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Application of Lime Sludge in Producing Low Cost Cement Concrete

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Abstract

Paper making generally produces a large amount of solid waste. Paper fibres 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 fibres are separated out to become waste sludge. To reduce disposal and pollution problems emanating from these industrial wastes, it is most essential to develop profitable building materials from them. Keeping this in view, investigations were undertaken to produce low cast concrete by blending various ratios of cement with Lime sludge. This paper is concerned with experimental investigation on strength of concrete and optimum percentage of the partial replacement by replacing cement via 10%, 20%, 30%, 40%, 50%, and 60% of Lime sludge. Keeping all this view, the aim of investigation is the behaviour of concrete while adding waste with different proportions of Lime sludge in concrete by using tests like compressive strength.

Keywords: *Concrete, Compressive strength, Cost, Lime sludge*

I. INTRODUCTION

Energy plays a crucial role in growth of developing countries like India. In the context 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 under estimated.

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In the context of low availability of nonrenewable energy resource coupled with the requirements of large quantities of energy for Building materials like cement, the importance of using industrial waste cannot be underestimated. During manufacturing of 1 tonnes of Ordinary Portland Cement an equal amount of carbon-di-oxide are released into the atmosphere. The carbon-di-oxide emissions act as a silent Killer in the environment as various forms. In this Backdrop, the search for cheaper substitute to OPC is a needful one.

Over 300 million tonnes of industrial Wastes are being produced per annum by chemical and agricultural process in India. These materials pose problems of disposal and health hazards. 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. Paper fibres can be recycled only a limited number of times before they become too short or weak to make high quality paper.

To reduce disposal and pollution problems emanating from the industrial wastes, it is most essential to develop profitable building materials from them. Keeping this in view, investigations were undertaken to produce low cast concrete by blending various ratios of cement with Lime sludge.

Lime sludge contains, minimum calcium chloride and high calcium and minimum amount of silica. Lime sludge behaves like cement because of silica and magnesium properties. This silica and magnesium improve the setting of the concrete.

OBJECTIVES AND SCOPE OF THE STUDY

To investigate the utilization of Lime Sludge as Supplementary Cementitious Materials (SCM) and influence of these Lime sludge on the Strength on concretes made with 0%, 10%, 20%, 30%, 40%, 50% & 60% Cement replacement levels.

Use of Lime sludge in concrete can save the disposal costs of the paper industry wastes and produces a ‘greener’ concrete for construction. The hazardous Environmental effects of paper industrial wastes can be reduced. Also the amount of cement manufacturing can be reduced up to some extent. A better measure by a

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New Construction Materials formed out through this project.

EXPERIMENTAL WORK

The Ordinary Portland Cement of 53 grades conforming to IS: 8112-1989 is used. The Coarse Aggregates from crushed Basalt rock, conforming to IS: 383 is being use. The Flakiness and Elongation Index were maintained well below15%. The river sand and crushed sand is be use in combination as fine aggregate conforming to the requirements of IS: 383. The river sand is wash and screen, to eliminate deleterious materials and over size particles. Table 1 & 2 shows the Lime sludge chemical properties and comparison between cement and Lime sludge.

Table 1 Properties of Lime Sludge as Cement Ingredient

Sr. No.	Constituents	%Present in Lime Sludge
1	Magnesium oxide (MgO)	3.44
2	Calcium Oxide (CaO)	43.13
3	Loss on ignescent	41.99
4	Acid insoluble	0.86
5	Silica (SiO2)	0.80
6	R2O3	1.53

MIX DESIGN

A mix M25 grade was designed as per Indian Standard method and the same was used to prepare the test samples. The design mix proportion is done as shown in the table 3 below for actual quantities (by mass) for one bag of cement.

Table 2 Comparison of Cement and Lime Sludge

Sr. No.	Constituents	Cement (In %)	Lime sludge (In %)
1.	Lime (CaO)	62	43.13
2.	Silica(SiO_2)	22	0.80
3.	Alumina	5	0.671
4.	Magnesium	1	3.44
5.	Calcium sulphate	4	0.565

Table 3 Mix Design

Water	Cement	Fine aggregate	Coarse aggregate
23.62 liter	50 kg	66.2 kg	135.18 kg
0.47 liter	1 kg	1.324 kg	2.71 kg

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RESULTS AND DISCUSSIONS

The replacement of lime sludge with cement by 10%, 20%, 30%, 40%, 50%, 60% to the mix. Compressive strength test results of cubes at 7 and 28 days are shown in table 4. The compressive strength of replaced lime sludge concrete is optimum at 20% as shown in figure 1. The compressive strength results of replaced lime sludge concrete of 20% is more than ordinary concrete. So lime sludge can be used as replacement to cement up to 20%.

