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Study of Fly-ash and Clay Compacts

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Abstract: Industrial waste like fly-ash is mainly used as a good building material due to its low weight. But the main disadvantage of these bricks is its low compressive strength. So, a lot of research is going on to increase the strength of these bricks. Normal clay is used for making bricks in a cheaper sense. The present research work is carried out to develop a new systematic procedure to produce a new type of brick which will have higher compressive strength than the normal clay bricks. Here the fly-ash is mixed with clay at different compositions and sintered at different temperatures to find out a solution to the brick industry.

Keywords: Fly-ash, Clay, Compressive strength, Pozzolona

1. Introduction

With the industrialization of the country it is but natural that the power generation should also increase. It has been estimated that 70% of the total power generated in the country is through thermal power generation. Generally pulverized coal, sub-bituminous coal/lignite are burnt in huge amount giving rise to two types of ashes [1]. Fly-ash is one of them resulting from combustion of coal which consists of inorganic mineral constituents of coal and organic matter that is not fully burnt.

The various problems caused due to fly-ash generation are: - Environment Pollution, Disposal Problem, Energy Consumption and Health Hazards. So, the utilization of the material is a big issue in scientific field. Hence the present study is made to investigate the use of fly-ash and clay mixture as a construction material. This investigation aims at the study of sintering characteristics of fly-ash and clay compacts.

2. Swelling of Clay & Its Stabilization by Fly-Ash

Expansive soils have upon saturation exerted enormous pressure and differential movement causing extensive damages to structures founded on such soils. In India uniform quality of soil isn't available due to varying weather and geological conditions. Most of the soils are expansive in nature, so it is difficult to make good quality bricks from this soil because of high plasticity and shrinkage value.

It has been seen that the plasticity index increases in swelling potential.

Swelling Potential	Plasticity Index
Low	0-15
Medium	10-35
High	20-55
Very High	35 & above

It is known that, fly-ash consists of large part of solid or hollow spherical particles of siliceous and aluminous glass with small proportions of thin walled multifaceted polyhedral called ceno spheres high in iron and of irregular shape [2]. Fly-ash is an artificial pozzolona. Pozzolona is defined as a siliceous material which while in itself possessing no cementious properties while in finely divided form and in presence of water reacts with calcium hydroxide at ordinary temperature to form compounds possessing cementious properties. Here the fly-ash is used to improve the engineering properties of expansive soil [3, 4].

3. Raw Material

3.1 *Fly-Ash*

Fly-ash used in our project work was collected from captive power plant of Rourkela Steel Plant.

Physical properties:

Particle size	100-0.5microns
Specific gravity	1.3to 3.0
Specific surface	150 to 1100cm^2/gm.
Morphology	Spherical

Chemical composition:

Element	**Weight Percentage**
SiO_2	40-80
Al_2O_3	10-20
Fe_2O_3	2-5
MgO	1-2
Cao	2-10
Na_2O	1-3
K_2O	1-2
TiO_2	1
LOI	0.18

3.2 *Clay*

Two types clay are used

Particle	Yellow clay	Black Clay
Particle size	<100micron	<100micron
Specific gravity	2.688	2.6
Mineralogy	Kaolinite Illite Frosterite Pyrophylite Silimanite Mg-Al Silicate Mg-Fe Silicate	Illite Pyrophylite Potassium Al silicate Kaolinite

4. Processing of Raw Material

4.1 *Grinding*

The two types of clays were taken in lump from and subjected to grinding in ball mill. Then we put them in day sunlight for drying.

4.2 *Screening*

We pass the clays through the sieve of size range 200μm. Fly-ash was also made to pass through the sieve size of 150 μm.

4.3 *Mixing*

Mixing was done thoroughly by a mechanical vibrator to get a homogenous mixture. Fly-ash and the two types of clays were mixed in the following compositions.

-clay +0% fly-ash

-clay+25%fly-ash

-clay+50%fly-ash

-clay+75%fly-ash

4.4 *Compaction*

Mixture of approximately 30gm. weight is taken and few drops of water were added to it to give some extra binding property. Water content varied between 8-17 drops depending on the composition. Then the die was cleaned with cotton followed by acetone so that all the dust is removed from the inside surface of the die and outside surface of the punch [5]. Then greasing was done to avoid sticking. Then the mixture prepared earlier was poured inside carefully. During the packing slight shaking was done to accommodate the maximum possible amount of material. Then the whole system was subjected to hydraulic seal valve made tight, mounting was done coaxially [6]. Then 10tons of load is applied on it very slowly. During all the compactions, the load was constant at stage three stages 4, 6, 8 ton for 5minute each. Then the load was kept constant for 5 minute [7].

