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# USE OF PAPER MILL SLUDGE AND COTTON WASTE IN CLAY BRICKS MANUFACTURING

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## ABSTRACT

A large amount of paper mill sludge waste & cotton waste is produced at a place where paper mill industry & textile industry is located respectively. So, many engineers are trying to convert a huge quantum of waste in to useful building material. Paper mill sludge & cotton waste as main raw material in the manufacture of bricks will not only create ample opportunity for its proper and useful disposal but also help in environmental Pollution control to greater extent. This will not only minimize the waste disposal problem in cities but also will minimize health hazards and pollution problem.

**Keywords:** Paper Mill Sludge, cotton waste, composite bricks, compressive strength and water absorption

## INTRODUCTION

India is basically an agricultural country. Around 70 % people make their living on agricultural related work. But in past few years there is a rapid migration of population from villages towards big cities. This has caused social imbalance along with crowding of cities thereby putting thrust on basic amenities in big cities, namely food, cloth and shelter. Demand of shelter has given rise to demand of building materials like bricks, cements, steel, etc. Since, the production of building materials is limited, their prices are sky touching and due to fast production, quality is being also suffered bricks made up from paper mill sludge and cotton waste can reduce the above problem to some extent by using this composite bricks. This will also produce economical building material since the waste is reused which would otherwise have been wasted. Recent trend indicates that there is a continuous doubling of rates of building materials in a span of five years. This will not enable a common person to build his house easily. An attempt has been made to produce durable and economical bricks from clay added with varying proportions of paper mill sludge & cotton waste.

## METHODOLOGY

In this paper it is estimated to take paper mill sludge in semi-solid form and cotton waste material will be collected from processing unit. The paper mill sludge in semi-solid form will be mixed with

water in proper proportion & it is estimated to make samples of that material. It is estimated that to prepare one fully burnt clay brick, fresh clay of 4.5 kg is required. The bricks size will be 230 mm x 115 mm x 75 mm. The mixing has to be properly done by manual means. Nine Specimens for each waste means combination of paper mill sludge & cotton waste will be prepared in percentage like 5%, 10%, 15%, 20%, 25%, 30%, 40%, 50% will be prepared. I.e. total 90 specimens we are going to prepare. Then all specimens will dried for four days and afterwards the bricks will take for burning process. The bricks which we are going to burn at kiln temperature of about $700^0$C & estimated time for burning is 15 days.

After proper burning of bricks it is estimated to take some tests on it like compressive strength test, tensile strength test & water absorption test because our final aim is to prove that a bricks which is manufactured by the combination of paper mill sludge & cotton waste gives equal strength and stability as compared with traditional bricks.

The compressive strength test on bricks we are going to take on the Compression Testing Machine Then we are going to apply load axially to a uniform rate of 14 N/mm$^2$ (1400 kg/cm$^2$) per minute till failure occurs and note maximum load at failure

Water absorption test is used to determine the amount of water absorbed by bricks under specified conditions. After 24 hrs we are going to remove the bricks specimen & wipe out trace of water with damp cloth and will weigh the bricks specimen. Dry the specimen in oven at temperature of $105^0$c-$115^0$c to attain constant mass. Then we are going to cool the bricks specimen at room temperature and will take weight. Then, the results of this test will be recorded carefully. It is estimated to take bulk density for bricks.

