STUDY AND PROPERTIES OF GEOPOLYMER ECO BRICKS

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ABSTRACT

The present study's purpose is to investigate the behavior and durability of geo polymer eco bricks made from fly ash. The bricks utilized in this investigation have dimensions of 20cm × 20cm x 40cm. Manufacturing of bricks was carried out by keeping ratio by weight of flyash to sand from river or eco-sand (silica sand) to 1:2.5. As alkaline activator sodium flume solution was used. 1:2.5 ratio of NaOH solution was taken as binder solution. 0.416 was taken as the ideal water/binder ratio which was established based on the available literature. The solution to fly ash ratio is represented by the water/binder ratio (NaOH and H2O). This research will use ambient curing to cast bricks. The blocks will be made from a variety of sands, including sand from rivers and sands containing silica also known as eco-sand. Locally available solid blocks of cement were used to perform comparative study with the results obtained in tests performed in this research work.

Keywords: Bricks, Fly ash, Geo polymer, NaOH Solution, Silica sand, Sodium silicate.

INTRODUCTION-

It is projected that 175 million hectares of our country's total land area (329 million mha) is degraded. Agriculture occupies 143 million hectares of land, with 56 percent of it deteriorating to varying degrees. As a consequence, it is necessary to evaluate alternative raw materials used in brick production, and protecting the land from further deterioration is critical for long-term development. In India, the burned clay bricks company manufactures approximately 360 billion bricks every year, and has severe consequences for soil disintegration and untreated emissions. Such a large number of bricks necessitate the use of 15,500 hectares of land. Traditional brick manufacture requires 2200m ^{3} of top soil per billion bricks per year; however clay brick production requires just 0.75 hectares of land. Other source of worry for soil degradation is the inefficient handling of thermal power plant fly ash (TPP). Over 120 million tonnes of fly ash are produced in India each year from 260 million tonnes of coal (65 percent of the nation's total coal production), covering almost 15,000 hectares of useable land. Only 3-4 percent of manufactured fly ash is used in India, whereas China, America, and Europe use 40 percent. “Geo polymer Solid Block is an innovative construction material made possible by the chemical activity of inorganic molecules. Regular Portland cement manufacture produces a large amount of carbon dioxide (Co2) into the atmosphere, which contributes significantly to greenhouse gas emissions. Geo polymer has the potential to reduce greenhouse gas emissions by up to 80 percent.” Concrete remains the most common construction material on the globe. Ordinary Portland cement (OPC) is often used as a binder in conjunction with other components such as water and aggregates. This study describes the technique for producing geo polymer solid blocks from low-calcium (Class F) dry fly ash, as well as the results of physical and durability tests on this material.

THEORETICAL BACKGROUND

1.Mterials 2 Fly-Ash

In this Geopolymer bloks, fly-ash is obtaied from Mettur power plant.

Fine Aggregate

Sand from Rivers

River sand from Karur, which belongs to Zone III, in this experiment, was employed as fine aggregates. and the data in the table 3.3 from IS:2386-1968 Part III was used.

Manufactured sand

Manufacturing sand was accessible in Coimbatore and is zone II, in the current study, was employed as fine aggregate, and the following tests were performed in accordance with IS:2386-1968 Part III. **Eco Sand**

In the current study, eco sand is a residue of the cement industry; for construction purposes, it may be utilised as fine aggregates and may be a better option to river sand.

Coarse Aggregate

Crus hed blue granite stones with a specific gravity of 2.77 that are locally available and conform to graded aggregate with a nominal size of 12.5 mm according to IS 383 – 1970.

Water

Potable water was used in the present research, as stipulated in IS 456-2000, for the plain concrete and RCC.

Sodium Hydroxide

Sodium hydroxides are often available in the form of pellets and flakes. The cost of sodium hydroxide is now mostly affected by its purity. Because our Geopolymer concrete is a uniform substance, and the sodium silicate is activated as the primary technique, It is suggested that the least expensive, i.e., up to 94 % to 96 % purity, be used. Sodium hydroxide granules were employed in this study.

