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Experimental Investigation on Mineral Content of Fly Bottom Ash and Strength Characteristics of Fly Bottom Ash Bricks – A Review

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ABSTRACT
This investigation is to study the mineral contents of fly-bottom ash. After many years of research in sustainable construction materials, the quality of producing construction materials has significantly improved. And the replacement of ordinary cement with fly-bottom ash has showed several improvements such as strength and other characteristics. During the production of ordinary cement, CO2 emissions are very high and energy consumption is also very high. Due to limited resources of nature, it has to be reconsidered to use the ordinary cement. The advancement of technologies has led to significantly promote the use of fly-bottom ash in ordinary cement in order to improve the quality of construction materials. The fly ash is been used for zeolite synthesis, synthetization of organic geo-polymer and in manufacturing of construction materials.

KEY WORDS: *sustainable; zeolite synthesis; geo-polymer*

1. INTRODUCTION

Rising population, urbanization and industrial revolution has significantly improved the production of solid waste and other wastes. Waste management is worldwide phenomenon. India produces about 40 million tones of solid waste every year. In our day to day life the collection of waste very tedious process and disposal of municipal solid waste is a great problem of urban life. The proper disposal of urban waste is necessary for the preservation of natural resources and development of environment. One of the major solid waste of Thermal power plant is fly ash. By mixing the fly ash with concrete during construction there will be significant reduction in production of solid waste and green house gas such as CO_2. Concrete is the most widely used construction material in the world. The green house gases produced during production of cement will cause serious environmental contamination such as smog and acid rain and harmful effects to living beings also. Mostly the fly-bottom ash is dumped in landfills which could cause potential damage to aquifers and ground water reserves. Studies showed many alternative methods for effective solid waste management and improved methods of producing construction materials. Along with Fly-bottom ash many natural organic materials are added to improve the strength characteristics of the construction materials.

The other replacements for ordinary cement are fly ash, bottom ash, silica fume, risk husk ash, and Metakaolin etc., through years furthermore researches have been carried out.

2. Geo-polymer

Geo-polymers are either organic or inorganic materials with are formed by repeating units of chemical compounds.

2.1 Geo-polymerization

It is the process of combining the chains of monomers to form a covalently bonded network.

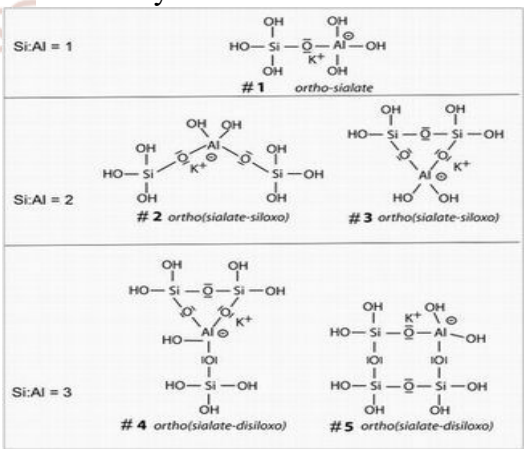

Figure 1.1

The above figure 1.1 shows 5 soluble oligomers which are the actual starting units of potassium-based alumino-silicate geo-polymerization.

2.2 Geo-polymer cement

It is a new type of concrete which utilizes only a small portion of ordinary cement as a binder, binding characteristics are based upon the reaction of an alkaline liquid with organic materials which are rich in silica and alumina.

2.3 Materials used in geopolymer concrete

2.3.1 Blast-furnace slag is a non-metallic fine powder material consists of silica and alumina essential for geopolymer synthesization , it is a by-product of iron and steel industry . It has the ability to improve the durability of the concrete so it has been widely used across the world.

2.3.2 Metakaolin is formed by heating china clay (kaolinite) between the range of 650°c-850°c. It is basically used to improve the binding property of concrete.

2.3.4 Alkaline Solutions, solutions which have PH value more than 7 are alkaline solutions these are used in many day to day applications. Some examples potassium hydroxide and sodium hydroxide etc.,

3. METHOD OF MANUFACTURING

Ash bricks can be prepared by the use of different semi automatic and automatic machines with 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. There are 3 different proportion by which fly ash bricks can be prepared which depends on the materials available.

3.2 PROCESS OF MANUFACTURING

Manufacturing process is illustrated in the form of flow chart as shown in the figure 1.2. The flow demonstrates the step by step process of preparing the fly-ash bricks.

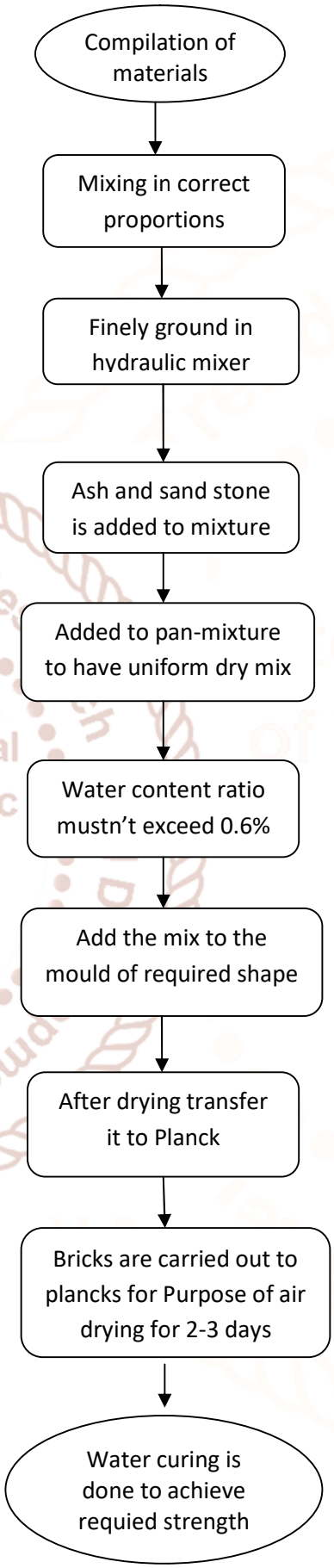

Figure 1.2 Process of manufacturing

4. MIXING PROPORTIONS

Mixing proportions make a great impact on strength characteristics of fly-bottom ash bricks, so in-order to know the optimize mixing proportions various research has been done over this area, Recent conclusions are reported below in table 1.1.

