

# Experimental Investigation in Developing Low Cost Concrete From Paper Industry Waste

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**Abstract-** *The rapid increase in construction activities leads to active shortage of conventional construction Materials such as cement, fine aggregate and coarse aggregate. To produce low cost concrete by blending various ratios of fine aggregate with hypo sludge and to reduce disposal and pollution problems due to hypo sludge it is most essential to develop profitable building materials from hypo sludge. These tests were carried out to evaluate the mechanical properties like compressive strength, flexural strength and E-for concrete after 28 days. This research work is concerned with experimental investigation on strength of concrete and optimum percentage of the partial replacement by replacing fine aggregate via 5%, 10%, 15%, and 20% 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. The mix design was carried out for M20 grade concrete as per IS: 10262-2009.*

**Keywords-** Cement, Hypo sludge, Paper waste.

## I. INTRODUCTION

Over 300 million tones of industrial wastes are being produced per annum by chemical and agricultural process in India, Paper making generally produces a large amount of solid waste. Paper fibers can be recycled only a limited number of times before they become too short or weak to make high quality paper. while producing paper the various wastes are comes out from the various processes in paper industries. From the preliminary waste named as hypo sludge due to its low calcium is taken out for our project to replace the cement utilization in concrete. To reduce disposal and pollution problems emanating from these industrial wastes, this project is concerned with experimental investigation on strength of concrete and optimum percentage of the partial replacement by replacing fine aggregate via 10%, 20%, 30%, and 40% of Hypo Sludge.

## II. LITRATURE REVIEW

**Jayeshkumar pitroda et al, (2013)** this paper deals with the innovative use of hypo sludge in concrete formulations as a supplementary cementitious material was tested as an alternative to traditional concrete. The cement has been replaced by waste paper sludge accordingly in the range of 0% (without Hypo sludge), 10%, 20%, 30% & 40% by weight for M-25 and M-40 mix. These tests were carried out to evaluate the mechanical properties like compressive strength up to 28 days and split strength for 56 days are taken. 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.

**Balamurugan et al, (2014)** this paper deals with make good quality paper limited number of times recycled Paper fibers can be used which produces a large amount of solid waste. The partial replacement by replacing cement via 5%, 10%, 15%, and 20% 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 test, slump test. The mix design was carried out for M25 grade concrete as per IS: 10262-2009.

**Abdullah shahbaz khan et al, (2014)** this paper presented on Hypo sludge behaves like cement because of silica and magnesium properties. The silica and magnesium improve the setting of concrete. 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% to 30% by weight of cement. Cubes of 150mm x 150mm size, Cylinders of 100 mm dia and 200mm height, and prisms of 100 mm x 100mm x 500mm are casted for conventional concrete and RPH (Replacement of hypo sludge by weight of cement) test specimen respectively, 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.

## III. EXPERIMENTAL INVESTIGATION

## MATERIALS USED

Cement, Coarse aggregate, Fine aggregate, Water, Super plasticizer, Hypo sludge.

## HYPO SLUDGE



Fig.1 Factory Outlet Hypo sludge

Hypo sludge is also known as paper industry waste. It is the byproduct of the paper waste. This hypo sludge contains low calcium and minimum however the hypo sludge used as partially replacement of sand, this hypo sludge is obtained from TNPL paper industry at karur district

## ADVANTAGES OF HYPO SLUDGE

1. It provides a most economical concrete.
2. It should be easily adopted in field.
3. Using the wastes in useful manner.
4. It reduces the cost of the construction.
5. It promotes the low cost housing to the (economical weaker section) E.W.S. Group people.)
6. It Minimize the maximum demand for fine aggregate.

## 1.5 DISADVANTAGES

1. It contains high amount of chlorine so it is difficult to handle.
2. At this stage it is difficult to collect it in a bulk quantity.
3. It is generally found in slurry form hence in order to mix it with fine aggregate one has to Remove water from it and make it dry.

