

Comparison Study Use Of Hyposludge With Partial Replaced With Cement In Cement Mortar

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Abstract - Concrete is strength and tough material but it is porous material also which interacts with the surrounding environment. 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. These tests were carried out to evaluate the mechanical properties like compressive strength up to 28 days. This research work is concerned with experimental investigation on strength of mortar and optimum percentage of the partial replacement by replacing cement via 4% to 16% of Hypo Sludge. Keeping all this view, the aim of investigation is the behavior of mortar while adding of waste with different proportions of Hypo sludge in mortar by using tests like compression strength.

Keywords - Hyposludge, Compressive strength, Durability, Waste Paper Pulp, workability

1. INTRODUCTION

Concrete, is most widely used man made construction material and is the largest production of all the materials used in construction industry. Concrete is basically made of cementations materials which have to properly bind themselves together, as well as with other materials to form a solid mass. Concrete or mortar is made up of cement, water and aggregates (Coarse and Fine Aggregate) and sometimes with necessary admixtures. Concrete has attained the status of a major building material in all the branches of modern construction. It is difficult to point out another material of construction which is as variable as concrete. Concrete is the best material of choice where strength, durability, impermeability, fire resistance and absorption resistance are required.

Hypo sludge is a recent arrival among cementations materials. It was originally introduced as artificial pozzolana 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 in mortar. Paper making industries generally produce a large amount of solid waste. Paper fibers can be recycled only a limited number of time before they become too short or weak to make high quality paper. From paper manufacturing process three types of sludge are obtained namely lime sludge (Hypo sludge), ETP sludge and De-Inking sludge. In my Study I have utilized lime sludge as a replacement for cement. Lime sludge Hypo sludge is a material obtained from the chemical recovery process of paper production. Hypo sludge is available abundantly worldwide, but its usage to date is very limited.

Energy performs an important role in growth of developing countries like India. In the environment of low availability of nonrenewable energy resources coupled with the requirements of large quantities of energy for Building materials like cement, the importance of using industrial waste cannot be neglected. Industrial wastes produced per annum by chemical and agricultural process in India possess problems of disposal, health hazards and aesthetic problem.

2. RESEARCH METHODOLOGY

Millions of tons of solid industrial wastes are produced in India every year. A large quantity of this is contributed by paper industry where three kinds of wastes are generated, i.e. , fibrous sludge called reject which is biodegradable, **Hypo sludge**, solid wastes generated during calcium hypo chlorite generation and Lime sludge, generated during causticisation of green liquor. The hypo sludge and lime sludge are purely chemical wastes and require large spaces of landfill for their disposal. Use of these wastes in cement concrete can not only solve the problem of their disposal but economize the concrete by partially replacing cement.

This project presents the test results of chemical and physical analysis investigating the utilization of hypo sludge in cement mortar. Chemical analyses have been conducted, to evaluate optimum proportions of these materials to be used in concrete following direct enumeration method. Study shows some important parameters such as workability, cube strength, stress-Strain characteristics (cube) of mix with 4%, 8%, 12% and 16% cement replacement with hypo sludge and comparison with that of conventional cement mortar.

