Production of Eco-Bricks By Alkali Activated Technology From Industrial Waste

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Abstract- *In spite of the fact that the utilization of fly ash has numerous focal points, its low hydration at beginning period causes the quality to be low. Right now, trial examination was completed to locate the ideal blend level of fly ash block. Anyway the block example of size 230mm x 110mm x 90mm were thrown for various blend level of Fly ash (15 to half), Gypsum (2%), Lime (5 to 30%) and Quarry dust (45 to 55%), compressive quality were read for various blend extents. The outcomes shows the variety of compressive quality for diverse blend extents of materials referenced before at various relieving ages. From the outcomes it was induced that, the most extreme upgraded compressive quality is gotten for ideal blend level of Flyash-15%Lime-30% Gypsum-2% Quarry dust-53%.*

Keywords- Fly ash, Lime, Gypsum, Quarry dust, Compressive strength and Water absorption.

I. INTRODUCTION

In the present situation in the development business, utilization of financial and ecological amicable material is of an incredible concern. One of the primary fixings utilized is concrete. It is seen from different examinations that the warmth radiated from concrete records to a more prominent rate in an unnatural weather change. Concrete enterprises record to a more noteworthy emanation of CO2 and they additionally utilize significant levels of vitality assets in the creation of concrete. So as to limit these impacts, supplanting of concrete with some pozzolanic materials, for example, fly ash, can have an improving impact against these unsafe elements. Right now, the ideal blend of fly ash (significant fixings) produced at Barapukuria Thermal Power Plant, sand, hydrated lime and gypsum and furthermore streamlined the block shaping weight. Fly ash 55%, sand-30% and hydrated lime – 15% with gypsum-14% was seen as the ideal blend. For the ideal blend considered the compressive quality, microstructure, shrinkage property, unit volume weight, Initial pace of assimilation, retention limit, obvious porosity, open pore and impenetrable pore of the fly ash sand–lime-gypsum blocks delivered with streamlined piece under different block framing weights, Efflorescence and radio action of the blocks shaped under advanced conditions were likewise investigated. In venture, tentatively researched the fly ash block blend extents by Taguchi technique. Least amount of concrete and fly ash has been utilized as restricting materials and considered the control factor as water fastener proportion.

Both. So the impacts of water/cover proportion, fly ash, coarse sand, and stone residue on the presentation qualities are broke down utilizing signal-to-commotion proportions and mean reaction information. Besides, the evaluated ideal estimations of the procedure parameters are comparing to water/cover proportion of 0.4, fly ash of 39%, coarse sand of 24%, and stone residue of 30%2. The expansion of fly ash up to 60% at a fixing temperature as 950ºc has no significant hurtful impacts on the block quality. It appears that the fly ash included structure blocks show sensibly great properties and may get serious with the customary structure blocks. Utilization of fly ash as a crude material for the creation of building blocks isn't just practical option in contrast to mud yet in addition an answer for troublesome and costly waste removal problem3. In the present work the endeavor has made to locate the ideal blend level of to get greatest compressive quality of fly ash block admixed with lime, gypsum and quarry dust at different extents.

II. OBJECTIVES

- To study the properties of quarry dust used in bricks.
- To study the different method for producing eco-bricks from waste material.
- To address the potential use if industrial waste from a raw material for the production of green bricks.
- To achieve technical, economical and environmental aspect with respect to standardizing and public education.

III. NEED FOR THE STUDY

1. To improve the designing properties, for example, workability, plasticity, water tightness, etc.

2. To improve the compressive solidarity to evaluate the strength and solidness of the block.
3. To keep up the uniform size and state of fly ash blocks and to decrease the putting thickness.

IV. PROBLEM STATEMENT

Development squander and oven dust not condition inviting which is unusable mass in development and non degradable. This overwhelming wastage is risky to condition. Development squander having exceptionally overwhelming substance so troublesome store in blustery season and furthermore transportation is expensive.

Usage of development squander and furnace dust is significant for human improvement in light of the fact that gigantic measure of glass squander produce by human builds the need of valuable land for dumping waste development material, diminishing conceivable region that can be utilized for landfills of other waste expanding the need to set up new far reaching landfills, lactates and gas discharges from the landfill site debase networks living condition and unsafe to human wellbeing, area of most reusing plants are worked inside low salary neighborhoods in light of modest work and severe guideline may influence respiratory framework if breath in contaminations.

