

Experimental Investigation on Tannery Waste with Partial Replacement of Coarse Aggregate in Concrete

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Abstract: Tannery sludge is one of major waste produced in production of leather products in India. The main objective of this study is to assess the likelihood of stabilization of the heavy metals in tannery sludge with the concrete mix and to assess the usability of the sludge in concrete mix for construction work. This experimental investigation is carried out to evaluate the compressive strength of concrete. An attempt has been taken to analyse the use of tannery sludge in a suitable sludge stabilization process to reduce the heavy metal concentration in tannery sludge. The tannery sludge is partially replaced with coarse aggregate of 20mm size in M35 grade of concrete and the mixing ratio are 5%, 10% and 15% respectively. A large number of concrete cubes of size 150x150x150 mm were casted with tannery sludge as coarse aggregates and compressive strength values of the cube is determined for 7 days, 14 days and 28 days for different percentage of sludge in concrete.

KEYWORDS: Tannery sludge, coarse aggregate, Compressive strength, Reduction of heavy metal concentration.

Introduction

Coarse aggregate is one of the most important material used in the field of construction. The increase in construction work is leading to depletion of raw materials of coarse aggregate. The major source of the coarse aggregates are rocks and mountains. The frequent utilization of these minerals causes minerals depletion and environmental hazards. The tanneries in India are mainly located in Tamil Nadu, West Bengal, Uttar Pradesh and Punjab. About 900 tanneries are present in Tamil Nadu. It has been found that the amount of tannery waste produced from these industries is about 43 million ton/year and about 30% is from Tamil Nadu. The wastes produced from these industries are difficult in disposal. The disposal of such waste can be done either by incineration or by land filling which leads to air or land pollution respectively. So to avoid pollution and reduce the cost of construction the experiment is carried out. Tannery sludge have high contents of chromium, lead, copper, dissolved, and suspended organic and inorganic solids. An attempt has been taken to use the hazardous tannery sludge in the concrete mix. Hence, the concrete mix to be proposed is not aimed at large scale

production for commercial purpose, but for the small-scale development and facilities that do not requires higher strength. The use of this type of concrete mix is proposed considering the compressive strength found and the leaching of the heavy metals concern of this study.

Materials and method

Cement: The cement used in this project is OPC 53 grade cement which follows the IS specification for physical and chemical properties of the cement. Cement is the basic binding material in concrete which the concrete strengthens by hydration of water.

Table 1 Test on cement

Sl.no	Values
Fineness test	9%
Standard consistency	25%
Initial setting time	30 min
Final setting time	10 hours
Specific gravity	3.15

Tannery

Sludge: The sludge used in this project is obtained from ranitec common effluent treatment plant v.c motur Walajapet. The dry crushed sludge passed through 20mm sieve is used in replacement of coarse aggregate in concrete. The physical and chemical properties of the sludge is tabulated.

Table3 Test on Tannery Sludge

Fineness modulus test	Water absorption	Specific gravity test
6.75%	1%	1.67

Coarse aggregate: The coarse used is of normally available aggregate. The maximum size of the coarse

aggregate is 20mm. The physical properties of the coarse aggregate used is tabulated.

Table3 Test on Coarse Aggregate

Fineness modulus test	Water absorption	Specific gravity test
6.38%	1%	2.446

Fine aggregate: The fine aggregate used in this project is locally available river sand. The fine aggregate is from palar river near arcot municipality. The physical properties of the fine aggregate used is tabulated.

Table2 Properties of Fine Aggregate

Fineness modulus test	Fine aggregate used	Specific gravity test
5.4%	River sand	2.64

Water: Portable water is used in the mixing and curing process of concrete.

Mix proportion

In this project the mix proportion for M35 grade of concrete was carried out according to IS: 10262-2009 recommendations. The mix proportions are tabulated

Table 4 Mix proportion of concrete

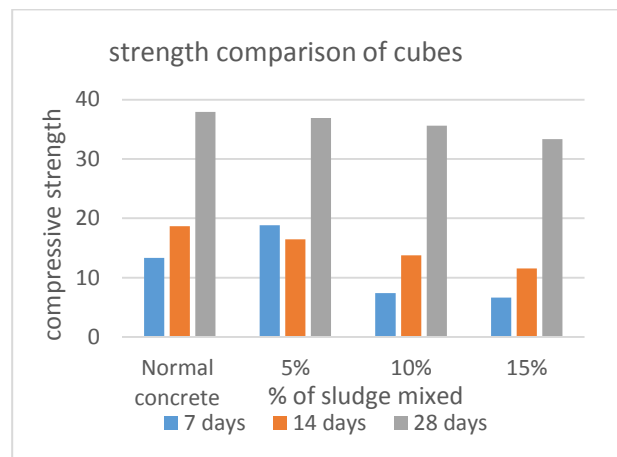
Material	Ratio
Cement	1
Fine aggregate	1.51
Coarse aggregate	2.33
W/C ratio	0.45

Result and discussions

The tests were carried out as per IS: 516-1959. The cubes, cylinder and prism of various concrete mix were cast to test compressive strength. The specimens made with replacement ratio of 5%, 10% and 15% are after demoulded and are stored in curing tanks. Removal of cubes, cylinder and prism from water and their compressive strength tests were conducted at 7 days, 14 days and 28 days. The test results were compared with conventional concrete. The compressive strength results are tabulated

Table 5 Compressive Strength of Different Trial Mixes

Trail mixes	Compressive strength in N/mm ²		
	7 days	14 days	28 days
0% mix	13.34	18.67	37.92
5% mix	11.85	16.44	36.93
10% mix	7.41	13.77	35.63
15% mix	6.67	11.56	33.37



Conclusion

The sludge from the tannery are harmful materials which has heavy metal concentration in it. The sludge which has been used is solidified by physical and chemical processes and presence of harmful metals has been reduced the replacement of sludge in concrete was based percentage of weight of the coarse aggregate used. The sludge is crushed manually and sieved, sieved sludge was used in concreting. The replacement of sludge in concrete was based percentage of weight of the coarse aggregate used. The sludge is crushed manually and sieved, sieved sludge was used in concreting.

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