Examining Strength Comparison Of Sawdust Added Clay Bricks In Different Percentage

1Dr. S.S. Syed Enayathali, 2Dr.V.Sathish Kumar
1Assistant Professor, 2Assistant Professor
1Bit Campus, Anna University, Trichy-21. Tamilnadu, India,
2Government college of Engineering,Dharmapuri,Tamilnadu, India

***Abstract* - Now a days the use of clay bricks in building construction is widely used. Such a time clay bricks to be used in better option of building construction as examining compared to the conventional clay bricks which is made by only on clay bricks in a cost view of point and better suitability. India is a developing country so here the construction of compound walls and building plays an important role. Nowadays most of the work related with building is done. Thus the clay bricks is light weighted and then to be used another option of prefabricated compound wall construction. This experimental investigation design bricks by using Indian standard code of dimension 230mm x 110mm x 75mm. In this project main mix design proportions is 2%, 3%, 6% and 9% of sawdust with jaggery water mixer. Ultimate aim of this study is to increase the compressive strength and weight to be reduction of clay bricks and to reduce the waste materials available in saw mills and timber industries. Then the water absorption to be noted and examine strength comparison in the specimen tests.**

***keywords* - Compressive Strength, Water Absorption, Clay bricks, Sawdust, jaggery**

I. INTRODUCTION

Bricks are one of the oldest building materials dating back to 7000BC where they were first found in southern turkey and around Jericho .The first bricks were sun dried mud bricks. Fired bricks were found to be more resistant to harsher weather conditions, which them much more than reliable bricks for use in permanent buildings, mud bricks would not have been sufficient. Fired bricks were useful for absorbing any heat generated throughout the day, then releasing in at night. Bricks now are more commonly used in the construction of buildings than any other materials except wood .Brick and terracotta architecture is dominant within its field and a great industry has developed and invested in the manufacture of many different types of bricks in all shapes and colours. Good quality bricks have a major advantages over stone as they are reliable, weather resistant and can tolerate acids, pollution and fire.

II. FACING TYPES OF BRICKS

Facing bricks are uniform in colour and shape can now be made to any almost any specification, texture, colour and size.

Wire cut extracted bricks – for the type of brick the clay is extracted and cut by info individual bricks. This is very cost effective way of producing bricks and is done by an automated production process. These bricks are readily available in a variety of styles and colours.

Stock bricks – are usually slightly more expensive than wirecut bricks. These are a soft mud brick which are sometimes irregular in shape.

Handmade bricks - as previously discussed above, handmade bricks are very desirable and individual in shape and colours. This bricks is most expensive sort of the bricks.

Fletton or London bricks – is a brick made from clay extracted from south east of England which contains traces of oil which is burnt off during the burning process in the kiln.

Arch and clinker bricks – this is used for bricks which are burned immediately. They are over burnt and sometimes distorted in shape. Body, cherry and hard bricks. These bricks are a higher quality and are generally the bricks that were in the centre of pile of bricks which have been burned. These bricks are top bricks as they have a higher overall quality and finish.

Salmon, pale or soft bricks – which were nearer to the outside of the kiln during burning which means they are slightly under burnt. These bricks are generally used for the interior walls.

Water stuck bricks – this type of bricks is a soft mud moulded bricks. It uses alluvial clay which deposited at the end of the last ice age. The clay is pressed into mould lined with silicate. When the bricks are removed from the mould, they are left with a textured effect which can only be achieved using this method. This type of bricks looks old and handmade even when now.

Engineering bricks – Engineering bricks are called so due to their overall strength and water absorption. The class A bricks has strength of 125 N\mm² and water absorption of less than 4.5%. Class B Engineering bricks have strength greater than 75 N\mm² and water absorption of less than 7%. Traditionally used in the Civil Engineering, these bricks are also useful for damp courses and structural design.

