6.0 Various Technologies for Fly Ash Bricks Making

Based on the availability of raw materials Fly ash bricks can be produced on large scale with different methods. These methods are:

1. Burnt clay fly ash bricks
2. High ash content burnt clay fly ash bricks
3. Flux bonded burnt clay fly ash bricks
4. Fly ash lime gypsum bricks
5. Fly ash cement bricks / Fly ash cement-gypsum bricks
6. High fly ash content bricks (Through Mineral Polymerization)

6.1 Burnt clay fly ash bricks:

Fly ash mixed with local soil can be used to manufacture burnt clay bricks. The manufacturing process is similar to conventional clay brick making process. The compatible physico-chemical & mineralogical properties with soil, capacity to modify the drying behaviour of sensitive plastic and saving in fuel requirement make fly ash conducive to use in burnt clay bricks. Its use also helps to conserve soil the natural resource. In clay ash brick making, soil is laid first and then required quantity of fly ash/ pond ash is laid over the soil. These two materials are first manually mixed thoroughly in dry form. Then required water is added and again mixed to make it homogeneous mix. This is kept for some time to get to it digested. The composite mass thus prepared is used to make brick using wooden moulds. Moulded bricks are air dried for about 4-6 days in open/ shed. The dried bricks are fired in commercial Bull's trench kiln. In burnt clay fly ash brick making any type of ash i.e. fly ash, bottom ash, pond
ash or mound ash can be used. However, pond ash, bottom ash and mound ash are more suitable as it contains higher un-burnt carbon which helps in reducing fuel requirement during the firing of bricks. This process of making ash bricks is having following advantages:

- Saving of coal up to 5 tonne per lakh bricks.
- Up to 40% additional

brick can be produced with same quantity of soil- thus saving of precious agricultural land.

- Light in weight compare to conventional clay brick - reduces dead load on structure.

- Better thermal insulation properties compare to conventional clay bricks.

- Bricks are thus environment friendly because to produce these bricks:
  - A thermal power station by - product is used.
  - Less soil is required leading for soil conservation.
  - Less energy is required as compared to common red bricks.
6.2 High fly ash content burnt Clay Fly Ash bricks

In this method, Fly ash / pond ash up to 60% can be used to manufacture burnt clay fly ash bricks. The technology is conducive where soil is having very high clay content like black cotton soil, clay. In this method required quantity of fly ash and high clayee soil are mixed manually or by mechanised means and then water is added and mixed thoroughly.
wet mix is kept for about 12 hours for its soaking and then hand moulded into bricks. Drying and firing process is similar to conventional burnt clay ash bricks. 10-15% of rice husk and rice husk ash can also be mixed for making such bricks. Rice husk and rice husk ash reduce fuel requirement further during the firing of bricks. Large numbers of bricks using this technology are being manufactured in and around NTPC - Ramagundam area in Karimnagar District in Andhra Pradesh.

This process has following advantages:

1. Less fuel consumption during firing process about 30% fuel saving.

2. Light weight compared to clay bricks therefore, less transportation cost for bricks as more bricks can be transported in one truck load because of light weight.

3. Process is environment friendly as it helps to reduce soil degradation and pollution because of reduced soil & coal consumption.
6.3 Flux bonded clay fly ash bricks:

In this technology fly ash (about 80%), flux making additive and small quantity of water to make semi dry mix are properly mixed and then moulded into brick shape through compaction machine. The bricks are air dried and fired in kiln at about 800°-1000°C. The flux bonding technique is based on addition of certain ceramic glass formers to fly ash which will form liquid phase in the temperature of 800-1000°C and bind the fly ash particles and provide strength, brick-red colour and the desired properties. By controlling the liquid phase and reactivity at the fly ash surface, a range of properties including porous to dense microstructures can be produced. In addition to bricks, good quality floor tiles, paving tiles and roof tiles can also be produced by this technology. The technology has been developed by National Institute for Interdisciplinary Science & Technology (NIIST), Thiruanathapuram.

![Diagram of the process](image)

The flow diagram of the process

Designer paving tile with flux bonding technique

Brick made with flux bonding technique
Glazed fly ash products made with flux bonding technique

Glazed fly ash hexagonal tiles
6.4 Fly ash Lime - Gypsum bricks:

Fly ash, in presence of moisture, reacts with lime & gypsum and forms compounds having cementitious properties. This property is used for making fly ash lime gypsum bricks. In this method, about 50-65% fly ash, 20-30% sand or stone dust, hydrated lime 8-12% and gypsum about 5% are thoroughly mixed in pan mixer. Sufficient quantity of water is added in this mix to make it semi dry mix. This semi dry mix is fed into vibro / hydraulic press machine for moulding into bricks. The green bricks are air dried for about 1-2 days period and than water cured for about 15-21 days. The exact mix proportions for required strength can be worked out by trial with varying composition of raw materials. The higher strength can be obtained by increasing the lime content in the mix. Sludge lime which is a by product of acetylene gas plant can also be used in place of hydrated lime. Lime content will have to be increased in the mix proportion when sludge lime is used as it has a lower CaO content as compared to hydrated lime. Large number of bricks are being manufactured in and around Vishakhapatnam in Andhra Pradesh area using this technology. Since, this technique of brick making does not require firing, therefore, less green house gas emission. Brick Manufacturers association of Vishakhapatnam got their project registered as CDM project and successfully received carbon credits.

6.5 Fly Ash Cement Bricks / Fly ash Cement Gypsum bricks

Fly ash bricks can also be made using cement in place of hydrated / sludge lime and gypsum. Raw material mix composition can be 50-60% fly ash, 30-40% sand / stone dust and about 8-10% Ordinary Portland Cement. Raw materials in required proportion is thoroughly mixed in pan mixer and made in semi dry mix by adding sufficient amount of water. This mix is fed in vibro / hydraulic press and moulded
in to bricks. The green bricks are air dried for 1-2 days and water cured for about 20 days period. In some places good quality fly ash bricks are being manufactured by adding about 1-2\% gypsum in addition to cement. The curing period can be reduced by steam curing process and also by keeping green bricks in closed chamber for about 1-2 days. Heat generated in hardening process increases the temperature of chamber which accelerates strength gaining process. After curing in closed chamber, bricks are kept in open space for about 7 days where it gains further strength. After 7 days bricks can be despatched for use.
6.6 High fly ash content bricks (Through Mineral Polymerization)

In this technique, Fly ash (about 90-94%), liquid caustic soda lye, additive and water are mixed in required proportion and fed into vibro press for moulding into brick shape. Bricks are then kept in air for air curing for about 28 days to gain the strength. The technology is developed by Institute of Mineral & Material Technology, Bhubaneswar and patented by them. For this technique, field trials have been made at NTPC Talcher Kaniha and more trial are planned to be taken up before its large scale production.