Mixing proportions used in this study.

Formulation	M65	M70	M75	F65	F70	F75
Mechanical-bed bottom ash (wt%)	65	70	75	-	-	-
Mechanical-bed fly ash (wt%)	15	10	5	-	-	-
Fluidized-bed bottom ash (wt%)	-	-	-	65	70	75
Fluidized-bed fly ash (wt%)	-	-	-	15	10	5
Reservoir sediment (wt%)	20	20	20	20	20	20

Table 1.1 Mixing proportions

5. ISSUES IN WASTE MANAGEMENT

Mr. Abhimanyu Sing (2014) has studied the waste management status & health effects, according to his study, the random wastes in the streets which remain uncollected are increasing on a day to day basis it has to be separated as bio degradable and non bio-degradable and to be sent for waste treatment.

An awareness program has to be conducted in order to increase public interest towards waste management.

5.1 ECONOMIC BENEFITS OF GEOPOLYMER CONCRETE

N A Lloyd and B V Rangan (2010)

In this study it is said that using fly ash based geo-polymer as a replacement for ordinary cement is very economical in both ecological aspect and monetary terms.

Other characteristic improvement in construction materials are the low creep, resistance to sulphate attack and good acid resistance.

Finally geo-polymer concrete saves lots of money thus caused due to repairs and maintenance of those infrastructures.

5.2 INEVITABILITY OF GEO-POLYMER CONCRETE

Due to the growth in population and development in infrastructure globally, demand for cement as per International Cement Review's report was 3,524 million tons in 2015 which is increasing by nearly 12% annually which could result in a huge shortage on limestone in future, in addition to this emission of CO_2 in the atmosphere is the major threat for climatic changes.

Vikas R Nadig et al (2015) studied the Bottom Ash as Partial Sand Replacement in Concrete. From this study physical characteristics of concrete when partially replaced with bottom ash as coarse aggregates. The implementation of Bottom ash in concrete shows a effective improvement in strength characteristics and waste management as well as resources conservation The density of Bottom Ash concrete decreases with the increase in bottom ash content, since the specific gravity of bottom ash is low as compared to fine aggregates.

A S Cadersa et al (2014) this study shows the Use of Untreated Bottom Ash as partial Replacement in Concrete. Unprocessed bottom ash is investigated for its structural characteristics in this study.

Varying compositions of bottom ash in percentage (20%, 30%, 40%, 60%, and 80% respectively) are experimentally investigated for its physical and chemical characteristics. The results show that increase in bottom ash content increases the blending capability. 40% replacement of bottom ash decreases characteristics such as, compressive strength, flexural strength, and modulus of elasticity. From this research it is said that 20% replacement of bottom ash is the optimum percentage also shows that 20% is the optimum percentage to achieve favorable strength.

Lokeshappa et al. (2011) has stated that the only a small portion of fly ash is utilized in construction field and the remaining is left unused and untreated. The fly ash pollute the atmosphere and water bodies. Many researches is to be done in order to utilize the industrial wastes into construction materials. Numerous research and development programs are undertaken for studying the characteristics of fly ash and to use it for better replacement for ordinary cement.

Due to this many benefits can be achieved and better replacement for ordinary cement which may significantly reduce the co_2 emission and global warming

Kumar V. et al. (2005) has estimated that the thermal power industry will produce fly ash at about 190 million tons by 2015 and 325 million tons by 2019.

OPTIMIZATION:

Muhammad N. S. Hadi et al (2018) this study was conducted on optimization of mixes i.e., sio_2 content and amount of alkaline liquids such as Na2SiO3 and NaOH . The result shows that the increase in contents of cao and Na_2O does not increase the compressive strength of fly ash bricks this led to the intervention of particle size the contents has significant effect on the strength of the bricks. The augmentation of alkaline liquids has showed some improvements in the strength characteristics up to a certain level of inclusion beyond that level the alkaline liquids increases the porosity of the bricks which in turn reduces the strength of the bricks.

Christof Lanzerstorfer et al (2018) this experimental review shows the particle size dependence on the composition of various mineral contents in the fly ash. It has been noted that decrease in particle size contrarily increase some of the minerals which contribute to the mass but heavy metals such as hg ,p ,pb etc., decrease in concentration. This phenomenon is due to the coarse particles will not mix well with the mortar. New phenomenon air classification has been applied in this study to classify metals which are independent of the particle size.

Conclusion:

From this review it has been understood that ashes from thermal power plant are rich in silica and alumina so it could be a better replacement for ordinary cement. Due to low specific gravity the bricks produced completely with ash may not be favorable. So in order to achieve physical strength blending of ash with ordinary cement could be a great solution for industrial waste management and reducing greenhouse gases.

From further research and study **A S Cadersa et al (2014)** has said that 20-30% replacement of ash in concrete is the optimum value to achieve desirable qualities beyond this may disrupt the qualities of ordinary cement.

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