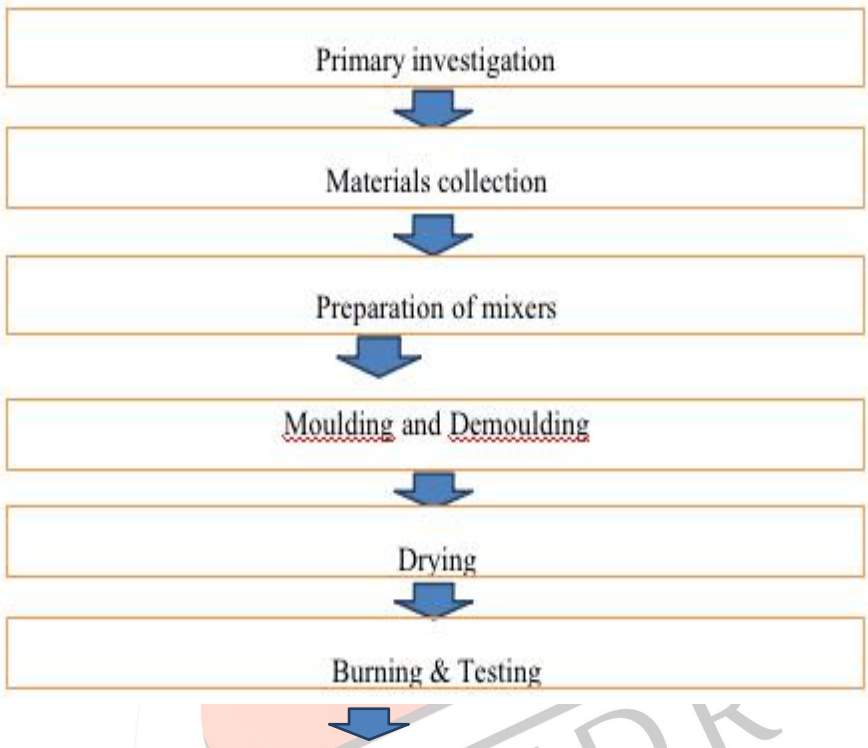
III. SAWDUST CLAY BRICKS

Sawdust or wood waste is a by- product of cutting, drilling, grinding, sanding or otherwise pulverizing wood or any other material with saw or other tools, it is also the by-product of certain animals, birds and insects which live in wood, such as the woodpecker and carpenter. It will present a hazards in manufacturing industries, especially in terms of its flammability. Sawdust is the main components of the clay bricks in manufacturing. Thus the sawdust is used as an addictive in the production of building materials, in this experiment sawdust is used as an addictive in the production of fired red clay brick.

Advantages of sawdust clay bricks

- Pollution level will reduce due to reducing saw dust in saw mill and other timber industries respectively.
- Increase the compressive strength of the bricks.
- Self-weight of concrete clay bricks is reduced by using the sawdust.
- Cost of the clay bricks is reduced due to reducing of raw materials.
- Reducing of Utilization of clay due to replacement of by saw dust.

IV. METHODOLOGY



V. MATERIALS COLLECTION

Materials used

- Clay
- sawdust
- Jaggery

Clay (maximum composition material)

Clay is a mineral made of earth or inhospitable rock. It is capable of mixing with water. It results a plastic glutinous mass when moulded and dried. It combines with one or more clay minerals with a small quantity of metal oxides and organic matter.

Due to their water content, the clays are plastic and become hard, brittle and non-plastic upon firing. Depending on the soil content present in the clay, it can appear in various colors from white to dull grey or brown to deep orange-red. White to cream or buff colors will produce if the clay containing up to 3% of iron oxide and change to pinks and reds when the iron oxide content increases between 8 and 10%. A range of grey and brown colors can be obtained by adding manganese dioxide from 1 to 4%.

Table.1 Chemical Properties of Clay

Sl.No	Composition Minerals
1	Iron
2	Magnesium
3	Alkali metals

4	Alkaline earths
5	Hydrous aluminium
6	Phyllosilicates

Fig.1Clay Saw Dust

Waste pieces of timber and other plywood industries which is available in dust or powder form. Saw dust is taken as 2%, 3%, 6% and 9% total weight of clay.

Table.2 Physical Properties of Saw Dust

S.No	Test	Result
1	Specific gravity	2.14
2	Optimum moisture content	19.80

Fig.2 Saw Dust

Jaggery

Jaggery is a traditional non-centrifugal cane sugar consumed in some countries in Asia and the Americans. It is product of date or palm sap without separation of **the** molasses and crystals, and can vary from golden brown to dark brown in colour.

Fig.3 Jaggery

Table. 3 Chemical Properties of Jaggery

Carbohydrates	Concentration of 100g jaggery
Zink	0.2-0.4

Chloride	0-5.3
Copper	0.1-0.9
Sodium	19-30
Calcium	40-100
Magnesium	70-90
Phosphorous	20-90

VI. TEST SPECIMENS

The process of making clay bricks as per the specifications provided by Indian Standards and Indian Road Congress is detailed.

