ABSTRACT
It is the action of human beings that determines the worth of any material. Materials having potential for gainful utilization remain in the category of waste till its potential is understood and is put to right use. Fly ash is one of such examples, which has been treated as a waste material, in India, till a decade back, and has now emerged not only as a resource material, but also as an environment savior. At present, disposal of such large quantity of fly ash involves man, material and money resources which incur an additional financial burden to the power station. This study was conducted upon utilization of waste material like fly ash for brick manufacturing with different proportions of lime, Quarry Sand, Polymer and Cement. The objective of this study is to use some other compounds in the manufacture of the bricks so as to enhance the properties of the bricks. The fly ash bricks were manufactured in four different proportions and tested for compressive strength at 7 days, 14 days and 28 day.

KEYWORDS: Fly ash, Compressive strength, Fly ash bricks.

1. INTRODUCTION
Man’s first civilization started about 6000 years ago. In those days stone was the main building construction material known to the man. It was known to the man since Stone Age. It had some limitations like availability of stone of desired quality and quantity at economically viable cost. Stone had to be dressed to attain desired finish. Stone had to be required to be quarried and transported? Due to excess use of stone the availability of the resource stone had been decreased. Therefore, around 7000 BC man invented manufacturing of the bricks. The technique was first found in Turkey and around Jdiricho. Brick making is an ancient art stood the test of time and are still being modern construction. In ancient time man made bricks from the clay and mud. This method was invented first the Egypt after that it was spread in all world.

At present, the fly ash is disposed by adopting two systems, such as, dry system and wet system. In dry system, the fly ash in dry form is carried away pneumatically into a bunker at the plant. The removal of dry fly ash by mechanical means, such as, screw feeders could be recommended only when the quantity of fly ash to be handled is small. In wet system, the fly ash is mixed with water and sluiced to the settling ponds or dumping areas near the plant. This method is widely adopted as it is cheaper than any other methods of fly ash disposal. The above two systems of fly ash disposal causing a very serious environmental concern and additionally, it occupies more space for storage which in turn makes the soil as infertile.

Fly ash is a fused residue of clay minerals present in coal. The high temperature generated when coal burns in thermal power plants, transforms the clay minerals in coal powder into a variety of fused fine particles of mainly aluminium silicate. In an industrial context, fly ash usually refers to ash produced during combustion of coal. Selection of fly ash bricks manufacturing technology should be based on the availability of raw materials, financial strength of the entrepreneur and market characteristics, namely, size and nature of applications required for the strength of the bricks.

2. MATERIALS AND METHOD
The bricks produced according to the patent have been given name Fly Ash Bricks. Essentially the only solid ingredient of the brick is the Ash and the main liquid ingredient is Water. Other ingredients that so far are commercially protected are only minor in quantities. The process of manufacturing fly ash bricks is based on the reaction of lime with silica of fly ash to form calcium silicate hydrates (C-S-H) which binds the ingredients to form a brick. The quality of bricks obtained is highly dependent on the quality of fly ash. The raw materials required for manufacturing of fly ash bricks are,
• Availability of MgO should not be greater than 15%
• SiO$_2$ content should not be more

**Source of ash**
- Ash from thermal power station
- Ash from coal boiler used in industry for generation for energy.
- Ash from Bagasse boiler used in Mostly sugar industry and other many industries which are using Bagasse boiler.

**2.1.2. Lime**
Commercially available chemically pure lime (CaCO$_3$) obtained from industry. Lime is important ingredient for manufacturing of fly ash brick. Lime should be satisfying the following requirement.
- During lime slaking, it should not attain less than 600 °C temperatures and slaking time should not be more than 15 min.
- Availability of CaO should be minimum of 60%.
- MgO content should be maximum of 5%.
- Should be in fine powdered form.

**Source of Lime**
- It is produced from industry in the form of calcium hydroxide sludge.

**2.1.3. Quarry Dust**
It referred to a waste material obtained from pulverizing coarse aggregate which are abundantly available.