4.5 *Sintering*

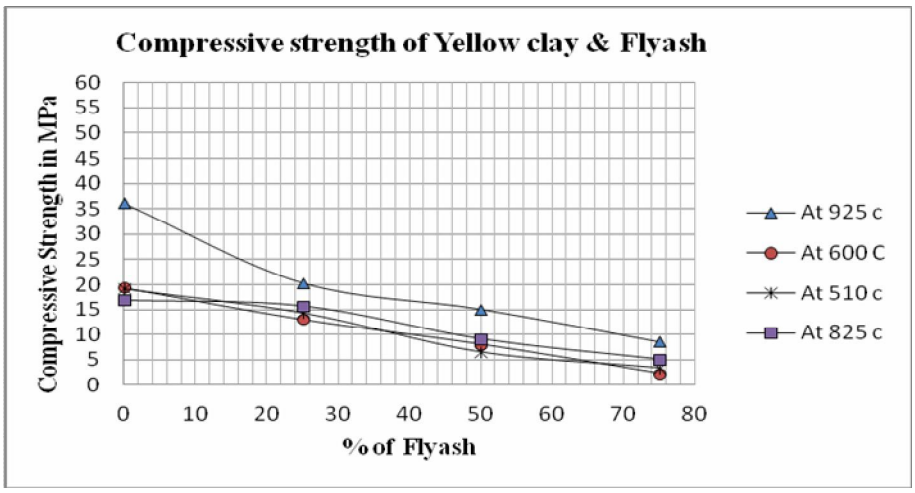
The green compacts were sintered at 510^0c, 600^0c, 825^0c, 925^0c for time period of 2.5 hours at each step and furnace cooled [8].

4.6 *Compressive Strength*

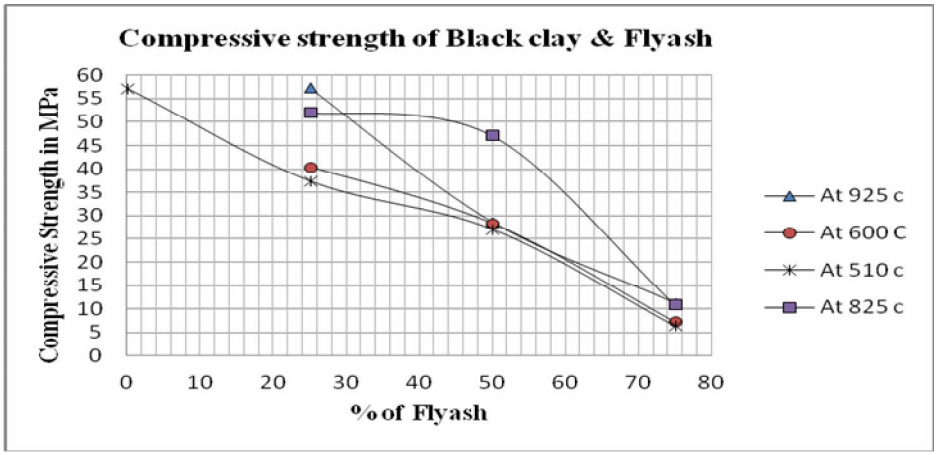
The INSTRON universal floor model testing machine 1195 series is used to determine the compressive strength of the different compacts [9, 10].

5. Compressive Strength Results

5.1 *For Yellow Clay*



5.2 *For Black Clay*



6. Conclusion

In the present investigation it is seen that the mineral compositions of the clay and fly-ash are different and produces different transformations at different temperatures. It has been seen that the compacts shrink after sintering.

Black clay compacts show higher compressive strength than of yellow clay and clay with fly-ash additions. With increase in fly-ash %, the compressive strength is found to be reduced than that of clay itself. The strength of fly-ash sintered compacts can be increased with addition of clay.

Higher sintering temperature proved to give higher compressive strength to the compacts.

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