Mixing of Raw Materials

Clay bricks contains clay, sawdust and jaggery mixer water is used. Clay brick is designed nominal mix provided by indian standards specifications.

Initially sawdust and jaggery with water is mixed thoroughly as per the nominal mix proportion calculated previously. Then the clay of about is taken 3.5 kg with the mixture of sawdust to be added as per the specifications provided by indian standards. Then the water is added to the mixture and it is mixed by hand mixing method because of low volume of clay mixers.

The same method used in first mix of preparation is repeated when clay constantly (94%) taken with added 2%, 3%, 6% and 9% of sawdust. Jaggery water mixer added for the strength to be improved. Sawdust easily found on wood mils or saw wood places. Again same process is repeated when replacing saw dust instead of clay which reduces the self-weight of clay bricks. It is not only reducing weight of clay bricks but also reducing compressive strength of clay bricks. After adding saw dust same process is taken for clay mixer preparation.

Below the test to be conducted in clay bricks.

- Compressive Strength Test
- Water Absorption Test
- Efflorescence Test
- Shape and Size Test
- Soundness Test
- Hardness Test

Compression Test

IS 3495 (part 1):1992 code to be used compressive strength test. Compressive strength analyses were done using Universal Testing Machine available in the Department of Physics, Eastern University, Sri Lanka. The testing procedure was performed according to the Sri Lankan Standards, which is similar to ASTM C67-05.

Initially, the brick surfaces were smoothen to get smooth parallel surfaces to form a good surface contacts between the brick and the two pressing discs fitted in the machine.

The compressive strength of bricks was measured with the help of a pressure gauge of sensitivity 2 kg.cm-2 attached to the Universal Testing Machine. The maximum force applied to just break the brick (or force at failure), width, and length of the block were recorded. Three bricks from each set were measured and the average compressive strength.

Table.4 Compressive Loads on Specimen

S.NO	Mixers	Compressive strength N/mm²
1	Mix 1	2.95
2	Mix 2	1.96
3	Mix 3	1.47

4	Mix 4	1.18
5	Mix 5	0.89

Fig.4 Compressive Test

Water Absorption Test

Clay bricks are taken. Then the bricks are dried to a constant weight by placing them in oven at 110° C± 5°C. This can take 24 hours or more time. After that the specimens are weighed individually.

Dry bricks are then immersed in water for 24 hours at room temperature. After 24 hours, the bricks are taken out from water. Each sample is dried and weighed individually within 3 minutes after that it is taken from the water. The water absorption is calculated by the equation. Finally, the average water absorption values are taken. As per IS 3495 (part):1992 code to be used in clay bricks water absorption test.

$$\text{Water absorption \%} = \frac{\text{wet weight} - \text{dry weight}}{\text{dry weight}} \times 100$$

Fig.5 Water Absorption

Specimen and Testing Details

Clay bricks burning in 7 days, then burning out the clay bricks to be air curing in 1 day. Next tests to be conducted. The universal testing machine is available in the concrete lab using compressive strength test.

Finally, 12 numbers of clay bricks were prepared for separate tests for various percentages of adding sawdust clay bricks.

