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Utilization of Water Treatment Plant Sludge in the Brick Manufacturing

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Abstract:
A rapid increase in the number of mineral water plants is an indicator of increased public awareness on importance of consuming safe drinking water. Increased environmental awareness among people exerts high pressure on water production industry for safe disposal of residues generated in water treatment plants. The sludge disposed during the various water treatment processes can be a major concern for water treatment plants. Most of the water treatment plants discharges the sludge in to the rivers or as land fill with no treatment .The discharging of sludge in to water body leads to accumulative rise of aluminum concentrations in water, aquatic organisms, and human bodies. There is an increasing interest in disposal by Sludge is an inevitable by-product of wastewater treatment. The disposal problems can be drastically reduced if sludge can be recycled into building and construction materials. This paper reports the use of sludge as new and non-conventional construction materials as an alternative means of sludge disposal. Sludge percentage is varied from zero to thirty percentages by weight. Parameters such as compressive strength and water absorption are studied as per BIS (Bureau of Indian Standards) procedure. Water treatment plant sludge up to 15 % can be added to get the higher compressive strength of 8.30N/mm^2

Keywords: *Water treatment plant sludge, compressive strength, brick, clay, water absorption, etc.*

1. Introduction

Sludge refers to the residual, semi-solid material left from industrial waste water or sewage treatment processes. It can also refer to the settled suspension obtained from conventional drinking water treatment and numerous other industrial processes. The term is also sometimes used as a generic term for solids separated from suspension in liquids this soupy material usually contains significant quantities of 'interstitial' water (between the solid particles). When fresh sewage or wastewater is added to a settling tank, approximately 50% of the suspended solid matter will settle out in an hour and a half. This collection of solids is known as raw sludge or primary solids and is said to be "fresh" before anaerobic processes become active. The sludge will become putrescent in a short time once anaerobic bacteria take over, and must be removed from the sedimentation tank before this happens. Use of sludge as construction and building material converts the waste into useful products that can alleviate the disposal problems. Tay and Show (1999) presented a summary of their studies on the feasibility of using sludge as construction materials, including building bricks, lightweight artificial aggregates, and cement like materials. While sanitary landfill are commonly used for disposal of sludge in Taiwan, rapid urbanization has made it increasingly difficult to find suitable landfill sites (Lin and Weng, 2001) -Utilization of sludge as an addition to construction and building material including building bricks, light weight artificial aggregates, and cement- like materials is a win-win strategy because it not also convert the wastes into useful materials but it also alleviates the disposal problems.
The prospective benefits of using sludge or sludge ash as the brick or tile additive include immobilizing heavy metals in the fired matrix, oxidizing organic matter and destroying any pathogens during the firing process, and reducing the frost damage based on the results of several full or bench scale study (Alleman et al., 1990; Okuno and Takahahsi, 1997; Wiebusch and Seyfried, 1997; Tay and Show, 1999; Weng and Lin, 2000; Lin and Weng, 2001). Chihpin *et al.,(2005)* use the water treatment sludge with addition of the excavation waste soil to make the manufacture of bricks. They conclude the 15% of the water treatment sludge addition to achieve the first class degree. The aim of project is to develop sustainable, low energy construction product by partially replacing the water treatment plant sludge in brick and determining the compressive strength and water absorption test.

2. Materials and Methods

The water treatment plant sludge is collected from Bhavani sagar dam. The dam is located on the Bhavani River between Mettupalayam and Sathyamangalam in Erode District, Tamil Nadu, and South India. The sludge obtained is exposed to direct sunlight

and stored in open yards. Sample from this sludge is pulverized and passed through 600 micron sieve size in order to get sludge in a in a fine form with uniform particle distribution that is suitable for brick making.

Clay available at the local commercial brick manufacturing unit was obtained for blending with the sludge. The clay is dried under direct sunlight and sieved through 600 micron sieve to achieve uniform particle distribution. The sludge and clay so obtained is blended at various proportions by weight. The following mix proportions are used for brick manufacturing; it is tabulated in table 1. The percentage of sludge in the mixed is varied from 0% to 30%. Each mix is kept undisturbed for 24 hours after addition of water, so the clay particles to absorb water and soften. For brick casting, a mould of size 190mm x 90mm x 90mm was used. A set of 6 bricks in each mixing proportion is cast, resulting in a 42 nos of total bricks are cast. The casted bricks are shown in Figure1. The methodology followed for the preparation of bricks is given in Figure 2.

