International Journal of Enhanced Research in Science, Technology & Engineering
ISSN: 2319-7463, Vol. 6 Issue 6, June-2017, Impact Factor: 4.059

Study on Fly Ash Polymer Composite

Sumit[1], Abhishek Arya[2]

[1]M. Tech. Student, Matu Ram Institute of Engineering and Management College (M.R.I.E.M), Rohtak
[2]HOD of Civil Engineering Department in Matu Ram Institute of Engineering and Management College), (M.R.I.E.M), Rohtak

ABSTRACT

Industrial waste like fly-ash that is creating environmental issues, is especially used as a building material because of its low value and easy handiness but the most disadvantage of these bricks is its low strength. So, a lot of research is going on to increase the strength of these bricks the present research work is carried out to develop a brand new systematic procedure to produce Fly ash composite bricks which is able to have higher compressive strength.

Keywords: Fly Ash, Strength Mixing, Resin, Bricks, Composite.

INTRODUCTION

The entire development of a country depends on the production value of power and consequently its consumption as energy. Our country, India desires vast power resources to fulfill the expectation of its inhabitant further as its aim to be a developed nation by 2020. fuel plays a vital part in meeting the demand for power generation .Coal is taken into account to be one amongst the world's richest and cosmopolitan fuel. around the world, india dominates the third position in the largest production of coal and has the fourth largest coal reserves approx. (197 Billion Tons). it's been calculable that seventy fifth of India's total put in power is thermal of that the share of coal is concerning ninetieth. Nearly concerning 600 Million tons of coal is produced worldwide each year, with Fly ash generation is concerning five hundred MT at (60-78 %) of whole ash made.

In India, the present generation of Fly ash is almost concerning a hundred and eighty MT/year and is probable to increase concerning 320 MT/year by 2017 and 1000MT/year by 2032 .No doubt Indian coal has high ash content and low heat value. so as to fulfill the increasing difficult demands, several coal based mostly thermal power plants are constructed. As a results of that immense quantity of combusted residue in the sort of ash (80 %), and Bottom ash (20%) has been made. The finely distributed particle from the burnt coal is discharged out through the flue gases that are detached automatically through electrostatic precipitators and separators that are then collected along within the field of hoppers. the speed of production of Fly ash is high and it goes on increasing year once year.

The annual production of Fly ash in China, india and America is approximated concerning 275 million metric tons. however but half this is often consumed in numerous areas. the best challenge before the process and producing industries is that the disposal of the residual waste product. The harmful impact on the environment suggests the requirement for acceptable dumping of Fly ash and justifies full utilization of Fly ash once possible.

LITERATURE REVIEW

The total installed capacity of electricity generation in india is concerning 100,000 MW. Out of that seventy three of power generated is from thermal Plants. india has coal reserves of about one hundred eighty billion metric tons. therefore it's value to mention that eighty eight maximize the thermal power plants of india utilize this extravagantly found natural resource. In our country there are many power generation units out of that around eighty five units are based on coal. large amount of ashes present (35–50%) and low calorific value (2,800–4,200 kcal/kg) is that the physical significance of Indian coal. to provide the desired energy high coal laid-off rate is necessary that therefore generates larger ash deposit. In india the present generation of coal ash is almost regarding one hundred eighty million metric tons; that is meant to be twice within the forthcoming decade. usually wet methodology is utilized in india for the ash disposal. For the assembly of one MW

power it needs roughly one acre land and a higher initial investment. In our country the occupancy of ash pool is nearly twenty six,300 hectare. until 1994 only third of total ash was utilised. Since then, it was accomplished that the environment should be preserved in india and for this our government planned a ash Mission (FLY ASH M) in 1994.The major purpose for this mission was the safe disposal and consumption of ash. In India, twenty one completely different locations are chosen to demonstrate fifty five technologies by FLY ASH M in ten major areas. The increment of the utilization of ash was recorded from three to thirteen since 1994 to 2002. Glogowski et al., (1992) studied the manual of EPRI and reported that with the assistance of ash thirty three ridges and thirty one fills were created in North America. per the ACAA in 1999, thirty third of the ash made in North American nation was utilized in many areas for various applications.

