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Manufacturing of Bricks Using Tannery Effluent sludge

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***Abstract*— Tanneries in India are mainly located in four states of Tamilnadu, West Bengal, Uttar Pradesh and Punjab. There are nearly 900 tanneries in Tamilnadu. The wastewater from the tannery industries are sent to tannery Effluent Treatment Plant. The sludge resulting from tannery effluents plants creates problems of disposal. General dewatered sludge is disposed off by spreading on the land or by land filling. However, for highly organized cities, sludge disposal by landfilling might not be appropriate due to land limitation. This project will lead to evaluate the suitability of sludge in manufacturing of bricks. Tannery sludge can replace cement up to 20% and quarry dust can replace sand up to 100% in cement bricks. The properties of tannery sludge and quarry dust is found out by using standard test procedures. In this project different proportions of cement, sludge and quarry dust are thoroughly mixed and moulded in the cube size of 7.045 cm X 7.045 cm X 7.045 cm and test were performed for the property of comprehensive strength for 7 days and 14 days of curing and 24 hours of sun drying.**

***Keywords*— Bricks, Quarry Dust, Tannery,**

I. INTRODUCTION

For thousands of years, bricks have been made from clay. The water treatment plant sludge is extremely close to bricks clay in chemical composition. So, the sludge could be a potential substitute for brick clay. It is very important that tannery wastes in the form of sludge are managed in an environmentally sound manner. This study focused on the heavy metal characterization and the influence of changing the physic – chemical properties of the medium throughout the composting on the concentrations, bioavailability or chemical forms of Cr, Cu, Zn, Pb and Cd in tannery sludge. This national resource has been gainfully utilized for manufacture of sludge as a supplement to common burnt bricks leading to conversation of natural resources.

Sludge bricks are obtained from materials consisting of tannery sludge in major quantity, quarry dust and cement. These bricks are suitable for use in masonry construction just like common burnt clay bricks. Production of sludge bricks lays down the essential requirements of sludge bricks so as to achieve uniformity in the manufacture of such bricks.

The common effluent treatment plant at Pallavaram in Chennai treats around 3000m^3/ day of waste water from the tanneries in the cluster processing mostly semi finish to finished leather.

II. LITERATURE REVIEW

P. C. Sabumona et.al (2010) suggests that the study used the sludge that passed a 212 – micron sieve and was retained on a 90 – micron sieve. Ordinary Portland cement (43 grades) was used. Mortar cube steel moulds of 70.6 X 70.6 X 70.6 mm size were used. The consistency limits of the cement with various percentage of sludge indicate that the consistency limit of sludge cement mixtures was increasing with increasing compressive strength showed a decline of the same trend as the present study. The properties of non – structural building material made of textile ETP sludge utilized as partial replacement of cement and partial replacement of clay. From the study, it is possible to conclude that the use of Textile ETP sludge up to a maximum of 30% substitution for cement may be possible in the manufacture of non – structural building materials.

Mahdi Haroun et.al (2008) describes that this study focuses on the characterization of tannery sludge and its development as a compositing material. The results show that electrolytic conductivity EC of the compost was 2 cm, pH 6.6 and C/N ratio of 6. Sludge from leather processing, a major industry that produces up to 600 tons of sludge annually contains large concentrations of inorganic nitrogen and N – rich organic residues. Samples were taken from 10 different points of the compost heap at each stage of composting and Physico – chemical analyses, pH test were taken conducted. The study concludes that the initial concentrations of chromium, cadmium, lead, copper and zinc decreased as the composting process progressed.

Oladoja et.al (2011) says that this work is focused on proper treatment to sludge from a textile factory using anaerobic digestion method. Composite samples were collected from teach industry once a week for seven weeks and analysed. Where analysis could not be carried out immediately, samples were preserved in a refrigerator at 4• c. at this temperature, biodegradation is inhibited.

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The BOD and COD values of the fresh sludge liquor were very high. The bacteria count also very high. The levels of nitrogen, phosphorus and potassium (NPK) are critical if the sludge is to be used for the agricultural purposes. The method has cheap operating cost.

III. Proportion Of Materials

The various materials used for the bricks are enlisted with their proportions. Different proportions were taken and their strength were examined are as follows

TABLE I
PROPORTION OF MATERIALS

Sl. No	No. of sets	Quarry dust	Cement	Sludge
1	Set 1	60%	20%	20%
2	Set 2	60%	10%	30%
3	Set 3	50%	30%	20%
4	Set 4	50%	20%	30%

IV. Experimental Programmes

A. *Fineness Test*

Put 100g of cement in the pan placed on the balance, weight will be W1. Put the cement in the sieve carefully, start shaking the sieve horizontally, and keep on shaking the sieve for 10 – 15 minutes. After 15 minutes take the weight, the weight is taken as W2. Then by using the formula calculate the percentage fineness of cement

Fineness of cement = (W1 –W2)/W1 X100

Where,

W1 – Total weight of cement

W2 – Weight of residue

The result got from the calculation, fineness of the cement is 6% and fineness of the tannery sludge is 7%

B. *Standard Consistency Test*

Weigh 400g of cement and mix it with a weighed quantity of water, the time gauging should be 3 – 5 minutes. Fill the Vicat Apparatus with the paste and level the trowel. Lower the plunger gently till it touches the cement surface. Release the plunger allowing it to sink into the paste. Repeat the above procedure with different quantities of water until the reading on the gauge is 5 - 7 mm.

