- quality paper fibers are

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separated out to become waste sludge. Paper sludge behaves like cement because of silica and magnesium properties which improve the setting of the concrete. The quantity of sludge varies from mill to mill. The amount of sludge generated by a recycled paper mill is greatly dependent on the type of furnish being used and end product being manufactured. Paper mill sludge can be used as an alternative material applied as partial replacement of fine aggregates in manufacturing fresh concrete intended to be used for low cost housing projects. About 300 kg of sludge is produced for each tone of recycled paper. This is a relatively large volume of sludge produced each day that makes making landfill uneconomical as paper mill sludge is bulky. By adjusting the mixture to an equivalent density, concrete mixtures containing the residuals can be produced that are equal in slump and strength to a reference concrete without residuals.

II. LITERATURE REVIEW

Experimental investigations in developing low cost concrete from paper industry waste R. Srinivasan, *K. Sathiya and M. Palanisamy, 2010

Over 300 million tones of industrial wastes are being produced per annum by chemical and agricultural process in India. The wastes like phosphogypsum, fluorogypsum and red mud contain obnoxious impurities which adversely affect the strength and other properties of building materials based on them

Utilization of waste paper pulp by partial replacement of cement in concrete Sumit A Balwaik; S P Raut, ISSN: 2248-9622

The use of paper-mill pulp in concrete formulations was investigated as an alternative to landfill disposal. The cement has been replaced by waste paper sludge accordingly in the range of 5% to 20% by weight for M-20 and M-30 mix. By using adequate amount of the waste paper pulp and water, concrete mixtures were produced and compared in terms of slump and strength with the conventional concrete.

III.MATERIAL COLLECTION AND CHARACTERIZATION

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

IV. PROPERTIES OF MATERIALS

Waste Paper Sludge Ash (WPSA) is a waste material collected from the Paper Industry. WPSA is used as cement replacement in producing mortar and was investigated on its chemical, physical and mechanical properties. Construction material with natural resources now become limited and causes of air pollution and environmental problems. WPSA becomes a new innovation material that can be used as material for masonry to support the green technology due to less presence of sulphate at only 0.57% of the total weight. Carbon dioxide (CO_2) and Sulphur dioxide emission also can be reduced since less cement productivity is involved. The physical properties of the WPSA were determined by comparing it with the Ordinary Portland Cement (OPC).

1.HYPO SLUDGE

Where, this hypo sludge contains,

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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 As the result of testing, it shows that WPSA is similar to the chemical properties of OPC and the water absorption of the mortar is 27.05%. However, the total percentage of the three combinations of SiO_2, Al_2O_3 and Fe_2O_3 was 45% and expected to possess low pozzolanic reactivity (50%). WPSA was used in mortar with proportions of 50%, 60%, 70%, 80%, 90% and 100% as cement replacement by volume along with sand and water in fix quantity. An additional control mix mortar without WPSA was also prepared. The compressive strength of each mortar mix was also determined on 3, 7, 28 and 60 days. Results show that the compressive strength increased with increasing curing age for all concrete mixes and the compressive strength decreases with increasing WPSA in the mortar.

TABLE-1 PROPERTIES OF RAW HYPO SLUDGE AND CEMENT

Sl. No	Constitutent	Cement(%)	Hypo Sludge (%)
1	Lime(Cao)	62	46.2
2	Silica(Sio_2)	22	9
3	Alumina	5	3.6
4	Magnesium	1	3.33
5	Calcium Sulphate	4	4.05

2.Cement: (OPC)

The most common cement used is an ordinary Portland cement. The Ordinary Portland Cement of 53 grades conforming to IS: 8112-1989 is being used. Cement (PPC) The most common cement used is portlandpozzolana cement. The Portland pozzolana cement of 53 grades conforming to IS: 1489 (PART-1) 1991 is being used

Table 4. Properties of Cement

Sl.No	Property	Value
1	Specific gravity	3.15
2	Fineness	97.8
3	Initial setting time	45 min
4	Final setting time	385 min
5	standard consistency	30%
6	Fineness modulus	6

3.Fine aggregates

Sand : River sand was used as fine aggregate. The size of the sand is used 4.75mm and down size. The properties of fine aggregate investigated are presented in table 1.

Physical Properties of Fine aggregate

Sl.No	Property	Value
1	Specific Gravity	2.65
2	Fineness Modulus	2.7
3	Water Absorption	0.66%
4	Free Moisture Content	0.20%

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4.WATER: water used in this project is potable water.

5. COARSE AGGREGATES

Machine crushed granite obtained from a local quarry was used as coarse aggregate. The properties of the coarse aggregate are shown in table 3

Table 3 Properties of Coarse Aggregate

Sl. No	Property	Value
1	Specific Gravity	2.8
2	Fineness Modulus	7.5
3	Water Absorption	0.5%
4	Particle shape	Angular
5	Impact Value	15.2
6	Crushing value	18.6

III Preparation of Specimens

Based on the above results the cement, fine aggregate coarse aggregate and water quantity required for design mix of M20 were calculated based on the procedure given in IS code method in IS :2009. The final mix ratio was 1:1.48:2.89 with water cement ratio of 0.48. The measurement of materials was done by weight in electronic weighing machine is used.Water was measured in litres. Concrete was placed in mould in layers. The cast specimen were removed from moulds after 24 hours and the specimens were kept for water curing. The details of specimens and mix designation used in experimental program are given in table

Sl. No	Mix Design	Cement	Sand	Hypo sludge	Coarse Aggregates
1	M0	100%	100%	0%	100%
2	M1	95%	100%	5%	100%
3	M2	90%	100%	10%	100%
4	M3	85%	100%	15%	100%
5	M4	80%	100%	20%	100%

