EXPERIMENTAL INVESTIGATION OF BRICK MANUFACTURING BY INCORPORATING SLUDGE AND SUGARCANE WASTE

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Abstract – Bricks are the major concern building material used for constructional purpose. In earlier days mud blocks were used and nowadays clay bricks are being used. In the manufacturing of clay bricks, the CO₂ emission is more since they are burned and the clay is also exhausting. Hypo sludge and sugarcane press mud are the waste materials which pollutes and harm to the environment. Many attempts have been made to overcome these problems. So the industrial waste materials and the by products are used in the manufacturing of bricks. Here we have incorporated the hypo sludge and the sugarcane press mud along with fly ash, lime, and quarry dust to get the better binding and compressive strength. The bricks are made without burning so the CO₂ emission is controlled. The attempt made will be a better solution for this problem. The hypo sludge and sugarcane press mud are added at different percentages such as 4, 8 and 12. The tests are conducted and the optimum percentage is obtained.

Keywords – Hypo sludge, Sugarcane press mud, Fly ash bricks, Compressive strength, Water absorption.

I. INTRODUCTION

Bricks have been used for more centuries. The present investigation, an attempt made with mixing hypo sludge and sugarcane press mud with other constituents. Hypo sludge can actually act as an adjoining material with cement and can be used as a successful building material. If it's mixed with cement then it actually increases the strength of the cement. If you compare both the constituents of cement and hypo sludge, then we get some results like this. Successful research have been performed to check the strength. It's is concluded that it actually increases the strength of cement.

Hypo sludge produced in a large amount as by product of paper industry and is usually used in concrete production as partial replacement of cement. It contains low calcium and minimum amount of silica and it’s due to presence of silica and magnesium properties that it behaves like cement. Use of hypo sludge in concrete can save the paper industry disposal costs and also produces a sustainable concrete for construction.

Influence on the nearby environment by eventual problems of odor nuisance. The sludge, fly ash and press mud are basically a waste material which can be converted to useful constructional material with least amount of investment. It helps in providing the low cost housing.

In sugar mills, sugar is produced through several processes and yields many solid waste in the production. The major byproducts of the sugar industry are Bagasse, Molasses and Press mud /Filter press cake. Press mud is a byproduct obtained from the clarification process of sugarcane juice, raw
juice has non-sugar contaminants are removed using a mixture of chemical reactants such as sulfur and lime. For every 100 tons of crushed sugarcane 3.3 tons of filter cake remain as a byproduct. The main chemical component of press mud is CaO. Sugarcane press mud can be used as filler material in bricks.

II. MATERIALS AND METHODS

**Hypo sludge:**
Hypo sludge is produced in a large amount as by product of paper industry. It contains low calcium and minimum amount of silica and it can be used as a partial replacement of cement.

![Fig 1: Hypo sludge](image)

<table>
<thead>
<tr>
<th>S. No</th>
<th>Properties</th>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Setting time in minutes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) Initial setting time</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>(b) Final setting time</td>
<td>595</td>
</tr>
</tbody>
</table>

*Table 1: Physical Properties of Hypo sludge*

**Fly ash:**
Fly ash is the ash produced from the combustion of coal or lignite. It is a puzzolanic material helps in gaining of strength with lime.

![Fig 2: Fly ash](image)

<table>
<thead>
<tr>
<th>Elements</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>43.12</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>5.26</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>15.97</td>
</tr>
<tr>
<td>CaO</td>
<td>5.56</td>
</tr>
<tr>
<td>MgO</td>
<td>0.85</td>
</tr>
<tr>
<td>Na₂O</td>
<td>0.52</td>
</tr>
<tr>
<td>LOI</td>
<td>26.79</td>
</tr>
</tbody>
</table>

*Table 2: Major constituents of fly ash*

**Sugarcane press mud:**
Press mud is also known as filter cake obtained from the clarification process of sugar. The disposal of these wastes into the environment causes the land pollution.
Lime:
Lime is used in the powdered form to get the better binding and strength.

Quarry dust:
In quarrying activities, the rock has been crushed into various sizes; during the process the dust generated is called quarry dust and it is formed as waste.

Water:
The normal water is used for the making of bricks.

