Feasibility study of textile effluents waste sludge for brick production

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***Abstract*—Bricks were the major material which is used for any construction purpose. To prepare bricks, clay was used as a binding material and with this clay the natural waste material and industrial waste were used. The main objective of the present study is to minimize the environmental waste and to reuse the waste material with clay to manufacture bricks that can be used in construction. The textile sludge waste was used to making the construction bricks that serve as a resolve of solid waste management.**

***Index Terms*—industrial waste, construction bricks, solid waste management**

I. INTRODUCTION

The textile industry is the biggest industry unit in India. A lot of environmental issues were developed due to the rapid incremental of industrialization. The textile industry generates different types of wastes over the world. For the human community, sludge management has become a great task in recent years.
A great area is utilized in dumping these industrial wastes, which may lead to contamination of soil, surface water and groundwater. Hence, recycling these wastes into an innovative material could be a practical solution to the problem of land filling and reduce its impact on the environment. Also, urbanization in urban/ rural areas has increased the demand for construction materials, and thus, the demand for new construction materials that are economically feasible is increasing exponentially.
It is also noted that there is a scarcity of clay in various parts of the world. To protect the clay resource and the environment, some countries had started to bind the use of bricks that prepared from clay. Build-up of unmanaged wastes particularly in developing countries has resulted in an increase environmental alarm.
Recycling of such wastes as building materials looks to be workable solution not only to the pollution problem but also to the problem of cost-effective design of buildings. The growth in the status of using environmentally friendly material, cost effective, lightweight and sustainable construction materials in building industry was increased.

II. OBJECTIVES

- To manufacture brick using varying amount of TES.
- To evaluate the properties of bricks containing TES.
- To compare test results of conventional bricks with brick manufactured using TES.
- To compare the cost conventional brick with brick manufacture using TES.

III. LITERATURE REVIEW

Premkumar R (2021)
["Properties and Environmental Features of bricks made from TES"]
Studies on the sludge produced by textile companies' combined effluent treatment plants have revealed that the sludge could be used in building materials. The use of sludge in cement for diverse uses as structural and nonstructural components in the construction sector may be investigated further. The conversion of textile sludge waste to fly ash bricks results in a significant reduction in brick density, as expected.

The brick density, for example, is reduced by 10% when 20% textile sludge is added. This is advantageous in terms of both cost and expertise. Lower block weight reduces transport and labour costs while allowing for greater structural plan adjustability. The cost savings reached a maximum of nearly 20%. The creation of sludge-incorporating bricks could result in large-scale disposal of industrial sludge, resulting in a more environmentally friendly scenario in the future.

Prafulla Pokhara , Aravinth S.S. Ekamparam b , Abhas Singh(2019)

["Activated alumina sludge as partial substitute for fine aggregates in brick making"]

This study shows that maximum of 10% replacement of conventional clay soil by sludge, from activated alumina (AA)-based water treatment plants, as raw material can be recommended for the manufacturing of structural clay bricks. Incorporating activated alumina sludge into clay bricks is also environmentally safe as the standard leaching tests performed on the manufactured bricks turned out to be within the acceptable limits. The partial replacement of AA sludge in clay bricks resulted in increased brick porosity relative to conventional bricks. The increased porosity is consistent with the decrease in compressive strength, flexural strength and thermal conductivity of the resultant bricks. However, inspite of this reduction the bricks met the minimum criteria for low-end structural applications. Overall, this study demonstrated a sustainable way to utilize the hazardous activated alumina water treatment plant sludge in brick manufacturing kilns, eliminating the need to dispose of this waste in secured landfills.

