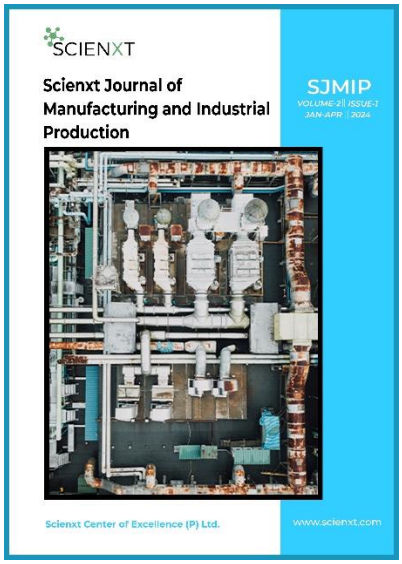

Scienxt Journal of Manufacturing and Industrial Production
Volume-2 || Issue-1 || Jan-Apr || Year-2024 || pp. 39-47

Industrial waste materials used as ingredients in fly ash brick manufacturing

[*1]Chandan Gupta, [2]Khursheed Alam, [3]Rahul Kumar Yadav

[*1]Assistant Professor, Department of Mechanical Engineering, Bhopal Institute of Technology, Bhojpur Road Bhopal, 462045 M.P. India

[2,3]Student, Department of Mechanical Engineering, Bhopal Institute of Technology, Bhojpur Road Bhopal, 462045 M.P. India

**Corresponding Author: Chandan Gupta*
Email: chandangupta140190@gmail.com

Abstract:

Industrial waste like fly-ash which is creating environmental problems, is mainly used as a building material due to its low cost and easy availability. But the main 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 new systematic procedure to produce fly ash composite bricks which will have higher compressive strength. Here the fly-ash is mixed with Cold setting resin at different proportions and water treated at different temperatures to find out a solution to the brick industry. The compressive strength, Hardness, water absorption, Density and thermal conductivity of the fly ash-resin powder bricks obtained under optimum test conditions are 11.24 MPa, 47.37HV, 19.09% 1.68 g/cm3, and 0.055 W/mK respectively. The sliding wear behavior is also investigated. The structure-property correlation of these composites are studied using X-ray diffraction, FTIR analysis and scanning electron microscopy

1. Introduction:

Bricks are an important construction material for almost 5000 years in human history. Bricks belong to the category of Masonry structures and remains common cost-effective way of construction even today. Brick as a construction material, didn't lose its significance like stones. Bricks are produced by burning dried hardened clay blocks. Burnt clay bricks remained a primary construction material for all ancient civilizations. Brick masonry was considered important because of several favourable features such as its ease of construction, high durability, easy manufacturing (clay is easily available for brick manufacture), thermal properties, etc. Clay was an easily available raw material in olden times. But population burst in our society has caused a high demand which has resulted in exploitation of this resource. Additionally, the brick production process involves burning which has high carbon footprint and has become a concern as carbon emissions across the world hike and its effects have started to give profound impacts in day to day life of the people.

Alternatives to Bricks are being proposed and used for centuries and several other materials have also been in the table for years. But still clay bricks were the most favoured in masonry construction. Among all other substitutes Pulverized Fuel Ash commonly known as Flyash brought a remarkable change. Flyash is a waste by-product of coal combustion process in Thermal Power plants. When coal is burned in thermal furnace the residue is carried away in the smoke and gets deposited in chimney stacks or ESPs (Electro Static Precipitators). Thus, it gets the name as flyash [5]. Flyash is a fine material which could undergo hydration with low heat emission making it as a replacement for cement. So flyash was incorporated in the manufacture of bricks as flyash bricks. Flyash possessed excellent binding capacity and its origin as a waste material. Flyash bricks are also light weight bricks making them valuable in design perspective.

2. Review of literature:

2.1. General:

Various literatures were collected to study and investigate to do project about bricks. Based on these collected literatures, the type of ingredients and the addition of ingredients were proportioned and moulded.

2.2. Literatures J.N. Akhtar& M.N Akhtar:

Bricks With Total Replacement Of Clay By Fly Ash Mixed With Different Materials. Fly ash is a powdery substance obtained from the dust collectors in the Thermal power plants that use coal as fuel. From the cement point of view the mineralogy of Fly ash is important as it contains 80% - 90% of glass. The impurities in coal-mostly clays, shale's, limestone & dolomite; they cannot be burned so they turn up as ash. The Fly ash of class C category was used as a raw material to total replacement of clay for making Fly ash bricks. In present study the effect of Fly ash with high replacement of clay mixed with different materials were studied at a constant percentage of cement i.e 10%. Three Categories of bricks were to be studied namely Plain Fly ash brick (FAB), Treated Fly ash brick (TFAB) and Treated Fly ash stone dust brick (TFASDB).In all the above mentioned categories the quantity of Fly ash was kept constant as 80%. It is found that the compressive strength of plain Fly ash brick (15FAB) and Treated Fly ash brick (15TFAB) was found to be higher with 5% coarse sand and 15% sand combination at 10% cement. The gain i n strength continues for Treated Fly ash Stone dust Brick (10TFASDB) and found to be higher with 10% stone dust and 10% sand combination. A variation in the quantity of Fly ash was also attempted and it was found that the 25TFASDB with 50% flyash, 25% stone dust and 25% sand combination at 10% cement achieved highest compressive strength.

