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FLY ASH BRICKS

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ABSTRACT

Fly Ash bricks can be extensively used in all building constructional activities similar to that of common burnt clay bricks. The fly ash bricks are comparatively lighter in weight and stronger than common clay bricks. Since fly ash is being accumulated as waste material in large quantity near thermal power plants and creating serious environmental pollution problems, its utilisation as main rawmaterial in the manufacture of bricks will not only create ample opportunities for its proper and useful disposal but also help in environmental pollution control to a greater extent in the surrounding areas of power plants. Also 180 billion tones of common burnt clay bricks are consumed annually approximately 340 billion tones of clay- about 5000 acres of top layer of soil dug out for bricks manufacture, soil erosion, emission from coal burning or fire woods which causes deforestation are the serious problems posed by brick industry. The above problems can be reduced some extent by using fly ash bricks. The object of this project is to represent the information regarding Fly Ash bricks and plant, properties and their uses in a most concise, compact and to the point manner. And also in this project various laboratory experiments were carried outon fly ash bricks samples. Some of them are Compressive strength study, water absorption study etc.

Keywords: coal fly ash, structural bricks, cement, sand, Fly Ash Brick, Compressive Strength, Clay Bricks.

I. INTRODUCTION

Fly ash is the by-product of coal combustion collected by the mechanical or electrostatic precipitator (ESP) before the flue gases reach the chimneys of thermal power stations in very large volumes. All fly ash contain significant amounts of silicon dioxide (SiO_2), aluminium oxide (Al_2O_3), iron oxide (Fe_2O_3), calcium oxide (CaO), and magnesium oxide (MgO) however, the actual composition varies from plant to plant depending on thecoal burned and the type of burner employed. Fly ash also contains trace elements such as mercury, arsenic, antimony, chromium, selenium, lead, cadmium, nickel, and zinc. These particles solidify as microscopic, glassy spheres that are collected from the power plant‘s exhaust before they can ―flyǁ away ― hence the product‘s name: Fly Ash. Chemically, fly ash is a pozzolan. When mixed with lime (calcium hydroxide), pozzolans combine to form cementitious compounds. The power requirement of the country is rapidly increasing with increase in growth of the industrial sectors. India depends on Thermal power as its main source (around 65% of power produced is thermal power), as a result the quantity of Ash produced shall also increase. Indian coal on an average has 30% to 40% Ash and this is one of the prime factors which shall lead to increased ash production and hence, Ash utilization problems for the country. Fly ash is one of the numerous substances that cause air, water and soil pollution, disrupt ecological cycles and set off environmental hazards. It‘s also contains trace amounts of toxic metals which may have negative effect on human health and on plants and the land where the fly ash decomposed not gets reused.

During the India day by days the growth of development is increased that requires of electricity generated from the thermal power plant and this plant gives residue in the form of Fly Ash in major quantity. The rate of generation of Fly Ash far exceeds the increasing growth rate of its user. In the next ten years, the target of 95 % use of Fly Ash likely bring into existence.

If one considers the expected generation of Fly Ash over the next two decades, the volume projected is gigantic and its use program will have to be far more challenging than what is perceived today. In construction industries clay bricks were used in 180 billion tons

of common burnt clay bricks are consumed annually approximately 340 billion tons of clay about 5000 acres of top layer of soil dug out for bricks manufacture, soil erosion, emission from coal burning or fire woods which causes deforestation are the serious problems posed by brick industry. Continuing use of clay bricks in the construction industry will lead to extensive loss of fertile top soil.

This could be a devastating environmental hazard. High demand for clay bricks would result in price hike of clay bricks. To keep the cost of building materials in a reasonable range, we should opt in for alternative building materials like fly ash bricks and hollow or solid blocks. The material required for the fly ash bricks as Fly ash, lime and gypsum are available in mutual proximity in many regions. An economical alternative to conventional burnt clay bricks will be available if these materials can be used to make bricks and hollow blocks of adequate strength. Lime and gypsum are usually available either from mineral sources or may be procured from industrial wastes.

