A Study on Various Types of Soil Bricks by Using Sugarcane Fibres Waste

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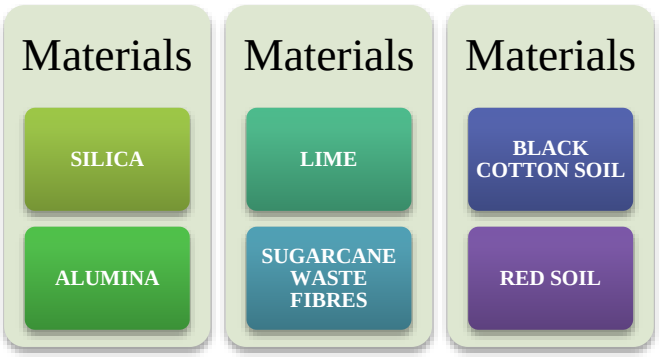
Abstract — Generally in India ranks in the world sugarcane production. In India the major districts growing sugarcane in Andhra Pradesh is Anakapalle. The bricks have been playing a significant role in a building of construction materials the main aim is to making a construction material of Bricks by using sugarcane waste fibres with black cotton soil and red soil. The sugarcane waste fibres are added to the bricks as an add on material of 0.2%,0.3%,0.4%,0.5%,0.6%,0.7&0.8% of the total weight of the brick and the lime powder is carry from 4-5 %to the total weight of brick it helps to prevent the brick from cracks.

Keywords: Sugar Cane Fibers, Black Cotton Soil, Red Soil, Silica Fume

I. INTRODUCTION

Over a past year there are widely ranges of alternative bricks in the construction. In this we are using a black cotton soil &red soils are used for manufacturing the building material of Bricks by using sugarcane waste fibres the Sugarcane waste fibres are produced from extract the juice from sugarcane the waste fibres are used as a fuel for production of heat, energy and electricity. The main ingredients of bricks are Alumina, silica, lime, iron oxide and sugarcane waste fibres are locally available materials These materials have provided a good environmental benefits and low cost advantage for the building material of Bricks The black cotton soil and red soils are easily available in India contex .it provides a good strength

MATERIALS:



1) SILICA: Silica is the sand .it stops unfinished bricks from twisting, Shrinkage and cracking. The bricks will more shape and uniformly textured the higher the sand content. High quality bricks have a silica content of 50-60 % by weight. Never the less too much silica weakens the bond between the clay particles in brick and makes it fragile. The ratio of silica and alumina affect brick durability significantly.
2) ALUMINA: clay primary constituent element is alumina .it serves as a cementing agent in unfinished brick .compared to other ceramics like lime, sand, alumina has higher heat resistance and corrosion resistance. The good quality bricks are made up of alumina of 20-30% by weight, Alumina bricks are more resistant to acidity, oxidation and metal fluid corrosion than fireclay bricks, although they are less resistant to thermal shock
3) LIME: The good quality bricks have 2-5 % of lime is present in the bricks. Lime prevents shrinkage of raw bricks .sand alone us infusible but it slightly fuses at kiln temperature in presence of lime .Excess of lime causes the brick to melt and hence it's shape is lost by adding the lime to the black cotton soil it prevent from the cracking
4) BLACK COTTON SOIL: Another name of black cotton soil is black dirt it is primarily found in Deccan trap area. The majority of India states including Andhra Pradesh and Tamilnadu have soil is typically black cotton. Moreover, it is extensively utilised in agriculture. The main component of black cotton soil is an inorganic clay with a larger percentage of fine grained particles , increased plasticity, compressibility and expansive the properties
5) RED SOIL: iron makes up a large portion of red soil composition giving it's colour This soil has a PH that ranges from neutral to acidic and is lacking in potash, nitrogen, humus, phosphoric acid, magnesium, and lime. It is the result of old crystalline and metamorphic rocks weathering, The specific gravity of red soil ranges from 2.6 to 2.8
6) SUGARCANE WASTE FIBRES :Sugarcane waste fibres is the fibrous residue of the cane stalk left after crushing and extraction of the juice .it consists of fibres , water and relatively small quantities of soluble solids – mostly sugar the fribres consists mainly of cellulose27%,pentosans 30% , lignin 20% and Ash 13%

