

Case Study on Eco Black Brick Alkaline Activation Technology

Rushikesh Daberao¹, Nitin Pal², Rutuja Bhoyarkar³, Sumeet Mishra⁴

¹⁻⁴U.G. Student, Department of CIVIL Engineering, G H Rasoni Academy of Engineering & Technology (GHRAET) Hingna, Nagpur, Maharashtra, India.

Abstract – There is a huge need to introduce an alternative of conventional bricks as it has some disadvantages and it has been preferred over the years as the construction demands increased. On the other hands paper mills are generating over 80,000 tons of waste fly ash daily which is produced by burning cheap raw materials. It is being dumped on the lands which is very harmful. We studied that this fly ash can be used to make Eco-Black bricks from it without any harm to the environment and is a low energy process unless it does not need any burning kilns like conventional bricks because alkaline activation technology is been used here. The Eco Black brick concept will save the world from infertile lands, emission of greenhouse gases and several kilns burning. Our study shows that the eco black bricks are highly durable, have more strength, economical, water resistant and moreover they are eco-friendly.

Key Words: fly ash, Eco black brick, alkaline activation technology, infertile land, greenhouse gases

1. INTRODUCTION

A brick is a construction material used to build walls, pavements and other elements of masonry. The bricks could be sun-dried or burnt. Burnt bricks are usually stronger than sundried bricks, especially if obtained from clay or clayey material. Bricks are categorized in different types depending upon the admixtures and raw material used for making bricks. It is also known that certain admixtures are added to burnt brick raw to produce different effects in the finished product. Conventional bricks are good in durability but the carbon emission is more during the baking process in kilns. So, improvement in the properties of Non-Fired clay bricks is under focus. Non-fired clay bricks are the types of bricks, which do not have to be burnt in kilns as no carbon emission takes place. Many complications can be seen related to durability and strength of the Non-fired Brick, which can be a fantastic area of study and research for the scientists and researchers. Normal fly ash brick and burnt clay brick is an old construction material which is used since a long decades mainly for housing in urban area as well as rural part of India. The bricks made from natural clay, which is sourced from agricultural land. If we speak logically the unlimited use of clay is harmful to the society. Loss of good fertile land and diversion agricultural land is seen due to excessive usage of agricultural land for this type of clay. The modified Fly Ash bricks are an alternative for the conventional bricks which can be used effectively to replace the conventional bricks. Various researchers studied properties of the bricks and

they came to a conclusion that these bricks can be used for construction of low budget house projects. Fly ash brick is generally believed to be an extraordinary fire proofing material. The performance and durability is based on the performance of its cement used, class F fly ash, quarry dust, metkaolin, and water used in the bricks. In India the building construction industry uses about 20000 million bricks and 28% of the natural energy consumption for their production. In addition to this, In certain region poor quality of Clay Bricks is available and which have lower compressive strength, higher water absorption, high efflorescence etc., and it have bound engineers to find more efficient and low cost construction material. Eco-BLAC bricks were developed using masonry boiler ash and alkali activation technology

