Utilization of Waste Plastic in Making of Bricks with Black Cotton Soil

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Abstract **- Over a past few decades, there are wide ranges of alternatives available in the field of construction with the changing in the raw material for the particulars. As concern with the brick there are some invention like fly ash brick, concrete blocks and brick. Here we are using black cotton soil as a raw material for the bricks and also using some admixture to alter the properties of the black cotton soil and plastic waste.**

Plastic is a non-bio-degradable substance which takes thousands of years to decompose that creates land as well as water pollution to the environment. The quantity of plastic waste in Municipal Solid Waste (MSW) is expanding rapidly. It is estimated that the rate of usage is double for every 10 years. The Plastic usage is large in consumption and one of the largest plastic wastes is polyethylene (PE). The utilization of earth-based clay material resulted in resource depletion and environmental degradation. As amount of clay required for brick is huge, in this project these waste plastics are effectively utilized in order to reduce the land space required to dump these wastes. This creates the prevention from various harmful diseases. Polyethylene (PE) bags are cleaned and added with fine aggregate at various ratios to obtain high strength bricks that possess thermal and sound insulation properties.

This is one of the best ways to avoid the accumulation of plastic waste. It also helps to conserve energy, reduce the overall cost of construction and hence in this project, an attempt made to manufacture the plastic soil bricks by utilizing the waste plastics. This research study describes the feasibility of using black cotton soil as a raw material with some additional stabilizer and waste plastic in the brick production.

Index Terms **- Polyethylene terephthalate, waste plastic, plastic soil bricks, construction.**

I.INTRODUCTION

A Brick is a block, or a single unit of a ceramic material used in a masonry construction. Typically, bricks are stacked together or laid as brick work using various kind of mortar to hold the bricks together and make a permanent structure. Moreover, the India and China are the major consumer countries of the bricks. Bricks are typically produced in common or standard sizes in bulk quantities. They have been regarded as one of the longest lasting and strongest building materials used in 20th century. Manufacturing of bricks produces harmful gases which results in substantial air pollution. India produces over 60 billion clay bricks annually resulting in strong impact on soil erosion and unprocessed emissions. Use of traditional technologies in firing the brick resulted in significant local air pollution. The standard size of brick provided by IS: 2212 (1991) is (19cm × 9cm x 9cm). The large volume of materials required for infrastructure construction is potentially a major area for the reuse of waste materials. Recycling the plastics has advantages since it is widely used worldwide and has a long service life, which means that the waste is being removed from the waste stream for a long period. Reuse of waste plastics has environmental benefits not only related to the safe disposal of bulk waste, but also to the reduction of environmental impacts that arises due to burning of plastics.

II. RESEARCH OBJECTIVE

The main objective of this project is to determine the compressive strength and water absorption percentage of brick made by using black cotton soil and waste plastic materials.

III .MATERIALS AND PROPERTIES

Materials: Materials required for experiments are: 1) Black cotton soil 2) Fly ash 3) Waste plastic.

3.1 Black cotton soil: - Manufactures of bricks from black cotton soil presence many difficulties because of its highly shrinkage nature and presence of line nodules coal ash is therefore used as an opening material. However, the quality of brick made is far from satisfactory as it has high water absorption and only 30 to 60 kg/sq.cm compressive strength. Black cotton soils are inorganic clays of medium to high compressibility and form a major soil group in India. They are characterized by high shrinkage and swelling properties. This black cotton soils occurs mostly in the central and western parts and covers approximately 20% of the total area of India. Black cotton fill hard in dry straight and possess a good shearing strength which drops down drastically on addition of moisture.
Properties: -
1.Specific gravity: - Specific gravity of soil solids is defined as the weight of soil solids to weight of equal volume of water. In effect, it tells how much heavier (or lighter) the material is than water. This test method covers the determination of specific gravity of soil solids. Its standard value is 2.65
Equation for specific gravity
G = (W2-W1) / (W2-W1) - (W3-W4)
Result: Specific gravity (G) = 2.31
2.Standard proctor compaction test: - Compaction is the application of mechanical energy to a soil so as to rearrange its particles and reduce the void ratio. It is applied to improve the properties of an existing soil or in the process of placing fill such as in the construction of embankments, road bases runways, earth dams and reinforced earth walls.

