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Creative Construction Using Waste and Residual Materials in Cement Bricks

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ABSTRACT

In this paper the attempts are made to find out the possibility of using pond ash and stone crusher dust and compare with burnt clay bricks. A large part of the cement is replaced by pond ash and stone crusher dust used as an additive in different compositions and the bricks are made as per the conventional standard codes of practice at a brick manufacturing plant. The properties then analysed are compared with those of conventional brick.

Keywords: Pond Ash, Stone Crusher Dust, Bricks, Cement, Clay, Mix Design, Standard Proctor Test, Water Absorption, Casting, Curing, Compressive Strength Test, Economy, Environment, Sustainability.

I. INTRODUCTION

In thermal power plants, coal is burnt to heat the water in order to generate steam, which is in turn used to run the turbines. Pond ash is the waste material produced from the boilers and is also known more commonly as wet fly ash because it is obtained from the wet disposal of fly ash. The generation of this pond ash poses as an environmental threat and utilizing it constructively is an innovative step in engineering research and management. Pond ash utilization in building materials have many advantages like cost effectiveness, environmental friendly, increases in strength and also conservation of natural resources and materials [1].

All standard components used in the formation of these bricks are: (1) Pond Ash, (2) Stone Crusher Dust, and (3) Cement. The study aims at complete generation of an unconventional brick from the physical and chemical testing of raw materials to the casting of bricks and compressive strength test. The objective of the project is to reuse waste and residual materials to reduce cost of construction and environmental pollution without compromising with the required characteristics of the subject.

II. METHODS AND MATERIAL

Pond Ash

The pond ash was obtained from thermal power plant and the physical and chemical composition was studied in laboratory. The material was found to be safe for use as construction material and standard tests were performed as per Indian Standard codes of practice.

Table 1. Physical Properties of Pond Ash

S.N.	Proprties	Pond Ash
1.	Lime Reactivity of Pond Ash	0.66
2.	Specific Gravity	2.16
3.	Bulk Density in Loose State	824 kg/m^3
4.	Bulk Density in Compacted State	990 kg/m^3
5.	Atterberg's Limits Liquid Limit Percentage	47.3

6.	Grain size distribution Sand% Silt% Clay%	 72 28 NIL
7.	IS Classification	SP-SM

Stone Crusher Dust

The crusher dust is created at quarrying or construction sites and is generally regarded as a pollutant. But with proper processing and utilization, it can effectively alter the properties of the pond ash brick. The crusher dust features gray or brown and the size is perfectly fine. In most situations, these products are used as the cement aggregate to form a specific texture. The dust could be used to make other products. In summary, in the construction industry, the crusher dust plays an important role. The dust comes from the stones and it retains the stones' benefits. For example, the dust is produced with high resistance to heat and the natural stones mean no harm to the environment. Thereby, compared with the chemicals, the dust would not pollute the environment over time.

Cement

The cement used was tested for all physical and chemical characteristics as per Indian Standard Code of Practice and used in minimum amount in the brick mix design.

Water

The water used for mixing and curing should be clean and free from injurious quantities of alkalis, acid, oils, salts, sugar, organic materials, vegetable growth and other substances that may be deleterious to the brick. The pH value should not be less than 6.

STANDARD TESTS

The detailed tests performed in the project are as follows:

Standard Proctor Test (Light) on Pond Ash

This test was performed in accordance with IS 2720-Part 7 (1980). 3 Kg of pond ash was taken and the water is added to it with the help of graduated cylinder at 2% increments by weight of pond ash. The mould with base plate attached is weighed to the nearest 1 gm. The extension collar is to be attached with the mould. Then the moist mix in the mould is compacted in three equal layers, each layer being given 25 blows from the 2.6 Kg rammer dropped from a height of 310 mm. The extension is removed and the compacted soil is levelled off carefully to the top of the mould by means of a straight edge. Then the mould and mix is weighed to the nearest 1 gm. The mix is removed from the mould and a representative soil sample is obtained water content determination. The test helps determine the optimum moisture content of mix, maximum dry density and water absorption of the pond ash.