A. Atterberg's Limit for Black Cotton Soil

S No	Description	Black Cotton Soil
1	Specific gravity	2.57
2	Fineness modulus	2.81
3	Liquid limit (wl)	48.64 %
4	Plastic limit (wp)	31.24%
5	Shrinkage limit	11.0 %
6	Plasticity index	32.4 %

B. Composition of Black Cotton Soil

S No	Description	Percentage (%)
1	Silica as sio2	56.3
2	Iron as Fe2o3	8.9
3	Alumina as Al2o3	21.5
4	Magnesium as Mgo	8.7
5	Sulphate as So3	4.6

The above composition observed from D. Chandan Kumar et al. 2020 "Experimental studies on composite bricks using black cotton soil, fly ash and granite waste"

II. NEED FOR THE STUDY

Black cotton soil has very low safe bearing capacity results, high pores and swelling property and more shrinkage characteristics due to which in construction field, replacement of the black cotton soil is done with any other soil which has better geotechnical characteristics, hence it is presumed that it can be partially used for manufacturing of bricks process using additive. And ordinary clay is little expensive in local Visakhapatnam, A.P. area where as black cotton soil is cheaply available.

III. OBJECTIVES:

Objectives Part - I
- To study the engineering properties of brick
- To reuse the sugarcane waste as fibres in the manufacturing of bricks

Objectives Part - II
- To enhance the compressive strength of the brick by using the sugarcane waste fibres

Objectives Part - III
- To make a Economical and Eco friendly brick
- To provide a better employment in local areas

IV. METHODOLOGY:

A. Selection of Site:

The ground should be of plain surface. The site should be connected with communicating roads for transporting materials etc. the site should offers all facilities to the workers and the materials used for the manufacturing of bricks are easily available near to the site to reduce the transportation charges

Fig. 1: Black cotton soil

Fig. 2: Red soil

Fig. 3: Sugarcane fibres

B. Collection of Clay and Sugarcane Waste Fibres:

For the manufacturing of bricks, the black cotton soil and red soil are collected at the site of where easily available.

Sugarcane waste fibres is another by product of the sugar production process. It is dry and pulp residue left behind when sugarcane stalk are crushed. Sugarcane waste is a fibrous material containing cellulose as it's main component. It is produced in large quantities across the world. It is a kind of waste material that comes from the sugar industry.

C. Preparation of Clay:

After the removal of top layer, the clay is dug out from the ground and spread on the plain ground. Cleaning in this stage, the clay is cleaned by separation of stones and vegetable matter etc. If large quantity of particulate matter is present and then the clay is washed and screened.

D. Weathering To Atmospheric Conditions and Room Temperature:

Fig. 5: Mixing with water

Weathering is a process whereby dugout clay is softened by adding a small amount of water and left exposed to the atmosphere. After this, the clay is heated and allowed to undergo weathering for several weeks. Once impurities have been removed, the clay is then left exposed to the weather for a few months. Which entire process known as weathering

E. Blending Of Clay:

The process of blending clay involves mixing the soil with sand in appropriate proportions to adjust the soil's composition, with the option of adding additional additives with necessary. To achieve the desired consistency for moulding, a moderate amount of water is added, but the water content must be carefully controlled to avoid problems during moulding and drying. Excessive moisture can impact the final bricks size and shape, making it essential to add the right amount of water during the mixing process .the mass is then uniformly kneaded with spades to ensure proper blending.