2.3. K. Abith, A.mohamed nazeem fazil:

In India the building industry consumes about 20000million bricks and 27% of the total natural energy consumption for their production. Fly ash is one of the numerous substances that cause air, water and soil pollution, disrupt ecological cycles and set off environmental hazards. It's also contain trace amounts of toxic metals which may have negative effect on human health and on plants and the land where the fly ash decomposed not get reused. Production of building materials, particularly bricks using fly ash is considered to be one of the solutions to the ever-increasing fly ash disposal problem in the country. Although there exist several technologies for producing fly ash bricks. All these materials are available in form of wastes and bi-products from industrial activities and are available in adequate quantities in the areas. Samander et al., 2013 Investigation was done to study of the effect of silica fume on fly ash cement bricks. The experiments were conducted in two phases to observe the variation in properties i.e., compressive strength, density and water absorption of flyashcement brick. In first phase the fly ash, stone dust percentage are kept constant and cement is replaced with silica fume in different proportion, where as in second phase, silica fume is added as admixture in same proportion of weight of cement. The flyash cement bricksaretestedafter7days, 14 days and 28 days curing in

fly ash material testing laboratory of the institute. The experimental results showed that in the compressive strength of fly ash cement brick decreases with increase in content of silica fumes as replacement of cement whereas increases with increase in content of silica fume as addition. The water absorption % in first phase of experimentation increases whereas in second phase of experimentation decreases D Yogesh Gowda, H G Vivek Prasad. An effort for an alternate approach in the manufacturing of brick was accomplished by using industrial byproducts like class F fly ash, granite dust and sludge lime as key ingredients. In India thermal power plants and granite industries are generating fly ash and granite dust in large quantities. Industrial waste are hazardous in nature, their disposal is of major concern. Recycling such wastes by utilizing them into building materials is a moderate solution forthe pollution issues. Much of an emphasis is laid on energy saving and economy. Ravi Kumar, Deepankar Kumar Ashish Efforts has been made to study the behavior of fly ash bricks by taking different proportions of fly ash, cement, lime, gypsum and sand. Three types of fly ash bricks in the different percentage of cement such as 3%, 5% and without cement are designed and then various tests such as compressive strength test, water absorption test, efflorescence, weight tes

3. Conclusion:

From the above literatures we found that the fly ash bricks are commonly used as an alternative for clay bricks and the study conducted for the addition of granite sawing powder resulted in increased strength and there are scopes for replacement of the use of quarry dust with similar other materials can result in minimizing cost.

4. Fly ash lime bricks specification:

Fly ash is a useful by-product from thermal power stations using pulverized coal as a fuel and has considerable pozzolanic activity. This national resource can be gainfully utilized for manufacture of fly ash-lime bricks as a supplement to common burnt clay building bricks leading to conservation of natural resources and improvement in environmental quality. Fly ash-lime bricks are obtained from materials consisting of fly ash in major quantity, lime and an accelerator acting as a catalyst. Fly ash-lime bricks are generally manufactured by inter-grinding or blending various raw materials which are then molded into bricks and subjected to curing cycles at different temperatures and pressures. On occasions, as and when required, crushed bottom ash or sand is also used in the composition of the raw material. Crushed bottom

ash or sand is used in the composition as a coarser material to control water absorption in the final product. Fly ash reacts with lime in presence of moisture to form a calcium silicate hydrate which is the binder material. Thus fly ash-lime brick is a chemically bonded brick. These bricks are suitable for use in masonry construction just like common burnt clay bricks. Production of fly ash-lime building bricks has already started in the country and it is expected that this standard would encourage its production and use on mass scale. This standard lays down the essential requirements of fly ash-lime bricks so as to achieve uniformity in the manufacture of such bricks

5. Process of manufacture:

The Process of manufacture is simple and suitable to start. A mix of Fly Ash, Cement, Gypsum and Sand/Crusher Dust are automatically weigh batched in a batching plant.

1. Loading of Raw materials- Mini Loader Loads materials into Batching plant
2. Automatic Batching – The Raw materials are automatically weighed as per the preset weights by means of Load cells and its control circuit. Cement, if it is available in Bulk, then silo and screw controller is used to auto weight. Otherwise, the batching is programmed as per 1 bag of cement.
3. Mixing - From the batching plant the mixture hopper pulls the materials and then the mix is blended homogenously and intimately in a semi wet form in a Twin shaft mixture. The Water is automatically added as per time set. The TWIN SHAFT mixture ensures that a perfect mix is done in shortest possible time.
4. Carrying to Brick machine - the mix is carried to the casting machine by means of conveyer belt.
5. Automatic Brick Making- there is a series of operations which is achieved by automatic PLC system. Pallet is pulled into the Machine. The mix is then collected fed into the machine moulds. There is a T boggy which uniformly spreads the materials in the moulds. Automatic PLC controlled Vibration and hydraulic pressure is given for a while and bricks are cast on the pallets. The dual application of Pressure and vibration (in a patent pending micro- sequence application) ensures perfect compaction with best quality of bricks