IV Testing of the specimen:

For each batch of concrete, 3 cubes of 150mm x 150mm x 150mm size were tested to determine compressive strength of concrete, 3 cylinders of 150mm diameter and 300 mm length were tested to determine split tensile strength of concrete

V Results and discussions:

Table 5(i) Comparison of compressive strength result (Conventional concrete and replacement of cement with hyposludge)

M_{20} mix No.of days	Conventional concrete (N/mm^2)	5% hyposludge concrete (N/mm^2)	10% hyposludge concrete (N/mm^2)	15% hyposludge concrete (N/mm^2)	20% hyposludge concrete (N/mm^2)
7	14.28	11.33	13.12	14.68	14.46
28	24.90	24.22	24.43	25.08	25.12

After 7 days curing for compressive strength

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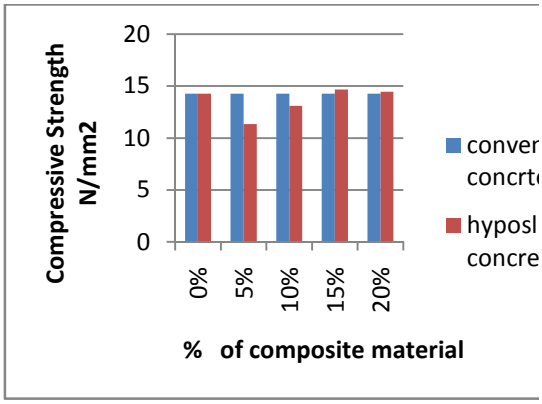


After 28days curing for compressive strength

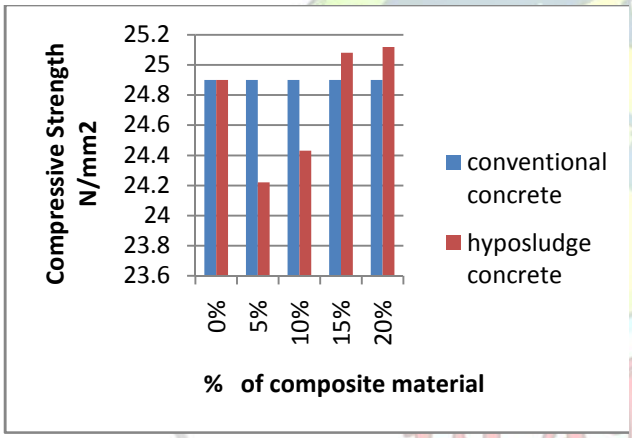
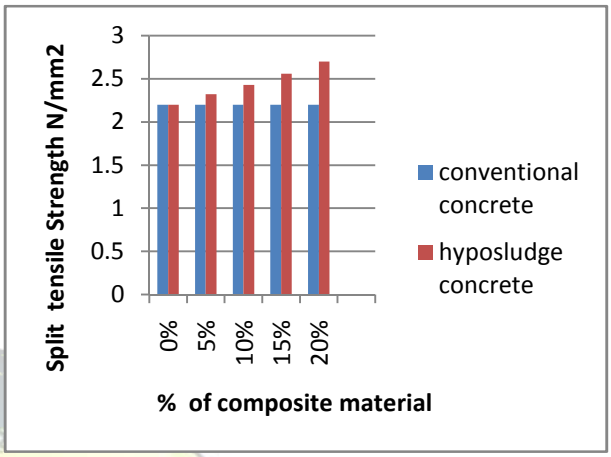


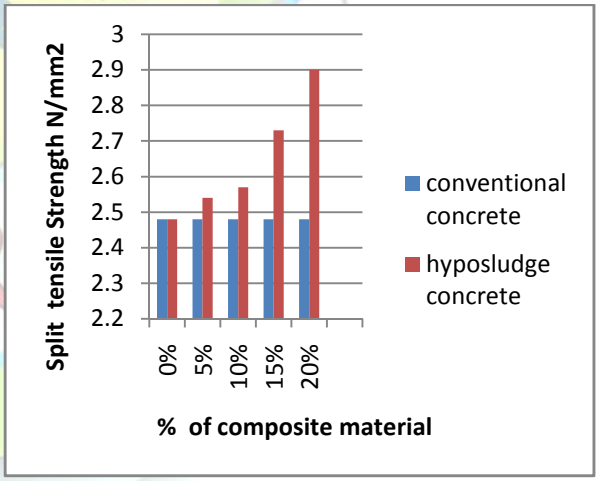
Table 5(ii) Comparison of Split tensile strength result (Conventional concrete and replacement of cement with hyposludge)

M_{20} mix No.of days	Conventional concrete (N/mm^2)	5% hyposludge concrete (N/mm^2)	10% hyposludge concrete (N/mm^2)	15% hyposludge concrete (N/mm^2)	20% hyposludge concrete (N/mm^2)
7	2.20	2.32	2.43	2.56	2.7
28	2.48	2.54	2.57	2.73	2.9

After 7days curing for split tensile strength



After 28days curing for split tensile strength



VI Conclusion

From the results of experimental investigations conducted it is concluded that the waste material from paper industry can be used as a replacement for cement. It is found that 20% replacement of cement by industrial waste give maximum result in strength and quality aspects than the conventional concrete. The results are

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proved that the replacement of 20% of cement by the paper waste induced compressive strength and split tensile strength is higher. Thus the environmental effects from the industrial waste can be significantly reduced and also the cost of cement can be reduced a lot by the replacement of this waste material for hyposludge.

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