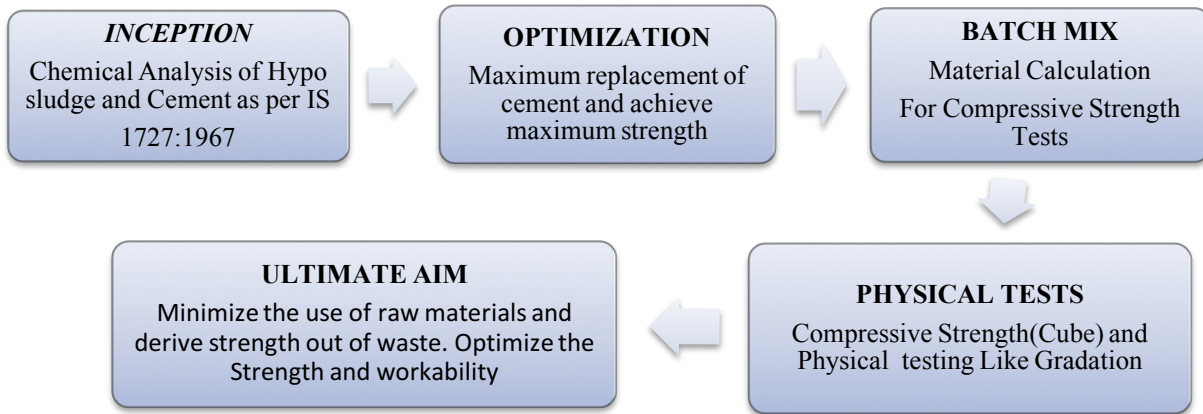


Figure3.1: Flow chart of Process of Analysis

3. RESULTS AND DISCUSSION

The variations in compressive strength of the specimens cured 3 days, 7 days and 28 days in water. Table shows Average Compressive Strength (MPa) at 3 days, 7 days and 28 days. In this experiment we found strength of mortar by adding 4%, 8%, 12% and 16% of hypo sludge. Also comparing with zero percent of hypo sludge mortar, physical properties such as compressive strength was evaluated best on the experimental results.

3.1 Experimental Analysis

3.1.1 Fineness Test: As per IS 4031 part 1: 1996 clause 4, following results are obtained,

Table 3.1: Fineness Test of Cement Samples

Sr. No.	Name of Cement Sample	Fineness Value (%)			Avg.
1	Birla Shakti PPC	1.00	0.87	0.81	0.90
2	UltraTech OPC 53 grade	1.97	1.95	1.90	1.94
3	Birla gold OPC 53 grade	4.50	4.25	4.22	4.32

3.1.2 Consistency Test: As per IS 4031 part 4: 1988 clause 4 and 5, following results are obtained

Table 3.2: Consistency test results of cement samples

Sr. No.	Name of Cement Sample	Consistency Value (%)
1	Birla Shakti PPC	33
2	UltraTech OPC 53 grade	30
3	Birla Shakti OPC 43	28

3.2 Compressive Strength: In this experiment we found strength of cement mortar concrete by partial replacement of hypo sludge with OPC and PPC cement at 4%, 8%, 12%, 16% and 20% also comparing with conventional concrete to study the compressive strength. Physical properties such as compressive strength was evaluated based on the experimental result the following conclusions are drawn as per IS 4031 part 6: 1988 clause 6 and 7.

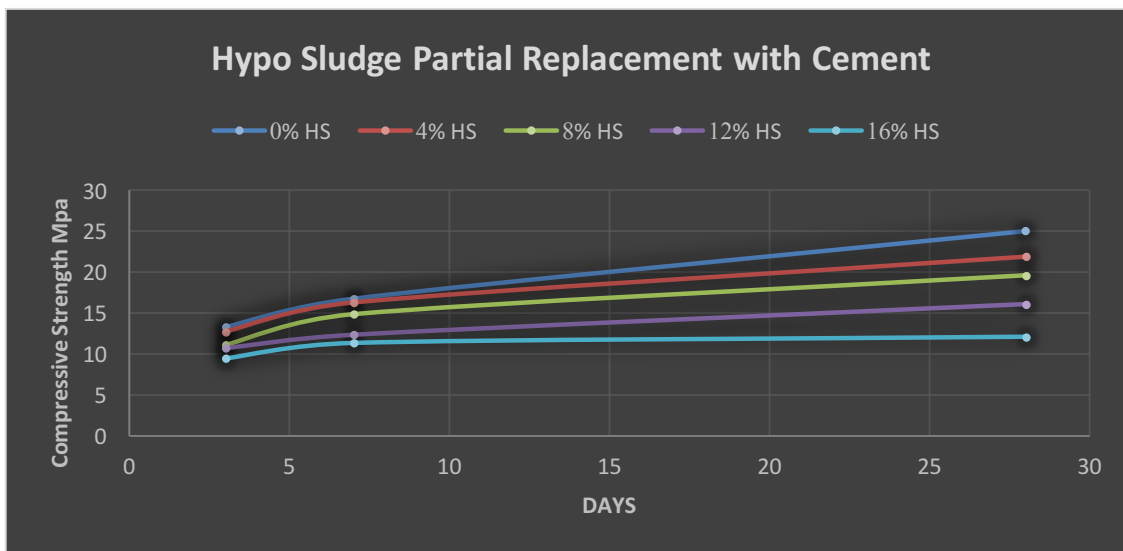
3.2.1 Compressive strength of Birla Shakti PPC cement (Fly Ash Based): Hypo sludge react with PPC cement as a bonding material and give following results as compare to conventional cement mortar concrete