III. METHODOLOGY

1. Preparation of sludge
2. Moulding of bricks
3. Drying and curing of bricks
4. Testing of bricks
IV. MIX PROPORTIONS

% weight by proportion

<table>
<thead>
<tr>
<th>Mix</th>
<th>Quarry dust</th>
<th>Fly ash</th>
<th>Lime</th>
<th>Hypo sludge</th>
<th>Sugarcane press mud</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>55</td>
<td>17.5</td>
<td>7.5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>M2</td>
<td>50</td>
<td>16</td>
<td>7</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>M3</td>
<td>45</td>
<td>15</td>
<td>6</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 3: Mix proportions

V. MAKING OF BRICKS

5.1. Sludge preparation
Sugarcane press mud is collected as sludge form and it is sun dried after drying under sun the sludge is crushed and sieved with 2.36 mm IS sieve and used as ingredients.

5.2. Moulding of bricks
Machine compaction is adopted for attaining better strength of bricks. Size of brick mould is 230mmX110mmX70mm

5.3. Curing and drying of bricks
Bricks are cured with water for 15 days and another 15 days it allowed to dry under shadow in open air.

VI. TESTING OF BRICKS

The test are conducted based on the Indian Standard Codes. The code books are
IS-3495 Part- 1:1992(Compressibility test)
IS-3495 Part-2:1992(Water Absorption test)
IS-3495 Part-3:1992(Efflorescence test)

6.1. Compression test:
To determine the compressive strength of bricks. The compressive strength of bricks are obtained by placing the brick on the flat horizontal surface between the plates of the testing machine. The axial load is applied at uniform rate until the brick gets failure.
The compressive strength of the brick is obtained by using the formula,
Compressive strength = Maximum load at failure/ Area of the surface.

6.2. Efflorescence test:
The efflorescence test of the brick is conducted by placing the end of the brick in the dish and the distilled water is filled up to the depth of 25mm. The whole arrangement is made in the room temperature with well-ventilated room until all water in the dish is absorbed by the brick and the surface water evaporate. The dish is covered in order to reduce excess evaporation. When the water is absorbed the bricks appeared to be dry, place a similar quantity in the dish allows it to evaporate as made before. The efflorescence is obtained after second evaporation is made.

Nil- No observable deposit of efflorescence.
Slight-Less than 10 % area of bricks covered a thin deposit of salt.
Moderate-Covering up to 50% area of the brick.
Heavy-Covering 50% or more area of the brick.

6.3. Water absorption test:
Dry the brick in an oven at a temperature of 105-115°C, cool the brick to the room temperature and it is weighed (W₁). Then immersed the dry brick in water completely at room temperature for 24hrs and remove the brick from the water and wipe out the traces of water with a cloth and the brick is weighed (W₂). Water absorption = (W₂-W₁)/(W₁) X 100.

6.4. Soundness test:
The two bricks are taken and made struck with each other. Brick of good quality should not break and produce a ringing sound.
6.5. Hardness test:
Scratch is made on the brick surface with the help of finger nail. If no impression on the surface, the brick is sufficiently hard.

VII. RESULTS
Tests are carried out after 28 days of manufacturing the bricks. The better compressive strength of the brick is obtained at the first mix. The compressive strength of the brick is 3.13 N/mm². The water absorption is less than 4% which should be less than 20%. On adding more amount of sludge and press mud it reduces the strength of the bricks it just occupies the space as filler. The following graph shows the compressive strength of bricks.

![Graph 1: showing the 14 days compression strength](image)

Graph 1: showing the 14 days compression strength

No observable deposit of efflorescence.
Brick sufficiently passed the hardness and soundness test.

VIII. CONCLUSION
1. Study shows that water absorption values for the bricks is less than 4% so the brick required very es amount of water for curing.
2. It has been observed that in case of compression test, for 4% sludge, compressive strength comes to be maximum.
3. Cost of brick will be reduced by addition of sludge as obtained from cost analysis.
4. Environmental effects from wastes and disposal problems of waste can be reduced or controlled through this research.
5. Environment is protected from the emission of CO₂.
6. A better measure by an innovative Construction Material is formed through this project.

We can use this type of brick in
a) For parapet wall,
b) Internal wall where loading is less,
c) Boundary wall of garden, park. d) Also it can use at top floor where dead load is minimum.
REFERENCES


VI. IS 3495 (Parts 1 to 4) - Methods of tests of Burnt Clay Building Bricks, Bureau of Indian Standards, New Delhi, 1992.