Observations:

- Quantity of soil = 3kg.
- Wt. of cylinder = 2008g
- Diameter of cylinder = 10cm.
- Volume of cylinder =997.45cc

Sr. No	Wt. of Cylinder + Compacted Soil (G)	Wt. of Compacted Soil (G)	Average Moisture Content (%)	Wet Density (G/Cc)	Dry Density (G/Cc)
1	3614	1606	8	1.61	1.27
2	3764	1756	10	1.76	1.54
3	3840	1832	13	1.84	1.56
4	3928	1920	16	1.92	1.61
5	3913	1905	18	1.90	1.56
6	3894	1886	20	1.89	1.52
7	3840	1832	22	1084	1.51

Table No. 1 Standard proctor compaction test

3.California bearing ratio test: - The California bearing ratio test is penetration test meant for the evaluation of subgrade of roads and pavements. The results obtained by these tests are used with the empirical curves to determine the thickness of the pavement and its component layers. This is most widely used method for the design of flexible pavement

3.2 Fly ash: -Coal contains trace levels of trace elements (such as arsenic, barium, beryllium, boron, cadmium, chromium, thallium, selenium, molybdenum and mercury), many of which are highly toxic to humans and other life. Therefore, fly ash obtained after combustion of this coal contains enhanced concentrations of these elements and the potential of the ash to cause groundwater pollution is significant. By using fly ash as a building material, It reduces dead load on structures due to light weight. Due to high strength, practically no breakage during transport and use.

Sr. No.	Components	Percentage (%)
1	SiO2	35-39
2	Fe2O3	0.5-2
3	Al2O3	20-33
4	CaO	5-16
5	Mgo	1-5.5
6	So3	0.5-1.5

Table No. 2 Chemical composition of fly ash.

Sr. No	Test	Standard
1	Specific Gravity	2.62%
2	Fineness	83%

Table No. 3 Physical properties of fly ash.

3.3 Waste plastic: -By definition the plastics can be made to different shapes when they are heated in closest environment it exists in the different forms such as cups, furniture's, basins, plastic bags, food and drinking containers, and they are become waste material.
Accumulation of such wastes can result into hazardous effects to both human and plant life. Therefore, need for proper disposal, and, if possible, use of these wastes in their recycled forms, occurs. This can be done through process of plastic management. Waste management in respect to plastic can be done by recycling. If they are not recycled then they will

become big pollutant to the environment as they not decompose easily and also not allow the water to percolate in to the soil and they are also poisonous.

Properties:

Coefficient of Thermal Expansion 7 x 10-3/ºC
Long Term Service Temperature 115 - 170ºC
Melting point 260ºC
Specific Gravity 1.3 – 1.4
Water Absorption0.07 – 0.10%

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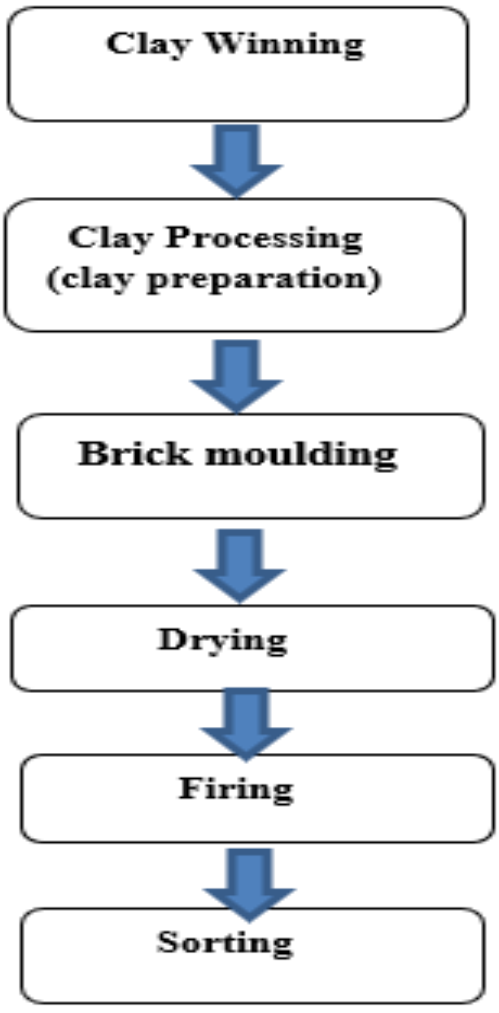
Table No. 4 Physical Properties of Plastic

IV. MANUFACTURING PROCESS



V. EXPERIMENTAL TEST RESULTS

The data obtained from the experimental investigations, On the basis on above methodology various test are performed on bricks. Following are the results obtained from experimental work.