Table 4.3: Compressive strength of PPC with Hyposludge

Sr. No.	% of Hyposludge Replacement	Peak Stress(Mpa)		
		Duration		
		3 days	7 days	28 days
1	0%	13.30	16.75	24.97
2	4%	12.70	16.27	21.88
3	8%	11.09	14.85	19.59
4	12%	10.72	12.35	16.05
5	16%	9.48	11.34	12.08

Figure Partial

4.1:



replacement of Hyposludge with Pozzolanic Portland Cement (PPC).

As the day's increases representation, from the table it is noted that compressive strength is found to increase. It as the results of the compressive strength are represented in above table and graphical reveals that the compressive strength of concrete is found to be decreased as the percentage of hypo sludge increases so that we concluded that hypo sludge is not suitable for Pozzolanic Portland Cement (PPC).

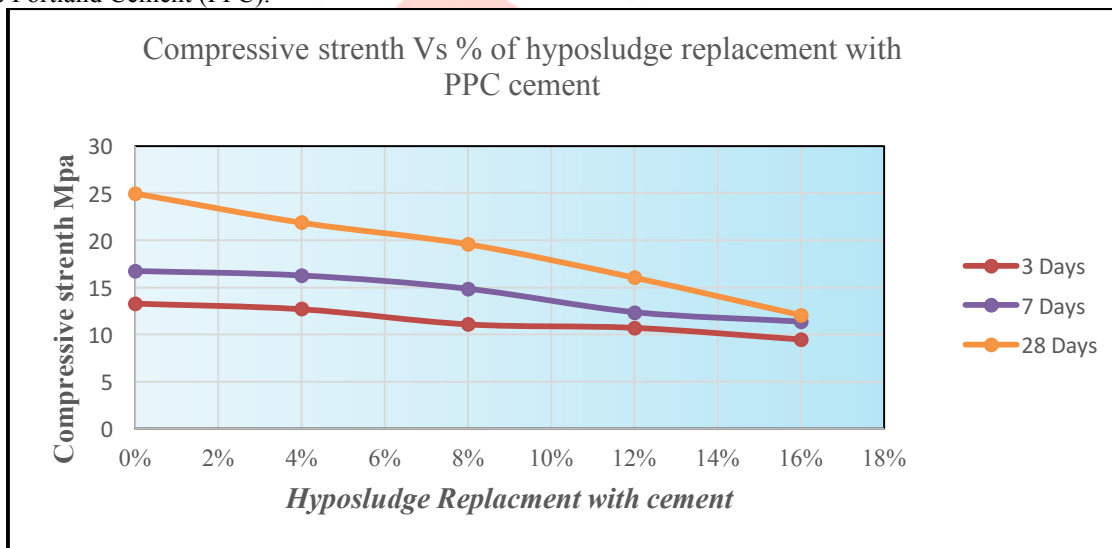


Figure 4.2: Graph showing % hypo sludge replacement with cement Vs Compressive Strength

Above graph shows relationship between compressive strength with increase in percentage of hypo sludge in PPC.

1.3.2 Compressive strength of UltraTech OPC Cement

Hypo sludge react with ingredient of OPC cement as a bonding material and give following results as compare to conventional cement mortar concrete also compare with PPC.