**Source of quarry dust**
- Quarry sand can collected from any construction site for manufacturing of fly ash bricks.

**2.1.4. Polymer: TBA (tertiary butyl acrylate)**
Polymer used as adhesive material for the manufacturing of fly ash brick. Polymer is one of the wastes generated from the chemical industry.

**2.1.5. Cement:**
Cement is constructing material it used as binder in the manufacturing of Brick. Cement can be easily available at construction place.

**2.1.6. Mould:**
150 X 150 X 150 blocks: iron blocks are used for the manufacturing of fly ash cubes.

**2.1.7. Vessel:**
Vessel for mixing the ingredient.

**2.1.8. Thapi:**
Mostly used at construction site but hear this used for the mixing of ingredient in equal manner.

**2.2. METHOD PROPORTIONING**
The mortar mix was designed to get the compressive strength as close to standard first class brick in Indian conditions. The mix proportion for each test series is given in Table-1 below. Six prism of different combination were prepared to determine compressive strength. For achieving the compressive strength as per the “Construction Norms” the sampling material are taken in proper proportion as follows:

**Table-1. Proportion of ingredients:**

<table>
<thead>
<tr>
<th>Material</th>
<th>Sample A</th>
<th>Sample B</th>
<th>Sample C (Bagasse Ash)</th>
<th>Sample D</th>
<th>Sample E</th>
<th>Sample F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fly Ash / Bagasse Ash</td>
<td>2 Kg</td>
<td>2 Kg</td>
<td>2 Kg</td>
<td>2 Kg</td>
<td>2 Kg</td>
<td>2 Kg</td>
</tr>
<tr>
<td>Quarry Sand</td>
<td>1 Kg</td>
<td>1 Kg</td>
<td>1 Kg</td>
<td>0.9 Kg</td>
<td>0.9 Kg</td>
<td>0.9 Kg</td>
</tr>
<tr>
<td>Lime</td>
<td>1 Kg</td>
<td>0.9 Kg</td>
<td>0.9 Kg</td>
<td>0.5 Kg</td>
<td>0.5 Kg</td>
<td>0.5 Kg</td>
</tr>
<tr>
<td>Polymer</td>
<td>Nil</td>
<td>Nil</td>
<td>Nil</td>
<td>0.5 Kg</td>
<td>0.5 Kg</td>
<td>0.5 Kg</td>
</tr>
<tr>
<td>Cement</td>
<td>Nil</td>
<td>0.1 Kg</td>
<td>0.1 Kg</td>
<td>0.1 Kg</td>
<td>0.1 Kg</td>
<td>0.2 Kg</td>
</tr>
</tbody>
</table>

**MIXING**
As per the proportion stated in above paragraph, the weighted material was placed on a level platform; geo fiber sprinkled gently on it and was mixed using “Thapi”. Care was taken to prevent agglomeration of fibers and to ensure their uniform distribution as far as possible. The fresh mortar of different proportion was poured in six equal layers in the brick mould, also properly placed and compacted. Mechanically operated Mixer is used on large scale production of brick in industry.

**MOULDING**
For the experimental study, size of MS mould was used 150 X 150 X 150. Two specimen sample of each proportion were made to check the compressive strength. Before pouring of Mortar, mould was prepared by applying oil to the internal surface for smooth functioning & avoiding the breakage of corners / edges.

**DRYING AND CURING OF THE BLOCK**
After making of block, it was kept for sun drying for 24hrs then block is removed and kept for further drying process. Curing means watering the bricks. This process is done after 48 hrs of manufacturing of bricks.

**TESTING**
Specimen block should be passes through the following tests after 7, 14 & 28 days from curing:
Weight of Dry Block
Weight of the block was taken to calculate the moisture content. As per the construction norms the brick should show the 10% moisture content of its weight. If the moisture content satisfy this test it will undergoes the next test.

Size of Block
Sizes of specimen brick were checked for the slump test & calculate the compressive strength of Brick. Also through this test the uniformity of the brick was checked in six samples.

