A REVIEW ON MECHANICAL PROPERTIES OF FLY ASH, CEMENT, LIME AND GYPSUM BRICKS

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Abstract: India is a major consumer of coal in India and will continue to remain so far many years to come. Combustion of coal in thermal power plant not only produces steam to run electricity generating turbine but also produces a large quantity of by-products like fly ash etc. About 80 thermal power plants in India are sources of fly ash, where around millions of tonnes of coal are used annually. India currently generates 100 million tons of fly ash every year. This produces 30- 40 million tonnes of fly ash unused every year. This disposal will need thousands hectares of storage land, which may cause further ecological imbalance. In fact, this waste material is simply disposed of in the form aqueous slurry on the adjoining areas. This type of disposal not only converts useful agricultural land to waste ones but also possesses a threat to the quality of environment. The human development of united nation development programme indicates that annually 83-163 million hectares of land is eroded in India causing productivity loss of about 4 to 6.3% of the total agricultural output worth $2.4 billion. Therefore, using fly ash as a building material has assumed great significance like never before. Several investigations have been carried out throughout the world to make an attempt to use fly ash in many civil engineering projects by virtue of its good properties as an ingredient of concrete.

Keywords: Bricks; Fly ash; Lime; Gypsum; Cement; Sand

1. INTRODUCTION

Fly Ash bricks are made of fly ash, lime, gypsum cement and sand. These can be extensively used in all building constructional activities similar to that of common burnt clay bricks. The fly ash bricks are comparatively lighter in weight and stronger than common clay bricks. Since fly ash is being accumulated as waste material in large quantity near thermal power plants and creating serious environmental pollution problems, its utilization as main raw material in the manufacture of bricks will not only create ample opportunities for its proper and useful disposal but also help in environmental pollution control to a greater extent in the surrounding areas of power plants.

Manufacturing of commercial brick produce a lot of air pollution. The technology adopted for making. The fly ash bricks are eco-friendly. It is no need fire operation in production unlike the conventional bricks. Among the traditional fossil fuel sources, coal exists in quantities capable of supplying a large portion of nation's energy need. That's why the power sector in India is a major consumer of coal in India and will

continue to remain so far many years to come. Combustion of coal in thermal power plant not only produces steam to run electricity generating turbine but also produces a large quantity of by-products like fly ash etc. About 80 thermal power plants in India are sources of fly ash, where around millions of tonnes of coal are used annually. India currently generates 100 million tons of fly ash every year. This produces 30- 40 million tonnes of fly ash unused every year. This disposal will need thousands hectares of storage land, which may cause further ecological imbalance. In fact, this waste material is simply disposed of in the form aqueous slurry on the adjoining areas. This type of disposal not only converts useful agricultural land to waste ones but also possesses a threat to the quality of environment. The human development of united nation development programme indicates that annually 83-163 million hectares of land is eroded in India causing productivity loss of about 4 to 6.3% of the total agricultural output worth $2.4 billion. Therefore, using fly ash as a building material has assumed great significance like never before. Several investigations have been carried out throughout the world to make an attempt to use fly ash in many civil engineering projects by virtue of its good properties as an ingredient of concrete.

Fly Ash bricks can be prepared by the use of different semi-automatic and automatic machines nu the use of moulds pre attached in machines, where using of manual moulds in the manufacturing method leads to frequent change in the size of the bricks and may results in the poor exterior quality of the bricks. Approximately every ash bricks manufacturing plant uses machines to produce ash bricks, which led to the use of less labours and makes the cost less of per ash bricks which can be easily afforded by low to high class families.

2. USES OF FLY ASH

These earth elements primarily consist of silica, alumina & iron etc. and its physicochemical parameters are closely resembles with volcanic ash, natural soil and Portland cement etc. These properties, therefore, makes it suitable for use in ceramic industries and helps in saving the environment and Natural resources.

Fly ash in bricks

Fly ash bricks have a number of advantages over the conventional burnt clay bricks. Unglazed tiles for use on footpaths can also be made from it. Awareness among the public is required and the Government has to provide special incentives for this purpose.

Fly ash in manufacture of cement

Fly ash when mixed with lime and water forms a cementious compound with properties very similar to that of Portland cement. Because of this similarity, fly ash can be used to replace a portion of cement in the concrete, providing some distinct quality advantages. The concrete is denser resulting in a tighter, smoother surface with less bleeding.

Fly ash in distemper

Distemper manufactured with fly ash has similar properties like white cement & has been used in several buildings in Neyveli, Tamil Nadu etc. in India. The cost of production will only be 50% that of commercial distemper.

Fly ash as fertilizer

Fly ash serves as a good fertilizer. It provides the uptake of vital nutrients/minerals (Ca, Mg, Fe, Zn, Mo, S and Se) to crops and vegetation, and can be considered as a potential growth improver.

