

## A Miniscule Endeavour for Accomplishing Hypo Sludge Fly Ash Brick in Indian Context

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**Abstract:** Paper waste can be recycled only a limited number of times before they become too short or weak to make high quality paper. Thus the broken, low-quality paper fibers are separated out to become waste sludge known as hypo sludge, which can be available at very negligible rate and in huge quantity from paper industry. Hypo sludge has a very good content of CaO, thus in this paper, study on hypo sludge for making bricks is done by partial replacement with lime in fly ash bricks. The replacement of hypo sludge by weight with lime with permutation of 5%, 10%, 15% and 20% is done. These bricks were tested in compression test and water absorption test per Indian Standards. The aim of this research is to make economical and green bricks to maintain environmental balance, and avoid problem of ash disposal.

**Keywords—**Fly ash (Class F), Hypo sludge, Sustainability, Environment, Waste re-uses, cost feasibility, Eco friendly bricks.

### I. INTRODUCTION

Production of paper all around world is about 8.4 to 11.2 metric tones per annum. Paper producing industries produce a large amount of solid waste. Many companies burn their sludge in incinerators which leads towards air pollution. Paper making generally produces a large amount of solid waste. Paper fibers can be recycled only a limited number of times before they become too short or weak to make high quality paper. It means that the broken, low-quality paper fibers are separated out to become waste sludge. Uses of hypo sludge in brick can save the paper industry disposal costs and produce a 'greener' bricks for construction. An innovative supplementary cementitious construction material formed through this study.

### II. EXPERIMENTAL MATERIALS

#### a) Hypo sludge



FIGURE 1: Hypo sludge

SOURCE: <http://www.engineeringcivil.com/wpcontent/uploads/2009/10/Factory-outlet-hyposludge1.jpg>

Paper fibers can be recycled only a limited number of times before they become too short or weak to make high quality paper. It means that the broken, low-quality paper fibers are separated out to become waste sludge, this waste sludge is known as Hypo sludge. To reduce disposal and pollution problems emanating from these industrial wastes, it is most essential to develop profitable building materials from them. Keeping this in view, investigations were undertaken to produce low cast concrete by blending various ratios of bricks with hypo sludge.

**TABLE 1 CHEMICAL COMPOSITION OF HYPO SLUDGE**

| Sr. No. | Chemical Compound                                | Percentage |
|---------|--|------------|
| 1       | Silicon Dioxide (SiO <sub>2</sub> )              | 5.28%      |
| 2       | Calcium Oxide (CaO)                              | 47.84%     |
| 3       | Magnesium Oxide (MgO)                            | 6.41%      |
| 4       | Sulphur Trioxide                                 | 0.19%      |
| 5       | Aluminum Oxide (Al <sub>2</sub> O <sub>3</sub> ) | 0.09%      |
| 6       | Ferric Oxide (Fe <sub>2</sub> O <sub>3</sub> )   | 0.73%      |
| 7       | Loss on Ignition                                 | 38.26%     |

SOURCE: [engineeringcivil.com](http://engineeringcivil.com)

**b) Flyash (Class F)**



**FIGURE 2: Fly ash (Class F) SOURCE: “Shreeji bricks” Sarkada**

The burning of harder, older anthracite and bituminous coal typically produces Class F fly ash. This fly ash is pozzolanic in nature, and contains less than 20% lime (CaO). Possessing pozzolanic properties, the glassy silica and alumina of Class F fly ash requires a cementing agent, such as Portland cement, quicklime, or hydrated lime, with the presence of water in order to react and produce cementitious compounds.

**c) Lime**



**FIGURE 3.3 Limestone quarry**

SOURCE: [http://en.wikipedia.org/wiki/Lime\\_\(material\)](http://en.wikipedia.org/wiki/Lime_(material))

Pure calcium oxide is fused with coke in order to render the highest yield in the manufacture of acetylene. The quality of the resultant carbide lime is a direct result of the excellent quality raw materials. Carbide lime is finer in particle size, and physically, having a very finely divided particle size makes carbide lime better. A finer particle size means faster and more reactivity

**d) Quarry dust**



**FIGURE 3 Quarry dust SOURCE: “Shreeji bricks” Sarkada**

Quarry dust is a waste product produced during the crushing process which is used to extract stone. It is rock particles. When huge rocks brake in too small parts for the construction in quarries. It is like sand but mostly grey in

color. It is mineral particles. The density of Quarry dust is 1650 kg/m<sup>3</sup>.

**e) Water**

Water is an important ingredient of brick as it actually used for manufacturing of brick. Since it helps to bind all the raw materials for giving proper mix. Water used for making brick should be free from impurities.