Compressive strength
Compressive strength of the specimen brick was calculated after 7s, 14 & 28 days of curing using the formula as follows,

$$\text{Compressive strength} = \frac{\text{Applied Max load} \times 1000}{\text{Cross sectional Area (mm}^2\text{)}}$$

3. RESULT AND DISCUSSION
Below Table-2, shows that the Compressive strength of bricks at 7 days, 14 days and 28 days.

<table>
<thead>
<tr>
<th>Sample No</th>
<th>Mass (Kg)</th>
<th>L (mm)</th>
<th>B (mm)</th>
<th>D (mm)</th>
<th>C/S Area (mm²)</th>
<th>Max Load 7 Days (kN)</th>
<th>Max Load 14 Days (kN)</th>
<th>Max Load 28 Days (kN)</th>
<th>Compressive Strength 7 days (N/mm²)</th>
<th>Compressive Strength 14 days (N/mm²)</th>
<th>Compressive Strength 28 days (N/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample A</td>
<td>3.798</td>
<td>155.3</td>
<td>150.8</td>
<td>150</td>
<td>23419.2</td>
<td>38.3</td>
<td>60.6</td>
<td>100</td>
<td>1.98</td>
<td>2.59</td>
<td>4.28</td>
</tr>
<tr>
<td>Sample B</td>
<td>4.226</td>
<td>150.2</td>
<td>151.2</td>
<td>150</td>
<td>22729.8</td>
<td>90.12</td>
<td>112</td>
<td>235</td>
<td>2.56</td>
<td>4.96</td>
<td>10.35</td>
</tr>
<tr>
<td>Sample C</td>
<td>3.200</td>
<td>151.0</td>
<td>150.3</td>
<td>150</td>
<td>22716.3</td>
<td>45.12</td>
<td>79.0</td>
<td>189</td>
<td>2.25</td>
<td>3.49</td>
<td>8.36</td>
</tr>
<tr>
<td>Sample D</td>
<td>4.120</td>
<td>152.2</td>
<td>152.1</td>
<td>150</td>
<td>23166.3</td>
<td>97.42</td>
<td>148</td>
<td>255</td>
<td>3.89</td>
<td>6.42</td>
<td>11.02</td>
</tr>
<tr>
<td>Sample E</td>
<td>4.172</td>
<td>151.8</td>
<td>150.0</td>
<td>150</td>
<td>22789.6</td>
<td>100.14</td>
<td>156</td>
<td>257</td>
<td>4.22</td>
<td>6.86</td>
<td>11.32</td>
</tr>
<tr>
<td>Sample F</td>
<td>4.349</td>
<td>150.0</td>
<td>150.1</td>
<td>150</td>
<td>22522.5</td>
<td>120.19</td>
<td>157</td>
<td>265</td>
<td>4.80</td>
<td>7.01</td>
<td>11.79</td>
</tr>
</tbody>
</table>

From graph we can say that the compressive strength of the brick is depend up on the curing and drying period of the brick. From above the compressive strength of 7 days drying is less than 14 days drying is less than 28 days drying. It means more dried period of bricks more will be compressive strength.

4. CONCLUSION
The results are indicative of the satisfactory performance fly ash bricks this type of brick uses 50% of fly ash but without using of clay. The mechanical properties of the fly ash bricks have exceeds that those of conventional brick. The study suggests that the fly ash from chemical industry ash/ Electrostatic Precipitators (ESPs) can be effectively used for manufacturing of bricks. Using of fly ash in to manufacturing of brick, helps in minimization of the waste also this method will help to conserve natural resource like air, water, soil. Fly ash is not only to enhance the mechanical properties of brick but the addition of polymer and lime correlate their benefits.
gap of strength and their use in helping to reduce environmental pollution and save energy. Because of uniformity of the fly ash bricks the Quality of Construction is improved Surface of wall is unique, it Can reduced the cost of the plastering after the brick work, Layers of the each brick shows the straight line.

REFERENCES