Category	Clay + red soil in %	Sludge in %
1	100	0
2	95	5
3	90	10
4	85	15
5	80	20
6	75	25
7	70	30

Table 1: Mix proportions

Figure 1: Casted bricks

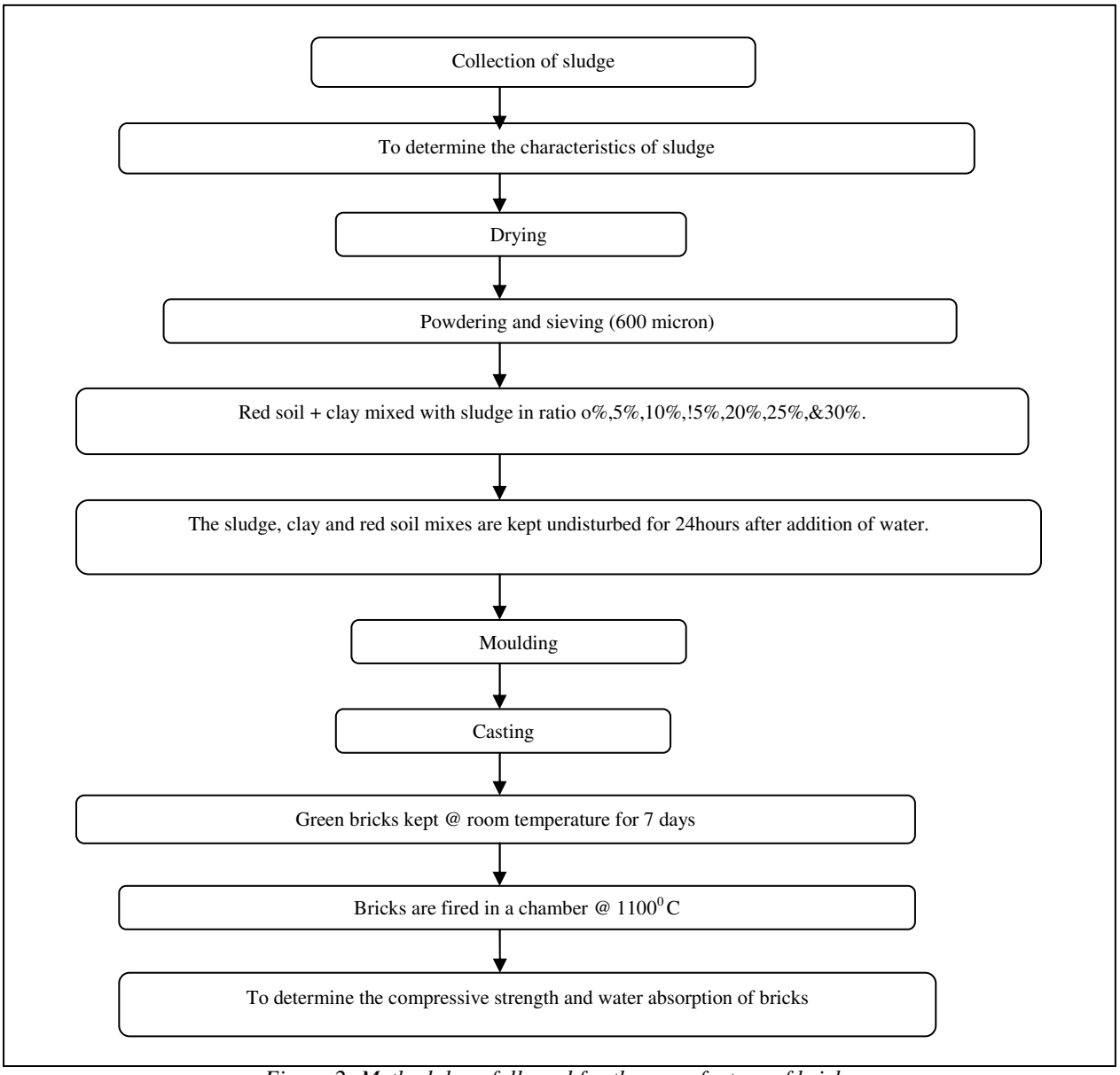

Figure 2: Methodology followed for the manufacture of bricks

3. Results and Discussion

3.1. Characteristics of Sludge

The sludge chosen for the test has the following physical parameter. The parameters are tabulated in table 2.