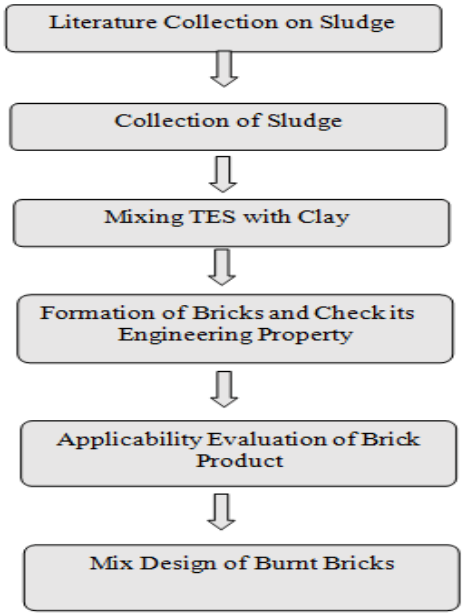
B. Priyadharshini and M. Kavisri (2018)

["Utilization of textile sludge in manufacturing e-bricks"]

Studied the characterization and tests of bricks, Textile sludge waste and its incorporation intomaterial used for brick manufacturing, led to the following conclusions. Textile Sludge can be a successful partial replacement material for clay soil in the manufacture of bricks. The manufactured burnt bricks strength observed to be above the minimum recommended compressive strength value of 3.5 N/mm2. Comparing the recommended compressive strength, M2 sample gives better compressive The water absorption property of proportions of burnt Brick is greater than the water absorption of normal good quality burnt clay bricks. From the results of technological tests, it is suggested that textile Sludge wastes can be incorporated up to 5% by weight of clay materials for the production of bricks and to optimum amount of textile Sludge waste was found to be 5% by weight of clay which give better bonding, higher compressive strength and lower water absorption. The possibility to use the Textile effluent treatment plant wastes as an alternative raw in the production of clay-based products will also induce a relief on waste disposal concerns. The Textile Sludge can also be extended and used for the manufacture of paver blocks and footpath constructions etc. Thus, the use of Textile Sludge reduces the both the land and air pollution problems and its environmentally effective.

IV. METHODOLOGY

Fig. No. 1 Methodology flow chart



3.1 Collection Of Sludge:-

We studied the Literature/research paper and decided the proportion or the quantity of the sludge required for the number of bricks we are making/producing. And then we are going to accumulate the Textile Effluent Waste Sludge (TEWS) 50kg from MIDC Avdhan Dhue.

3.2 Mixing TES With Clay:-

The collected/received sludge is in granular form, after making the sludge in a proper powder form we are going to mix it with soil/clay in a particular proportion. We are making bricks with varying amount of sludge percent(15% , 20% , 25% & 30%).We prepare a separate mix with varying amount of sludge percentage.

3.3 Formation Of Bricks & Check It's Engineering Property:-

The prepared mix is then put in the mold which is of standard size (23cm x 10cm x 10cm). It takes 6-7 days to dry and once the bricks are dried, we are going to burn them in the Brick Kiln at Dhule. It will take 20-25 days for proper burning of brick to achieve it strength .once the bricks are ready, we are going to conduct engineering property test on them like Water absorption test, Compressive Strength, Hardness Test, Presence of soluble salts (Efflorescence Test) etc .

3.4 Applicability Evaluation of Bricks:-

Assessing its suitability for specific use considering factors such as Performance, Durability & Environmental impact.

Some key aspects considered when conducting an applicability evaluation for a brick product.

i. Physical Characteristics :

(a) Size and shape

(b) Color and texture

ii. Mechanical properties :

(a) Compressive Strength

(b) Flexural Strength

Table no. 1 Mix Design of Burnt Bricks

Mix	Percentage of Sludge (%)	centage of clay (%)	Water
M-1	15	85	As per requirement
M-2	20	80	As per requirement
M-3	25	75	As per requirement
M-4	30	70	As per requirement

