

# Utilization of Textile Effluent Waste Sludge in Brick Production

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## Abstract

Textile industry is one of the oldest and largest sectors in India. The exports for the year 2007-08 stood up to \$20.5 billion. Even it is a value adding industry, it has several environmental impacts causing land and water pollution with toxicity. Effluent sludge waste management becomes a big problem nowadays. Except engineered landfills, rest of the methods for dumping, leads ground water contamination and there by other socio-economic impacts. Many studies have been conducted in this area and reported that the pollution level is high in ground water and nuisance due to dumping in the treatment plant area premises. There is a growing need to find alternative solutions for the sludge management. In the present study, an attempt has been made to utilize the textile ETP sludge (dry) in making of construction materials. Even to analyze the sludge, process variables for particular sludge generation can be studied. For inducing strength materials like fly ash, silica fume can be used. Textile sludge was incorporated in fly ash brick manufacturing and it was observed that with increase in sludge content, there is a decrease in compressive strength of bricks. Pulverized and sieved bricks show better compressive strength when compared with pulverized form and grinded form. There is increase in compressive strength with increase in sand, fly ash, cement and quarry dust proportion.

**Keywords:** Sludge, sand, Fly ash, quarry dust, cement, compressive strength.

## 1. Introduction

The textile units are scattered all over India; out of 21,076 units, Tamilnadu alone has 5285 units this reference is not within the references list??please correct it. Textile industry involves processing or converting raw material/fabric into finished cloth materials employing various processes, operations and consumes large quantities of water and produces extremely polluting waste effluents. Textile industry is one of the water intensive industries, which consumes large quantities of water for various processes and discharge equally large volumes of waste water containing a variety of pollutants.

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In textile industries, all the three types of wastes i.e. liquid, solids and gaseous are generated and the liquid effluent is essentially a mixture of dissolved, colloidal and suspended materials. The solid waste usually comprises of fibre/yarn/ scard from spinning unit, waste fabric, packaging materials and sludge from effluent treatment plants. The gaseous waste is generally produced by volatile reactants/by products and the gases from boilers.

There is more number of textile industries in Erode and Tiruppur District of Tamilnadu. According to records of the Tamilnadu state pollution control board (TNPCB), there are 830 units engaged in textile industry processes in Tiruppur. These industries have established eight common effluent treatment plants (CETPs). About 200 tons/day of textile sludge are generated in Tiruppur. Although some of the sludge is disposed in an engineered landfill, much of the sludge is openly dumped, which leads to soil, surface water and groundwater contamination. The inorganic salts and toxic metals in the sludge pose a threat to residents (Thomson et al, 1999; Palanivelu and Rajakumar, 2001). There is a growing need to find alternative solutions for textile sludge management. As per TNPCB records, there are about large number of units engaged in textile industry processes in India. These industries have established

several common effluent treatment plants and several individual effluent treatment plants. It is estimated that when these units function to full capacity 400 million tons of sludge is generated during the treatment process consisting of coagulation (by addition of aluminum/iron salts), flocculation and liquid/solid separation. The sludge produced is classified as hazardous, as per category No.12 of earlier hazardous waste, 1989 rules of our country. The recent amended rules of January 2000 also classify the sludge as hazardous. This sludge creates more negative impacts in many ways as far as the correct disposal techniques are not adopted.

It includes multimedia filtration, chemical coagulation, chemical precipitation, reverse osmosis, dialysis and activated carbon adsorption. Other methods such as evaporation, freezing and ion exchange are not practiced much. It can be proceeded further to remove toxic substances and specific contaminants. The sludge is the inevitable byproduct obtained in the textile industry common effluent treatment plant. The effluent treatment process flow is given in Figure 2.1. The raw effluents (excluding dye bath) from the various textile units are collected in a receiving sump after the removal of floating material using a bar screen. This collected effluent is pumped to equalization tank with 12 -16 hrs retention period, which is provided to homogeneous effluent with the help of high speed floating aerators.

## **2. Materials and methods**

The following gives the details on materials and methods used in the study so far conducted.

### *2.1 Materials used*

- Textile effluent sludge waste (Chemical processing industry, Erode)
- Sand (local brick manufacturing plant, Dindigul)
- Quarry dust (local brick manufacturing plant, Dindigul)
- Portland cement (43 grade)
- Fly ash (Class F) (Thermal power station, Mettur) and
- Water.

### *2.2 Methods*

#### *2.2.1 Preparation of textile effluent sludge*

The dewatered and open air dried sludge samples were obtained from textile processing unit, Erode. The samples

of the sludge were dried at temperature of 105°C until the net weight was constant. The dried samples were then made in powder form by following routes

- Grinding
- Pulversing into fine powder
- Sieving the dry sludge

### 2.2.2 Preparation of other additives

Class F Fly ash was procured from the mettur thermal power station and was used as binding material with some additives. Cement Ordinary Portland cement (43-grade) confirming to IS: 12269 were used. River sand passing through an IS: 1.18 mm sieve was used for making bricks. The quarry dust used for the project was procured from the local brick manufacturer.