Table 4.4: Compressive strength of OPC replaced with Hyposludge

Sr. No.	% of Hyposludge Replacement	Peak Stress(Mpa)		
		Duration		
		3 days	7 days	28 days
1	0%	23.23	25.80	31.00
2	4%	25.64	29.94	36.42
3	8%	11.23	12.47	17.36
4	12%	4.03	5.80	13.98
5	16%	1.46	2.50	5.33

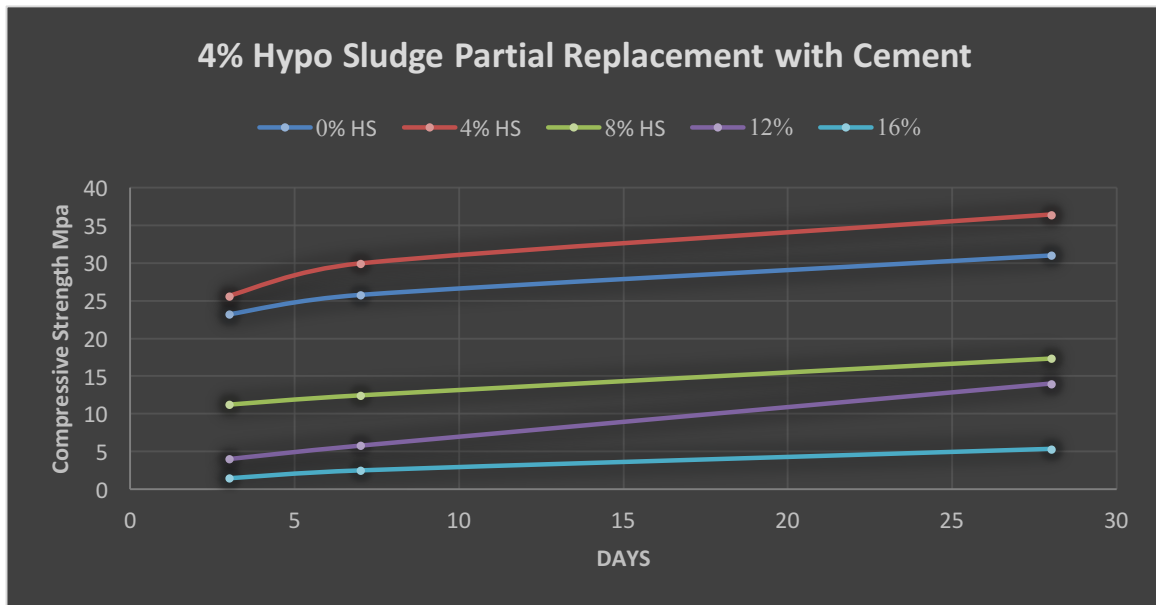


Figure 4.3: Partial replacement of Hypo Sludge with Ordinary Portland Cement (PPC).

As the day increases representation, from the table it is noted that compressive strength is found to increase. As the results of the compressive strength are represented in above table and graphical reveals that the compressive strength of concrete is found to be increased at the 4% of hypo sludge and decreased with 8%, 12% and 16% of hypo sludge. Maximum value of compressive strength found to be 36.42 Mpa. So that we concluded that strength increases at 4% and gradually decreases with increasing in percentage of hypo sludge.