## SUPER PLASTICIZER (CONPLAST 430-DIS)

The purpose of using a super plasticizer is to produce flowing concrete with very high slump. The ability of a super plasticizer to increase the slump of concrete depends on such factors as the type, dosage, and time of addition, w/c and the

nature or amount of cement, the super plasticizer improves the workability of concrete.

## PRELIMINARY TEST FOR THE MATERIALS

TABLE 1 PRELIMINARY TEST RESULTS

SL NO	SPECIFIC GRAVITY OF THE MATERIAL	TEST RESULTS
1	Specific gravity of cement	3.106
2	Specific gravity of fine aggregate	2.62
3	Specific gravity of coarse aggregate	2.58
4	Specific gravity of hypo sludge	2.34
5	Fineness modulus of fine aggregate	2.69
6	Fineness modulus of coarse aggregate	2.9

## 4.3 MIX PROPORTIONS

The concrete mix is designed as per IS 10262-2009 and IS 456-2007 for the conventional concrete. Finally the superplasticizer, conplast which is 13 ml by weight of cement is added to the concrete. The grade of concrete which we adopted is M20 with water cement ratio of 0.47. The mix proportion ratio used in experimental programme is given in Table - 2

Table 2 mix proportions for conventional and hypo sludge concrete

Mix	CC (kg/m <sup>3</sup> )	FA (kg/m <sup>3</sup> )	CA (kg/m <sup>3</sup> )	HS (kg/m <sup>3</sup> )	W/C	Mix Ratio
C/C	395.7	605.4	1074.2	-	186 0.7	1:1.52:2.71
10%	395.7	544.8	1074.2	60.5	186 0.47	1:1.3:2.7:0.1
20%	395.7	484.3	1074.3	121.0	186 0.47	1:1.2:2.7:0.3
30%	395.7	423.8	1074.3	181.6	186 0.47	1:1.0:2.7:0.4
40%	395.7	363.2	1074.3	242.1	186 0.47	1:0.9:2.7:0.6

**IV. MECHANICAL PROPERIES**

**COMPRESSIVE STRENGTH TEST**

The results obtained from the compressive strength of the concrete with various mix proportions as shown in table -3 and fig-2.



Fig. 2 Compressive Strength Testing Machine

Table 3 Compressive Strength Test Result

Partial replacement in (%)	Compressive strength N/mm <sup>2</sup>		
	7 days	14 days	28 days
0% (CC)	17.3	23.94	26.6
10% of HSC as FA	18.54	24.65	26.59
20% of HSC as FA	19.98	26.34	27.65
30% of HSC as FA	15.43	22.68	19.05
40% of HSC as FA	13.01	21.08	16.53

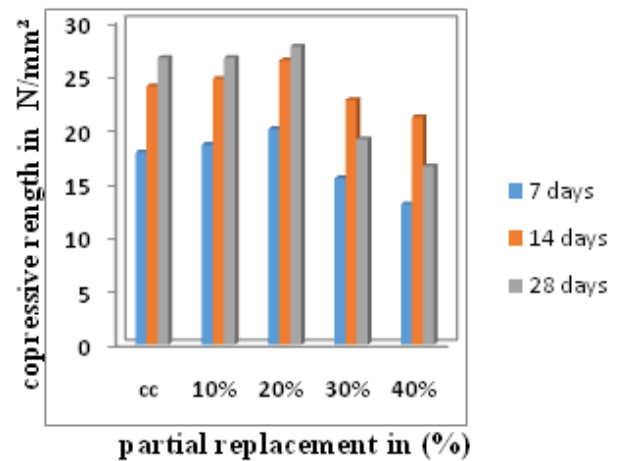


Fig.3 Comparison of Compressive Strength Test Result

**FLEXURAL STRENGTH TEST**

The results obtained from the flexural strength of the concrete with various mix proportions as shown in table 4.