Sodium Silicate

Sodium silicate, often known as water glass or liquid glass, is a liquid (gel) that may be manufactured. In this study, sodium silicate 2.0 (the Na2O/SiO2 ratio) is employed. The same sodium silicate that is used as a bonding agent in the detergents and textile industries is used in the production of geopolymer concrete. The physicochemical properties of silicates, as per the producer, are as follows:

BRICKS

A brick is a single unit or block of a ceramic material used in masonry building. It is a rectangular block of clay that has been sun- or kiln-cooked till hard. Bricks are often piled or used as brickwork, with different kinds of mortar used to hold the bricks together and produce a long-lasting construction. Bricks are often mass-produced in common or standard sizes. It had long been acknowledged as one of history's most enduring and sturdy construction materials. A "brick" in the broadest meaning is a regular sized weight bearing construction piece. Dry and mortared bricks are put in horizontal courses. The brick might be composed of clay, lime-and-sand, concrete, or shaped stone in this context. In a less technical and more colloquial meaning, bricks are made from dried soil, primarily from clay-bearing subsurface. Some bricks are merely dried, such as adobe. More often, it is fired in a kiln of some kind to create a true ceramic.

TYPES OF BRICKS –

SOLID BRICK

A clay brick with less than 25% holes by volume that is solid rectangular in form.

PERFORATED BRICK

A clay brick having vertical holes to reduce weight, increase insulating characteristics, and decrease capillary attraction through a wall.

FROGGED BRICK

A clay brick with a perforation rate of 25% by volume. The phrase "frog" for the depression on one bed of the brick is a word that frequently describes the hollow produced on the brick. The most plausible reason is because brick makers refer to the block that is placed in the mould to generate the depression as a frog. This sort of brick is more commonly utilized for mortar placement in its bindings.

BRICK INDUSTRY

With an approximate coal usage of 15-20 million tonnes annually, the Indian brick industry is the third biggest consumer of coal in the country, behind power plants and the steel sector. Carbon dioxide (Co2), carbon monoxide (CO), sulphur dioxide (SO2), nitrogen oxides (NOx), and particulates are all released into the environment as a result of coal burning. At the local level, several of these contaminants are hazardous to human health, plants and animals' life (around a brick kiln). Pollutants such as CO2 contribute to climate change and global warming on a global scale. With increased environmental consciousness at all levels of society, the pollution created by the brick business is being closely scrutinised by environmentalists and the government. The publication of emission regulations for brick kilns by the Government of India in April 1996 was the first move in controlling pollution from brick kilns. Pollution control and energy conservation are intertwined; enhancing the efficiency of fuel consumption in brick kilns is the key to managing combustion-related pollution in the brick sector.

The combined effect of saving energy and reduction of environmental pollution is a win scenario, wherein industry ultimately benefits because of reduction in fuel costs and better workplace circumstances; and the nation and society continues to gain due to a decrease in pollution and also savings of valuable natural resources in terms of fuel.

BRICK MANUFACTURING PROCESS-

One of these three procedures is used to make modern clay bricks.

1. Soft modification approach 2. Pressed dry technique 3. Extruded technique

EXTRUDED METHOD-

In a pug mill, clay is combined with 10-15% water (stiff extrusion) or 20-25% water (soft extrusion) for extruded bricks. This combination is pressed through a die, leading to a long wire with the required size and depth. This pile is subsequently chopped into bricks of the necessary length by a wire wall.