Fly ash Bricks

Bricks has been used as a significant construction and building material. Since long Aluminous –silicate and silicon dioxide bricks are chosen as refractory materials in several industrial applications, as a result of their high wear resistance, long lasting, durable and load bearing capacity at high temperatures. as a result of the limitation of clay resources, china has partly restricted the utilization of typical fired bricks produced from clay. So the last word aim is to find raw materials for brick production different to clay. Currently energy savings has become a really necessary environmental and economic issue. The consumption of energy from buildings includes regarding one third of the entire consumption, with nearly 1/2 its energy lost through the walls.

One of the effective approaches to reduce energy consumption is to decrease the thermal conduction of wall material, like brick. Organic residues like saw mud, polystyrene, paper sludge, coal, coke and inorganic products are usually used to decrease the thermal conduction of the brick. These residues used as a pore forming additives to get extremely porous bricks. various studies have been conducted on dismissed brick manuFly ash ctured from ash. Fly ash bricks show higher mechanical and chemistry properties which has low dense structure with high strength, negligible consistence and shrinkage, excellent thermal stability and durability, high surFly ash cement hardness, hearth and chemical resistance than standard material bricks.These bricks are an atmosphere friendly value saving building product.

Salient features of Fly Ash bricks:-

1. Practically no damage can be seen during transport and use, due to their high strength.
2. Owing to uniform size of bricks mortar required for joints and plaster reduces by almost 50%.
3. The seepage of water through bricks substantially reduces due to its low water penetration.

Material used

Fly ash

The used in this project was collected from electrostatic precipitators of the captive power plant (CPP-II) in dry condition. Fine powders were oven dried at 110^{o}C-160^{o}C and should keep in air tight bottle for late.

Uses of Fly ash

Huge amount of Fly Ash is utilized in various areas which are of little significance in terms of cost. Some of the common uses are in brick industry, filling of mines, ridges, surFly ash cing and recovery of Fly ash llow land etc. A lot of efforts have been made for manuFly ash cturing of bricks by different agencies using lime, different types of resins, gypsum and clay.

Fly Ash are commonly used as cement stabilizer, light weight filler materials for prestressed structures ,wall slates and roofing tiles ,for insulating blocks ,in paints and enamels and as herbicide in agricultural science to destroy unwanted vegetation. These all comes under the category of medium cost values.

Recovery of various Magnetic oxides, Aluminum oxides (Al2O3), and different trace elements , synthesis of Zeolites for industrial applications and making of inorganic wools. Removal of bleaches and organic compounds from waste water, mercury from the flue gases, adsorbents for cleaning of flue gases (Sox and Nox emissions). These are grouped under high cost values.

Reviews on FLY ASH

Several investigators had worked on the coal ash properties to evaluate its importance in various fields. Some of them are mentioned below:-

Sherwood and Ryley states that Fly ash possesses self-hardening features due to the presence offree lime in the form of calcium oxide or calcium hydroxide.

Mc-Laren and Digi-oiab showed that specific gravity of Fly ash is comparatively lower than thatof soils .The density of the ash fills gets reduced which is a major advantage in terms of its use as various filler materials. Now these fillers can be used in spongy walls and ridges particularly when the foundation is weak.

Sridharan et al., studies the micrographs of FLY ASH particles through SEM. These particles are mostlysolid spheres with glassy appearance, hollow spheres with smooth-edged porous grains, asymmetrical agglomerates and irregular absorbent scraps of unburnt carbon.Occurrence of iron particles that are dark grey in color can be identified as pointed grains.

According to **Mohini Saxena and P.Asokan** a lot of multidisciplinary tests on coal ash have been conducted at various lab centers. Regional Research laboratory, Bhopal has worked a lot on FLY ASH and enhanced the various methodologies for pilot scale demonstration. They cultivated Crops,

Lee H, Lee CH, and Kim PJ stated that Fly ash when incorporated with soil improves its physic-chemical and organic properties which has its great benefit in agricultural sector. Many agricultural scientists have proved that Fly ash possesses almost all the essential nutrients which are required for cultivation of crops. However it is not used as commercial manure.

Reviews on Fly ash Bricks

Fly ash based bricks offer exciting advantages over traditional clay bricks. Aggressive research is being carried out worldwide on Fly ash based geo polymers to improve functional properties. This chapter focusses some of the recent reports published in literature on Fly ash based on geo polymers, its uses for making bricks and its mechanical properties. Fly ash bricks have created prodigious attention and awareness among materials experts and engineers in current years due to the considerations of developing an environmental friendly, high strength material and partially switching currently used clay bricks.