Fig. 6.Test Specimens

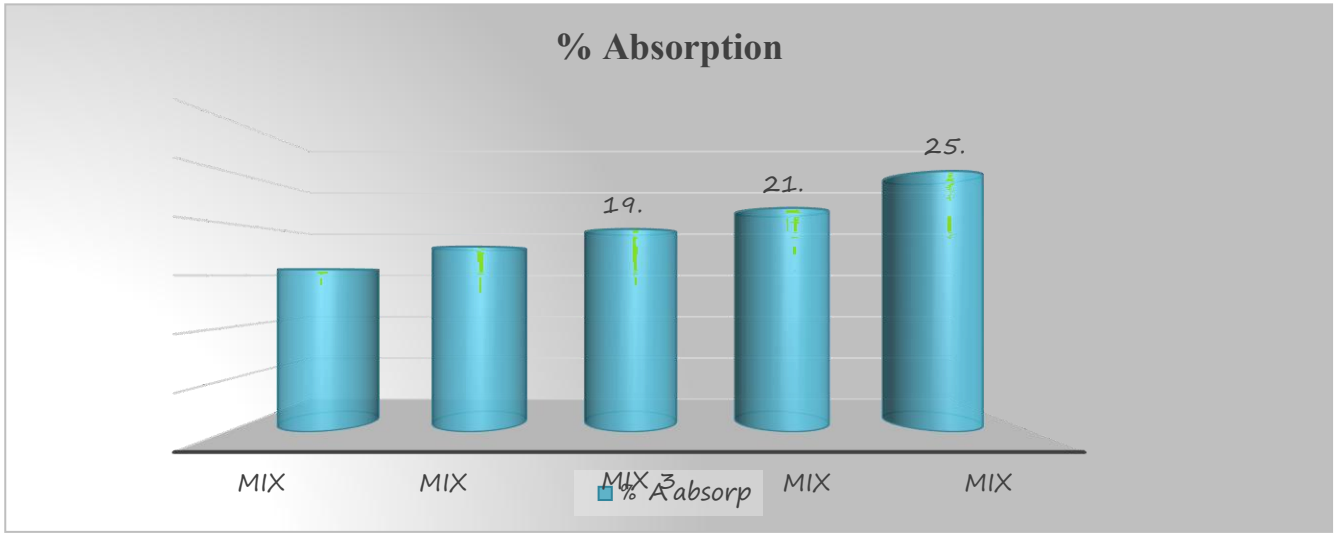
II. WATER ABSORPTION TEST

As per IS 3495(part 3):1992 code to be consider for Clay bricks dry in a ventilated oven at a temperature of 105 to 115°C till it attains substantially particular weight. Then the clay bricks cold water to be used. Cool the bricks to room temperature and obtain its weight .Bricks warm to touch shall not be used for the purpose Then the water absorption not more than 20% thus the bricks to be below the minimum strength so it is to be neglected. Higher classes water absorption 12.5 % - 15 %.

Table. 5 Water Absorption Test

S.NO	Mixer	Weight of dry (kg)	Weight of wet (kg)	% Absorption
1	Mix 1	2.954	3500	15.6
2	Mix 2	2.550	3100.7	17.76
3	Mix 3	2.394	2972.1	19.45
4	Mix 4	2.266	2885.6	21.47
5	Mix 5	2.125	2502.8	25.01

Above the absorption of water content to noted information, which weight of the sawdust to be increased at that water absorption to be increased. Minimum water absorption is to be crossed the mix 4,5 thus the mixer clay added with 0.210 g and 0.315 g. So thus the mixers don't consider for our project details. Because porosity of the bricks increased less solid materials be strength decreased. Porosity has to be increased which lead to other water related deflect such as frost action and efflorescence. Mix 1,2,3 is good water absorption results to be consider in our project. Is solid condition is confirmed.



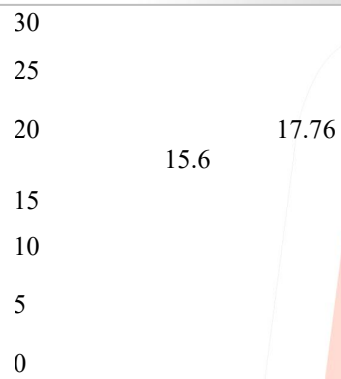


Fig. 7 Water Absorption Test Relationship between water absorption and compressive strength

Compressive strength is mostly depends on the water absorption.

$$\text{Compressive strength} = \frac{1}{\%\text{ of water absorption}}$$

So water absorption to be affected on the strength of the bricks. Water absorption will get and the increased compressive strength will get decreased.

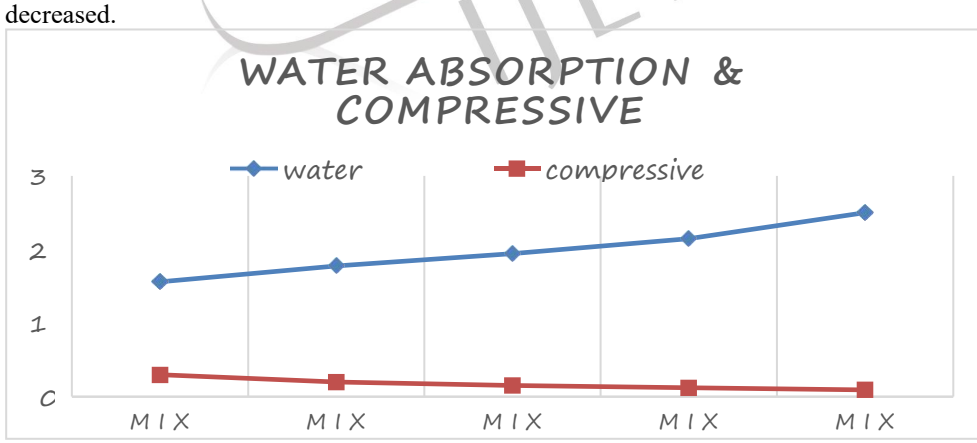


Fig.8 Relation between Water Absorption & Compressive Strength

III. CONCLUSIONS

- By results of clay bricks testing the weight of bricks is differed depending on the sawdust material replaced. Conventional clay bricks gets 3.2 kg of average weight after hardened. But other bricks are light weighted.
- By adding the sawdust 2% at that time clay bricks weight is high when compared to other adding percentages