### 2.2.3 Procedure for brick manufacturing

The sludge obtained from the effluent treatment plant and prepared according to the three different preparation processes was utilized for commercial Fly ash brick manufacturing as shown in the figure 1. The binding materials like fly ash were mixed with the sludge by a measured weight by adding a small amount of water followed by addition of quarry dust and cement. Now the mixture is completely mixed and then later on after few minutes sand is mixed in the mixer. If the sludge is not mixed properly the water absorption will be high, which will lead to breakage of the block.

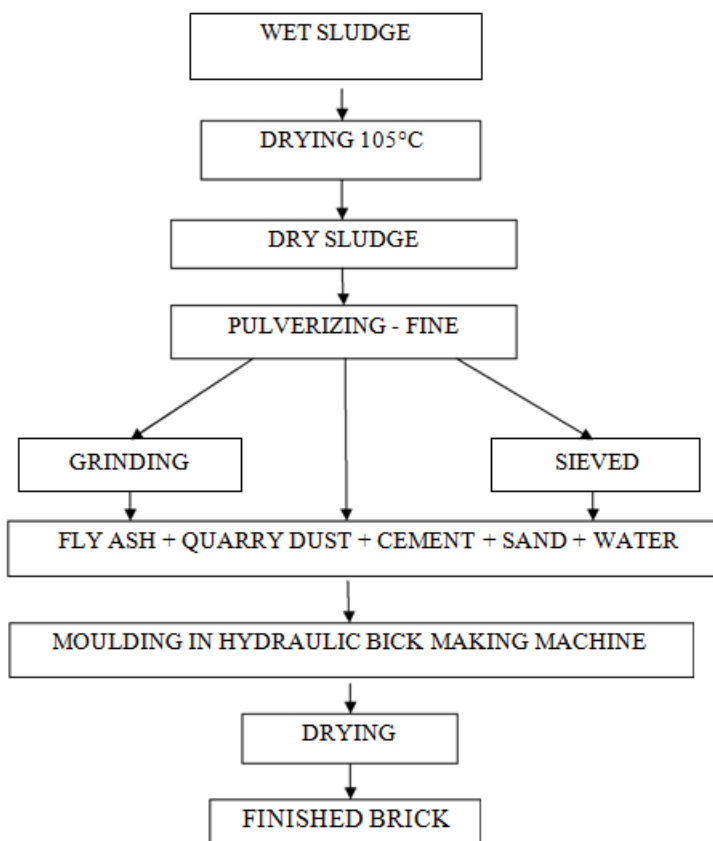


Figure 1: Flow chart for manufacturing sludge brick

### 2.3 *Testing of bricks*

Normally the bricks are cured for fourteen days, so that it attains full strength. Then those bricks are tested for Compressive strength test.

#### 2.3.1 *Compressive strength test*

The compression test of the bricks was tested using tester as shown in Figure.2



Figure 2: Compressive strength tester

## 3. Results and discussions

The process sequence of the effluent treatment plant in the processing house is shown in the figure 3.

### 3.1 *Sludge composition*

The estimated physico - chemical properties of the textile sludge from the processing house is shown in Table 1. The sludge was black in color and the major components of the sludge are given below and the components

available in sludge collected from literature are listed table 1.

### 3.2 Compressive strength analysis

#### 3.2.1 Effect of various sludge content on compressive strength of fly ash bricks

The fly ash bricks were manufactured in the brick manufacturing industry in Dindigul. Figure 4 shows the effect of sludge and manufacturing route on the compression strength of the bricks. From the figure 4 it can be seen that the compressive strength of the brick decreases with increase in sludge content for both wet grinded sludge and pulverized sludge. However, when the sludge was pulverized and sieved the reduction in compressive strength was minimal up to 25% of the sludge addition and above 25% it decreases gradually. This may be due to uniform mixing of sludge and other additives leading to better compressive strength. Therefore for future processing all the sludge was pulverized and sieved and used up to 20%.