High fineness, low coal content, and rounded particle shape are, in general, favorable properties for use in cement and concrete. The amount of cement or lime or lime plus gypsum required to achieve a certain strength depends on the amount of free lime available in the fly ash.

Fly ash does not modify the hydric properties of the bricks but it does make them lighter. In fact, all the bricks with fly ash have a lower density. Fly ash bricks show less damage than conventional bricks when exposed to salt crystallization cycles. This improvement is due to the reduction of the surface area of the bricks, i.e. the reduction of the volume of the smallest pores, the ones that cause the most damage to the bricks due to soluble salt crystallization. The addition of fly ash can enhance the quality of the brick, although for restoration purposes if too much fly ash (P10 wt. %) is added, this can spoil the aesthetic appearance of the buildings being restored, due to excessive color differences. Bricks with larger amounts of fly ash could, however, be considered for use in the construction of new buildings.

II. METHODOLOGY

MANUFACTURING PROCESS

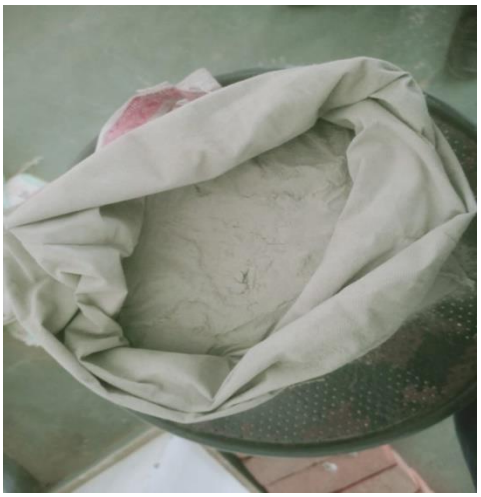
Fly ash, lime, sand and gypsum are manually fed into a pan mixer where water is addedin the required proportion for intimate mixing.

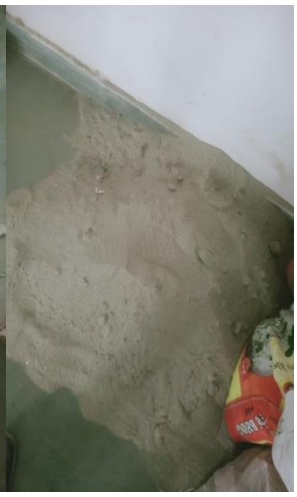
The proportion of the raw material is generally in the ratio 60-80% of fly ash 10-20% sand and 10% cement, depending upon the quality of raw materials.

The materials are mixed in pan mixture. After mixing, the mixture is conveyed through belt conveyor to the hydraulic/mechanical presses. The homogenised mortar taken out of roller mixer is put into the mould boxes. Depending on the type of machine, the product iscompacted under vibration / hydraulic compression etc.

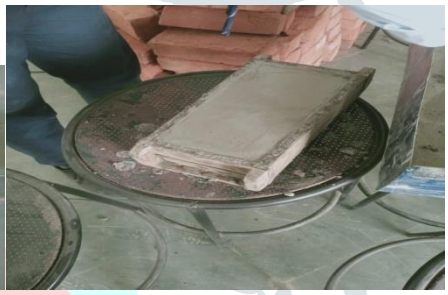
The green bricks are dried up under sun from 24 to 48 hours, depending whether lime route or cement route; the dried up bricks are stacked and subjected for water spraycuring once or twice a day, for 7-21 days, depending on ambience. The bricks are tested and sorted before dispatch.

MATERIALS:





FLY ASH CEMENT SAND

III. MODELING AND ANALYSIS

RESEARCH SIGNIFICANCE

Continuing use of clay bricks in the construction industry will lead to extensive loss of fertile top soil. This could be a devastating environmental hazard. High demand for clay bricks would result in price hike of clay bricks. To keep the cost of building materials in a reasonable range, we should option for alternative building materials like fly ash bricks and hollow or solid blocks. Modern Fly ash bricks are manufactured using high end pre-programmed hydraulic machines. Bricks from these machines are tested for its quality and durability and strength.