3. JOURNEY FROM BURNT CLAY BRICKS TO ASH BRICKS

The brick was traditionally produced by mixing the virgin resources, forming the bricks, drying them and then firing them. The current trend in bricks manufacturing has major emphasis on the use of post-consumer wastes and industrial by-products in the production process. Most of the researches went through enhancing the clay brick quality and properties by mixing the clay with various recycled wastes as foundry sand, granite sawing waste, harbour sediments, sugarcane baggase ash, clay waste and fine waste of boron, sewage sludge, waste glass from structural wall and other different wastes. Furthermore researches were held in developing bricks from wholly waste materials without exploiting any sort of natural resources, in order to achieve sustainability. They used entirely wastes in bricks making like waste treatment residual, granite waste, paper sludge, straw fibres, waste treatment sludge, fly ash and few other wastes. The conventional method of bricks making has caused serious environmental contamination represented by the enormous emissions of greenhouse gases (GHG) resulted in unusual climate changes as smog, acid rain and global warming. Furthermore, energy as fuel and electricity showed a drastic consumption during the traditional manufacturing of bricks led to highly economical expenditures. As a result, vast forests are in current deforestation in order to utilize their woods and trees as source of energy in the firing stage of bricks production. Hence, recycling the wastes in the bricks production appears to be viable solution not only to environmental pollution but also economical option to design of green building. However, the chronicle problem of (GHG) and energy consumption has not yet been tackled properly as most of the previous works were mainly focused on recycling the wastes traditionally in the bricks. Several researches addressed the amount of (GHG) emission and their impacts on the context as well as the energy consumption [12]-[13]. Few researches took the initiative in developing eco- friendly bricks in an economical environmental concern [14]-[15].

4. ENERGY SCENARIO IN INDIA AND FLY ASH GENERATION

Energy is the key resource for development of any country. The per capita energy consumption in a country is an index of living standard of society. After the first industrial revolution initiated in Europe and America, the global energy demand has increased steeply. It is interesting to note that worlds' 75% energy is used by the 25% population of developed countries and vice-versa (Pachauri et al 1998). Amongst various forms of

energy, electricity is considered to be superior and cheaper. Because it can be transported very easily in a short span of time, it can be converted to any other desired form without much loss and time and it does not created pollution at t6he point of used. Hence the modern equipment's are designed to use electrical energy. Thus the electricity demand all over the world is increasing tremendously. In order to meet ever rising demand for electricity, all over the world major power projects are being installed. Till date thermal power is the major source of electricity generation in India that provides 60% of its electricity. India's power generation has grown at a CAGR of 7 % since 2010. The country's installed power generating capacity of 334.4 gigawatt (GW, or 1,000 megawatts) as of January 2018 is the world's fifth-largest.

In 1947, there was just 1331 MW of power generation and in 1998, it has reached about 89167 MW. Yet there is no respite. Demand continues to outstrip supply. Presently India largely depends on coal for its electricity generation since it is considered as cheaper as and safer than nuclear power generation. The nation produces 65% of its electricity by thermal power plants.

5. REVIEW OF PAST WORK

T. U. Ahmed et al. (2018) reveals the mechanical properties of fly ash bricks taking different proportions of fly-ash, gypsum, sand and a fixed amount of cement. To perform this research a varieties of tests were conducted i.e., compressive strength, water absorption, unit volume weight, apparent porosity, open pore, and impervious pore in the laboratory. Ingredients were being used to produce the bricks at four proportions of using fly-ash (50%, 55%, 60%, 65%), gypsum (12%, 9%, 6%, 3%), sand (28%, 26%, 24%, 22%) respectively and 10% of cement in each and every proportions. Md. Ashikuzzaman et al. (2018) studied the effect of brick forming load on the crushing load, water absorption and unit volume weight were studied. For this purpose bricks were prepared for different fly-ash (50% to 65% at 5% increments), gypsum (12% to 3% at 3% decrements), sand (28% to 22% at 2% decrements) and 10% cement. All ingredients were thoroughly mixed and then poured them to a mold of 9.5cm x 4.5cm x 2.75cm. Bricks were made by different forming load and mechanical properties were noted. This research suggested that it was possible to make good quality bricks using fly-ash, gypsum, sand and cement. Manish Kumar Sahu and Lokesh Singh (2017) explained about manufacturing of fly ash bricks in present era and advantages of using it as a construction material. In this paper author explain about advantages of fly ash bricks over burnt clay bricks or red bricks and manufacturing process of fly ash brick. In India, bricks are mainly composed up of clay, and are generally produced in traditional, unorganized small scale industries. Bricks are important building material and about 250 billion bricks are annually produced by the brick industries. Red clay bricks making consumes larger amount of clay which leads to top soil removal and land degradation. Large areas of lands are destroyed every year especially in developing countries due to collection of soil from a depth of about 1 to 2 m from agricultural land. An important step in brick making is firing of bricks in brick kilns which cause serious environmental pollution and health problems. Brick burning largely influence the concentrations of greenhouse gases in the atmosphere. This causes serious air pollution and also workers in