respectively, Adding the jaggery water mixer to be increased soundness and hardness because its composition chemicals.

- Compressive strength of clay bricks has to be increased by adding of sawdust decreased and is high when 2% of sawdust and 100 ml of jaggery water mixer.
- Conventional bricks with standard material gives the compressive strength of 3.5 to above N/mm².
- Water absorption test is calculated at various percentages of sawdust adding clay bricks to be 6% and 9% is to very low strength.
- Good future reception is great the weight is less and the strength of it is going to happen and it will be an example of such innovations. After doing various studies of different compounds

REFERENCES

[1] K.C.P. Faria, R.F. Gurgel, J.N.F. Holanda. "Recycling of sugarcane bagasse ash waste in the production of clay bricks", Environmental Management, Vol. 101. Pp. 7-12, 2012

[2] J.A. Cusido, L.V. Cremades, M. Gonza´lez. "Gaseous emissions from ceramics manufactured with urban sewage sludge during firing processes", Waste Management, Vol. 23. Pp. 273–280, 2003.

[3] S.P. Raut, R.V. Ralegaonkar, S.A. Mandavgane. "Development of sustainable construction material using industrial and agricultural solid waste: A review of waste-create bricks", Construction and Building Material, Vol. 25. Pp. 4037-4043, 2011.

[4] M.I. Carretero, M. Dondi, B. Fabbri, M. Raimondo. "The influence of shaping and firing technology on ceramic properties of calcareous and non-calcareous illitic–chloritic clays", Applied Clay Science, Vol. 20. Pp. 301– 306, 2002.

[5] VorradaLoryuenyong, ThanapanPanyachai, KanyaratKaewsimork, ChatnarongSiritai. "Effects of recycled glass substitution on the physical and mechanical properties of clay bricks", Waste Management, Vol. 29. Pp. 2717– 2721, 2009.

[6] C. Martínez-García, D. Eliche-Quesada, L. Pérez-Villarejo, F.J. Iglesias-Godino, F.A. Corpas-Iglesias. "Sludge valorization from wastewater treatment plant to its application on the ceramic industry", Journal of Environmental Engineering, Vol. 95. Pp. 5343-5348, 2012.

[7] Michele Dondi, GuiaGuarini, MariarosaRaimondo, Chiara Zanelli, Daniele DalleFabbriche, Antonio Agostini. "Recycling the insoluble residue from titania slag dissolution (tionite) in clay bricks", Ceramic International, Vol. 36. Pp. 2461-2467, 2010.

[8] Ismail Demir. "Effect of organic residues addition on the technological properties of clay bricks", Waste Management Research, Vol. 28. Pp. 622–627, 2008.

[9] M. Dondi, G. Guarini, M. Raimondo, C. Zanelli. "Recycling PC and TV waste glass in clay bricks and roof tiles", Waste Management, Vol. 29. Pp. 1945–1951, 2009.

[10] Kae Long Lin. "Feasibility study of using brick made from municipal solid waste incinerator fly ash slag", Journal of Hazardous Materials, Vol. 137. Pp. 1810–1816, 2006.

[11] D. Eliche-Quesada, C. Martínez-García, M.L. Martínez-Cartas, M.T. Cotes-Palomino, L. Pérez-Villarejo, N. CruzPérez, F. A. Corpas-Iglesias. "The use of different forms of waste in the manufacture of ceramic bricks", Applied Clay Science, Vol. 52. Pp. 270-276, 2011.

[12] Ismail Demir, Mehmet Orhan. "Reuse of waste bricks in the production line", Building and Environment, Vol. 38. Pp. 1451–1455, 2003.

[13] Pai-Haung Shih, Zong-Zheng Wu, Hung-Lung Chiang. "Characteristics of bricks made from waste steel slag", Waste Management, Vol. 24. Pp. 1043–1047, 2004.