TABLE II
STANDARD CONSISTENCY READING

Sl.no	% of water added to cement	Quantity of water added	Initial reading	Final reading
1	25	100	50	40
2.	26	4	50	39
3.	27	4	50	38
4.	28	4	50	36
5.	29	4	50	29
6.	30	4	50	20
7.	31	4	50	16
8.	32	4	50	10

The result obtained from the Standard consistency test for cement is 33%

C. *Setting Time of Cement*

For finding out the setting time of cement two tests are carried out they are as follows

Initial Setting Time: Weigh 400g of cement and the volume of water taken were 0.85 times of water required for standard consistency, and mixed thoroughly to form a neat cement paste. At the instance of adding water to the cement the time is noted by stop watch. The mould is placed in the Vicat apparatus, the needle was gently lowered to touch the surface of the plate and then the indicator was adjusted to show zero reading. The initial setting time of cement is observed as 30 minutes.

Final Setting Time: The needle used in the test is replaced by the annulae attachment. The needle was released quickly allowing it to penetrate into the paste. The needle comes to rest, the reading on the index scale shows 5+ or - 0.5 mm from bottom of the mould. The releasing needle was continued at every 2 min till the needle makes an impression on the block.

D. *Specific Gravity Test*

Take 100g of cement and fill with 990 ml of kerosene in the specific gravity bottle. The quantity of the cement placed in the bottle is calculated by using the following formula

Specific Gravity = wt. of cement (vol. of 10 ml by wt of kerosene of equal vol of cement).

From the calculations, the specific gravity of cement is obtained as 3.19, specific gravity of tannery sludge is 2.90 and the specific gravity of the Quarry dust is 2.65

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E. Compressive Strength

The compressive strength is the capacity of a material or structure to withstand loads tending to reduce size. It can be measured by plotting applied force against deformation in a testing machine. Some material fracture at their compressive strength limit, others deform irreversibly. So a given amount of deformation may be considered as the limit for compressive strength is a key value for design of structures.

Compressive strength of the cube = (Avg of load/ Area of the cube) kN/ m2

TABLE III
COMPRESSIVE TEST FOR VARIOUS PROPORTIONS

Sl.no	No of sets	7 days (kN/m^2)	14 days (kN/m^2)	28 days (kN/m^2)
1	Set 1	2.09	2.62	3.12
2	Set 2	2.1	2.4	2.8
3	Set 3	5	5.27	6.01
4	Set 4	1.05	1.05	1.98

The compressive strength for various proportions of cubes were given in the graphical representation

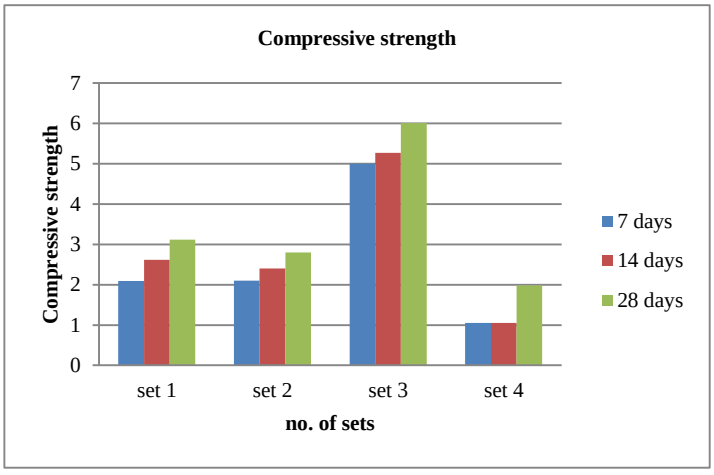

Figure 1 compressive strength

F. Water Absorption test

First dry weight of sludge brick is found (W1). The brick is immersed in water for 24 hours. After 24 hours the brick is taken out from water and weigh (W2). Water absorption of the brick is found out by the following formula

Water absorption of brick = (W2 – W1)/W1 X100

The results obtained from the water absorption for the cube is 11%

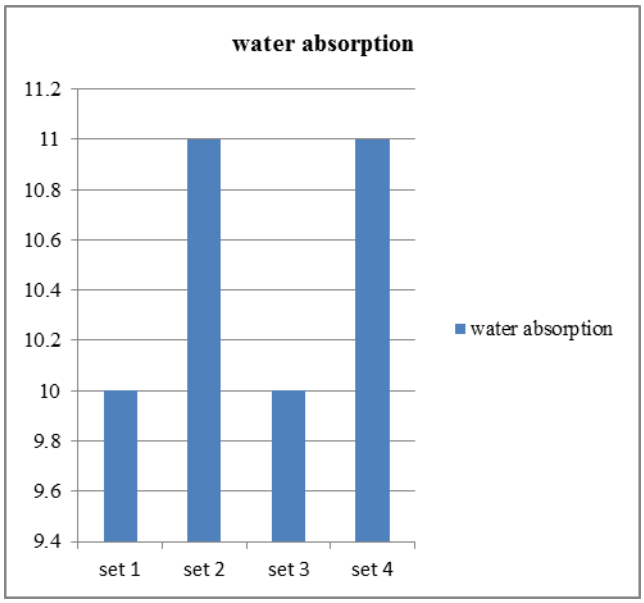

Figure 2 Water Absorption test

V. CONCLUSION

The conclusions reached in this study were based on the experimental program executed in this research and limited on both the tested materials and the testing procedures employed.

1. Water treatment plant sludge can be a successful partial substitute for cement bricks incorporated with industrial waste materials, which contains high chrome content, under the conditions, mixing proportions and manufacturing methods used in this study.
2. The research brick types were competitors to both the research control cement brick types and commercial clay brick types available in the market.
3. The optimum sludge addition to produce brick from sludge was 20% and based on the experimental program executed in this research and limited on both the tested materials and the testing procedures employed.
4. The Set 3 can be applicable to structural applications
5. The Set 1 and Set 2 can be applicable to non-structural applications

6. The Set 4 is not applicable to structural as well as non-structural applications.

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