S.NO	PARAMETER	VALUE
1	pH	6.2
2	Aluminium	12.5 %
3	Lead	92.0mg/kg
4	Chromium	259.0mg/kg

Table 2: Characteristics of sludge

3.2. Water Absorption Test

Water absorption is a key parameter that establishes the durability of the brick. Lower the amount of water absorption indicates has the presence of pores in the brick is less; if the amount water absorption increases it indicates presence of pores is more; high amount of water absorption leads to the reduced strength and weight. This type of brick is not suitable for structural applications. The percentage of water absorbed after immersion of the water is presented in table 3. The amount of water absorption is calculated from the following equation.

Amount of water absorbed (%) = (W2-W1)/W1

Where, W2 = weight of wet brick in gm,

W1= weight of dry brick in gm,

S.NO	PERCENTAGE OF SLUDGE	WEIGHT OF DRY BRICKS(W1) (gm)	WEIGHT OF WET BRICK (W2) (gm)	AMOUNT OF WATER ABSORBED (%)
1	0	3217	3457	13.3
2	5	3142	3551	13.01
3	10	2930	3419	16.68
4	15	2884	3407	18.13
5	20	2734	3315	21.25
6	25	2635	3210	21.82
7	30	2518	3131	24.34

Table 3: Water Absorption Test

The water absorption value for different mix proportions is represented through a bar chart as given below. From the test results, the percentage of water absorption increases with increase with sludge content due to presence of pores. With the addition of sludge up to 15%, the Percentage of water absorption is less than 20% as specified in IS 1077-1976.

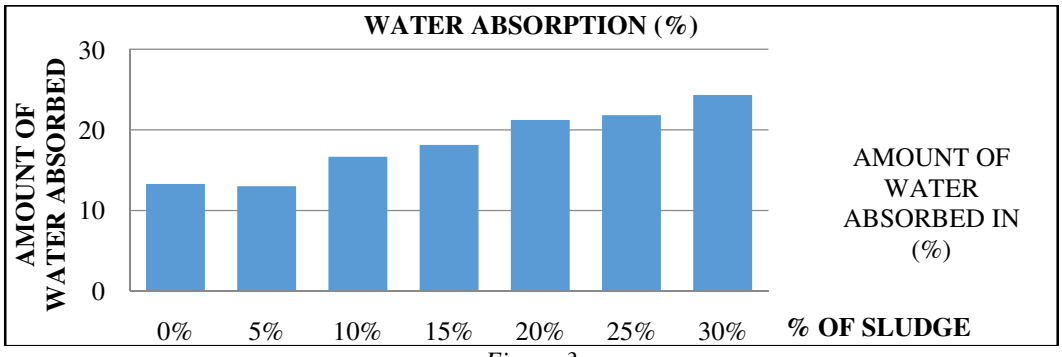

Figure 3

3.3. Compressive Strength Test

Compressive strength is the most important test for assuring the engineering quality of a building material. The strength of the brick is greatly dependence on the amount of sludge added to the clay. Compression tests were conducted using the brick with varying percentage of sludge as shown in table 4. Compressive strength is calculated from the following equation. Compressive strength = load/area ($N/mm^{2)}$.

S.NO	PERCENTAGE OF SLUDGE	LOAD AT FAILURE (N)	AREA (mm^2)	COMPRESSIVE STRENGTH (N/mm^2)
1.	0	92.5	92x72	13.96
2.	5	85	92x72	12.83
3.	10	70	92x72	10.56
4.	15	55	92X72	8.30
5.	20	32.5	92X72	4.91
6.	25	30	92X72	4.53
7.	30	20	92X72	3.20

Table 4: Compressive Strength Test

From the Figure 4 the results shown up to 15 percentage of sludge can replaced for clay for load bearing Structures. Compressive strength goes on reducing as the percentage of sludge increases in brick manufacturing.