According to IS 3495(Parts 1 to 4): 1992 Tests to be conducted for Bricks are:

1. Determination of Compressive Strength.
2. Determination of Water Absorption

Compressive Strength: The tests on Compressive strength of the specimen brick shall be calculated for 3 aspects after 7, 14 & 28 days of curing using the formula as follows,

$$\text{Compressive strength} = \frac{\text{Applied Max load x 1000 (N)}}{\text{Cross sectional Area } (mm^2)}$$

Sample No.	Plastic Percentage	Compressive strength
1	0	25
2	5	27.65
3	10	29
4	15	30
5	20	31.85

Table No .6 Compressive Strength Test

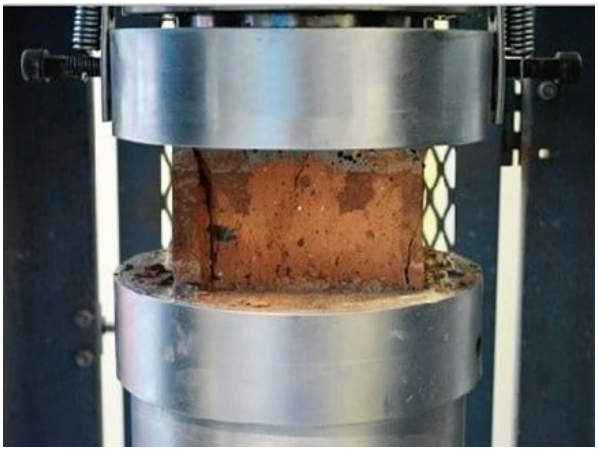


Fig. No.1 Crushing in UTM

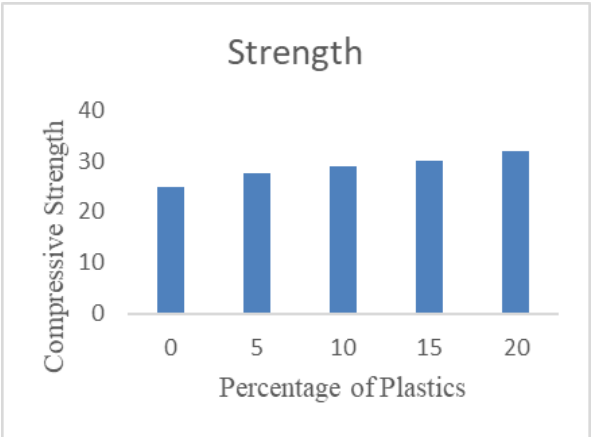


Fig.No. 2 Compressive Strength Test Result.

Water Absorption: Bricks should not absorb water more than 12% by its weight. The bricks to be tested should be dried in an oven at a temperature of 105oC to 115oC till attains constant weight cool the bricks to room temperature and weight (W1). Immerse completely dried and weighed (W1) brick in clean water for 24 hrs. at a temperature of 27±20oC. Remove the bricks and wipe out any traces of water and weigh immediately (W2).

$$\text{Water absorption in \%bywt.} = \frac{W_2 - W_1}{W_1} \times 100$$

Sample No.	Plastic Percentage	Water Absorption
1	0	0.22
2	5	0.13
3	10	0.10
4	15	0.08
5	20	0.074

Table No. 6 Water Absorption Test

Fig. No. 3 Bricks Soaked in water.

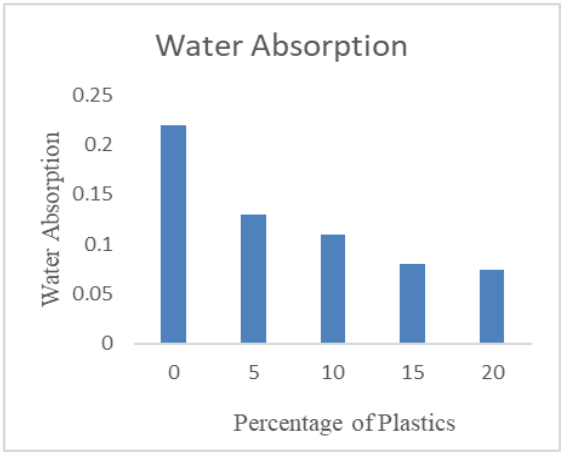


Fig.No.4 Water Absorption Test Result

VI.CONCLUSION

- Plastic soil bricks possess more advantages which includes cost efficiency, resource efficiency, reduction in emission of greenhouse gases, etc. They are made by black cotton soil which has very good bonding strength when is added with admixture. Plastic soil brick is also known as "Eco-Bricks" made of plastic waste. As plastic waste is harmful to all living organisms and also to nature and thus can be used for construction purposes. It increases the compressive strength compared to conventional bricks.
- By use of plastic soil bricks, the water absorption presence of alkalis was highly reduced. The strength of bricks produced using black cotton soil and plastic are expected to be greater compared to normal bricks. Owing to numerous advantages further research would improve quality and durability of plastic soil bricks.
- After preparing a brick out of plastic waste it can be concluded that it will be proved the helping reason for the rural and costal region people.
- Local people of this areas will be free from the hazardous issues from the waste around them and these brick will be used for redesign there houses which get lightly destroyed in the monsoon season due to rain.
- Will have great impact on reducing the environmental pollution created by plastic waste.
- Waste plastic which is available in everywhere, may be put to an effective use in bricks.
- Due to this approach the eco-friendly environment is being created.

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