EXPERIMENTAL PROCEDURE

CLAY BRICKS

The process of making a brick has not changed much over the centuries or across geographies. The clay is mined and stored in the open. This makes the clay soft and removes unwanted oxides then mixed with water to get the right consistency for Moulding. Mixing is done manually with hands and feet. A lump of the mix is taken, rolled in sand and slapped into the mould. Initially, moulds were made of wood of size 22 X 10 X 7.5 mm (8.66 X 3.93 X 2.95 inch), now metal moulds are used. Sand is used so the brick does not stick to the mould. The mould is emptied onto the drying area, where the bricks are arranged in a herringbone pattern to dry in the sun. Every two days they are turned over to facilitate uniform drying and prevent warping. After two weeks they are ready to be burnt. The green bricks are arranged in a kiln and insulation is provided with a mud pack. Fire holes left to ignite the kiln are later sealed to keep the heat inside. This is maintained for a week. Firing like other operations also depends on the knowledge and experience of the brick maker. After the kiln is disassembled, the bricks are sorted according to color. Colour is an indication of the level of burning. Over burnt bricks are used for paving or covering the kiln while slightly under burnt bricks are used for building inner walls or burnt once again in the next kiln.

FLY ASH BRICKS

Fly ash, cement, and sand are manually fed into a pan mixer where water is added to the required proportion for homogeneous mixing. The proportion of raw material may vary depending upon the quality of raw materials. After mixing, the mixture is allowed to belt conveyor through feed into automatic brick making machine where the bricks are pressed automatically. Then the bricks are placed on wooden pallets and kept as it is for two days thereafter transported to open area where they are water cured for 10 -15 days. The bricks are sorted and tested before dispatch.

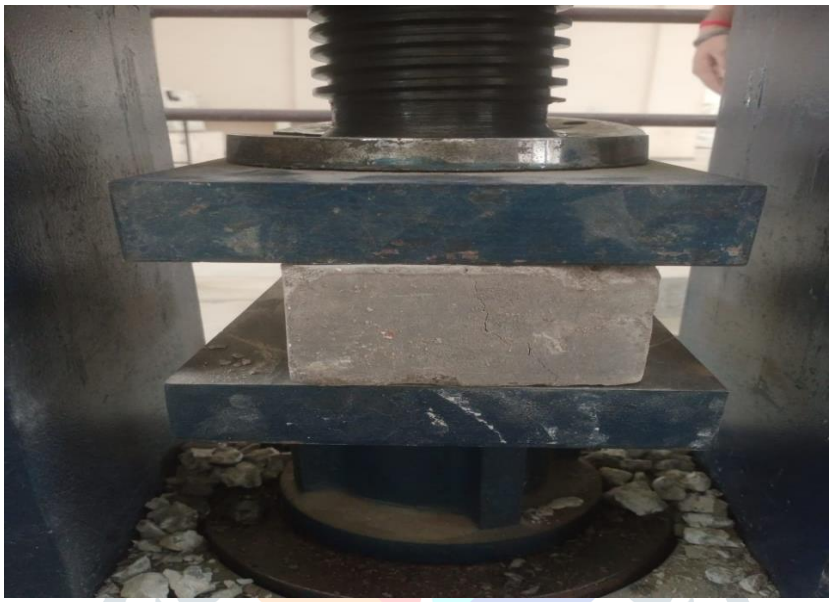
IV. RESULTS AND DISCUSSION

A comparison between the bricks that conducted from experimental work. The fly ash bricks and clay bricks are tested on universal testing machine(UTM). The crevice occur in normal clay brick at end of brick corner which depicted figure 4 and crunch at end. However, in fly ash bricks crevice fall out less than that of clay bricks depicted figure 5. The experimental effect or response of bricks remark in table 1(see.figure 1,2,3). On study of fly ash bricks benefits as given bellow.

ample	Dimension of Fly ash Bricks			Avg. Area ofbed surface (mm^2)	Max load at ailure(KN)	mpressive trength (N/mm^2)
	ength(mm)	Width(mm)	eight(mm)			
A	234	117	77	27378	120	4.38
B	234	117	77	27378	115	4.20

