

A Suitability Analysis of Paper Waste Sludge in Cement Concrete

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Abstract— Portland cement is that the most vital ingredient of concrete and may be a versatile and comparatively high value material. massive scale use of cement is inflicting environmental issues on one hand and depletion of natural resources on different hand. This work examines the likelihood of victimization paper sludge (hypo sludge and brine sludge) to provide an occasional value concrete by mixing varied ratios of cement and fine combination (sand) with hypo sludge and brine sludge and to cut back land disposal issues thanks to paper sludge. The innovative use of hypo sludge and brine sludge in concrete as a supplementary building material and fine combination material was tested as another to concrete. during this study hypo sludge and brine sludge was partly replaced from 3%, 5%, 7%, 10% and 12% in cement to induce optimum for M30 and M40 grades of concrete and conjointly hypo sludge and brine sludge was partly replaced from 5%, 10%, 15% and 20% in fine aggregate to induce optimum purpose in concrete for M40 combine and tested for its compressive strength, up to twenty-eight days of strength and compared with standard concrete. This study was supported the comparison of hypo sludge concrete and brine sludge concrete with partial replacement of cement and fine combination severally. The study results indicate that use of paper sludge ash in concrete has improved the performance of concrete in strength and economic side. The optimum strength was achieved at 7% once replaced with cement and at 15% once replaced with fine aggregate.

Keywords: Waste Sludge, Cement Concrete, Fine Aggregate

I. INTRODUCTION

In order to make concrete industry sustainable, the use of waste materials in place of natural resources is one of the best approaches because natural resources are not unlimited therefore, they must be carefully consumed. This will help not only to control degradation of environment but also conserve them for the use of future generation. This can be achieved by the process of recycling and making use of industrial wastes, disposal of which otherwise is a serious problem. Recycling of waste product is a great way to dispose of industrial waste because the waste can be reused to make new product. Material such as glass and aluminum can be recycled and used in manufacturing other products. If there is industrial waste which can't be recycled in our planet, waste is seen everywhere. Therefore recycled is best way to make our planet green.

II. LITERATURE REVIEW

After studying most the literature paper on the paper industry wastes, we investigate that there are various types of paper waste used in construction material such as hypo sludge, brine sludge, paper mill waste ash and lime sludge, but most commonly used paper mill waste was hypo sludge. The researcher were used these sludge as replacement of cement and fine aggregate in concrete at various percentage

of replacement such as from 5%, 7.5%, 10% and up to 40% in nominal mix or low grade such as M20 and M25. The various strength properties were tested on the paper sludge concrete for fresh and hardened state such as slump cone test, compressive strength test on cubes and cylinders, flexural strength test on beams & cylinders and split tensile strength on beams. In most of the researches, it was concluded that the compressive strength, flexural strength and split tensile strength of the concrete cubes, cylinders and beams made by replacing cement and fine aggregate with these sludge increases to a certain extent then starts decreasing. So to produce the economical concrete used in construction work, these sludge should be used smartly. After reading literature on the paper industry wastes it was clearly seen that most of the researches have been done on Hypo sludge and Brine sludge which was used as a replacement of Cement and Fine Aggregates at different percentages. Researchers concluded that the compressive strength of the concrete prepared by replacing cement with paper wastes increases to a certain extent. Research studies show that optimum percentage for replacing cement is 5% to 10% by total weight of cement and for replacing fine aggregate is 10% to 15% by total weight of fine aggregate. Researchers also concluded paper waste makes concrete economical and eco-friendly

III. METHODOLOGY

In this research raw material used and their properties as per Indian standards code (IS: 383–1996) procedures. Mix design for concrete proportion has been developed as per IS: 10262–2009. The Casting, compaction and curing of the concrete specimens has been done as per Indian standards procedures. Grade of the concrete used for this research is M30 & M40. Slump cone test and compressive strength test is performed on concrete containing brine sludge and hypo sludge. The concrete mix design for M40 & M30 concrete with and without replacement is calculated using IS: 10262-2009 as shown in table below.