Because it produces sturdy, thick bricks with holes, this method is utilized to build the bulk of structural bricks. The insertion of such holes reduces the amount of clay needed and hence the cost. Hollow bricks are lighter and easier to work with than solid bricks, and they offer unique thermal properties. The cut bricks are hardened before fire by drying for 20 to 40 hrs at 50 to 1500 ° C. Kiln waste heat is typically utilized for drying. In single-wall construction, European-style extruded bricks or blocks are utilized, having finishing provided within and around. Their many cavities use a larger portion of the volume than dried clay's hard, thin walls. These bricks are manufactured in widths of 15, 25, 30, 42, and 50 cm. Some variants have excellent thermal insulation capabilities, making them ideal for zero-energy building.

Fig 1 : Brick manufacturing process

DIMENSION OF THE BRICK-

CONTENT	LENGTH(L) (mm)	WIDTH(W) (mm)	HEIGHT(H) (mm)
The standard modular size of common building bricks	190	90	90
The non-modular sizes of the bricks	200	200	400
For obtaining proper bond arrangement and modular dimension for brick work, with the non-modular sizes of the bricks	200	200	400

Table 1.1 Dimensions of the Bricks

ADVANTAGES OF GEOPOLYMER BRICKS

- No any inflammable and dangerous geopolymer resins and binders in use.
- Geoploymer is being studied widely and act as a Greener cloth 2nd to Ordinary Portland cement which acts as a binder in cement primarily based totally fly ash bricks
- It has been observed that geopolymer brick has proper engineering houses as evaluate to fired clay bricks.
- The dangerous effect at the environment indicates the need for complete usage of fly ash whilst it`s possible to apply in brick production.
- The use of fly ash is good for environment safety.
- Bricks are uniform in form and length in assessment to burnt clay brick, therefore, require much less mortar in brick paintings and completing paintings ensuing in saving of cement mortar..
- No kiln burning is required.
- Bricks are uniform in shape and size in comparison to• burnt clay brick, therefore, require less mortar in brick work and finishing work resulting in saving of cement mortar.
- Bricks are environment friendly as:•
- It is a green building product and recommended in LEED & TERIGRIHA systems.
- It uses fly ash, which is a waste – product of thermal¬ power plants having no value itself.
- Save fertile agriculture land which is used for¬ manufacturing clay bricks.
- Less energy consumption in manufacturing and act as¬ more insulating material compared to clay bricks and help in keeping clean environment.
- Utilization of by-products hence good solution to the• disposal problem.
- Economical product.•

CONCLUSION-

This programmer intended to cover enormous volumes of information in order to enhance fly ash utilization. Even though fly ash is a pollutant, it is a crucial raw material for a range of reasons. The use of fly ash in various industries can put a heavy emphasis on the growth of novel methods so as to use fly-ash more effectively. Fly ash utilization plan must be broadly carried out embracing various concerns at diverse levels so as to curtail impact on environment to the highest possible degree. In order to make superior blends of cement that contain higher amounts of fly-ash from about 15-25% to 50-60% by employing mechanical activation of fly-ash without compromising properties of cement. A number of geo-polymer compounds containing about 60-90% fly-ash with varied characteristics have been fabricated. Regulation of air quality was also one of the focuses of this programme. According to the review, fly ash may be utilized as absorbents to remove oxides of sulphur and nitrogen, mercury, and other gaseous organic contaminants. This paper also emphasises and discusses the role of Hg-fly ash reactions in the elimination of Hg from exhaust gases. More research on pilot plant and manufacturing levels is recommended to strengthen the use of fly ash. In exclusion of a number of pollutants that contaminate the air the unburned carbon in fly-ash is rather significant. Carbon that has not yet been burnt can be turned into activated carbon, which boosts absorption capacity. Fly ash's fine texture is beneficial for Increasing the water - holding capacity of sandy soils while reducing compaction in clayey soils. Poor soils become efficient in the production because of these physiochemical benefits, as well as it also has a good effect on soil microbes. Ground water contamination may be easily repaired by employing weathered fly ash. Phytoremediation is an excellent approach to keep toxins from fly ash from recirculating, and growing versatile species of trees on poor soils is an environmentally safe way to use fly ash effectively.