AVERAGE	**4.29**

Table 1: Compressive Strength test



DIMENSION TEST

DIMENSION TEST

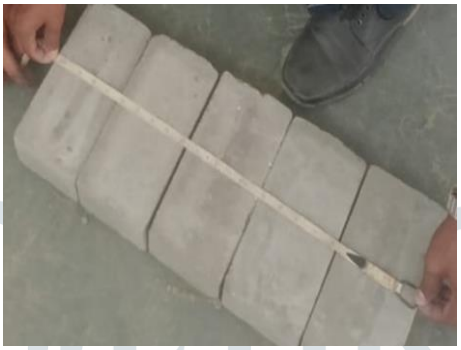
Measurement of the bricks‘ dimensions was done based on the procedures . The results of the measurement should comply with the limits stated in IS 12894:2002. Table below shows the results obtained from the measurement of 5 bricks.

Dimensions	**l Measurement for5 Bricks mm)**	**an Measurement forSingle Brick (mm)**
Length, L	169	234
Width, W	85	17
Height, H	81	7

Table 2 the results obtained from the measurement of 5 bricks

From the measurement done on 5 bricks, the total length, width and height obtainedwere 1169 mm, 585 mm and 381 mm. By taking the mean for the dimensions of a single brick, a brick was 234mm in length,117 mm in width and

77 mm in height.



DETERMINATION OF WATER ABSORPTION:

❖ **PROCEDURE:**

Immerse completely dried specimen in clean water at a temperature of 27 ± 2 °C for 24 hours.

Remove the specimen and wipe out any traces of water with a damp cloth and weigh the specimen. Complete the weighing after the specimen has been removed from water (M_2). Water absorption, percent by mass, after 24-hour immersion in cold water is given by the following formula:

$$\frac{M_2 - M_1}{M_1} \times 100$$

Sample	Weight (dry) gm	Weight (wet, after 24 hr) gm	% of water absorption
A	2626	3050	16.14
B	2797	3179	13.65
C	2773	3107	12.04
D	2822	3232	14.49
E	2383	2890	21.27
		Average	**5.58%**

Table 3 Water absorption test

From the result average % of water absorption is 15.58 %.

Appearance: The bricks have the appearance which is very pleasant like cement; Due to smoothness and finish on their surface they require no plastering for building work. These are compact, uniformly shaped and free from visible cracks. They are lighter in weight than ordinary clay bricks and are less porous. The color of these bricks can be altered by the addition of admixtures during the process of brick making. The size of these bricks can vary but they are generally available in the same sizes of the normal clay bricks.

Structural Capability: These bricks do not cause any extra load on the design of structures due to its comparable density and thus provide better resistance to earthquakes and other natural calamities. The compressive strength of Fly Ash and lime bricks is average 1305 psi (9.00 N/mm2) (as against 507 psi [3.50 N/mm2] for handmade clay bricks). The bricks possess high compressive strength which eliminates breakages/wastages during transport and handling. When a structure is formed using Fly Ash bricks the possibility of cracking of plaster is reduced due to lower thickness of joints and plaster and basic material of the bricks, which is more compatible with cement mortar.

Thermal Properties: These bricks have got thermal conductivity around 0.90-1.05 Webster/m2 (20-30% less than those of concrete blocks). These bricks do not absorb heat; they reflect heat and gives maximum light reflection which causes less heating of huge structures.

Sound Insulation of Fly Ash Bricks: It provides an acceptable degree of sound insulation. The sound produced at one side of a wall made using Fly Ash bricks do not let the sound waves pass easily to the other side of the wall due to its compactness. Hence they may be considered for the abatement of the noise pollution.

Durability and Moisture Resistance: Fly Ash blocks are highly durable. When their joints are properly joined, the bricks are ready to be directly painted with the paints available in the market or with the cement paint without plaster. The bricks, usually, are rectangular faced having sharp corners, solid, compact and uniformly shaped. The bricks are said to absorb the moisture approximately 6- 12% than that of 20-25% for handmade clay bricks thus they help reducing dampness of the walls.

