Resource Management – A Review

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ABSTRACT

With the development of technologies, the demands of people are increasing day by day as compared to old times. To accomplish these demands, resources are required from which the large quantity of waste is generated and disposal issue arises. If we utilize the waste for the production of any resource then the pollution can be reduced to some extent. Using waste as a secondary material in construction projects would be a solution to overcome the crisis of producing large amount of waste materials in one hand and improving the structure's characteristics on the other hand. Paper making generally produces a large amount of solid waste. The hypo sludge has a potential to replace cement in the construction work due to its cementing properties. Efforts have been made to reduce the cement to some extent by replacing with waste paper sludge. This paper highlights the waste management in civil engineering field which leads to sustainable construction.

Keywords: Hypo Sludge, Partial Replacement, Supplementary Cemetitious Material

1. INTRODUCTION

In India, Over 300 million tonnes of industrial wastes are being produced per annum by chemical and agricultural process. These materials create problems of disposal and health hazards. 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. The material is a by-product of the de-inking and re-pulping of paper. The main recycling and disposal routes for paper sludge are land-spreading as agricultural

fertiliser, producing paper sludge ash, or disposal to landfill. In functional terms, paper sludge consists of cellulose fibres, fillers such as calcium carbonate and china clay and residual chemicals bound up with water. The moisture content is typically up to 40%. The material is viscous, sticky and hard to dry and can vary in viscosity and lumpiness. It has an energy content that makes it a useful candidate as an alternative fuel for the manufacture of Portland cement. Concrete is a composite construction material composed of cement, aggregate (generally a coarse aggregate made of gravels or crushed rocks such as limestone, or granite, plus a fine aggregate such as sand), water, and/or admixtures. Concrete is made by mixing: Cement, water, course fine aggregates and admixtures (if required). The objectives are to mix these materials traditionally to make concrete that is easy to: Transport, place, compact, finish and to give a strong and durable product. The proportionate quantity of each material (i.e. cement, water and aggregates) affects the properties of hardened concrete.

2. LITERATURE REVIEW

Shah and Pitroda (2013) analysed the performance of cement mortar by replacing the cement with hypo sludge. The evaluation of Hypo Sludge for use as a supplementary cementitious material (SCM), i.e., as a pozzalona, begins with the mortar testing. Mortar is similar to concrete in that it contains cement, water and aggregate, except that in mortar graded fine aggregate is the only aggregate present. With the control mortar, i.e.10 %, 30% and 50% of the ordinary Portland cement (OPC) confirming IS 269IV is replaced with Hypo Sludge, The data from the Hypo Sludge mortar is compared with data from a "control" mortar without Hypo Sludge. Three cube samples were cast in the mould of size 70.7 x 70.7 x 70.7 mm for each 1:3 cement mortars with partial replacement of cement with Hypo Sludge witha W/C ratio as 0.43 were also cast. After about 48 h the specimens were de-moulded and water curing was continued till the respective specimens were tested after 7 & 28 days for compressive strength.

Table 2: Compressive strength of cement mortar (N/mm^2) at 7 days

Types of Mortar	Average Early Compressive Strength of cement mortar (N/mm2) at 7 days	% change in compressive strength of cement mortar (N/mm2) at 7 days
A1	33.81	0
E1	24.34	-28.00
E2	16.34	-49.57
E3	8.00	-76.33

A1 = Nominal Cement Mortar (0% hypo sludge)
E1 = with 10% hypo sludge replaced with cement
E2 = 30% hypo sludge replaced with cement
E3 = 50% hypo sludge replaced with cement

Table 3: Compressive strength of cement mortar (N/mm^2) at 28 days

Types of Mortar	Average Early Compressive Strength of cement mortar (N/mm2) at 7 days	% change in compressive strength of cement mortar (N/mm2) at 7 days
A1	50.42	0
E1	33.01	-34.53
E2	21.54	-57.28
E3	11.54	-77.11

They concluded that adequate strength developments were not found in mortars made of the mixed cement and Hypo Sludge as cement replacement for 1:3 mortars at 28 days. So it can be used in non-structural elements in the low range compressive strength where strength is not required.

Solanki and Pitroda (2013) investigated the strength of concrete and optimum percentage of the partial replacement by preparing a mix M20 grade was designed as per Indian Standard method and the same was used to prepare the test samples. The design mix proportion used were Conventional Concrete, 10%, 20%, 30%, 40% replacement of cement by industrial waste hypo sludge. In the test performed, the optimum compressive stress obtained by utilizing paper waste was at 30% replacement. At the place where strength is not of more importance or rather structure is for temporary basis then design mix proportion up to 40% replacement can also be utilized. Test also point towards developing low cost concrete by varying design mix proportion from 10% replacement to 40% replacement. The compared values of cost show gradual decrement in total cost of per cubic meter concrete. The difference in cost from normal concrete to partially replaced concrete is about Rs.850/-.When government implement the projects for temporary shelters for who those affected by natural disaster, this material can be used for economic feasibility. Compressive strength of the concrete measured after 7 days increases when the percentage of replacement 10 % hypo sludge used. Compressive strength of the concrete measured after 28 days increases when the percentage of replacement of 20 % hypo sludge used.