Cement	Hypo Sludge	Mix	Name
		M30	M40
100%	0%	CC30	CC40
97%	3%	HC30A	HC40A
95%	5%	HC30B	HC40B
93%	7%	HC30C	HC40C
90%	10%	HC30D	HC40D
88%	12%	HC30E	HC40E

Table 1: Mix Names when Cement replaced with hypo sludge

Cement	Brine Sludge	Mix	Name
		M30	M40
100	0%	CC30	CC40
97%	3%	BC30A	BC40A
95%	5%	BC30B	BC40B
93%	7%	BC30C	BC40C

90%	10%	BC30D	BC40D
88%	12%	BC30E	BC40E

Table 2: Mix Names when Cement replaced with Brine Sludge

Fine Agg.	HS	Mix Name	Fine Agg.	BS	Mix Name
		M40			M40
100%	0%	CC40	100%	0%	CC40
95%	5%	HF40A	95%	5%	BF40A
90%	10%	HF40B	90%	10%	BF40B
85%	15%	HF40C	85%	15%	BF40C
80%	20%	HF40D	80%	20%	BF40D

Table 3: Mix Names when Fine Aggregate replaced with Hypo and Brine Sludge

IV. RESULT & DISCUSSION

A. Comparison of Hypo Sludge and Brine Sludge when Replaced with Cement

Result of slump cone test shows that in both brine and hypo sludge slump value decreases with increase in the percentage of hypo sludge & brines sludge, but brine sludge posses higher slump value when compare to hypo sludge. Hypo Sludge at 12 % the compressive strength of concrete is 40.6 N/mm² which slightly less than that of conventional concrete i.e., 40.74 N/mm² which shows that the compressive strength decreases at 12% replacement for M30 grade of Concrete. For M40 grade of concrete At 12 % the compressive strength of concrete is 51.70 N/mm² which was slightly less than that of conventional concrete i.e., 51.89 N/mm² which shows that strength will further decreased as cement was replaced. So, on comparing results it is clear that 10% replacement of cement with Hypo sludge is optimum for this study. For Brine Sludge the Compressive Strength of M30 Grade of concrete reached to 41.19 N/mm² at 7% cement replacement with Brine Sludge. At 10 % the compressive strength of concrete is 39.33 N/mm² which nearly same to that of conventional concrete i.e., 39.5 N/mm² the compressive strength decreases further when 12% cement was replaced. The Compressive Strength of M40 Grade of concrete reached to 50.23 N/mm² at 7% cement replacement with Brine Sludge. At 10 % the compressive strength of concrete is 48.91 N/mm² which nearly same to that of conventional concrete i.e., 49.1 N/mm² the compressive strength decreases further when 12% cement was replaced. So, on comparing results it is clear that 7% replacement of cement with brine sludge is optimum for this study.

B. Comparison of Hypo Sludge and Brine Sludge when Replaced with Fine Aggregate

Slump cone test shows that in both brine and hypo sludge slump value decreases with increase in the percentage of hypo sludge & brines sludge, but brine sludge posses higher slump value when compare to hypo sludge. Strength of brine sludge concrete cubes increases from 0% replacement to 5% and up to 10% replacement i.e. at 0% - 51.89 N/ mm², at 5% - 53.1 N/ mm², at 10% - 54.6 N/ mm². But further increase in replacement percentage i.e. 15% and 20% the compressive strength was decreased i.e. at 15% - 49.68 N/ mm² and at 20% - 47.3 N/ mm². The optimum compressive

strength of brine sludge concrete cubes was at 10% replacement and is 54.6 N/ mm². The graph shows that at 0 % replacement the strength of concrete is similar to the mean target strength of M40 grade of concrete but as fine aggregate was replaced by hypo sludge the strength increased till 10 % replacement. But further increase in hypo sludge content i.e. at 15% the compressive strength was decreased and was similar to the mean target strength but at 20% replacement of hypo sludge resulted into further decreased compressive strength. So, the optimum compressive strength of hypo sludge concrete was at 10% replacement.

V. CONCLUSION

The Compressive Strength of Concrete increased when the Cement is replaced by Hypo Sludge up to 10% by weight of Cement. The Compressive Strength of Concrete increases when the replacement of Cement with Brine Sludge up to 7% replacement by weight of Cement. The Compressive Strength of Concrete increases when the replacement of Fine Aggregate with Hypo Sludge up to 10% replacement by weight of Sand. The Compressive Strength of Concrete increases when the replacement of Fine Aggregate with Brine Sludge up to 10% replacement by weight of Fine Aggregate. Comparatively Hypo Sludge give more compressive strength till 10 % than Brine Sludge but when replaced with fine aggregate the optimum replacement for both sludge is 10%. Hypo Sludge and Brine Sludge are a better innovative supplementary cementitious construction material which is used in concrete, so it can save the paper industries waste disposal costs and produce a greener concrete for construction. This research concludes that hypo sludge and brine sludge can be innovative supplementary cementitious and fine aggregate Construction Material in Concrete up to certain extent.

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