V. RESEARCH METHODOLOGY

- Identify the physical properties of raw material used to prepare fly ash brick by using quarry dust, lime and gypsum as a partial replacement of cement.
- Manually calculate the mix proportion of the mixes to prepare fly ash brick by partial replacing cement with quarry dust, lime and gypsum and compare the compressive strength of fly ash brick with and without crushed construction material.
- Compare the compressive strength of the Fly ash brick containing quarry dust, lime and gypsum with normal fly ash brick.
- Cost comparison between the fly ash brick quarry dust, lime and gypsum with Normal fly ash brick.

a) Material used

i. **Fly ash:** Bottom ash is part of the non-combustible residue of combustion in a furnace or incinerator. In an industrial context, it usually refers to coal combustion and comprises traces of combustibles embedded in forming clinkers and sticking to hot side walls of a coal-burning furnace during its operation.

Fly ash is finely divided residue resulting from the combustion of powdered coal and transported by the flue gases and collected by electrostatic precipitator. ASTM broadly classify fly ash into two classes

i. Class F: Fly ash normally produced by burning anthracite or bituminous coal, usually has less than 5% CaO.

ii. Class F fly ash has pozzolanic properties only. Class C: Fly ash normally produced by burning lignite or sub-bituminous coal. Some class C fly ash may have CaO content in excess of 10%. In addition to pozzolanic properties, class C fly ash also possesses cementious properties. Fly ash used is of type class C with a specific gravity of 2.19**.**

ii. **Gypsum:** Gypsum is a non- hydraulic binder occurring naturally as a soft crystalline rock or sand. Gypsum have a valuable properties like small bulk density, incombustibility, good sound absorbing capacity, good fire resistance, rapid drying and hardening with negligible shrinkage, superior surface finish, etc. In addition it can strengthen material or increase viscosity. It has a specific gravity of 2.31 grams per cubic centimetre. The density of gypsum powder is 2.8 to 3 grams per cubic centimetre.

iii. **Lime:** Lime is an important binding material in building construction. It is basically Calcium oxide (CaO) in natural association with magnesium oxide (MgO).Lime reacts with fly ash at ordinary temperature and forms a compound possessing cementitious properties. After reactions between lime and fly ash, calcium silicate hydrates are produced which are responsible for the high strength of the compound.

iv. **Quarry dust:** It is residue taken from granite quarry. Due to excessive cost of transportation from natural sources locally available river sand is expensive. Also creates environmental problems of large-scale depletion of these sources. Use of river sand in construction becomes less attractive; a substitute or replacement product for concrete industry needs to be found. Whose continued use has started posing serious problems with respect to its availability, cost and environmental impact. In such a case the Quarry rock dust can be an economic alternative to the river sand. Usually, Quarry Rock Dust is used in large scale in the highways as a surface finishing material and also used for manufacturing of hollow blocks and lightweight concrete prefabricated Elements. After processing fine particles of size less than 4.75 mm is used in this work.

b) Mix proportion: To make the fly ash brick following mix proportions are arrived by trial and error method. The Table.1shows the various mix proportions

Table 1 Various Mix Proportions

Proportio-ns	Fly ash (%)	Lime (%)	Gypsum (%)	Quarry dust (%)
I	15	31	02	52
II	20	26	02	52
III	20	30	02	48
IV	25	21	02	52
V	30	16	02	52
VI	35	11	02	52
VII	40	06	02	52
VIII	40	10	02	48
IX	50	25	02	23

c) The quantity of materials required to cast a single brick is arrived by taking a brick weight of 3.0 kg is given in the Table.2.

Table 2 Quantity Table of Materials used

Proportions	Fly ash (kg)	Lime (kg)	Gypsum (kg)	Quarry dust (kg)
I	0.450	0.900	0.171	1.590
II	0.600	0.750	0.171	1.590
III	0.600	0.900	0.171	1.590
IV	0.750	0.600	0.171	1.590
V	0.900	0.450	0.171	1.590
VI	1.050	0.300	0.171	1.590
VII	1.200	0.150	0.171	1.590
VIII	1.200	0.300	0.171	1.440
IX	1.500	0.750	0.171	0.690

d) Water-binder ratio: Water- binder ratio is calculated based on weight of fly ash and weight of lime to total weight of the brick. It also plays the significant role on the compressive strength of the brick. Considering the water content or water to binder ratio is an indirect approach to sizing the volume, thus ensuring greater durability in the mixture proportions for bricks made. Then water-binder ratio used for various proportions is given in the Table.3

Table 3 Water-Binder ratio (%)

Proportions	Water- Binder ratio (%)
I	0.46
II	0.43
III	0.50
IV	0.46
V	0.46
VI	0.46
VII	0.46
VIII	0.50
IX	0.75

e) **Preparation and Testing of Specimens**. Casting of bricks The normal hand mould is used to cast the bricks with the Standard size of 230mm x 110mm x75mm.They were cast According to the standard procedure with various mix Proportions arrived. The required quantity of Fly ash, Lime, Gypsum, Quarry dust is calculated previously, according to that the materials mixed properly. Then required quantity of water was added. Then they mixed thoroughly. Then the prepared mix was poured in to the mould and it is compacted. After compacting gets over then the mould is removed. Then the wet brick was kept under air curing for 2 days and then bricks were water cured for a period of 7,14,21days

Casted Brick

VI. RESULTS AND DISCUSSIONS

The investigation was carried out to determine the optimal mix percentage of fly ash brick admixed with lime, gypsum, and quarry dust and also to determine the water absorption.

