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Utilization of Sludge in the Production of Bricks

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Abstract:
Increasingly stringent environmental pressures in India encourage alternative solutions towards waste management. An effort towards the use of waste material in structural elements like bricks without any combustion and autoclave pressure is not taken up very effectively and implemented in real time projects so far by the industry because not aware of recycling techniques, not of such possibilities and no specifications for use. Therefore, there is a need to develop a sustainable technology for replacement of natural resource by waste products in the manufacture of bricks. Hence, in this project, the sugarcane sludge from Walajabad sugar cane mill is used for the manufacture of sludge brick and its compressive strength, water absorption and presence of efflorescence is compared. This project will be very useful in eco-friendly environment.

Keywords: *Sludge bricks, water absorption, compressive strength, efflorescence*

1. Introduction

There is a strong demand for environmentally safe reuse and effective disposal methods for sludge due to the increasing amount of sludge generated by the various industries or plants in India. Landfills are commonly used for disposal of sludge in India, rapid urbanization has made it increasingly difficult to find suitable landfill sites. Therefore, incineration has become one of the few alternatives available for disposal of sludge. The ultimate disposal of incinerated sludge ash can be accomplished by using it as engineering construction materials. One possible solution for the management of this sludge is to re-use it as a building material, namely, to incorporate this sludge into bricks. The fired clay brick is one of the most common and abundant masonry buildings & materials and remains popular for its many characteristic properties. As such, the recycling of waste materials by incorporating them into bricks has been a popular topic of investigation over the last century, with varying degrees of success across a wide range of waste materials. This popularity is likely due to the flexibility on the type of wastes which can be mixed into the brick making material, but more importantly, the high temperatures involved in firing the brick allows for the volatilization of dangerous components, as well as the fixation of wastes into the vitreous phase of the brick. The current study investigates the potential for reusing sugarcane sludge by using it as a partial replacement material in clay bricks. The brick characteristics (i.e. compressive strength and initial rate of absorption) are investigated as well as the aesthetic qualities such as the potential to efflorescence as a result of the presence of salt.

2. Study Area

The Sugarcane mill from where we got the sugar cane ash is also known by the name of S V SUGAR MILLS LIMITED. This plant is located about 70 kms from Chennai and also nearer to the state highway road connecting Kanchipuram and Chengalpet.. This unit is located north direction of this road. The nearest major human settlement and railway station is Walajabad. The Government of Tamilnadu has recognized the location of this unit as an industrial area. For the preparation of sludge brick we required about 80 kgs of sugarcane sludge. Now coming to the brick chimney, the chimney is located at north east direction from the Thiruvannamalai state highway road and is located exactly 26 kms from kanchipuram towards Vandavasi route.

3. Methodology

The constituents of bricks are Sugarcane sludge waste , Sand and water. A steel mould was used to produce cubic bricks (190 mm x 90 mm x 90mm). Bricks were made from clay and dried sludge mixtures containing 0%, 10%, 20% and 30% sludge by weight. The clay and dry sludge were mixed together by tossing in a sealed bag. Water was added according to the optimum moisture content before the mixture was kneaded into the moulds in thin layers by applying a hammering motion using a steel rod in order to compact it. The wet bricks were left to air-dry in the moulds over-night in ambient room temperature. The unfired brick was then removed and placed into a 45 °C oven with a temperature rate of 15 °C per hour to a maximum of 105 °C to dry over-night. Slow drying was necessary to prevent the bricks from cracking or bursting due to internal steam formation. Finally, the completely dried unfired bricks were placed into a furnace and fired at a rate of 48°C per hour from room temperature to 1200°C which was held for 4 hours to sinter. The furnace was then shut down and bricks were left inside to cool naturally. The slow firing rate was used to prevent cracking. Compressive strength was determined for 0%, 10%, 20% and 30% sludge content bricks using

a compression testing machine. A loading was applied to the bricks until they failed and the maximum loading rate was recorded. The compressive strength was taken as the average result from a set of five tests for each respective brick type.
The following tests were conducted on the sludge bricks to ascertain the quality of bricks: Water absorption Test, Efflorescence Test, Compressive strength test, Size, Shape and Color Test, Soundness Test, Hardness Test

4. Results and Discussion

The sugarcane sludge bricks are tested for their performance by determining their compressive strength developed, water absorption, the effect of efflorescence for mix proportion bricks. The results obtained are discussed in detail in the following sections.