brick industries are prone to respiratory diseases, to avoid all this environmental threats brick made of waste that is originated from the waste as a residue from the different industries and factories, this types of bricks is termed as fly ash bricks which is composed by the different materials such as lime, gypsum, sand, fly ash etc. Vijay Bhatt et al. (2017) done the experimental investigation was carried out to find the percentage of optimum mixture of fly ash building brick, so that we utilize and recycle as much as fly ash with optimum required building bricks strength. However the size of brick specimen is taken as 230mm x 100mm x 90mm according to Indian standard for different mixture percentage of Fly ash (10 to 30%), Gypsum (3%), Lime (25 to 35%) and Sandy (45 to 55%), with three different particle size of fly ash 425micron, 600micron, 825micron, compressive strength, Water absorption, Efflorescence test were studied for different mix proportions. The results shows the variations in compressive strength, Water absorption, and Efflorescence test for different mixture proportions of different materials mentioned earlier at three different curing temperature that is 1000^{o}C, 1100^{o}C, 1200^{o}C. From the present research based results it was evidently expected that, the maximum optimum compressive strength is obtained for optimum mixture percentage of Flyash-10% Lime-35% Gypsum-3% Quarry dust-52%. Nitin S. Naik et al. (2016) studied the strength and durability aspect of bricks prepared using Fly Ash, Cement and Phosphogypsum. Various properties of these bricks were studied by different researchers and they found that these bricks can be used for construction of low cost houses in the area in the vicinity of thermal power plant. Tarun Gehlot and S.S Sankhla (2016) analyzed the influence of bond strength on compressive strength of brick masonry and the compressive strength of brick prism of fly ash concrete brick with variation in percentage of Recron fiber with cement mortar of 1:6 and 1:8 ratios. Robiul Islam (2015) studied the possibility of using fly ash as a partial replacement of clay for brick manufacturing considering the local technology practiced in Bangladesh. The effect of fly ash with different replacing ratio (0%, 20%, 30%, 40%, and 50% by volume) of clay on properties of bricks was studied. Bricks were made in the field parallel to ordinary bricks marked with specific number for different percentage to identify them at time of testing. No physical distortion is observed in fly ash brick after burning in the kiln. Results from laboratory test show that compressive strength of brick is decreased with the increase of fly ash and maximum compressive strength is found to be 19.6 MPa at 20% of fly ash. In addition, water absorption of fly ash brick is increased with the increase of fly ash. The abrasion value and Specific gravity of coarse aggregate prepared from brick with fly ash also studied and the results of this study suggests that 20% fly ash can be considered as the optimum fly ash content for producing good quality bricks utilizing present practiced technology. M. Narmatha et al. (2014) done project comprises of strengthening the compressed fly ash bricks by addition of Ironite powder. The green movement has greatly influenced the design and construction of the built infrastructure across the globe. There is a growing interest in delivering high performance building systems. A high performance building is as defined in the Energy Policy Act of 2005: a building that integrates and optimizes all major high performance building attributes, including energy efficiency, durability, life cycle performance, and

occupant productivity. This view was echoed by the US building enclosure community in 2008 when they launched a formal initiative which underscored the linkages between energy efficiency, durability and the quality of the indoor environment. The discussion in this paper focuses on the realization of high performance buildings through developing more ecological and durable walling elements based on the use of compressed fly ash bricks by adding the admixture named Ironite materials to the compressed fly ash bricks at certain ratio. In this we are going to show the improvement of strength in fly ash bricks through a comparative study. Abhijit Chakraborty (2014) presented an idea of developing a new design for the material mix of the fly ash bricks that are very much of better quality as compare to traditional bricks by applying VE concept. The critical success factor for any fly ash industry is their ability to develop the product which meets customer's requirements while offering high value that provides increased reassurance of market success and development. Tahmina Banu et al. (2013) done the production of light weight structural bricks using fly ash, generated at Barapukuria Thermal Power Plant, as the major ingredient has been investigated. Optimum mix of fly ash, sand, hydrated lime and gypsum has been identified and the brick forming pressure was also optimized. 55% fly ash, 30% sand and 15% hydrated lime with 14% gypsum was found to be the optimum mix. The compressive strength, microstructure, shrinkage property, unit volume weight, Initial rate of absorption, absorption capacity, apparent porosity, open pore and impervious pore of the fly ash–sand–lime-gypsum bricks produced with optimized composition under various brick forming pressures were determined. Efflorescence and radio activity of the bricks formed under optimized conditions were also investigated. Later on effect of various curing process and variation of curing period were studied. The results of this study suggested that it was possible to produce good quality light weight non-fired structural bricks from coal fly ash generated at Barapukuria Thermal Power Plant.

6. CONCLUSION

With increasing inflow of migrants to cities, the need to have houses becomes impertinent. The construction industry has grown at a fast pace. India being a developing country it has seen many ongoing infrastructural projects being carried out like road development, housing schemes. Increasing housing and industrial development require more of raw material like bricks, cement and sand. Many additives and admixtures have been tried to enrich the brick matrix. Few have successfully used local fly ash of their region in the clay brick manufacturing and have found it to be suitable even for high proportion in bricks production.

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