Fig. 4 Flexural Strength Testing Machine

Table 4 flexural Strength Test Result

Partial replacement in (%)	flexural strength N/mm <sup>2</sup>		
	7 days	14 days	28 days
0% (CC)	2.17	2.82	3.14
10% of HSC as FA	2.19	2.97	3.25
20% of HSC as FA	3.0	3.09	3.37
30% of HSC as FA	2.02	2.17	2.5
40% of HSC as FA	1.3	1.5	1.96

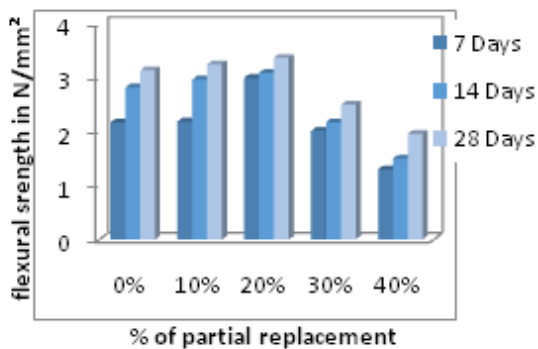


Fig. 5 Comparison of flexural strength test results for cube at 7, 14 and 28 days

**ELASTIC MODULUS OF CONCRETE TEST**

The 100x100 mm cylindrical specimen was used to test the elastic modulus of concrete. The test results were shown in table-5



Fig.6 test setup of e- for concrete

Table 5 Modulus of elasticity Test Result

Partial replacement in (%)	Modulus of elasticity in N/ mm <sup>2</sup>
0% (CC)	22370
10% of HSC as FA	23461
20% of HSC as FA	24524
30% of HSC as FA	21052
40% of HSC as FA	20017

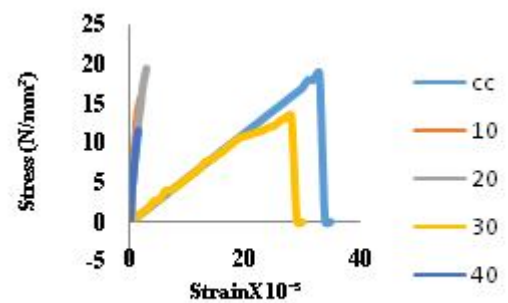


Fig.7 comparison of elastic modulus of elasticity

#### IV. CONCLUSION

- The physical properties of specific gravity of hypo sludge is 15% lower than the fine aggregate.
- The workability of fresh concrete is measured in terms of slump, the overall workability of hypo sludge concrete is less compared to conventional concrete.
- The various replacement of hypo sludge concrete, the optimum strength is obtained at 20% replacement of hypo sludge as fine aggregate.
- The Compressive strength of concrete by partial replacement of hypo sludge as fine aggregate with different curing periods which are 7,14,28 days. The strength of the hypo sludge is 3.9% more than the conventional concrete.
- The 30%, 40% replacement is start decreasing in strength.
- In the flexural strength of the hypo sludge concrete is 7.3% higher when compared to the conventional concrete at 20% replacement.
- Similarly the elastic modulus for hypo sludge concrete is 9.6% higher than the conventional concrete.
- The use of hypo sludge the environment effects from waste is reduced through this project.