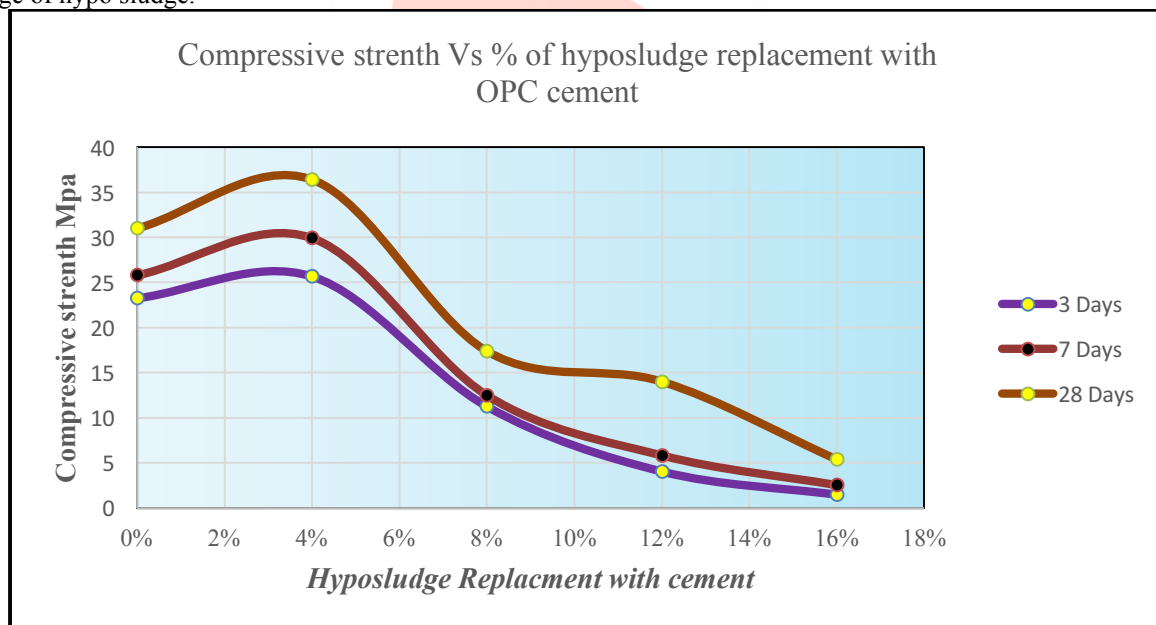


Figure 4.4: Graph showing % hypo sludge replacement with cement Vs Compressive Strength

4. CONCLUSION

Normal concrete has been designed based on experimental investigation. The concrete with various percentage of hypo-sludge such as 4%, 8%, 12% & 16% are used and the test result have been evaluated. The following conclusions are arrived at based on the experimental results of the study.

- The partially replaced cement mortar was found to be more effective than conventional mortar. Desired strength test results were obtained by replacing cement by considerable percentage, from the compressive strength results; it was found that partially replaced cement has given more strength than that of conventional cement mortar. The cement mortar specimen with 4% hypo-sludge has showed increase in strength than other percentage.
- From the consistency test results of conventional cement mortar and mortar with hypo-sludge, it is found that hypo-sludge containing mortar requires more amount of water content for getting effective consistency.
- The environmental issues associated with disposal of solid waste and carbon dioxide emissions from production of Portland cement is reduced with the use of hypo sludge hence it gives a way for greener concrete. Effective utilization of Hypo Sludge in concrete can save the Paper industry's disposal costs and storage problems; and also produce a greener concrete for low cost rural roads.
- This research study concludes that Hypo Sludge can be an innovative Supplementary. The Cementations Material useful for construction of rigid pavement in development of low cost rural roads.

- Hypo-sludge which is available in abundance in the vicinity of every paper mill is not a waste but a useful material which can be used in concrete manufacturing. Helps to some extent in preserving the environment as its application reduces the requirement of cement's raw material and solves its problem of disposal.
- To control the environmental pollution.
- To produce low cost concrete.
- To reduce demand of cement.

A lot more work needs to be done before we can freely use the hypo-sludge compounds as a replacement to conventional cement. Since the strength results are as good as compared to that achieved by conventional cement mortar method but it needs additional research work to improve its quality and will certainly help to promote the usage of hypo-sludge in the concrete.