Arriving proportions

Mix proportions are arrived by referring the articles and data collecting from local manufacturing companies. For the various proportions arrived bricks are casted and the following tests were conducted.

Tests are applied to bricks

i. Compressive strength test
ii. Efflorescence test
iii. Water absorption test

- **Compressive strength test**

The compressive strength of fly ash brick is three times greater than the normal clay brick. The minimum compressive strength of clay brick is 3.5 N/mm².So as the fly ash brick has compressive strength of 10-12 N/mm². Bricks to be used for different works should not have compressive strength less than as mentioned above. The universal testing machine is used for testing the compressive strength of bricks.

After the curing period gets over bricks are kept for testing. To test the specimens the bricks are placed in the calibrated Compression testing machine of capacity 3000 kN applied a load uniform at the rate of 2.9 kN/min. The load at failure is the maximum load at which specimen fails to produce any further increase in the indicator reading on the testing machine. In that three numbers of bricks were tested for each mix proportion. Each brick may give different strength. Hence, average of three bricks was taken

Table 4 Mean values of Compressive Strength (N/mm²)

Proportions	7 days (N/mm²)	14days (N/mm²)	21days (N/mm²)
I	1.98	3.95	8.0
II	1.68	3.36	6.75
III	1.81	3.43	6.97
IV	1.44	3.08	5.98
V	1.22	2.43	5.37
VI	1.03	1.97	5.04
VII	1.12	2.25	5.14
VIII	1.23	2.67	5.29
IX	1.34	2.62	5.45

- **Efflorescence test**

For this test, brick was placed vertically in water with one end immersed. The depth of immersion in water being 3.0 cm, then this whole arrangement should be kept in a warm-well-ventilated room temperature until all evaporates. When the water in the dish is absorbed by the brick and surplus water evaporates. When the water is completely absorbed and evaporated place similar quantity of water in dish and allows it to absorb and evaporate as before. Examine the brick after this and find out the percentage of white spots to the surface area of brick. If any difference is observed because of presence of salt deposits then the rating is reported as 'effloresced'. If no difference is noted, the rating is reported as 'not effloresced'. Percentage of white spot in the brick = Nil

- **Water absorption test**

Fly ash Bricks should not absorb water more than 12%. The bricks to be tested should be dried in an oven at a temperature of 105 to 115^{o} C till attains constant weight cool the bricks to room temperature and weight (W1). Immerse completely dried and weighed W1 brick in clean water for 24 hrs at a temperature of 27±20 Degree Celsius. Remove the bricks and wipe out any traces of water and weigh immediately (W2).

$$\text{Water absorption in \% by weight} = (W2 - W1/W1) \times 100$$

The average of three bricks should be taken. Our bricks absorb 10.11 % of water only. It has less water absorption property.

VI. CONCLUSIONS

Based on the experimental study, following conclusions can be drawn regarding the strength behavior of fly ash brick;The study was conducted to find the optimum mix percentage of fly ash brick. However the brick specimen of size 230mm x 110mm x 75mm were cast for different mix percentage of Fly ash (15 to 50%), Gypsum (2%), Lime (5 to 30%) and Quarry dust (45 to 52%). However the specimens have been tested for seven mix proportions. The mechanical properties such as compressive strength were studied for different mix proportions, at different curing ages. From the results it was inferred that, among the seven proportions the maximum optimized compressive strength is obtained for optimal mix percentage of Flyash-15% Lime-30% Gypsum-2% Quarry dust-52% as 8.0 N/mm².

VII. ACKNOWLEDGEMENT

It is not possible to express the things in words what we feel, but here we tried to express our thoughts in the form of acknowledgement. It has been privilege for us to be associated with **Mrs. P. S. Dhole** our project guide. We are greatly benefited by his valuable suggestions and ideas. It is with great pleasure that we express our deep sense of gratitude to her for her guidance, constant encouragement, for her kindness, moral boosting support and patience throughout this work. We profoundly thank her for all this and owe much more than we could possibly express. We are thankful to Head of Civil Engineering Department **Mrs. T. D. Sayyad** and Project coordinator **Mr. S. M. Palande** for providing the required facilities to complete this report. We must say thanks to all the teaching and non-teaching staff of department for their valuable cooperation and support. I thank Dr. S. V. Admane Principal, Jayawant Shikshan Prasarak Mandal's Bhivarabai Sawant Polytechnic Wagholi, Pune 407412

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