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#### REFERENCES

- [1] Abhinandan Singh Gill (2014). Study of utilization of hypo sludge in high performance concrete, *IJETT*. Vol.15, pp. 278-281.
- [2] Amaia lisbona, Inigo Vegas, Javier ainchil and caralina Rios (2012). Soil stabilization with calcined paper sludge laboratory and tests,*ASCE*. Vol. 24, pp.666-673.
- [3] Abdullah shabaz, ram panth, gagan Krishna, Suresh (2014). Structural performance of concrete by partial replacement of cement with hypo sludge, *IJETE*. Vol.1, pp.175-181.
- [4] P.Banfill, Moises Frias (2006). Rheology and conduction calorimetry of cement modified with alcined paper sludge, *Cement and concrete*, Vol.37, pp.184-190.
- [5] Mr.Balamurugan, Mr.Karthick raja (2014). An experimental investigation of partial replacement of cement by industrial waste,*International journal of engineering research and applications*. Vol.4, pp.430-435.
- [6] S.Goni, M.Frias, I. Vegas, R.Garcia, R.Vigil de la villa (2012). Quantitative correlations among textural characteristics of C-S-H gel and mechanical properties: Case of ternary Portland cements containing activated paper sludge and fly ash, *Cement and concrete composites*. Vol.34. Pp.911-916.
- [7] Gregor J, G.Gluth, Christian Lehmann, katrin rubber and hans-carsten kuhne (2014). Reaction production and strength development of waste paper sludge ash and the influence of alkalis, *Cement and concrete composites*.Vol.45, pp.82-88.
- [8] Hong S.Wong. Robert Barakat, AbdullaAlhilali, Mohamed saleh, Christopher and R.Cheeseman (2015).Hydrophobic concrete using paper sludge ash, *Elsevier ltd*.Vol.70, pp.9-20.
- [9] IS 10262:2009.Concrete mix proportioning-Guidelines.
- [10]IS 456:2000.Plain and Reinforced Concrete- Code of Practice.
- [11]IS 12269:1987. Specification for 53 grade ordinary Portland cement.
- [12]IS 383:1996 Specification for coarse and fine aggregate from natural sources for concrete.
- [13]IS 516:1959 Method of test for strength of concrete
- [14]Jayeshkumar pitroda, Dr.L.B.Zala, Dr.F.S.Umrigar (2013). *Innovative use of paper industry waste (hypo sludge) in design mix concrete*.IJAET, Vol. 4, pp 31-35.
- [15]Jayeshkumar R. Pitroda, Dr F S Umrigar (2013). Evaluation of Modulus of Elasticity of Concrete with Partial Replacement of Cement by Thermal Industry Waste (Fly Ash) and Paper Industry Waste (Hypo Sludge), *IJESIT*. Vol.2,pp 133-138.
- [16]Jayaraj Vinodsinh Solanki, Jayeshkumar pitroda (2013). Investigation of low cost concrete using industrial waste as supplementary cementitious materials.*IJESIT*, Vol.2, pp 1-8.
- [17]Jayeshkumar pitroda, Dr.L.B.Zala, Dr.F.S.Umrigar (2013). Utilization of hypo sludge by Eco-Efficient development of rigid pavement in rural roads, *IJETT*.Vol. 4, pp 3994-4000.
- [18]Jean pera and Acene Amrouz (1998). Development of highly reactive metakaolin from paper sludge, *Elsevier science ltd*.Vol. 7, pp 49-56.
- [19]Jayeshkumar pitroda, Dr.L.B.Zala, Dr.F.S.Umrigar (2013). Durability of concrete with partial replacement of cement by paper industry waste (hypo sludge), *IJITEE*. Vol 2, pp 101-104.
- [20]Mehtab Alam, Vebhav Berera (2015). An experimental

- study on use of hypo sludge in cement concrete, *ICBCC*, vol.7, pp 14-24.
- [21] E.Mozaffari, M.O'Farrell, J.M.Kinuthia, S.Wild (2005). Improving strength development of waste paper sludge ash by wet-milling. *Cement and concrete composites*, Vol.28, pp 144-152.
- [22] E.Mozaffari, J.M.Kinuthia, J.Bari, S.Wild (2009). An investigation into the strength development of waste paper sludge ash blended with ground granulated blast furnace slag, *Elsevier science ltd*. Vol. 39, pp 942-949.
- [23] Raul Fernandez, Len Nebreda, Raquel Vigil de la Villa, Rosario Garcia, Moises Frias (2010). Mineralogical and chemical evolution of hydrated phases in the pozzolanic reaction of calcined paper sludge, *Cement and concrete composites*. Vol.32,pp 775-782.
- [24] N.sivakumar, C.K.Shidhardhan (2014). Experimental studies on partial replacement by using hypo sludge concrete, *IJESRT*. Vol.3, pp 2096-3001.
- [25] R.Srinivasan, K.sathya and M.Palanisami (2010). Experimental investigation on developing low cost concrete from paper industry waste, *International journal*. Vol.4, pp 43-56.