

EXPERIMENTAL STUDY ON ECO-BLAC BRICKS

B. Aravindhan¹, J. Arniha², S. Ganeshkumar³, C. Gayathri⁴, S. Mohanasundari⁵

^{1,2,3,4} UG Student, Department of Civil Engineering, Valliammai Engineering College, Tamilnadu, India

⁵Assistant professor (S.G), Department of Civil Engineering, Valliammai Engineering College, Tamilnadu, India

Abstract - Eco-BLAC bricks uses the boiler ash and alkali-activation technology. This technology uses boiler ash as an aluminosilicate, combining it with an alkaline activator solution. When combined, the ash dissolves, followed by the construction of a geo-polymer gel, a solid that gives the brick strength. This solution reuses industrial waste rather than topsoil, and is low-cost and low energy. By using a chemical reaction rather than a firing, the bricks gain strength at ambient temperatures, not requiring the massive consumption of coal (roughly 24 million tons annually) in traditional clay-fired brick production.

Key words: fly ash, alkali activation, geopolymer, aluminosilicate.

1. INTRODUCTION

Eco-BLAC bricks is a way of repurposing boiler ash, reducing landfills. Boiler ash is produced by small to medium factories such as paper mills when they burn cheap materials to produce energy. Due to its uselessness in most applications, it ends up in landfills where it possess serious hazards to the environment and human health.

In addition to finding a way to repurpose boiler ash, it also took the opportunity to address another environmental issue in India - the production of clay-fired bricks. On top of requiring topsoil for production, degrading farmland, the manufacturing process of clay-fired bricks causes air pollution and requires significant energy consumption, with bricks being fired at temperatures approaching 1000°C. Workers must endure these vicious work conditions for little pay as well.

As a solution to both problems, Eco-BLAC bricks were developed: masonry using boiler ash and alkali-activation technology. The bricks have been subjected to various tests, including mechanic resistance under compression, durability, and water absorption, all with promising results.

2. OBJECTIVES

1. To reduce the disposal of paper industry waste into landfills.
2. To manufacture a low cost bricks.

3. To prevent air pollution, by avoiding burning of kilns.
4. To manufacture a brick without consumption of energy.
5. Maximum use of boiler ash
6. Low energy process
7. Low natural resource consumption.

3. SCOPE

1. Due to the day by day increase of industrial waste the land filling and land pollution increases. This project helps in reducing the disposal of plastic waste for future.
2. To reduce the usage of natural clay, in order to avoid top soil depletion.
3. To provide green environment which is one of the major need today.
4. To increase the strength of bricks and to reduce cost of construction.

4. ALKALI ACTIVATION TECHNOLOGY

The reaction of a solid aluminosilicate with a highly concentrated aqueous alkali hydroxide solution produces a synthetic alkali aluminosilicate material generally called a 'geopolymer'. This material can provide comparable performance to traditional cementitious binders in a range of applications, but with the added advantage of significantly reduced greenhouse emissions. Depending upon the raw material selection and processing conditions, geopolymers can exhibit a wide variety of properties and characteristics, including high compressive strength, low shrinkage, fast or slow setting, acid resistance, fire resistance and low thermal conductivity. Despite this wide variety of commonly boated attributes, these properties are not necessarily inherent to all geo polymeric formulations. Inorganic polymers, as well as some of the extrinsic properties that may be imparted by appropriate raw material selection and mix design.

Although the term 'geopolymer' is generally used to describe the amorphous to crystalline reaction products

from synthesis of alkali aluminosilicates from reaction with alkali hydroxide/alkali solution, geopolymeric gels and composites are also commonly referred to as 'alkali-activated cement'. Despite this variety of nomenclature, these terms all describe materials synthesised utilizing the same chemistry, which can be described as a complex system of coupled alkali mediated dissolution and precipitation reactions in an aqueous reaction substrate.

5. A CONCEPTUAL MODEL FOR GEOPOLYMERIZATION

In the 1950s Glukhovsky proposed a general mechanism for the alkali activation of materials primarily comprising silica and reactive alumina. The Glukhovsky model divides the process into three stages: (a) destruction-coagulation; (b) coagulation-condensation; (c) condensation-crystallization. More recently, different authors have elaborated on and extended the Glukhovsky theories and applied the accumulated knowledge about zeolite synthesis in order to explain the geopolymerization process as a whole.

The reaction mechanism outlines the key processes occurring in the transformation of a solid aluminosilicate source into a synthetic alkali aluminosilicate.