REFERENCES: -

1. Vinay Kumar Jha, Arvind Pathak "Comparative Study of the Geopolymers Synthesized from Various Types of ConstructionWastes..", Nepal Journal of Science and Technology Vol. 14, No. 1 (2013).

2. Arturs KorovkinsOlga Mutere,Ingunda Sperberga,Maris Rundans, Gaida Sedmale, (doi: 10.7250/msac.2013) "Comparison of Structure and Properties of Differently Treated Illite Clay and Products". Material Science and Applied Chemistry (2013)

3. Sivakumar Naganathan, Kamal Nasharuddin Bin Mustapha , Alaa.A.Shakir "Development of Bricks From Waste Material" ,.Australian Journal of Basic and Applied Sciences. ISSN 1991-8178. Vol. 7(8). 2013.

4. M, Bennet Jose Mathew, Sudhakar M., "Development of Coal Ash – GGBS based geopolymer bricks".European International Journal of Science and Technology. ISSN: 2304-9693.Vol. 2 No, 5 June 2013.

5 P.M.Vijaysankar, R. Anuradha, V.Sreevidya, Dr. R. Venkatasubramani "Durability Studies of Geopolymer Concrete Solid Blocks" International Journal of Advanced Scientific and Technical Research, Vol.3(2), 2013.

6 Madheswaran C. K, Gnanasundar G., Gopalakrishnan.N,, "Effect of molarity in geopolymer concrete", International journal of civil and structural engineering. ISSN 0976 – 4399. Vol.4(2). 2013.

7 S.D. Muduli. J.K. Sadangi, B.D. Nayak, B.K. Mishra "Effect of NaOH Concentration in Manufacture of Geopolymer Fly Ash Building Brick". ISSN: 2276-7851,Vol. 3 (6), pp. 204-211, October 2013.

8. Energies. Francesco Colangelo, Giuseppina De Luca, Alessandro Mauro "Experimental and Numerical Analysis of Thermal and Hygrometric Characteristics of Building Structures Employing Recycled Plastic Aggregates and Geopolymer Concrete".ISSN 1996-1073. 2013.

9 G. Saravanan "Fly ash Based Geopolymer Concrete – A State of the ArtReview"., International Journal Of Computational Engineering Research. ISSN:2250- 3005. Vol.3(1). 2013.

10. s e wallah. d m j sumajouw. B.V. Rangan, D Hardjito "Introducing fly ash-based geopolymer concrete:manufacture and engineering properties.." CI- Premier PTE LTD.

2005.

11. Ali Ahmed Mohammed , Alaa A. Shakir "Manufacturing of Bricks in the Past, in the Present and in the Future: A state of the ArtReview". International Journal of Advances in Applied Sciences. ISSN:2252-8814. Vol.2(3). ,pp.145-156. 2013.

12. Radhakrishna, G. S. Manjunath. Tirupati Venu Madhava., K. Venugopal Phenomenological Model to Re-proportion the Ambient Cure Geopolymer Compressed

Blocks" International Journal of Concrete Structures and Materials.ISSN 1976- 0485/eISSN 2234-1315. Vol.7, No.3, pp.193–202, September 2013.

13. Niranjan PS, Radhakrishna., Jayasudha R K. "Properties of fal-g masonry blocks." International Journal of Research in Engineering and Technology.

14. Mr. M Sudhakar, Dr. C Natarajan, Mr. Bennet Jose Mathew "Strength, Economic and Sustainability Characteristics of Coal Ash" –GGBS Based Geopolymer Concrete.

15. Cheah Chee Ban,C. A. Jeyasehar, S. Kandasamy "The high volume reuse of hybrid biomass ash as a primary binder in cementless mortar block"., Journal of Engineering Science and Technology Review 6 (1) (2013) 25-32. 2013.

16. Dhiraj Agrawal Pawan Hinge U. P. Waghe,, S.P. Raut "Utilization of industrial waste in construction material – A review"., International Journal of Innovative Research in Science, Engineering and Technology. ISSN: 2319-8753. Vol.3(1). 2014.