Obada Kayali studied the properties of Fly ash and clay made bricks and concluded that themechanical properties of Fly ash bricks have exceeded to those of standard load bearing clay bricks. Compressive strength was 24% superior than good quality clay bricks and tensile strength was nearly three times the value for standard clay bricks. The bond strength of the Fly ash bricks is 44% higher than the normal clay bricks. Density of Fly ash bricks is 28% less than that of standard clay brick. The reduction in a weight of bricks results in a great deal of savings in terms of raw materials and transportation costs. Bricks of Fly ash can be easily soak up mercury from normal air which is in contact with it and thus makes it cleaner for berating.

Rayl weigh has presented an extensive review in reported work on Fly ash bricks. Heinvestigated the flexural strength, water absorption test, density, porosity and stability of these solid bricks and hollow blocks. Researcher proved that these bricks and blocks have sufficient strength for their usage in low rate housing growth. Tests were conducted to determine the compressive strength and hardening effects and to analyze the effects of curing with time. The compacts treat in hot water gives better strength and hardening effects if compares to normal water cured compacts. Initially the strength of these blocks and bricks increases with higher rate and then at a comparatively lower rate.

Thermal conductivity

To measure the thermal conductivity of Fly ash and resin powder mixture, KD2 Pro analyzer as shown in figure 3.3 was used and it follows ASTM Standard D5334-08 [28]. It comprises of a handheld controller and a various sensors that operator can embed into very nearly any material. Single probe of 6cm long and 0.127 mm diameter was inserted in a small plastic bottle filled with FLY ASH & resin powder to find the conductivity value .At least ten values of each composition was recorded to get the appropriate result. KD2 Pro uses the transient line heat source mechanism to evaluate the conductivity and diffusivity of the given mixture. A restrictive calculation fits time and temperature information with exponential functions via nonlinear least squares technique.

Fig. 1 KD2 Pro analyzer

Microstructural Characterization

SEM Study

In present study, A JEOL 6480 LV Scanning Electron Microscope (Fig. 2) was used for the characterization of microstructural changes (pits, cavities, and porosity), determination of particle size and morphology of FLY ASH compacts. To get the better image resolution, secondary electron imaging with accelerating voltage of 15 KV was used.

Fig. 2 Scanning Electron Microscopy (JEOL JSM-6480LV)

XRD Study

The mineralogical composition of Fly ash and the different phases present was determined by XRD analysis in a Philips X-pert multipurpose x-ray diffractometer (shown in figure.4) using Cu Kα (λ=1.5418A^o) radiation. The patterns were examined by comparing the positions of peak and intensities of the samples with those in the (JCPDS) data files. The diffraction patterns were recorded in the scanning range of 20^0-80^o with a step size of 2^0 C per minute

.

Fig.3 Philips X-pert multipurpose x-ray diffractometer

FTIR Study

FTIR spectroscopical technique is used to understand the chemistry of surnter|port}Fly ash ce for Fly ash in thermally active state along side completely different state of mineral phases, H2O and –OH group on silica and alumina. Fourier transforms infrared radiation (FITR) spectrometer (shown in figure.4) is used to calculate the transmission share of infrared. so as to arrange pellet very little amount of potassium bromide (KBr) was segregated with powder sample and then pressing of mixture was done. Analysis of that pellet was done using FITR by keeping the pellet in sample holder.

Fig.4 Perkin-Elmer Spectrum RXI, (FTIR) Spectrometer

RESULT

Density Measurement

Density of the samples was calculated before and after treatment. we can say that density of dry compacts decreases with increase in weight percentage of FLY ASH . As the dry compacts are immersed in water at 110^0C -180^0C, then through

capillary action voids are filled and it becomes hard and the porosity is eliminated. As a result of which the compacts become dense and finally the density increases with increase in FLY ASH content.

Table 1 Density value of dry and wet FLY ASH polymer compacts

Mix Composition (Wt. %)	Density (g/cm^3)	
	Dry	Wet
(FLY ASH)75%+ (RP)25%	1.40	1.60
(FLY ASH)80%+ (RP)20%	1.38	1.62
(FLY ASH)85%+ (RP)15%	1.35	1.67

Hardness Measurement

The Hardness values the composites of Fly ash of different compositions, both in the dry and wet condition, are measured by the help of LECO, LM 248AT Vickers hardness tester. The Hardness values as obtained are shown in Table 4.4. The values of hardness are in the range of 32.93 HV – 44.08 HV for dry composites and 39.78 HV – 47.37 HV for wet FLY ASH composites respectively.