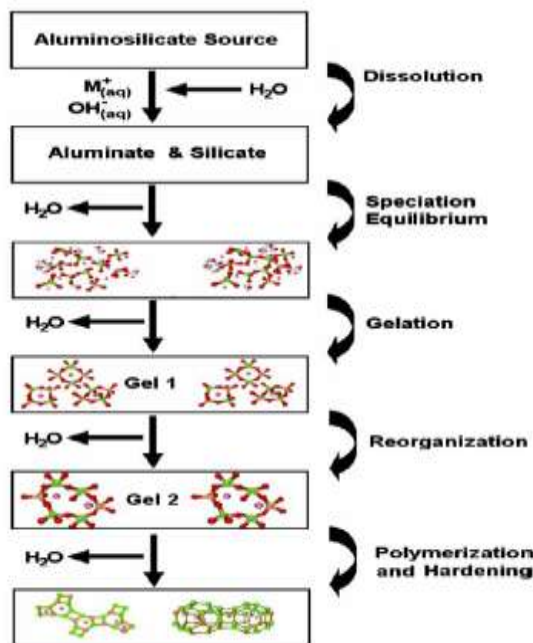


FIG. 1 conceptual model for geopolymerization

6. MANUFACTURING PROCESS

6.1 SOLUTION PREPARATION

Alkali activation is a chemical process in which a powdery aluminosilicate such as fly ash is mixed with an

alkaline activator to produce a paste capable of setting and hardening.

Geopolymer material were prepared by mixing aluminosilicate with the alkaline activator solution. The alkaline activator solution were prepared by the dissolution of sodium hydroxide in one litre of distilled water in a volumetric flask to obtain 2M concentration.

6.2 SAMPLE PREPARATION

The alkaline solution was added to the geopolymeric precursor (fly ash), and other materials required for composition and mixed for 5 minutes to obtain a homogenous mixture. The geopolymer mixture formed a slurry paste and was poured into a steel sample mould which was then allowed to stand at room temperature for few hours.

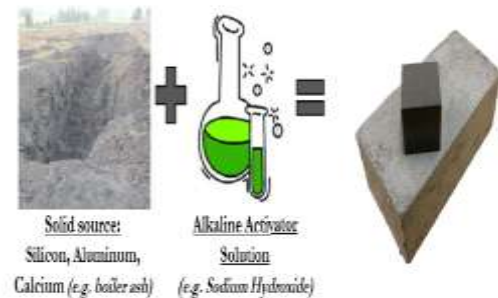


Fig. 2 alkali activation

7. RAW MATERIALS

1. Fly ash
2. Clay
3. Lime
4. Sodium hydroxide
5. Stone dust
6. Gypsum

8. MIX PROPORTIONS

Table1: partial replacement or clay

Mix proportion	Fly ash	Clay	Lime
I	60%	30%	10%
II	70%	20%	10%
III	80%	10%	10%

Table2: Fully replacement of clay

Mix proportion	Fly ash	Stone dust	Lime	gypsum
IV	60%	25%	10%	5%
V	70%	15%	10%	5%
VII	80%	5%	10%	5%

8. TEST TO BE CONDUCTED

8.1 COMPRESSIVE STRENGTH TEST

The brick specimens are immersed in water for 24 hours. The specimen is placed in compression testing machine with 6 mm plywood on top and bottom of it to get uniform load on the specimen. The load is applied axially at a rate of 14 N/mm². The crushing load is noted. Then the crushing strength is the ratio of crushing load to the area of brick loaded. Average of three specimens is taken as the crushing strength. The crushing load is noted for bricks named I, II, III, IV, V & VI (different proportions).

8.2 WATER ABSORPTION TEST

A brick is taken and it is weighted dry. It is then immersed in water for 24 hours. It is weighed again and the difference in weight indicates the amount of water absorbed by the brick. It should not be exceed 20 percent of weight of dry brick.

8.3 SHAPE AND SIZE TEST

In this test, a brick is closely inspected. It should be of standard size and its shape should be truly rectangular with sharp edges. For this purpose, 3 bricks are selected at random and they are stacked length wise, along the width and along the height.

8.4 EFFLORESCENCE TEST

This test is carried out to obtain the presence of alkaline substances in bricks. First, bricks are fully submerged in fresh water for 24 hours. After 24 hours they are collected from water and let them to dry. After completely dried, the bricks are closely observed to find the presence of alkali. If a white or grey layer is formed on the brick surface, it means alkali is present in the brick.

8.5 IMPACT TEST

In this test, few bricks are dropped from 1 m height. If bricks are broken it indicated low impact value and not acceptable for construction work. Good quality bricks do not break at all.

8.6 SOUNDNESS TEST

In this test, two randomly selected bricks are hardly punched with each other. If they produce a clear metallic sound and remain unbroken then they are good quality bricks.

8.7 HARDNESS TEST

In this test, scratches are made on the surface of the brick by a one-rupee coin. If it does not leave any impression the brick surface then it will be considered as good quality bricks.

9. CONCLUSIONS

Based on the above experimental procedure and test, we conclude as;

Use of fly ash, quarry dust in brick can solve the disposal problem, reduce cost and produce a Eco-friendly brick for constructions. The compressive strength of bricks named as I is 3.13N/mm², II is 3.60N/mm², III is 2.79N/mm², IV is 6.24N/mm², V is 5.07N/mm² and VI is 3.10N/mm². Hence we strongly recommend that in fully replacement of clay method brick IV has a good compressive strength and suitable for non-load bearing wall constructions

Environmental effects of wastes and disposal problems of waste can be reduced through this brick manufacturing process. This study helps in converting harmful fly ash in to bricks and make it valuable. From this research, maximum compressive strength of correct proportion by alkali activation technology is obtained. The expected cost of bricks can be reduced.

10. REFERENCE

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