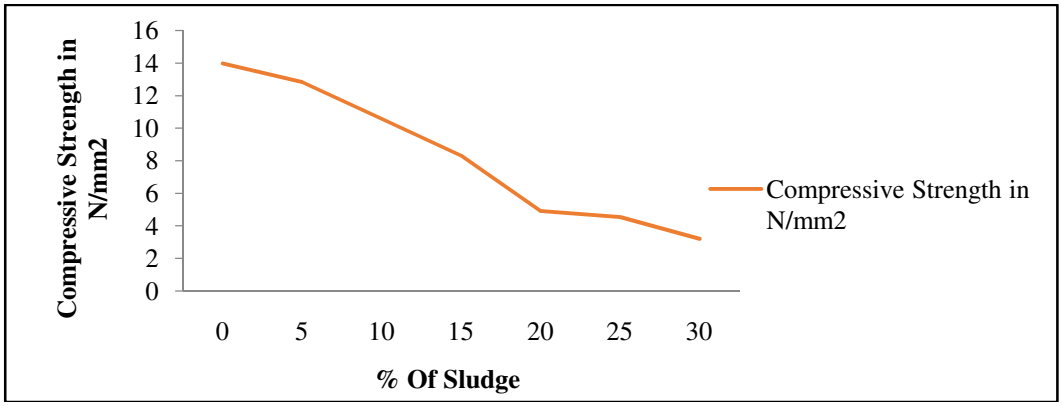

Figure 4: Compressive Strength

3.4. Ringing Sound and Efflorescence

There is no efflorescence for 0% sludge; the efflorescence is slight to moderate for the increasing addition of sludge. Very low efflorescence is observed for 15% sludge addition bricks. Ringing sound of brick goes on decreasing with increase in the amount of sludge content. Ringing sound is excellent for original bricks with 0% sludge. Ringing sound is least for 30% of sludge addition bricks. This may be because of increased porosity of the bricks. For bricks up to 15% sludge addition has good ringing sound is heard.

4. Conclusion

The water treatment plant sludge could be used as a partial substitute for clay in the manufacture of bricks. The percentage of sludge addition is based on the need for which bricks are produced. Utilising the alum sludge bricks saves the aquatic environment. The problem of sludge disposal is completely solved. The use of clay can be minimized and the rate of depletion of the natural resources is reduced. The water treatment plant sludge up to 15% can be effectively added to make brick. Up to 30% addition of sludge is suitable for non load bearing structures.

5. References

i. Alleman, J.E., Bryan, E.H., Stumm, T.A., 1990. Sludge amended brick production: applicability for metal-laden residues. Water Sci. Technol. 22 (12), 309–317

ii. Chihpin, H., P.J. Ruhsing and L. Yaorey, 2005. “Mixing Water Treatment Residual with Excavation Waste Soil in Brick and Artificial Aggregate Making”, Journal of Environmental Engineering, 131(2): 272-277.

iii. Lin, D.F., Weng, C.H., 2001 Use of sewage sludge ash as brick material, J. Environ. Eng. 127(10), October issue. 922–927.

iv. Okuno, N., Takahashi, S., 1997. Full scale application of manufacturing bricks from sewage. Water Sci. Technol. 36 (11), 243–250.

v. Tay, J. H., and Show, K. Y. (1997). “Resource recovery of sludge as a building and construction material – a future trend in sludge management.” *Water Science and Technology,* 36(1), 259-266.

vi. Weng, C.H., Lin, D.F., 2000. Utilization of bio solid ash as tile materials. Proceedings of Critical Technologies to the World in 21st Century: Pollution Control and Reclamation in Process Industries, IAWQ Specialty Conference of Chemical and Petrochemical Industries Group, Beijing, PR China. pp.142–151.

vii. Wiebusch, B., Seyfried, C.F., 1997. Utilization of sewage sludge ashes in the brick and tile industry. Water Sci. Technol. 36 (11), 251–258.