4.1. Test Results

Properties of Sludge bricks	**Percentage of Sludge Bricks**			
	0 %	10 %	20%	30%
Initial weight of bricks	3.221	3.094	2.848	2.606
Weight of bricks after 24 hours	3.623	3.513	3.351	3.227
Water Absorption (%)	12.480	13.542	17.662	23.829
Compressive strength (Kg/cm^2)	53	39.75	26.50	12.23
Efflorescence	Nil	Slight presence of salts		

Table 1

4.2. Discussion

4.2.1.Water Absorption

From the test result, it was observed that there is a slow increase in water absorption with respect to increase in percentage of sludge brick. The water absorption value for different mix proportions is represented through a bar chart as given below.

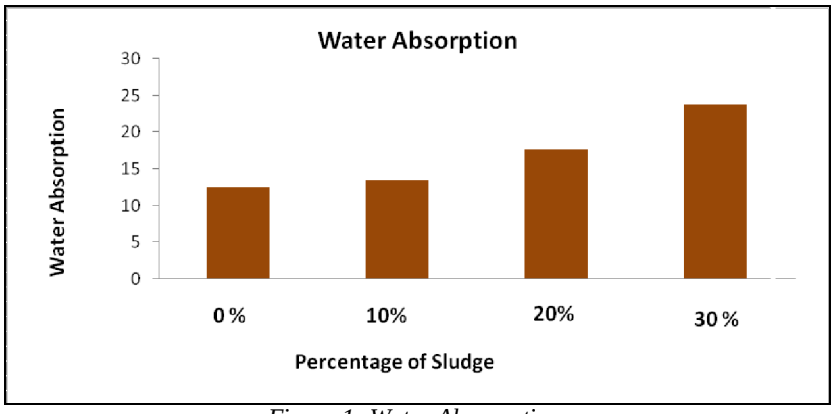

Figure 1: Water Absorpation

In general the test results indicate that the water absorption property for all mix proportions (10%, 20%) of sludge brick does not exceed 17.661%, but in case of 30% sludge brick the water absorption is 23.829%. Hence it shows that the normal clay bricks absorb less water as compared with the sludge bricks.

4.2.2. Compressive Strength

From the test results, the percentage of sludge increases, the compressive strength of the bricks goes on decreasing. Thus 10%, 20% sludge can be used in the construction work while 30% due to its low compressive strength can‘t be used for any work.

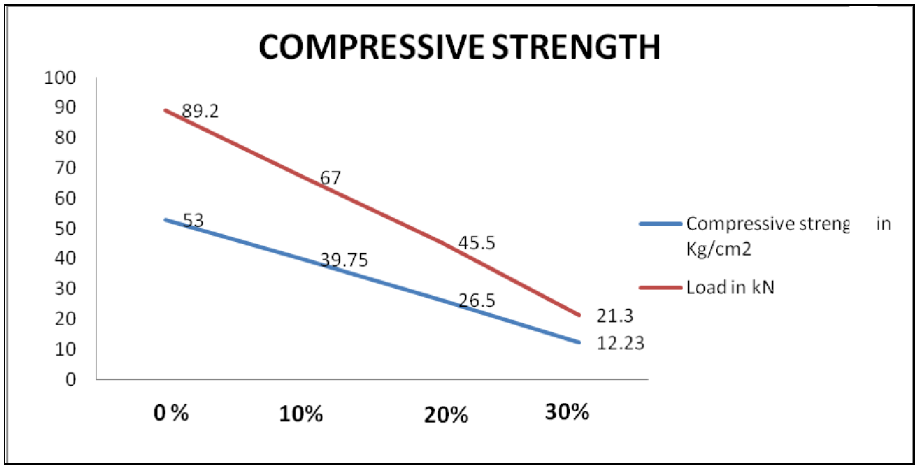

Figure 2: Compressive Strength

4.2.3. Effect of Efflorescence

No efflorescence was found in the case of the original bricks. While in case of 10%, 20% and 30% there is a slight presence of salt was observed.

5. Conclusion

The present study is made to find the most effective way of utilizing waste material such as sugarcane sludge in brick production. From the experiments conducted for this purpose, the following conclusions have arrived.

- The water absorption property of all sugarcane sludge brick is lesser than the water absorption of normal good quality burnt clay brick (20%) except 30% sludge bricks whose absorption value is 23.829%
- The compressive strength of all mix proportions of sugarcane sludge bricks is lesser than 140kg/cm^2. Hence it is weaker than conventional burnt clay bricks
- The shape of all mix proportions bricks was uniform except 30% sludge bricks whose edges weren‘t sharp and also do not have uniform shape.

These bricks require no skilled labour and can also be moulded into any shape and size depending upon the requirements similar to conventional bricks. Hence the proper study and analysis of these bricks may provide them as a good alternative and replacements for burnt clay bricks.

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