Table 4 Compressive strength of cubes at 28 days

		Compressive strength of cubes at 7 days			Compressive strength of cubes at 28 days		
Partial replacement in%(Lime sludge)	Number of specimen	Ultimate load (kN)	Average ultimate load (kN)	Average Ultimate Compressive Strength (N/mm²)	Ultimate load (kN)	Average ultimate load (kN)	Average Ultimate Compressive Strength (N/mm²)
0%	1	570	533.330	23.700	720	730	32.445
	2	500			740		
		530					
10%	1	580	556.67	24.746	750	753.34	33.482
	2	540			740		
	3	550			770		
20%	1	580	566.67	25183	810	796.66	35.407
	2	550			800		
	3	570			780		
30%	1	520	516.667	22.963	750	763.34	34.074
	2	530			760		
	3	500			790		
40%	1	420	460	20.445	620	716.67	31.852
	2	490			710		
	3	470			820		
50%	1	400	386.667	17.815	590	626.67	27.852
	2	390			580		
	3	370			710		
60%	1	330	346.67	15.407	510	583.34	25.925
	2	360			540		
	3	350			600		

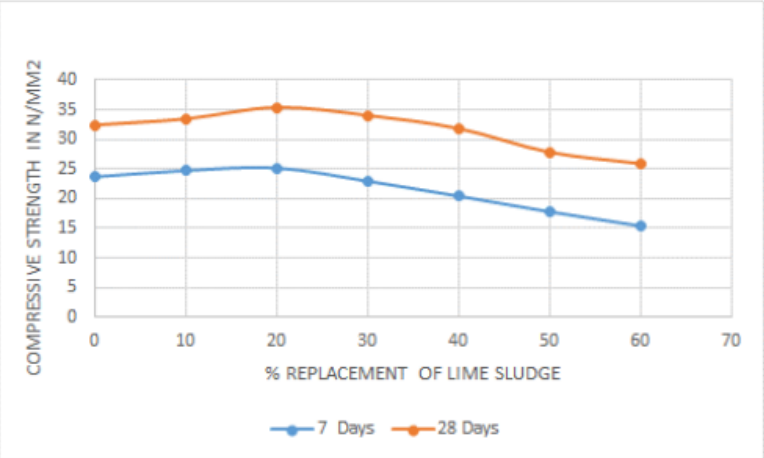


Figure 1 Comparison of Compressive Strength of Cubes at 7 Days & 28 Days

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ECONOMIC FEASABILITY

Cost analysis is carried out for the optimum proportion of percentage of lime sludge in concrete. The cost is compared to the conventional concrete. Cost of materials: Cost of cement per bag = Rs.300.00 Cost of lime sludge per kg = Rs. 1.00 Cost of sand per m3 = Rs. 275 Cost of coarse of aggregate per m3 = Rs. 540 (All the rates are including lead charges) The compared values of cost show gradual decrement in total cost of per cubic meter concrete. The above tables shows cost values up to 60% replacement and cost difference for normal concrete to 20%partially lime sludge replaced concrete is Rs. 505.13 Per m3.

CONCLUSIONS

Based on limited experimental investigation concerning the compressive strength of concrete, the following observations are made regarding the strength of partially replaced lime sludge:

a) Compressive strength of the concrete increases when the percentage of replacement is increased up to 20% and decreases when replacement is increases beyond 20%.

b) Form this study; it is found that replacement of cement with this waste of lime- sludge material provides maximum compressive strength at 20% replacement.

c) In this study, it is observed that cost difference for normal concrete to 20% partially replaced with lime sludge we can save Rs. 505.13 per m3 of concrete.

d) This material can be used for economic feasibility. We are getting sufficient strength at 28 days curing test. We can use this material for the government projects for temporary shelter for those who are affected by tsunami, E.Q., etc

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