Table 2 Hardness values of various FLY ASH resin mix compacts

S.NO	Mix Composition (Wt. %)	Micro hardness value (HV)	
		Dry	Wet
1	(FLY ASH)75%+ (RP)25%	32.93	39.78
2	(FLY ASH)80%+ (RP)20%	38.26	43.04
3	(FLY ASH)85%+ (RP)15%	44.08	47.37

Fig. 2 shows a comparison between the hardness values of dry and wet Fly ash composites. It is evident from figure that as we go on increasing the wt. % of FLY ASH , i.e., resin content decreases the hardness values of both the wet and dry compacts increases. Maximum hardness values in case of 85 wt. % FLY ASH is achieved.

It is evident from the XRD analysis as shown in fig. 4.4 (b) of water treated 85 wt. % FLY ASH compact that a Calcium Silicate Hydrate (C-S-H) and Calcium Aluminate Silicate Hydrate (C-A-S-H) phase appears which are responsible for the hardness improvement. Both these phases are formed by the reaction of Ca (OH) 2, Sio2 and H2O when treated in water at 110^0 C-180^0 C.

CONCLUSION

1) Water absorption increases with increase in FLY ASH content. Maximum of 19% water is absorbed in case of 85 wt. % FLY ASH .

2) Density of dry compacts decreases with increase in FLY ASH content. While in case of wet compacts, it increases with increase in FLY ASH content.

3) SEM analysis revealed the morphology of FLY ASH particles that are mostly spherical in shape. With decrease in polymer addition i.e. increase in FLY ASH content the interFly ash ce bonding becomes better and less amount of cracks were found at the interFly ash ces.

4) XRD analys is exposed that FLY ASH particles mainly consist of Silica and alumina with less percentage of Fe2O3, Cao and others.

5)The Fly ash –resin powder composite produced in the present study seem to be appropriate for use as construction material. The production of this type of composite will certainly contribute to the use of Fly ash for value added products. On the other hand, the reduction in clay usage for the production of conventional clay bricks will help to protect the environment.

REFERENCES

[1]. Joshi RC, Lothia RP. Fly ash in concrete: production, properties and uses. In: Advances in concrete technology, vol. 2. Gordon and Breach Science Publishers; 1999

[2]. Ahmaruzzaman M. A review on the utilization of Fly ash . Prog Energy Combust 2010; 36:327–63.

[3]. Rai A.K., Paul B. and Singh G., A study on physico chemical properties of overburden dump materials from selected coal mining areas of Jharia coalfields, Jharkhand, India, Int. Journal of Environmental Sc., 1 (2011): pp. 1350-1360.

[4]. Sahay A.N., R&D initiatives in utilization of Fly ash in coal sector, in: Proc. of Fly ash an opportunity for Mining Sector, New Delhi, India, 2010, pp. 26-35.

[5]. Das S.K. and Yudhbir, Geotechnical properties of low calcium and high calcium Fly ash , Journal of Geotechnical and Geological Engineering, 24 (2006): pp. 249-263.

[6]. Sinsiri T, Chindaprasirt P, Jaturapitakkul Ch. Influence of Fly ash fineness and shape on the porosity and permeability of blended cement pastes. Int J Miner Metal Mat 2010; 17:683-690.

[7]. P.S.M. Tripathy, S.N. Mukherjee, Perspectives on Bulk Use of Fly ash , CFRI Golden Jubilee Monograph, Allied Publishers Limited, 1997, p. 123.

[8]. Sidhu, Buta Singh, Singh, Harpreet, Puri D., Prakash, S., "Wear and Oxidation Behavior of Shrouded Plasma Sprayed Fly ash Coatings", Tribology International, Volume 40,(2007), pp.800-808.

[9]. China Economic Trade Committee, Tenth five-year program of building materials industry, China Building Materials 7, 2001, pp. 7–10.

[10]. P. Wouter, Energy Performance of Building: Assessment of Innovative Technologies, ENPER-TEBUC, Final Report, 2004

[11]. M. Anderson, G. Jackson, The history of pulverized fuel ash in brick making in Britain, J. Inst. Ceram. 86 (4) (1987) 99–135.