EFFECTIVE UTILIZATION OF SLUDGE PRODUCED DURING WASTE WATER TREATMENT FOR BRICK MANUFACTURING

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Abstract : The disposal of sewage waste is the major problem in urban cities as it causes many harmful effect to the environment. Sludge is the main product from sewage waste. Conventional brick is mostly prepared by using clay. Chemical composition of sludge is nearly similar to the clay. Hence sludge can be used as a replacement for a clay, soil in manufacturing of bricks. In this study , bricks were produced with sewage sludge addition ranging from 10, 20, 30, 40 and 50% by dry weight respectively and compare produce brick with regular brick. Also from this investigation, we can solve the disposal problem completely and also construct and economical structure with easy designing.

Index Terms **- : Brick, sludge, strength**

I. INTRODUCTION

As we know the human life is totally dependent upon the natural resources available on the earth, so it is our prime duty to save the natural resources. We can save the Natural resources by recycling, reuse the waste materials. By using waste material after recycling we can save the natural resources. Waste material includes plastics, glasses, construction material, sewage sludge, Fly Ash etc. Most of all the waste products are getting recycled using latest techniques, But Dry sludge is the material which is being used only for the Fertilizer system as manure with any treatment.

Dry sludge without any treatment causes soil pollution which can be hazardous to the human health. Otherwise, the Sludge is dumped into the land, which is also a major issue for the environment. Sludge is produced on site by treating the wastewater using a septic tank and Off-site by using Activated sludge system. wastewater treatment is to remove the solid particles present in it. As wastewater contains the organic materials also, which later on converted into the bacterial cells. These solid waste and bacterial cells can be removed by the treatment of wastewater. The disposal of sewage wastes comprises as one of the major worldwide environmental problems as these wastes render the environment unfriendly. The growing demand for waste utilization has made solid wastes like sludge and demolition waste an essential composition of this study. The possibility of reduction of the production costs provides a strong logic for use of this waste.

In the earlier days, 6000 B.C. bricks were prepared by an ancient method, in which the moist clay was pressed into the rectangular moulds by hand and then let it dry in sun light. To prevent the moist clay from the sticking to the moulds, the moulds were dipped into the water before being filled. In nowadays, the bricks are made with the partial or fully replacement of clay soil with the various waste materials like rice husks, sludge, marble dust, tea wastes etc. This paper presents use of dry sludge in the manufacturing of brick material or as the partial replacement of the clay soil in the bricks..

II. LITERATURE REVIEW

" Mr.Pratik P. Shinde" (EA.TL) (2018): The disposal of sewage waste is the major problem in urban cities as it causes many harmful effect to the environment. Sludge is the main product from sewage waste. Conventional brick is mostly prepared by using clay. Chemical composition of sludge is nearly similar to the clay. Hence sludge can be used as a replacement for a clay, soil in manufacturing of bricks. [9]

" R. Venkatakrishnaiah" (2014): Tannery sludge can replace cement up to 20% and quarry dust can replace sand up to 100% in cement bricks. 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.[8]