## MANUFACTURING PROCESS

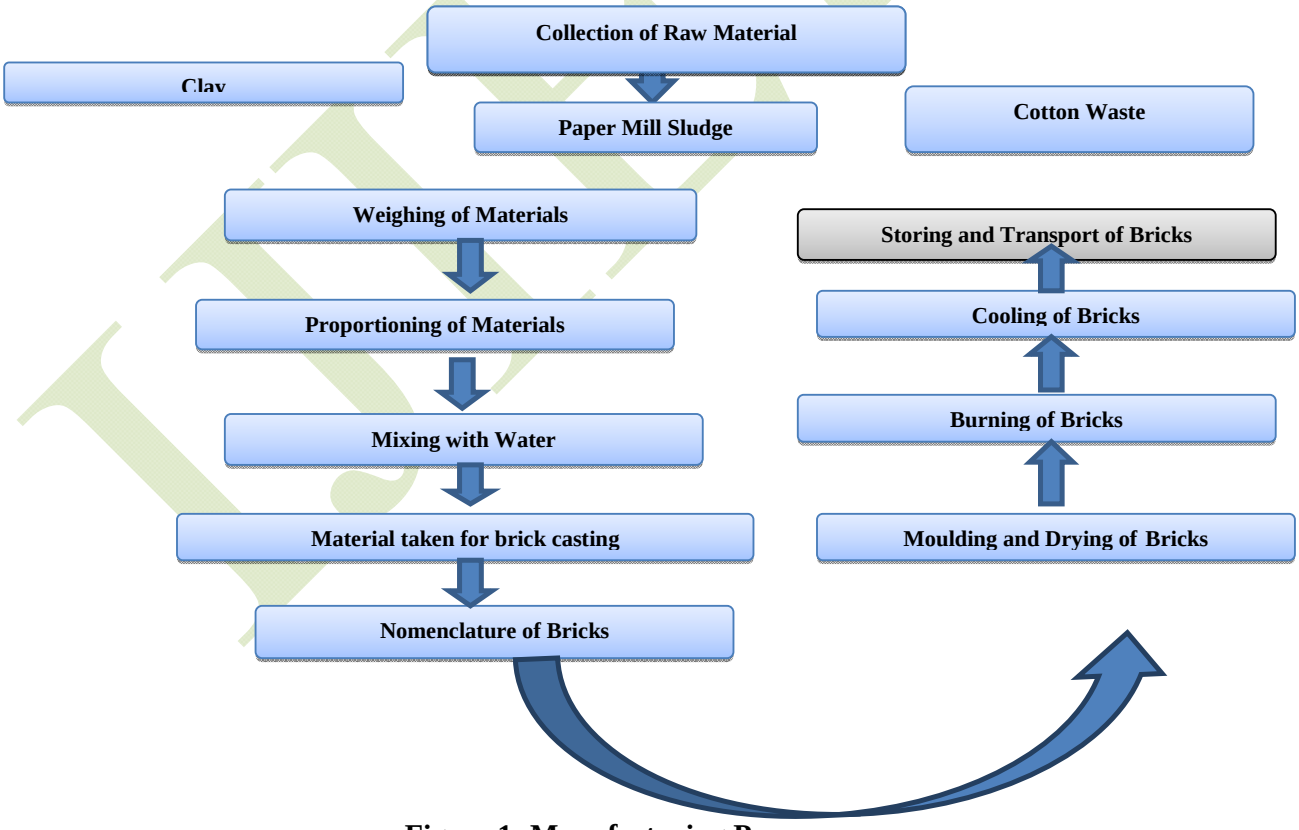



**Figure 1: Manufacturing Process**

## Physical requirements

Compressive strength-The bricks, when tested in accordance with the procedure lay down in IS 3495 (Part I): 1992 shall have a minimum average compressive strength for various classes as given. In figure, the compressive strength of any individual brick tested shall not fall below the minimum compressive strength specified for the corresponding class of brick. The lot shall be then checked for next lower class of brick. Water Absorption-The bricks, when tested in accordance with the procedure laid in IS 3495 ( Part 2) : 1992 after immersion in old water for 24 hours, water absorption shall not be more than 20 % by weight up to class 12'5 and 15 % by weight for higher classes.

**Figure 2: Compression Testing Machine**

### Determination of compressive strength

Scope-This standard covers the method of determination of compressive strength of burnt clay building bricks.
Reference- the Indian Standard IS 5454:1976 "Method of sampling of clay building bricks (first revision)" is a necessary adjunct to this standard.
General-
1. The dimensions shall be measured to the nearest 1 mm.
2. All apparatus & testing equipment's shall be calibrated at frequent interval.
3. The number of specimens for the test shall be selected as per IS 5454:1976.

## METHODS

### A. For solid bricks

**1. Apparatus**- A compressive testing machine, the compression plate of which shall have a ball seating in the form of portion of a sphere the centre of which coincides with the centre of the plate, shall be used.