Toxicity and Breath-ability: There are no positive evidence and studies that suggest about toxic fume emissions or the indoor air quality of structures built with Fly Ash bricks. Fly Ash as a raw material is very fine so care has to be taken while its handling and transport to avoid any kind of air pollution in the view of occupational safety. Once it is flue, it can remain airborne for long periods of time, causing serious health problems relating to the respiratory system. But block manufactured from Fly Ash has no such problems.

Sustainability: We can conclude that Fly Ash is a cocktail of unhealthy and hazardous elements like silica, mercury, iron oxides, calcium, aluminum, magnesium, arsenic, and cadmium. It poses serious environment and health hazards for a large population who live in the nearby area of the plants. But the brick is better off, during the process of brick making the toxins associated with Fly Ash gets changed into a non-toxic product. The mixing of with lime at ordinary temperature leads to the hydration of calcium silicate and formation of a dense composite insert block. Thus it has the potential of being a good building material. In India about 100 million tons of Fly Ash is produced annually by the numerous thermal power plants, which could cause serious contamination of land, groundwater, and air but due to the practice of Fly Ash bricks now it is safe and sound.

BuildAbility, Availability, and Cost: The compressive strength of Fly Ash blocks is so high that it eliminates breakages/wastage during handling and gives a neat finish, with a lower thickness of joints and plaster. The construction technique does not change in the case of Fly Ash bricks and remains as same as in the case of regular bricks which ensures an easy change of material. Masons do not require additional training while construction. Though these bricks are abundantly and widely available closer to thermal power plants all over the country for obvious reasons, finding dealers in all major cities and towns wouldn't be a problem. Comparison between Clay Brick and Fly Ash Brick

1) Normal clay bricks have varying color as per soil whereas Fly Ash bricks have a uniform pleasing color like cement. 2) As normal clay bricks are handmade they have an uneven shape, on the other hand, Fly Ash bricks are uniform in shape and smooth in the finish.

3) Normal clay bricks are lightly bonded whereas there is a dense composition in the case of Fly Ash bricks.

4) Plastering is required in case of normal clay bricks whereas no plastering is required in case of Fly Ash bricks.

5) Fly Ash bricks are lighter than clay bricks.

6) The compressive strength of Fly Ash bricks is more than that of clay bricks.

7) Fly Ash bricks are less porous than that of clay bricks.

V. CONCLUSION

1. Fly Ash Bricks were found to be sufficiently hard as scratching by the finger nail on the surface left no impression on it as compared to normal bricks.

2. The Efflorescence of all bricks tested were found to be slight as white or grey deposits were less than 10% on surface of the bricks which is almost same as that in the normal bricks.

3. A ringing sound in the Fly ash Bricks was observed to be far better than that in normal bricks.

4. Structure of the bricks was found to be compact, homogeneous and free from any defects like holes, lumps etc as compared to normal bricks.

5. The average absorbed moisture content of clay bricks is found to be 11.93% and for fly ash bricks are found to be 9.77%. Thus there is net 18.10% decrease in moisture absorbed for fly ash bricks as a part to clay bricks.

6. The crushing strength of clay bricks is found to be 8.14 N/mm2 and for fly ash bricks is found to be 18.81 N/mm2 . Thus there is net 56.72% increase is crushing strength for fly ash bricks as a part to clay bricks.

7. The crushing strength by prism of clay bricks is found to be 1.31 N/mm2 and for fly ash bricks is found to be 1.8 N/mm2 . Thus there is net 27.22% increase is crushing strength by prism for fly ash bricks as compared to clay bricks. 8. The crushing strength by prism of clay bricks is found to be 1.19 N/mm2 and for fly ash bricks is found to be 1.56 N/mm2 .Thus there is net 23.71% increase is crushing strength by prism for fly ash bricks as compared to clay bricks. 9. The crushing strength by prism of clay bricks is found to be 1.21 N/mm2 and for fly ash bricks is found to be 1.59 N/mm2 .Thus there is net 23.90% increase is crushing strength by prism for fly ash bricks as compared to clay bricks.

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