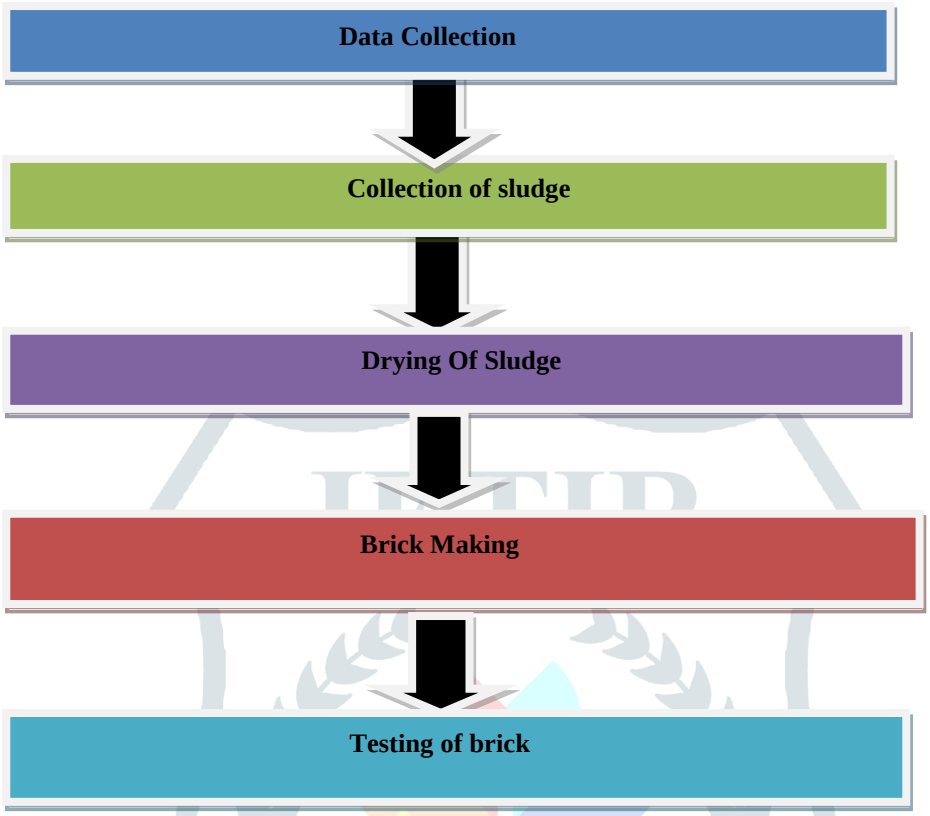
"Yousif Algamal "(2018): The results of these study show that the production of bricks with the sludge from water treatment plant is feasible and promising, since they can be used directly without additional grinding and at a relatively low firing temperature.It can be assumed that this sludge could be a valuable renewable resource of raw materials in the manufacture of bricks.[9]

III. PROBLEM STATEMENT

Keeping in view the huge amount of these waste materials, their disposal problems their use in the production of brick appears a good alternative.

- To solve disposal problem of sludge as a waste product of SWTP.
- Disposing the sludge was the major problem arising due to disposing in nearest water bodies and land.

IV. RESEARCH METHODOLOGY



Flow chart

4.1 Collection Of Sludge: Collection of waste sludge is done in sludge drying bed which is generated from WTP. Sludge is brought from holding tank and then left over the bed.

4.2 Drying Of Sludge: The waste sludge whi ch is left over drying bed is allowed to dry for 7to 10days.The drying method is completely natural. Natural solar energy is used for the drying purpose. Available water in sludge is evaporated in atmosphere by the sun heat.

4.3 Brick Making: For the given study proper solidification of brick is necessary essential. Selection of suitable proportion of different kind of material for achieving good strength is essential. After selection of proper proportion for brick the dry homogenous mixture is done.

4.4 Collection of material: Collection of sludge, fly ash, sand (murrum), and water etc.

4.5 Test on materials: Test on sludge: specific gravity of sludge, dry density of sludge, water absorption.

4.6 Mix design of bricks: There are six different series of mixing ratios were tried. However, the batching proportions of raw materials required to produce brick with standard dimension are shown table.Percentage of Sludge, brick clay, fly ash, sand (murum) and water is decided.

Different percentage of sludge	Soil %	Sand (murum) %	Fly Ash %	Water
0%	60%	28%	12%	As per req.
15%	50%	23%	12%	As per req.
18%	48%	22%	12%	As per req.
20%	47%	21%	12%	As per req.
22%	46%	20%	12%	As per req.
25%	44%	19%	12%	As per req.