**III. MIX DESIGN**

**TABLE 2 DESIGN MIX PROPORTION**

| Sample | F.A (kg) | H.S (kg) | Lime (kg) | Q.D (kg) |
|--------|----------|----------|-----------|----------|
| STD    | 60.00    | 0.00     | 20.00     | 20.00    |
| L1     | 60.00    | 5.00     | 15.00     | 20.00    |
| L2     | 60.00    | 10.00    | 10.00     | 20.00    |
| L3     | 60.00    | 15.00    | 5.00      | 20.00    |
| L4     | 60.00    | 20.00    | 0.00      | 20.00    |

F.A=Fly ash, H.S = Hypo sludge, Q.D= Quarry Dust

**IV. EXPERIMENTAL METHODOLOGY**

The evaluation of Hypo sludge for use as a replacement of fly ash material begins with the brick testing. Brick contains fly ash, Lime, water, and Quarry dust. With the control brick, i.e. 5%, 10%, 15% and 20% of the lime is replaced with Hypo sludge, the data from the hypo sludge fly ash brick is compared with data from a standard fly ash brick without Hypo sludge. Five bricks samples were cast having size of 230x115x75mm. The manufacturing process of bricks broadly consists of three operations viz. mixing the ingredients, pressing the mix in the machine and curing the bricks for a stipulated period. Selection of machinery depends on the bricks mix contents. For manufacturing hypo sludge fly ash bricks, the best suited machinery is a Vibro - press machine, which is an indigenous low cost machine and can be run by ordinary semiskilled worker. Its production capacity is 1000 bricks per shift and can be

operated in two shifts without any operation/maintenance load. The maintenance cost is so low that it can be ignored. 15 lakh bricks can be produced for each machine in its life cycle.

**A. Compression Test**

The brick specimens are immersed in water for 24 hours. The frog of the brick is filled flush with 1:3 cement mortars and the specimen are stored in damp jute bag for 24 hours and then immersed in clean water for 24 hours.

The specimen is placed in compression testing machine with 6 mm plywood on top and bottom of it to get uniform load on the specimen. Then load is applied axially at a uniform rate of 14 N/mm<sup>2</sup>. The crushing load is noted. Then the crushing strength is the ratio of crushing load to the area of brick loaded. Average of five specimens is taken as the crushing strength.

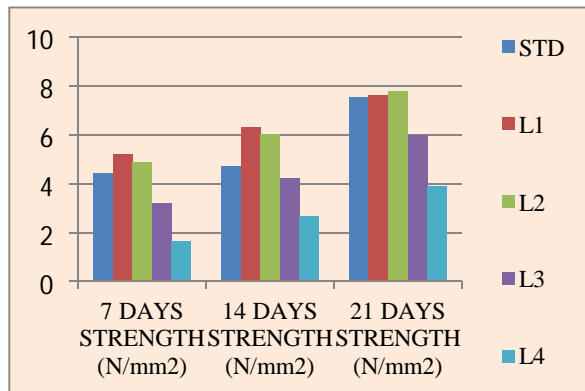


**SOURCE: Concrete lab “SIGMA INSTITUTE”**

**TABLE 3 COMPRESSION STRENGTH OF BRICKS (230X115X75) AT 7, 14 AND 21 DAYS FOR HYPO SLUDGE FLY BRICKS**

| Sample | 7 DAYS | 14 DAYS | 21 DAYS |
|--------|--------|---------|---------|
| STD    | 4.43   | 4.70    | 7.55    |

|    |      |      |      |
|----|------|------|------|
| L1 | 5.22 | 6.32 | 7.65 |
| L2 | 4.90 | 6.03 | 7.76 |
| L3 | 3.22 | 4.23 | 6.00 |
| L4 | 1.67 | 2.67 | 3.26 |



GRAPH 1: Percentage replacement(X axis) Vs Compressive Stress

#### VI. ECONOMIC FEASIBILITY

TABLE 4 COST OF MATERIALS

| Material    | Rupees/kg |
|-------------|-----------|
| Hypo sludge | 0.20      |
| Fly ash     | 0.55      |
| Lime        | 1.50      |
| Quarry dust | 0.35      |

TABLE 5 TOTAL COST OF BRICKS OF DIFFERENT PROPORTION

| Samples | Cost |
|---------|------|
| STD     | 3.36 |

|    |      |
|----|------|
| L1 | 3.17 |
| L2 | 2.98 |
| L3 | 2.79 |
| L4 | 2.61 |

#### VII. CONCLUSION

Based on limited experimental investigations concerning compressive strength of Brick, the following observations are made regarding the resistance of partially replaced hypo sludge:

- Compressive strength increases on increase in percentage of Hypo sludge as compare to lime.
- Use of Hypo sludge in brick can solve the disposal problem; reduce cost and produce a 'greener' Ecofriendly bricks for construction.
- Environmental effects of wastes and disposal problems of waste can be reduced through this research.
- A better measure by an innovative Construction Material is formed through this research.
- This study helps in converting the non-valuable Hypo sludge into bricks and makes it valuable.
- Hypo sludge bricks reduce the seismic weight of building.
- It reduces the density of brick masonry from 20 (clay bricks) to 12(Hypo sludge bricks)
- It reduces the cost of material per unit

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