6. Automatic Stacking - the pallets along with the freshly cast bricks are rolled on a roller platform to the pallet stacker. The Pallet stacker stacks the pallets along with the bricks automatically and the
7. Fork lift shifting– The Final stack of 5 to 10 pallets and bricks are lifted with a Fork Lifter and carried to the drying bay/room for 24 Hours for initial setting.
8. Curing - Soon after the initial setting, the Blocks/ Bricks are stacked for curing in layers. The layers are stacked in a way to enable water and air to go all around, to ensure proper curing and drying. The curing process is continued for 7 days. The blocks are allowed to normally dry for a day. Now they are ready for dispatch. Alternatively, the blocks/bricks can be steam cured for 8 hours or mist cured for 24 hours immediately after production, and made ready for dispatch immediately.
9. Dispatch - the cured bricks can be dispatched to market.

5.1. Advantages Key advantages of using fly ash:

1. Improved workability
2. Reduced permeability
3. Reduced heat of hydration
4. High sulphate resistance
5. Increased long term strength
6. High chloride corrosion resistance
7. Grater resistance to alkali reactivity
8. Better concrete finish reduced shrinkage
9. Improved workability

5.2. Environmental effects:

Utilization of fly ash is environment friendly with improved cementitious binder economics.

1. Fly ash utilization reduces the requirement of clay, sand, lime stone in cement manufacturing and hence conserves natural resources.
2. Fly ash utilization reduces the cement requirement and hence carbon-dioxide liberation during cement manufacturing is reduced.

3. Fly ash utilization reduces the top soil requirement for land filling / brick manufacturing and saves agricultural land.
4. Fly ash utilization achieves increased strength of the finished concrete product without increasing the cement content

6. Conclusion:

From this investigation, the following conclusions can be derived on the basis of the tests performed: The primary raw material used for bricks is the soil, which is often taken from prime agricultural land, causing land degradation as well as economic loss due to diversion of agricultural land. Use of traditional technologies in firing the bricks results in consequential local air pollution. At the same time, the thermal power plants in India continue to generate a huge amount of fly ash, disposal of which poses significant challenges for the power plants. Plastic waste which is increasing day by day becomes disgrace and in turn pollutes the environment, especially in high mountain villages where no garbage collection system exists.

The study presented above helps in reducing the fly ash and plastic waste disposal problem as it utilizes the both even in its finest form and converts that useless material into a useful construction material forming ecofriendly bricks .In Compression test, Sample B of 7% at 14 days curing gave optimum value of 4.12 N/mm2 while the fly ash bricks only 3.24 N/mm2.its shows that with the addition of molten PET plastic in fly ash bricks the compressive test is increased by 27.16%. In Compression test, Sample A of 5% at 14 days curing gave the value of 3.72 N/mm2 while the fly ash bricks only .24 N/mm2.

Its shows that with the addition of molten PET plastic in fly ash bricks the compressive strength is increased by 15%.In Water Absorption Test, it was found that Sample B of 7% brick curing at 14 days is 16.67% less than the fly ash bricks. In Water Absorption Test, it was found that Sample A of 5% brick curing at 14 days is 12.97% less than the fly ash bricks. When the bricks are immersed in water and dried, white patches are not formed, so the results for efflorescence of bricks are nil. Since plastics are used as a partial replacement of quarry dust, the bricks are economical and the cost of brick is lesser than normal fly ash bricks. Since plastics are added as a partial replacement for quarry dust, the weight of the brick decreases.

From above analysis, this brick can be effectively used in construction field. Its uses are not restricted as only brick; it can even be utilized as a building block by increasing the dimension of the mould.

7. References:

1. Gupta P.C, Ray S.C.," Commercialization of Fly ash", The Indian Concrete Journal, 167, 1993, 554-560.
2. Peter George Kenneth Kingth, "Pulverized fuel ash as a construction material" proceedings of institution of Civil Engineers,16, 1960, 419-432.
3. . TabinRushad S, Abhishek Kumar, Duggal S.K, Mehta Experimental Studies on Lime-Soil-Fly Ash Bricks', International Journal Of Civil And Structural Engineering Volume 1, No
4. , 2011. 4. ObadaKayali ,'High Performance Bricks from Fly Ash 2005', World of Coal Ash (WOCA), April 11-15, 2005, Lexington, Kentucky,USA.
5. JayeshPitroda, Prof. Sameer Mistry, Dr. L. B. Zala, Prof. Samip Patel (2011) 'Fly Ash Bricks Masonry: An Experimental Study' National Conference on Recent Trends in Engineering & Technology May2011.
6. H N Rajendra Prasad, H G Vivek Prasad, Chetana Hamsagar (2014)