Table 4.1 Percentage of Sludge, brick clay, fly ash, sand (murum) and water

4.7 Mix Design For Fly ash sludge brick: There are six different series of mixing ratios were tried. However, the batching proportions of raw materials required to produce brick with standard dimension are shown table. Percentage of Sludge, fly ash, sand dust, lime, Gypsum

Different percentage of sludge	Fly ash %	Sand dust %	lime %	Gypsum %
0%	62%	25%	8%	5%
15%	56%	22%	8%	5%
18%	50%	19%	8%	5%
20%	48%	19%	8%	5%
22%	46%	19%	8%	5%
25%	43%	19%	8%	5%

Table 4.2 Percentage of Sludge, fly ash, sand dust, lime, Gypsum

4.8 MANUFACTURING OF BRICKS

1. Weight batching
2. Mixing of material
3. Casting of material
4. Placing of bricks
5. Burning of brick

4.9 TESTING OF BRICKS

1. Compressive strength test
2. Water absorption test
3. Efflorescence test

V. TEST CONDUCTED ON BRICKS

5.1 Compressive Strength Test: The compressive strength bricks are obtained by placing the brick on the flat horizontal surface between the plates of testing machine. The axial load is applied at a uniform rate until the brick gets failure.

Fig 5.1 Compressibility test of clay Brick + sludge

Fig 5.2 Compressibility test of Fly ash Brick + sludge

As per Indian standard compressive strength of clay brick is 3.5 N/mm^2

No of bricks	% of sludge	Compressive strength (N/mm^2)	Remark
1	0%	3.5	As per I.S.standard
2	15%	3.9	As per I.S.standard
3	18%	3.8	As per I.S.standard
4	20%	3.6	Good
5	22%	3.4	Lesser

Table.5.1 Compressive strength Table (clay brick + sludge)

No of bricks	% of sludge	Compressive strength (N/mm^2)	Remark
1	0%	12.6	As per I.S.standard
2	15%	12.4	As per I.S.standard
3	18%	12.3	As per I.S.standard
4	20%	12.1	Good
5	22%	11.9	Lesser

Table.5.2 Compressive strength Table (Fly ash+ sludge)

5.2 Water Absorption Test: The brick is immersed completely in water at room temperature for 24 hrs and remove the brick from the water and wipe out the traces of water with cloth and brick is weighed.

Fig.5. 3 water absorption test

No of bricks	% of sludge	Weight before test in (Kg)	Weight after test in (kg)	% of water absorption
1	0%	3.990	4.380	9.77
2	15%	3.475	4.175	20.14
3	18%	3.350	4.027	20.20
4	20%	3.240	4.154	28.20
5	22%	3.170	4.075	28.54

Table.5 .3 % of Water absorption table (Clay sludge brick)

5.4 EFFLORESCENCE TEST:

% of sludge	Status
0%	Nil
15%	Slight
18%	Moderate
20%	Moderate
22%	Heavy
25%	Serious

Table 5.4 Efflorescence test result

VI. RESULTS AND DISCUSSION

6.1 Result of Compressive Strength of clay sludge brick and Fly ash sludge brick

As per Indian standard compressive strength of clay brick is 3.5 N/mm^2.
The average strength of brick with **20%** sludge is **3.6 N/mm^2**