**2. Preconditioning**- Removes unevenness observed in the bed faces to provide two smooth & parallel faces by grinding. Immerse in water at the room temperature for 24 hrs. Remove the specimen & drain out any surplus moisture at room temperature. Fill the frog(where provided) & all voids in the beds face flush with cement mortar (1 cement, clean coarse sand of grade 3 mm & down). Store under the dump jute bags for 24 hrs. Followed by immersion for clean water for 3 days. Remove and wipe out traces of moisture.

**3. Procedure**- Place the specimen with flat faces horizontal, and motor filled face upwards between two 3-ply plywood sheets each of 3 mm thickness and carefully centred between plates of the testing machine. Apply load axially at a uniform rate of 14N/mm2 per minute till failure occurs and note the maximum load at failure. The load at failure shall be the maximum load at failure. The load at failure shall be the maximum load at which the specimen fails to produce any further increase in indicator reading on the testing machine.

**NOTE-**In place of plywood sheets Plaster of Paris may be used to centre a uniform surface for application of load.

The paper shall be as given below:

Compressive strength in n/mm2

(Kg/cm2)= Maximum load at failure in N (Kg) Average area of the bed faces in $mm^2$ ($cm^2$)

## PROCEDURE

Place the perforated faces of the brick between two 3-ply plywood sheets each of 3mm thickness and carefully centre between the places of the testing machine. Apply the load axially a uniform rate of 14 $n/mm^2$ per minute till the failure occurs and note the maximum load at failure. The load at failure shall be the maximum load at which the specimen fails to produce any further increase in the indicator reading on the testing machine.

**NOTE-** In place of plywood sheets plaster of Paris may be used to ensure uniform surfaces for application of load.

The paper shall be given as- Compressive Strength in N/mm2 ($Kg/cm^2$) = Maximum Load at failure in N (Kg) the average results shall be papered.

**Figure 3: Water Absorption Test**

Determination of Water Absorption Test

**IS code for water absorption test is 3497:1992**

**scope**

This standard covers the method of determination of water absorption of burnt clay building bricks

**Reference**

The Indian standard IS 5454:1976 Method for sampling of clay building bricks is necessary adjunct to this standard

**General**

The dimension shall be measured to the nearest 1 mm

All apparatus and testing equipment's shall be calibrated at frequent intervals. The number of specimens for the tests shall be selected according to IS 5454: 1976

**Methods**

24 hour immersion cold water test

Apparatus

A sensitive balance capable of weighing within 0.1 percent of the mass of the specimen and a ventilated oven

Preconditioning

Dry the specimen in a ventilated oven at a temperature of 105 to 115 0 C till it attains substantially constant mass. Cool the specimen to room temperature and obtain its weight (M1). Specimen warm to touch shall not be used for the purpose

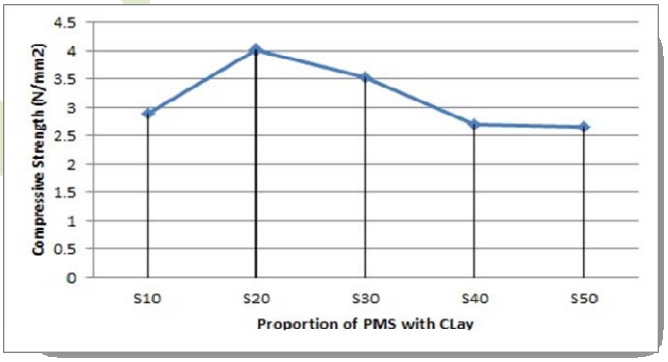
Procedure

Immerse completely dried specimen in clean water at a temperature of 27 + 2 0 C for 24 hours. Remove the specimen and wipe out any traces of water with a damp cloth and weigh the specimen. Complete the weighing 3 minutes after the specimen has been removed from water (M2)

