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Development of Bricks using Industrial and Agricultural Waste

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Abstract

Brick is the most fundamental building material for house construction. In recent years, there has been a significant disparity between the availability of traditional building materials and their demand. As the industrialization activities occur they produce a variety of waste materials in India, including thermal power plants, municipal solid waste, agricultural waste and their disposal is one of the world's most pressing issues. Burning of rice straw in India, releases large amounts of air pollutants causing serious environmental problems. Fly ash is produced by coal-fired power stations, and it contains significant levels of potentially damaging environmental elements. Plastic is an extremely common substance that is currently utilized by almost everyone on the planet and their breakdown is a major issue. This research looks at how to make light-weight and cost-effective with appreciable compressive strength bricks using fly ash, plastic, rice straw and cement. Standard size brick samples were produced in order to achieve mechanically sound bricks. Brick samples were put through conventional tests under the optimum circumstances indicated. The bricks were found to produce a cost-effective, light-weight brick with comparable appropriate mechanical properties.

Keywords: Fly ash, plastics, rice straw, cement, brick, utilization of waste.

1. Introduction

For construction industry, the most significant materials are bricks. The traditional brick-making procedure has a number of flaws that must be addressed. Brick production used earth-based elements such as shale, clay and sand which cause resource depletion, energy usage and environmental deterioration. Brick industry is the prime contributor in degradation of environment. Huge quantity of toxic elements are emitted from brick kilns. In this study, waste materials are used to sort out the problems related to disposal and their use in construction materials. Plastic used is LDPE (low density polyethylene). These were taken in shredded form and replacement is done by weight. Rice straw is taken in chopped form. Fly ash is taken from coal combustion process in thermal power plants. It has pozzolanic character which can contribute to the strength of the final product and also an important advantage for the utilization of fly ash. The use of fly ash in construction materials is low which can be efficiently used for sustainable development. Cement is also used as binding material. The cement used is ordinary Portland cement.

Several studies have been done by using waste materials as construction materials. But the combination of these waste material are rarely examined together. This paper investigates the effect of all the waste products for making of bricks used in construction.

2. Mix Design Of Bricks

The constituents considered in preparing the sample bricks in this study is presented in following table.

Samples/Materials	Plastics	Rice straw	Cement	Fly ash
Sample 1	2.5	1	26.5	70
Sample 2	5	2	26.5	66.5
Sample 3	7.5	3	26.5	63

Sample 4	10	4	26.5	59.5
Sample 5	12.5	5	26.5	56

Table 1: Materials in Percentage by Weight

Samples/Materials	Plastics	Rice straw	Cement	Fly ash
Sample 1	50	20	530	1400
Sample 2	100	40	530	1330
Sample 3	150	60	530	1260
Sample 4	200	80	530	1190
Sample 5	250	100	530	1120

Table 2: Materials by Weight in grams

3. Methodology

- Collection of materials
- Batching
- Mixing
- Moulding
- Curing

3.1 Collection of materials

Plastics used are LDPE (low density polyethylene) is a soft, light weight plastic material. For example plastic bags, water bottles. These are collected locally from shops. Then it is converted into shredded form with the help of shredder machine with length up to 1 cm. Rice straw has been collected from village near Kanpur Nagar (U.P.). Then it is chopped with length ranging from 0.5 to 1 cm. Fly ash is collected from Parichha Thermal Power Station, Jhansi (U.P.). Cement used is Ordinary Portland cement (OPC) from local market. Water used is fresh drinking water free from impurities.

3.2 Batching

Batching refers to the process in which the quantity or proportion of materials are measured on the basis of either weigh or volume to prepare the mix. In this study, weigh batching is considered.

Figure 1: Shredded plastic

Figure 2: Chopped rice straw

Figure 3: Fly ash

Figure 4: Cement

3.3 Mixing

Mixing is simply defined as complete blending of the materials producing homogeneous and uniform mix of the given materials. Generally, there are two types of mixing, Hand mixing and mechanical mixing. In this project, we adopted hand mixing. After batching, materials are mixed together by adding water.

Figure 5: Mixing Of Materials

3.5 Curing - The samples were kept to dry for 48 hours. Then the samples were allowed to cure for 14 days.

Figure 7: Samples After Removing Mould

3.4 Moulding

Before placing the mix, oiling is done from inner side of the mould with machine oil. Then the mix prepared is placed into the mould. In this project, the size of mould taken is of normal brick size (19x9x9 cm). Then remove the mould when the mix is slightly set.

Figure 6: Mix Placed into Brick Mould

4. Experimental Test Conducted

4.1 Compressive Strength-

After the curing phase, the compressive strength of the bricks is retained for testing. The bricks are placed in the calibrated compression testing equipment to test the specimens. After 7, 14, and 28 days, the specimen brick's compressive strength will be calculated.

Compressive strength = Applied max. load *1000(N)/Cross sectional area (mm^2).

The bricks are placed in a calibrated compression testing machine with a capacity of 50 tons and a load uniform delivered at a rate of 3.9 KN/sec.

4.2 WATER ABSORPTION TEST-

Bricks are subjected to water absorption tests in order to determine their durability. Water absorption tests can be used to determine the degree of compactness of bricks, as water is absorbed through pores in bricks. Water absorption by bricks increases as the number of pores increases. The bricks to be tested should be dried in an oven at 105°C to 115°C, until they reach a consistent weight, then cooled at room temperature and weighed (W_1). Immerse the (W_1) brick in clean water for 24 hours after it has been properly dry and weighed. Remove the bricks, wipe away any wetness, and weigh them right away (W_2).