Fig. 7,8: BLENDING OF CLAY

F. Moulding:

Moulding is a critical aspect of brick manufacturing, as it involves shaping prepared clay into rectangular brick shape .Hand moulding can be an effective method for small scale brick production, particularly if labour is in expensive. Hand moulding involves the use of rectangular wooden moulds with open top and bottoms, with handles projecting from the longer side of the mould. The ground is levelled and sand or Ash is sprinkled over it .The wet mould is then placed on the ground filled with tampered clay, the hands are used to press the clay into all corners of the mould .Any excess clay is removed using a wooden strike or wire.

Fig. 8: Moulding of brick

G. Drying:

Drying is an important step in brick manufacturing as bricks are typically contain between 7-30% moisture depending on the method of manufacture. The primary aim of drying is to remove this moisture which helps to control shrinkage during burning while also save a fuel and time .The amount of drying shrinkage that occurs is influenced by clay's pore spaces and the water content .adding sand ground burnt clay can reduce Shrinkage, increase porosity and make drying more efficient. Typically it takes about 3-4 days of exposure to bring the moisture content down to around 3%, which increases the strength of the bricks and makes them safer to handle

Fig. 9: Drying process

H. Burning:

The temperature range for melting low and high melting clay is 900°c- 1100°cand 1000°c-1250°c respectively and careful cooling is necessary to prevent cracking. Clay products are typically vitrified to point viscosity, but paving bricks required complete verification for maximum hardness and toughness. The burning process takes place in either a

temporary clamp or a permanent kiln, with former being temporary and the latter being permanent.

The standard size of brick provided by IS: 2212 (1991) is 19cm × 9cm × 9cm.

Fig. 10: Burning of Bricks

I. Tests: Compressive Strength

Compressive strength was conducted as per IS: 3495 (part-lll). Compressive strength test is conducted in compressive testing machine for finding out compressive strength specimens of every percentage of vermiculite, perlite and sawdust. Specimens are tested one by one. The first specimen is put on compressive testing machine and applied pressure till it breaks. The ultimate pressure at which brick is crushed is taken into account then maximum load to area of specimen gives compressive strength .Compressive strength can be calculated by using

compressive strength=maximum load at failure / average area of the brick

Fig. 11: Strength test by CTM

WATER ABSORPTION

Water absorption test was conducted as per IS: 3495(part-lll). For finding out water absorption use 3 specimens for every percentage of vermiculite, perlite and sawdust. First, we are taken weight of burnt brick then immersed the brick in water for 24 hours. Then taken weight of brick immersed in water then water absorption is calculated by using the below formula

Water absorption=Ww-Wd/Wd*100

Fig. 12, 13: Water Absorption Test

V. RESULTS:

S.No	Type of brick	Compressive strength (N/mm2)	Water absorption (%)
1	Normal Clay brick	9.8	22.66
2	Black cotton soil brick without fibres	4.2	29.80
3	Black cotton soil brick with fibres 5gm	4.7	28.45
4	BCB with fibres 10 gm	5.1	30.21
5	BCB with fibres 15 gm	5.64	31.04
6	BCB with fibres 20 gm	4.9	31.93
7	BCB with fibres 25 gm	4.2	32.47
8	BCB with fibres 30gm	3.8	33.2

Table 1: Test results of black cotton soil brick

Minimum average compressive strength of brick shall not be less than 7.5 N/mm2 when tested as per IS-3495 (Part- 1):1976

S.No	Type of brick	Compressive strength (N/mm2)	Water absorption (%)
1	Red soil brick without fibres	5.4	24.94
2	Red soil brick with fibres 5 gm	5.2	24.2