5. REFERENCES

- [1] Pera, J. and Amrouz, A.. (1998). Development of highly reactive metakaolin from paper sludge. *Advanced Cement Based Materials*. 7 (1), 49-56.
- [2] Ishimoto H., Origuchi T., Yasuda M., (2000), "Use of papermaking sludge as new material", *Journal Material Civil Engineering* 12(1), pp.310-313.
- [3] Bai J., Chaipanich A., Kinuthai J. M., O'Farrell M., Sabir B.B., Wild S., Lewis M.H. (2003), "Compressive strength and hydration of waste paper sludge ash ground granulated blast furnace slag blended pastes", *Cement and concrete research* 33, 1189-1202.
- [4] T.R. Naik, Y. Chun, R.N. Kraus, Concrete containing pulp and paper mill residuals, Report No. CBU-2003-42.1, UWM Center for By- Products Utilization, Department of Civil Engineering and Mechanics, The University of Wisconsin-Milwaukee; 2003
- [5] Shukeri Ritzawaty binti Mohamad and Ghani A.Naser Abdul, (2008), "Concrete Mix with Paper waste", 2nd International Conference on Built Environment in Developing Country (ICBEDC 2008), Penang, Malaysia.
- [6] R. Srinivasan, K. Sathiya, and M. Palanisamy. (2010). Experimental investigation in developing low cost concrete from paper industry waste . *The Bulletin of the Polytechnic Institute of Jassy, Construction Architecture Section (Romania)*. 111 (3), 34-35.
- [7] Sumit A Balwaik, S P Raut, (2011) "Utilization of Waste Paper Pulp by Partial Replacement of Cement in Concrete", *International Journal of Engineering Research and Applications (IJERA)*, Vol. 1, Issue 2, pp.300-309.
- [8] Balwaik Sumit A, Raut S P, (2013), "Utilization of Paper waste Pulp by Partial Replacement of Cement in Concrete", Sumit A Balwaik, S P Raut/ *International Journal of Engineering Research and Applications (IJERA)*, ISSN: 2248-9622, Vol. 1, Issue 2, pp.300-309.
- [9] R. Srinivasan, K. Sathiya and, "Experimental Investigation in Developing Low Cost Concrete From Paper Industry Waste", *The Bulletin of the Polytechnic Institute of Jassy, Construction Architecture Section (Romania)*, pp.43-56, Jan 2010
- [10] Ahmad Ruslan Mohd Ridzuan, Mohd Azrizal Fauzi, Ezliana Ghazali, MohdFadzil Arshad and Mohd Afiq Mohd Fauzi (2011) "Strength Assessment of Controlled Low Strength Materials (CLSM) Utilizing Recycled Concrete Aggregate and Waste Paper Sludge Ash", *IEEE Colloquium on Humanities, Science and Engineering Research (CHUSER 2011)*, Dec 5-6, Penang, PP-208-211
- [11] Fava Gabriele, Letizia Ruello Maria, Corinaldesi Valeria (2011), "Paper Mill Sludge Ash as Supplementary Cementitious Material", *Journal of Materials in Civil Engineering*, Vol. 23, No. 6, June, pp. 772-776,
- [12] Mohammed B.S., Fang.O.C. (2011), Mechanical and durability properties of concretes containing papermill residuals and fly ash. *Construction and Building Materials*. 25 (1), 717-725.
- [13] Jayraj Vinodsinh Solanki1, Jayeshkumar Pitroda, "Investigation of Low Cost Concrete Using Industrial Waste as Supplementary Cementitious Materials", *International Journal of Engineering Science and Innovative Technology (IJESIT)*, Volume 2, Issue 1, ISSN: 2319-5967, pp.81-88, January 2013.
- [14] Jayesh kumar Pitroda, L.B.Zala, F S Umrigar, "Durability of concrete with Partial Replacement of Cement by Paper Industry Waste (Hypo Sludge)" *International Journal of Innovative Technology and Exploring Engineering (IJITEE)*, ISSN: 2278-3075, Volume-2, Issue-3, pp.101-104, Feb 2013.
- [15] Effect Of Hypo Sludge As Partial Replacement With Cement In Mortar Rushabh A. Shah* Prof.
- [16] Shah R A and Pitroda J (2013) Effect of hypo sludge as partial replacement in mortar. *J Int Acad Res* 1(4):195-05.