**Results**

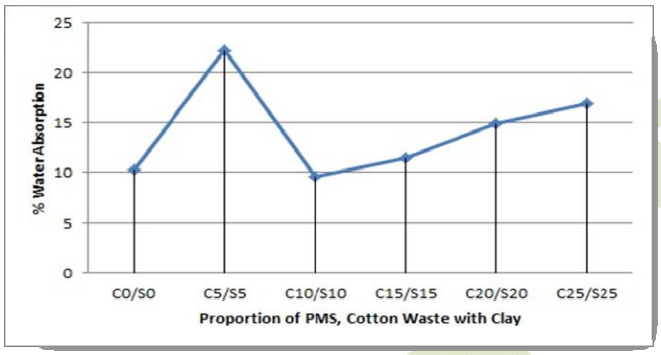
**A-Result of Compressive Strength Test on Bricks**

**Graph1: Proportion of PMS, Cotton Waste with clay vs. % Reduction in Compressive Strength**



**B-Result of water Absorption Test on Bricks**

**Graph 2: Proportion of PMS, Cotton Waste in Clay vs. % Water Absorption**




**Advantages of composite bricks**

**1. Sustainability-**

Paper mill sludge and cotton waste is some of numerous substance that cause air, water and soil pollution, disrupt environment. But the brick is better off, for paper mill sludge and cotton waste changes into a nontoxic product when mixed with clay. Thus it having the potential as a good potential as a building material.

**2. Cost analysis**

The bricks have equal compressive strength which eliminates the breakage during handling. These bricks will be available closer to paper mill and cotton manufacturing industries. Finding dealers in all major cities and towns wouldn't be a problem.

**3. Applicability**

The composite bricks will be available in several load bearing grades are suitable for use:-
a. Non-load bearing internal walls in low and medium size RCC structures
b. Non-load bearing internal or external wall in RCC structures.

The following points had been reached based on the experimental program executed in this research and limited on the tested material and testing procedure employed. Bricks can be successfully produced from paper mill sludge incorporated with cotton waste, under the conditions mixing proportions and manufacturing methods use in this study.
Based on the results for the experiment done on this composite brick for the proportion of C10/S10 we have received compressive strength is
Compressive strength = 3.529 N/mm2
% water absorption = 9.765 %
Bulk density = 1398.079 kg/m3

1. When normal clay is incorporated with 20% of combined waste the compressive strength % water absorption bulk density was found to be much similar to ordinary clay bricks.
2. 20% waste incorporated bricks are economical than ordinary clay bricks, so through this investigation for waste management and economical aspect 20% combined waste bricks are recommended further composite bricks have many advantages like

a. Economical
b. Environment friendly
c. Use of wastage

d. Equal compressive strength, bulk density, and % water absorption as compared with traditional bricks

3. It may conclude that use of paper mill sludge and cotton waste in brick manufacturing is techno economically viable so this brick manufacturing is potential field of application where in large scale utilization of paper mill sludge and cotton waste is possible.
4. From the previous chapter it can be understood that this composite bricks are better alternative to conventional burnt clay bricks in structural functional and economic aspect. by use of this aspect we can convert waste into wealth.
5. 1770 m3 per million of bricks per annum and 0.116 hectare per million of bricks per annum is loss so loss of land There is a alternative need to produce more building materials for various elements of construction and role of alternative and innovative options would come into sharp focus and environmental considerations for the traditional materials.
6. Further the composite bricks which made from paper mill sludge and cotton waste have many advantages like- Economical, Environmental friendly, equal compressive strength, water absorption and bulk density as compared with traditional clay bricks.

From the previous chapters it can be understood that composite bricks are better alternative to conventional burnt clay bricks in structural and economical aspect

## CONCLUSION

### A. Compressive Strength Test

According to Indian Standard 1077:1992 class designation 3.5, the average compressive strength should not be less than 3.5 $N/mm^2$, and the received results are Compressive test on bricks C10/S10 is 3.529 $N/mm^2$ so, this brick comes under class designation 3.5 under Indian Standard 1077:1992

### B. Water Absorption Test

According to Indian Standard 1077:1992, water absorption should not be more than 20% by weight, and the received results is Water absorption test on bricks C10/S10 is 9.765% so, this brick comes under higher class

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