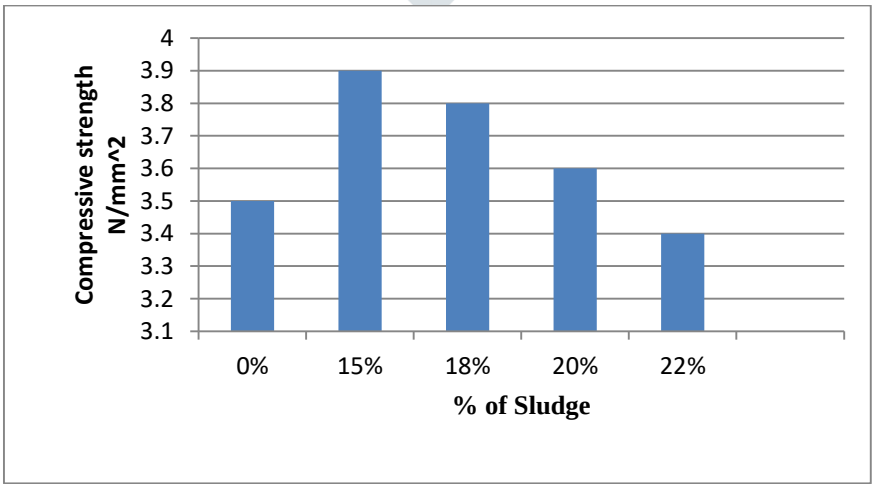


Figure .3 Variation of compressive strength with % of sludge

As per Indian standard compressive strength of Fly ash brick is 12 N/mm^2.
The average strength of brick with **20%** sludge is **12.1 N/mm^2**

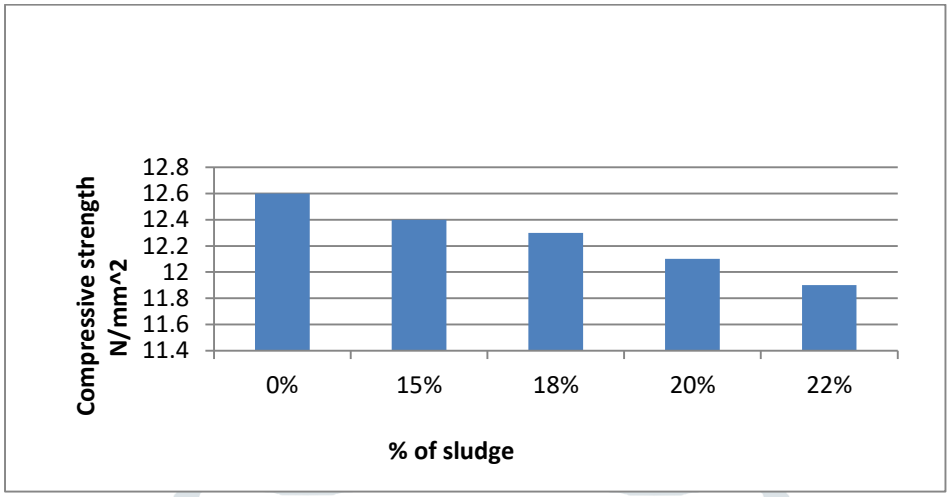


Figure .4 Variation of compressive strength with % of sludge(fly Ash sludge brick

VII. COST COMPARISION

After all the tests over the dry sludge bricks, we did an analysis to the cost of the brick. The analysis of the cost of the brick is done on the basis of the four factors.

- Price of clay soil
- Price of sludge
- Price of fly ash
- Labour cost

7.1 Cost Analysis of clay sludge brick

The cost of manufacturing of clay sludge brick is much less then clay bricks.

No of Bricks	**Fly Ash brick (Rs)**	**15% sludge brick**	**18% sludge brick (Rs**	**20% sludge Brick (Rs)**
1	4.00	3.75	3.60	3.58

Table.7.1Cost Analysis of clay sludge brick

7.2 Cost Analysis of fly ash sludge brick

The cost of manufacturing of fly ash sludge brick is much less the fly ash bricks.

No of bricks	**Conventional brick (Rs)**	**15%sludge brick (Rs)**	**18% sludge brick (Rs)**	**20% sludge Brick (Rs)**
1	5.00	4.52	4.17	3.78

Table.7.2 Cost Analysis of Fly ash sludge brick

VIII. CONCLUSION

- When sludge is used as partial substitute in clay bricks it is seen that compressive strength decreases as sludge proportion is increased.
- From the above samples tests we got to know that adding 20% of sludge of the total weight of brick gives satisfactory results.
- For 1000 number of bricks and hence modified bricks prove economical then conventional bricks .
- Current scenario of sludge disposal problem will be solved and will prove beneficial to environment as it reduces the use of fertile layer of agricultural land (clay) for manufacturing of bricks.

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