Mix Design

The required raw materials like fly ash, pond ash, lime, gypsum and sand have to be mixed as per the ratio in pan mixer. These mixed materials are conveyed to the brick mould through the conveyor. After processing, as per required size of bricks were casted and taken in pallet truck for curing purpose. At early stages, bricks were cured by normal water curing and then by sprinkling of water.

Compressive Strength Test on Brick

This test was performed in accordance with IS 3495-Part 1 (1992). Unevenness observed in the bed faces of bricks is removed to provide two smooth and parallel faces by grinding. It is immersed in water at room temperature for 24 hours. The specimen is then removed and any surplus moisture is drained out at room temperature. The frog and all voids in the bed face are filled with cement mortar. It is stored under the damp jute bags for 24 hours followed by immersion in clean water for 3 days. The specimen is placed with flat faces horizontal, and mortar filled face facing upwards between two 3 ply plywood sheets each of 3 mm thickness and carefully centered between plates of testing machine. Load is applied axially at a uniform rate of 14 N/mm^2 per minute till

failure occurs. The maximum load at failure is noted down. The load at failure is considered the maximum load at which the specimen fails to produce any further increase in the indicator reading on the testing machine. The test helps determine compressive strength of cement bricks.

PROCEDURE

The experimentation is done to study the effect of pond ash in clay-pond ash burnt bricks. The clay is replaced with pond ash. The pond ash is mixed with the local clay, which is being used for making the bricks [2]. The mixtures of clay and the pond ash with different percentage by weight are prepared. These mixtures are mixed thoroughly by adding the appropriate amount of water, are used to make the clay-pond ash bricks. The prepared bricks are then air dried in an open atmosphere for 4 - 5 days. Thereafter, these bricks are fired in a central portion in a traditional way as practiced. All the bricks are taken out from the Kiln as per usual procedure, cooled and thereafter transported to the material testing laboratory. The flow chart of the process is given in the Figure-1.

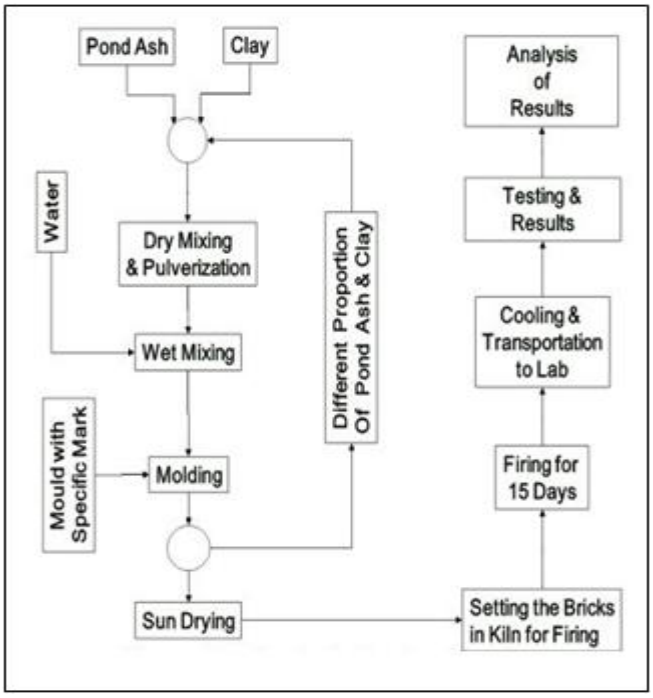

Figure 1. Flow Chart showing Experimental Procedure.

III. RESULTS AND DISCUSSION

The results from the tests conducted on pond ash bricks are finally compared with the results obtained for conventional burnt clay bricks. The cost of the production of both bricks is also compared. The project work was found to be-

- Safe in design
- Adequate in strength
- Durable
- Economic
- Environmentally friendly

Additionally, the project creatively uses materials such as pond ash and stone crusher dust which might otherwise have to be discarded, thus reducing cost of generation of newer raw materials for basic construction units.

IV. CONCLUSION

Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions. Authors are strongly encouraged not to call out multiple figures or tables in the conclusion these should be referenced in the body of the paper.

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