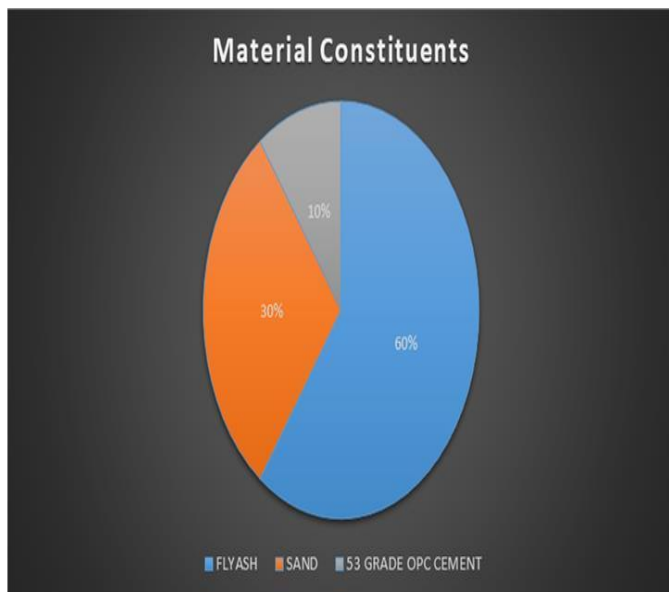
The bricks have been gone through to different tests, including mechanic resistance under compression, durability, and water absorption, all with promising results. Alkali-Activation is the most preferable technology, which involves chemical reaction between aluminosilicate and alkaline activator. Varying proportion of Sludge, Boiler ash, Lime, Clay and NaOH will be mixed into mixer where water will be added to get a homogeneous mixing in the required proportion. The proportion of raw materials may vary depending upon quality of raw materials. The process of Mixing of NaOH and lime to the sludge, Boiler ash and clay in the production of ECO Bricks is termed as “Alkali Activation Technology”. Alkali activation technology also provides the opportunity for the utilization of waste streams that may not be of significant benefit in OPC-blending applications. Alkali-Activated Bricks are capable of meeting or exceeding the vast majority of existing performance requirements commonly specified in construction applications, especially where acid, chemical and/or fire resistance may be required.

1.1 Objectives

1. To manufacture economical bricks than the convectional brick.
2. To prevent infertility of the land.
3. To minimize the consumption of energy used for manufacturing the bricks.
4. To reduce the environmental harm produced by the Kilns.
5. To use maximum percentage of solid waste such as boiler ash, stone dust.
6. Introducing a better and economical way of construction for future.

1.2 Sample Preparation & Methodology

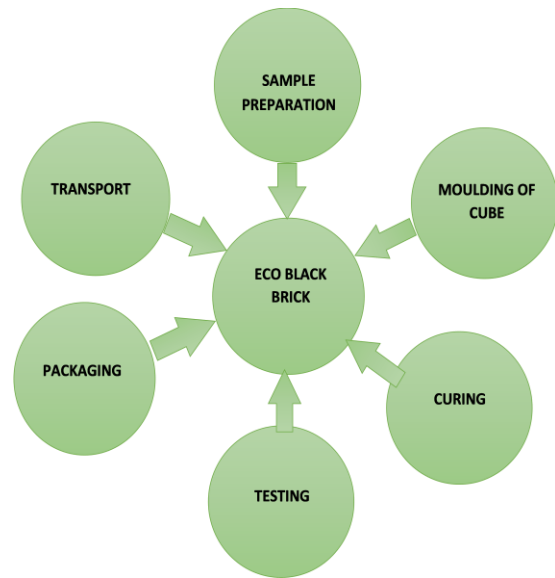
Alkali-Activation is the chemical process in which Fly Ash is a powdery Alumina-Silicate which is mixed with an Alkaline Activator such as Sodium Hydroxide (NaOH). This Solution which is prepared is also known as Geopolymer. The alkaline activator solution is prepared by mixing of sodium hydroxide in one litre of distilled water in a volumetric flask. to obtain 2M concentration. We are using proportion of Fly Ash, Sand and 53 grade of OPC cement as 60%, 30% and 10% respectively.



Sodium Hydroxide (NaOH) will be fed into the mixer where required proportion of water will be added for homogeneous mixing. Alkaline solution was added to (fly ash) which is also called as geopolymer precursor and other constituents required for composition and mixed for 5 minutes to obtain a homogenous mixture. A slurry paste is formed from the geopolymer mixture, which is poured into the steel mould and kept for curing for 7 days, 14 days and 28 days simultaneously.