17. Singh.R. K.,Gupta. N. C Int. "Value added utilization of fly ash- prospective and sustainable Solutions." Journal of Applied Sciences and Engineering Research. ISSN:2277 – 9442. Vol.3(1). 2014.

18. Monita Olivia and Hamid R. Nikraz. Strength and Water Penetrability of Fly Ash Geopolymer Concrete. ARPN Journal of Engineering and Applied Sciences, Vol. 6(7), 2011.

19.Shankar H. Sanni1 and R.B.Khadiranaikar. Performance of geopolymer concrete under severe environmental conditions. International Journal of Civil And Structural Engineering, Vol.3(2), 2012.

20. R. Anuradha, V. Sreevidya, R. Venkatasubramania and B.V. Rangan. Modified Guidelines for Geopolymer Concrete Mix Design Using Indian Standard. Asian journal of Civil Engineering, vol. 13(3), pp.353-364, 2012.

21. IS:2185 (Part II)-1983. Specification For concrete masonry units Part II Hollow and solid light weight.

22. B. Vijaya Rangan, Djwantoro Hardjito, SteenieE.Wallah, and Dody M.J. Sumajouw. Geopolymer: Green chemistry and sustainable development solutions, pp.133-137.

23. Lingling, Xu, et al. "Study on fired bricks with replacing clay by fly ash in high volume ratio." Construction and Building Materials 19.3 (2005): 243-247.

24. Malhotra, S. K., and S. P. Tehri. "Development of bricks from granulated blast furnace slag."Construction and Building Materials 10.3 (1996): 191-193.

25. Turgut, Paki, and Halil Murat Algin. "Limestone dust and wood sawdust as brick material." Building and Environment 42.9 (2007): 3399-3403.

26. Rahman, M. A. "Properties of clay-sand-rice husk ash mixed bricks." International Journal of Cement Composites and Lightweight Concrete 9.2 (1987): 105-108.

27. Caroline EV, Dylmar PD, Jose N, Ronaldon P. "The use of submerged-arc welding flux slag as raw material for the fabrication of multiple-use mortars and bricks." Soldagem Insp 2009;14(3):257–62.

28. Raut, S. P., R. V. Ralegaonkar, and S. A. Mandavgane. "Development of sustainable construction material using industrial and agricultural solid waste: A review of waste creates bricks." Construction and Building Materials 25.10 (2011): 4037-4042.

29. Davidovits, J. "Soft Mineralurgy and Geopolymers." In proceeding of Geopolymer 88 International Conference, the Université de Technologie, 1998, Compiègne, France.

30. Davidovits, J. "Chemistry of geopolymer systems, terminology." In Proceedings of Geopolymer "99 International Conferences,1999, France.

31. Duxson P, Fernandez-Jimenez A, Provis JL, Lukey GC, Palomo A, Van Deventer JSJ. "Geopolymer technology: the current state of the art." Journal of Material Science 2007;42:2917–33.

32. Dimas, D., I. Giannopoulou, and D. Panias. "Polymerization in sodium silicate solutions: a fundamental process in geopolymerization technology." Journal of materials science 44.14 (2009):3719-3730.

33. Majidi, Behzad. "Geopolymer technology, from fundamentals to advanced applications: a review."Materials Technology: Advanced Performance Materials 24.2 (2009): 79-87.

34. Joseph Davidovits, James L. Sawyer "Early high-strength mineral polymer", US Patent Publication No. US 4509985 A.

35. Lyon, Richard E., et al. "Fire-resistant alumina silicate composites." Fire and Materials 21.2 (1997):67-73.

36. Palomo, A., M. W. Grutzeck, and M. T. Blanco. "Alkali-activated fly ashes: a cement for the future."Cement and Concrete Research 29.8 (1999): 1323-1329.