W.A. in % by wt. = (W_2) - (W_1)/(W_1)

5. TEST RESULTS-

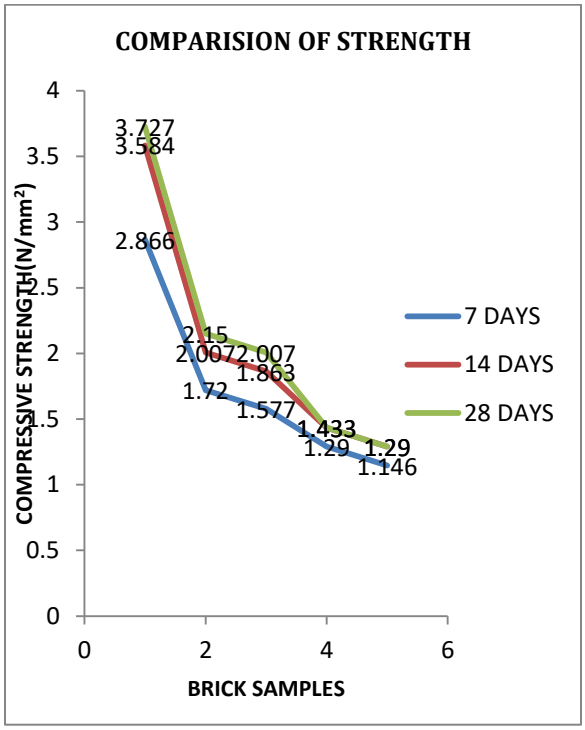
5.1 COMPRESSIVE STRENGTH TEST RESULT-

COMPRESSIVE STRENGTH (7 DAYS)	
SAMPLE	**C.S.(N/mm²)**
Sample 1	2.866
Sample 2	1.720
Sample 3	1.577
Sample 4	1.290
Sample 5	1.146

COMPRESSIVE STRENGTH (14 DAYS)	
SAMPLE	**C.S.(N/mm²)**
Sample 1	3.584
Sample 2	2.007
Sample 3	1.863
Sample 4	1.433
Sample 5	1.290

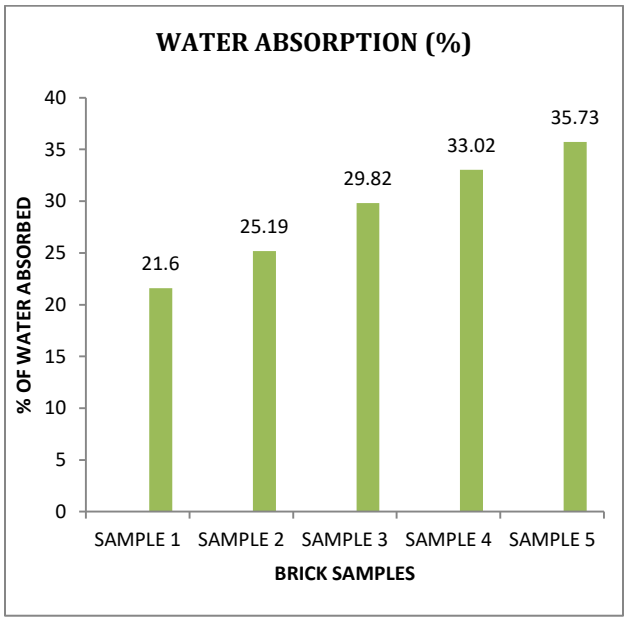
COMPRESSIVE STRENGTH (28 DAYS)	
SAMPLE	**C.S.(N/mm²)**
Sample 1	3.727
Sample 2	2.150
Sample 3	2.007
Sample 4	1.433
Sample 5	1.290

From results it can be determine that the sample 1 after 14 days have attain minimum compressive strength as per the IS code i.e. 3.5 N/mm². A slight increment is observed in strength of other samples. Sample 4 and 5, almost gives same strength after 14 days and 28 days.



5.2 WATER ABSORPTION TEST RESULT-

WATER ABSORPTION			
SAMPLE	DRY WEIGHT (gm)	WET WEIGHT (gm)	% ABSORPTION
SAMPLE 1	2182.5	2654	21.60
SAMPLE 2	1769.5	2215.25	25.19
SAMPLE 3	1678	2178.5	29.82
SAMPLE 4	1490	1982	33.02
SAMPLE 5	1125	1527	35.73



6. FUTURE PERSPECTIVES-

• By making green use of waste substances including plastics, fly ash, and rice straw, troubles related to their disposal may be avoided.

• By changing clay withinside the manufacture of bricks, the lack of fertile soil and agricultural vicinity may be decreased to a more extent.

• Unfired bricks emit no carbon dioxide.

• The traditional technique of manufacturing bricks pollutes the air. Air pollutants may be reduced via way of means of enforcing new unfired brick techniques.

7. CONCLUSIONS-

Plastics, fly ash, and rice straw have all been used in the past to make bricks with clay or sand separately, according to earlier study. In this study, various waste materials are combined to make bricks, completely replacing the need of clay and sand. The specific findings in this study with regard to various unfired bricks led to the following conclusions.

• By making bricks with fly ash, plastics, rice straw, and cement, it can be concluded that the mix proportion used in sample 1 can achieve the minimum compressive strength of bricks i.e. 3.5 N/mm2 .

• Adding more shredded waste plastics and chopped rice straw would result in a lower compressive strength than the minimum value determined by IS code for third class bricks.

• Water absorption increases as the percentage of shredded plastic and chopped rice straw used in brick production increases.

• As the ratio of shredded plastic and chopped rice straw in the brick increased, the brick became lighter.

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