The tests, which we performed on the sample, are as follows

1. Compressive Test
2. Water Absorption Test
3. Shape and Size Test
4. Efflorescence Test
5. Impact Test
6. Soundness Test
7. Hardness Test



2. Cost Analysis

Raw Material	Formula	Calculation	Cost/ brick
Fly Ash /ton	$A * \text{Brickweight} * \text{Composition} \%$ $\frac{1000 * 10}{1000 * 10}$	$\frac{250 * 3 * 60}{1000 * 10}$	0.45rs
Sand / ton	$B * \text{Brickweight} * \text{Composition} \%$ $\frac{1000 * 10}{1000 * 10}$	$\frac{650 * 3 * 30}{1000 * 10}$	0.59rs
Cement opc 50 kg/bag	$C * \text{Brickweight} * \text{Composition} \%$ $\frac{40 * 10}{40 * 10}$	$\frac{350 * 3 * 10}{40 * 10}$	2.1rs
			Total = 3.14rs

Composition of Brick = 60% - 30%- 10%

Fly ash (A) = 250rs/ton

Sand (B) = 650rs/ton

Cement (C) = 350rs/bag

THE COST OF 1 BRICK IS 3.14rs

No. of bricks in 1m³ :

Standard size of brick: 0.19m x 0.09m x 0.09m

Volume of 1 Brick : 0.001539m³

No of Bricks = 650 nos.

Now,

Alkali activator sodium hydroxide (NaOH) = 200gm / m³

NaOH= 80rs / kg

Adding 200gm of NaOH in 1 m³ of raw material 1

brick= 3.14 rs

And the price after adding Alkali activator price vary by +0.02 rs.

I:e 1 brick = 3.16rs (Only Material)

3. Result & Conclusion

Through this brick manufacturing process Environmental effects of wastes and disposal problems of waste can be reduced. This study gives us the provision of converting harmful fly ash into efficient and economical construction

Properties	Clay Bricks	Eco Black Brick	Remark
Density	1675 kg/m ³	1775 kg/m ³	Higher Load Bearing
Compressive Strength	33 kg/m ³	95 kg/m ³	Higher Load Bearing
Absorption	20-25%	6-12%	Less Dampness
Dimensional Stability	Very Low Tolerance	High Tolerance	Saving in mortar up to 20%
Wastage during transit	Up to 15%	Do not exceed 2%	Saving in cost up to 13%
Plastering	Thickness vary on the both sides of wall	Even on both Sides	Saving in plaster up to 20%

material. From this research, above mentioned properties were obtained by adding a correct proportion of alkali activator, by which the expected cost of bricks can be reduced. This project gives us ability to utilize industrial wastes such as Fly Ash which leads to minimize the depletion of top fertile soil of agricultural land. The effect of Carbon Dioxide that emits into the Environmental was completely reduce with the use of alkali activation technology.

In this project different proportion of the industrial waste such as flyash & stonedust were added as a partial replacement of a cement and clay in the production of Eco Bricks by using Alkali Activation Technology, and the results were compared with the same bricks of same proportions without adding alkali compound. Comparing the results, efficient proportion is finalized. The test results were compared with and without the addition of NaOH with burnt and unburnt bricks. We performed all the tests as we mentioned on the sample and the results were extremely satisfactory.

4. Future Scope

1. We will get a low cost Building Construction material with efficient and durable properties.
2. Environment can be saved from ill effects of carbon dioxide emission by using Alkali Activation Technology.
3. The quantity of solid wastes excreted by the Paper mills and Other Industries can be minimized and utilized for manufacturing of durable construction materials.

4. The excessive amount of energy which was used to build Clay bricks can be optimized by using Alkali Activation Technology.
5. As engineering properties of the Eco Black bricks is more reliable and more than satisfactory, It can become one of the most effective and demanded construction material in the future.
6. Alkali Activation Technology is the rapidly growing method that will be adopted for building construction materials.
7. The weight of Eco Black brick is almost 2/3rd of conventional clay brick. Total Dead Load of the building is reduced due to its light weigh.
8. These bricks are potentially ideal material for earthquake prone areas as they are lightweight and flexible.

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