Pitroda, Zala and Umrigar (2013) checked the durability of concrete by replacing cement with hypo sludge. The pores in concrete as a result of incomplete compaction are voids of larger size which give a honeycomb structure leading to concrete of low strength. There is a need for another type of test rather than the absorption test and permeability tests to measure the response of concrete to pressure. This test should measure the rate of absorption of water by capillary suction, "sorptivity" of unsaturated concrete. In this paper, an attempt is made to study the properties of Paper Industry Waste (Hypo Sludge) concrete to check durability. The mix design was carried out for M25 and M40 grade concrete as per IS: 10262-2009.

The water absorption and sorptivity of Paper Industry Waste (Hypo Sludge) concrete shows lower water absorption and sorptivity at 10% replacement with Paper Industry Waste (Hypo Sludge) for M25 and M40 grade concrete. There after the water absorption and sorptivity shows an increasing trend. For 90 days, where percentage decreases in water absorption is found to be 1.13% for M25 and 1.53% for M40 and sorptivity is found to be 2.32 mm/min0.5 for M25 and 4.65mm/min0.5 for M40 with respect to reference mix. The water absorption and sorptivity of Paper Industry Waste (Hypo Sludge) concrete shows lower water ab-sorption and sorptivity at a replacement level of 10% with Paper Industry Waste (Hypo Sludge) for M25 and M40 grade concrete. The water absorption and sorptivity of Paper Industry Waste (Hypo Sludge) concrete shows higher water ab-sorption and sorptivity than traditional concrete. The water absorption and sorptivity of M25 Paper Industry Waste (Hypo Sludge) concrete is higher than water absorption and sorptivity M40 grade concrete.The Paper Industry Waste (Hypo Sludge) can be innovative supplementary cementitious Construction Material but judicious decisions are to be taken by engineers.

Solanki and Pitroda (2013) studied the effect of hypo sludge on flexural strength of concrete. The results of study undertaken to investigate the feasibility of using hypo sludge as cement in concrete. The effects of replacing cement by hypo sludge on the flexural strength of beams (500 mm*100 mm*100 mm) are evaluated. Two test groups were constituted with the replacement percentages of 0%, 10%, 20%and 30%.The results showed the effect of hypo sludge on concrete beams has a considerable amount of increase of the flexural strength characteristics. To investigate the utilization of Hypo Sludge as Supplementary Cementitious Materials (SCM) and influence of hypo sludge on the Strength on concretes made with different Cement replacement levels. Flexural strength of the concrete increases when the 10% replacement of cement by hypo sludge is increased up to 8.91%. Environmental effects from wastes and residual amount of cement manufacturing can be reduced.

Pitroda and Umrigar (2013) Evaluated the Modulus of Elasticity of Concrete with Partial Replacement of Cement by Paper Industry Waste (Hypo Sludge). The cement has been replaced by

hypo sludge in the range of 0%, 10%, 20%, 30% and 40% by volume for M-25 and M-40 mix. Concrete mixtures were produced, tested and compared in terms of modulus of elasticity with the conventional concrete. The test was carried out to evaluate the modulus of elasticity after 56 days. This study included different concrete mixtures which were produced to determine the influence of hypo sludge derived from J.K.Papers mill Pvt.Ltd, plant near Songadh, Tappi District to the Modulus of Elasticity. The modulus of elasticity of concrete is a very important mechanical parameter reflecting the ability of the concrete to deform elasticity. For concrete material, the secant modulus is defined as the slope of the straight line drawn from the origin of axis to the stress-strain curve at 1/3 of the ultimate strength. For M40 grade 10% replacement with hypo sludge gave modulus of elasticity same as M40 grade traditional concrete. This research concludes that hypo sludge can be used as construction material where less strength is required.

Balamurugan and Karthickraja (2014) replaced the cement content with 0%, 5%, 10%, 15% and 20% hypo sludge and found the compressive strength after 28 days. He concluded that Casting of conventional cement concrete cubes has been done and casting of concrete cube added with industrial waste has also been done. Comparison of results has been done Testing of concrete cubes with various methods like compression and slump test has been done for both cubes. Upto 10% of hypo sludge concrete, the compression strength has been increased, so upto 10% cement has been replaced by hypo sludge. By replacement of hypo sludge the cost of construction should be minimized. By effective utilization of waste product into concrete also reduce the environmental effects. If silica is added the strength will be considerably increased because hypo sludge has less quantity of silica as compared to cement. This type of concrete will be used for road works effectively with less consumption of cement.

Table 1" Comparison of Cement and Hypo Sludge

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

3. CONCLUSIONS

- Use of hypo sludge in concrete can save the disposal costs and produces a green concrete for construction.
- Modulus of elasticity decreases with % replacement of hypo sludge.
- Up to 10% of replacement of hypo sludge with cement, the compression strength has been increased.
- Hypo sludge can be used in non-structural elements in the low range compressive strength where strength is not required.
- Hypo Sludge can be used to prepared low cost temporary structure.
- Adequate strength developments were not found in mortars made of the mixed cement and Hypo Sludge as cement replacement for 1:3 mortars at 28 days.
- Modulus of elasticity decreases with % replacement of hypo sludge.
- Hypo sludge can be used as Construction Material where less strength is required.
- Compressive strength of the concrete measured after 28 days increases when the 20 % hypo sludge is replaced with cement.
- Environmental effects from wastes and residual amount of cement manufacturing can be reduced through this low cost concrete.

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