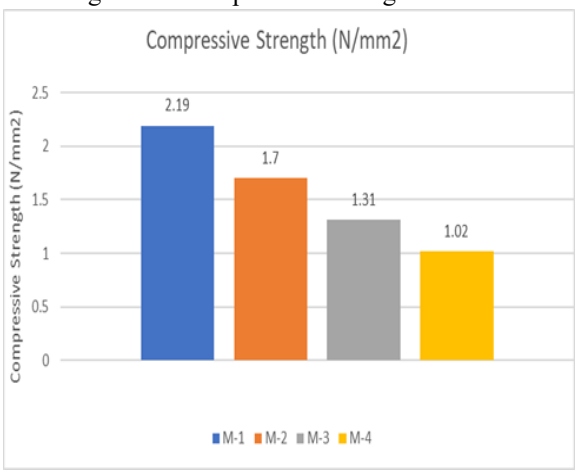
V. TESTS ON BRICKS

A.Compressive Strength

Compression tests are used to determine a material's behavior under applied crushing loads, and are typically conducted by applying compressive pressure to a test specimen. During the test, various properties of the material are calculated and plotted as a stress-strain diagram for some materials, compressive strength.

It is observed from the results that, there is difference in compressive strength of produced brick with 15%, 20%, 25% and 30% of dry sludge and clay for each mix with the normal brick.

Fig. No. 2 Compressive Strength of Brick



However, the difference between compressive strength of normal brick and produced brick of 30% of sludge is slightly high as dry sludge proportion increases, strength goes on decreases.

B. Efflorescence Test

Efflorescence is a whitish crystalline deposit on surface of the bricks. Usually magnesium sulphate, calcium sulphate and carbonate of sodium and potassium are found in efflorescence. The movement of groundwater into the foundations of buildings and by capillary action into brickwork is very often the cause of efflorescence.

When bricks are completely absorbed by the water and get evaporated, place the same quantity of the water in dish and allow the bricks to be absorbed and evaporate as before. Then examine the bricks after all above process finishes and determine the percentage of the white spots on the surface area of the brick. If any difference is observed in the bricks report the results as:

- Nil- when there is no perceptible deposit of efflorescence
- Slight - thin deposit of salt is covered not more than 10%.
- Moderate - covering up to 50% of the brick area.
- Heavy - covering more than 50% brick area.

In this all mix M-1 of bricks all are free from salt deposit.

C. Water Absorption Test

As far as water absorption is concerned, the water absorption of brick with proportion (15%, 20%, 25%, and 30%) of dry sludge with clay for each mix of dry sludge is 20.64%, 27.94%, 28.65%, and 37.57%. We can absorb that as the sludge proportion increases, the absorption goes on increases. Durability of brick

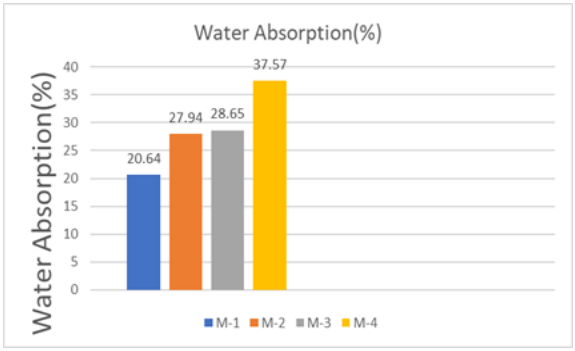


Fig. No. 2 Water Absorption of Brick

depends on the water absorption, as water absorption increases durability decreases. As per the IS 1077-1992, the maximum water absorption of brick should be 20%. in this study, mix (15% of sludge) added to brick is close within in this limit. The bricks produced with 15% of sludge can be recommended for construction of non-load bearing walls.

VI. CONCLUSION

1 The bricks can be very effectively used with 15% to 20% of TEP dry sludge and clay for each mix of dry sludge with clay for non – load bearing structures, because the framed structures requires filling the panels.

2 As the water absorption is slightly higher in case of TEP sludge bricks, it is recommended plastering to avoid water absorption.

3 As the efflorescence effect is absolutely nil, so the TEP sludge bricks do not have any effect on the any type of brand of cement used in construction.

4 This study concludes that some proportion of Textile sludge can be used for making bricks to required size and shape, because dumping and disposal of sludge requires more space and creates an impact on the environment.

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