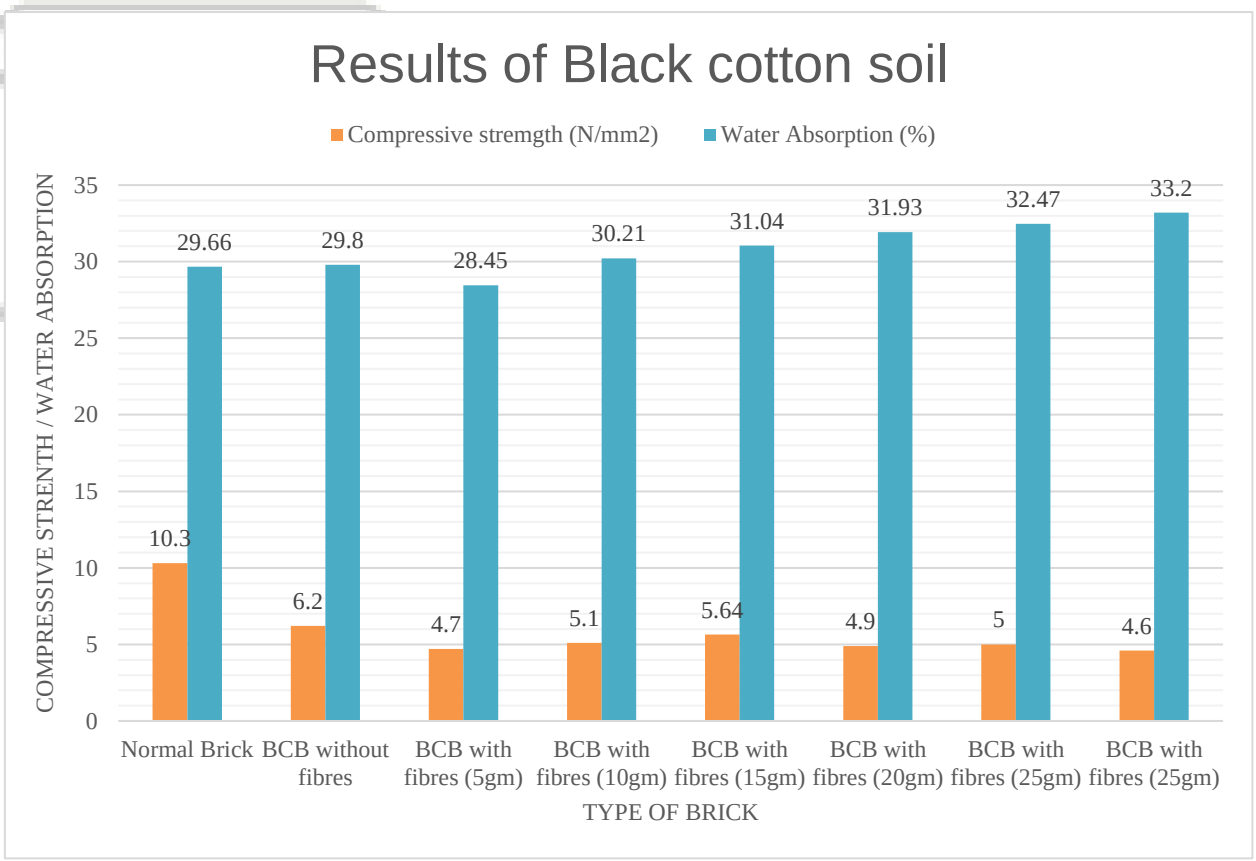
3	RSB with fibres 10 gm	5.9	25.87
4	RSB with fibres 15 gm	6.02	25.68
5	RSB with fibres 20 gm	6.13	26.11
6	RSB with fibres 25 gm	5.96	27.06
7	RSB with fibres 30 gm	5.89	28.13

Table 2: Test results of red soil brick

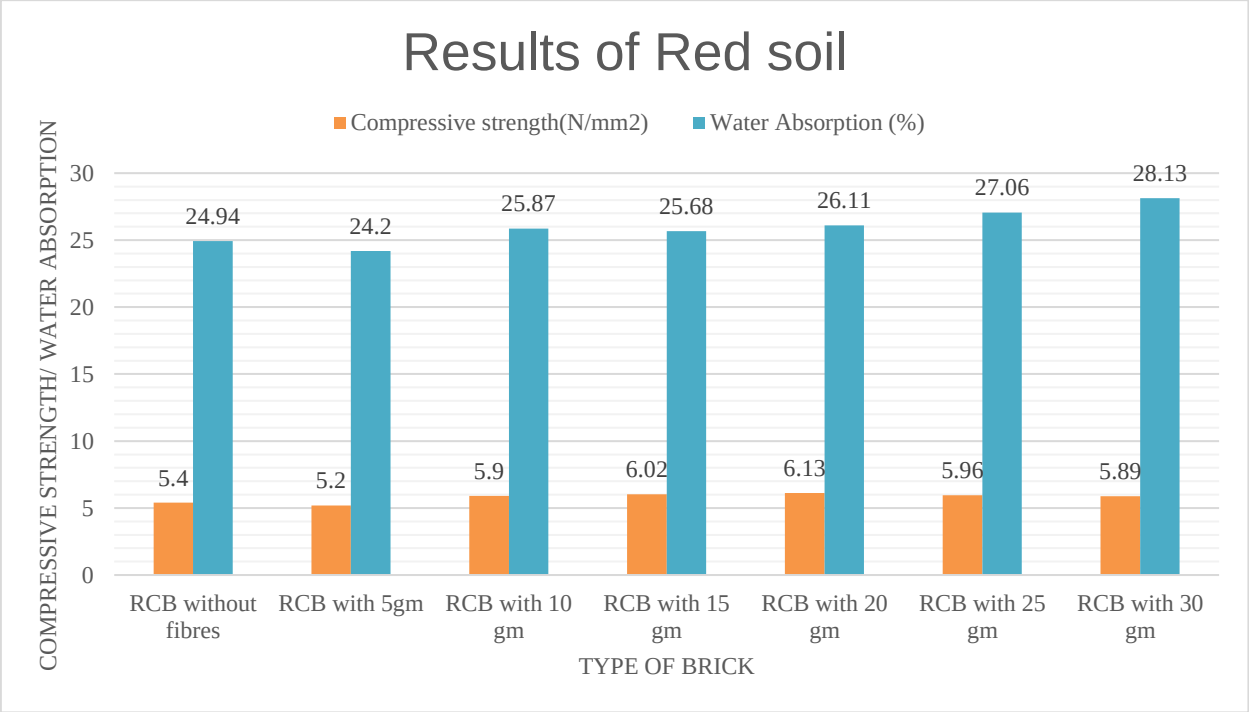
S.No	Type of brick	Compressive strength (N/mm2)	Water absorption (%)
1	Black cotton soil(40%) + Red soil(60%) without fibres	6.1	26.81
2	Black cotton soil(40%) + Red soil(40%) + Cement(20%) without fibres	6.7	27.12
3	Black cotton soil(40%) + Red soil(40%) + Cement(20%) without fibres with fibres 10 gm	6.9	25.87
4	Black cotton soil(40%) + Red soil(40%) + Cement(20%) without fibres with fibres 15 gm	7.4	27.68
5	Black cotton soil(40%) + Red soil(40%) + Cement(20%) without fibres with fibres 20 gm	8.6	28.13
6	Black cotton soil(40%) + Red soil(40%) + Cement(20%) without fibres with fibres 25 gm	7.2	30.06
7	Black cotton soil(40%) + Red soil(40%) + Cement(20%) without fibres with fibres 30 gm	6.2	33.13

Table 3: Test results of Black cotton soil(40%) + Red soil(60%) + Cement

Dinesh W.Gawatre et al 2014 "Strength Characteristics of Different Types of Bricks" stated that the composition of ingredients into the manufacturing of bricks.



Graph 1: Test results of black cotton soil brick



Graph 2: Test results of Red soil brick

VI. CONCLUSION:

- The study focused on the use of different percentages of sugarcane waste fibres with black cotton soil and red soil in brick production
- The bricks made with sugarcane waste fibres had higher strength compared to traditional bricks
- The result shows that the use of sugarcane waste fibres in brick production can improve the overall quality and strength of the bricks, while also providing a sustainable solutions for waste management

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