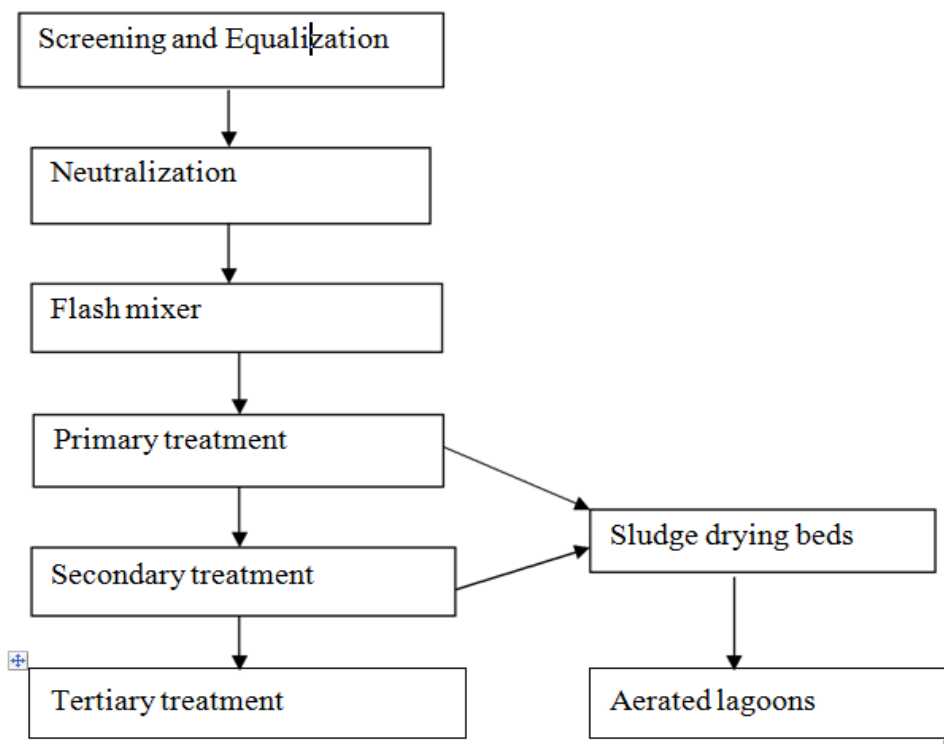


Figure 3: Process sequence of ETP in processing industry

Table 1: Comparison of sludge properties

Parameter	Sludge ( from industry)	Sludge ( Basker et al 2006)
Physical state	Solid	Solid

Color		Black	Brown
Texture		Dry powder and lumps	Agglomerated fine -----
Bulk density	gm/cc	1.16	-----
pH		8.53	-----
Loss on drying at 105	°C	7.98	-----
Loss on ignition at 550°C	°C	34.27	-----
Calorific value	Cal/gm	1192	-----
Flash point	°C	60	-----
Water soluble organics	%	0.27	-----
Water soluble inorganic	%	1.14	-----
Total lead	mg/kg	29.4	
Total cadmium	mg/kg	1.43	5.6
Total chromium	mg/kg	6.10	358
Total zinc	mg/kg	229.2	190
Total copper	mg/kg	28.7	119
Calcium	%	-----	28.4
Iron	%	-----	9.1
Silicon	%	-----	7.1
Aluminium	%		0.698
Nitrate	Mg/L	<1	-----
Fluoride	Mg/L	<1	

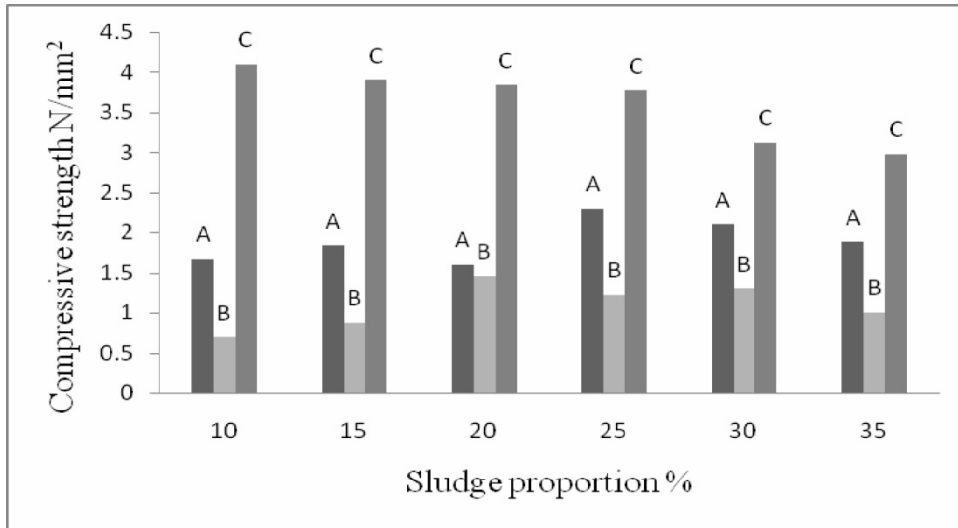


Figure 4: Effect of various sludge content on compressive strength of fly ash bricks

A – Grinded sludge

B – Pulverized sludge

C – Pulverized and sieved sludge

### 3.2.2 Effect of cement

Decrease in cement proportion leads to decrease in compressive strength gradually as shown in the figure 5. Meanwhile sludge addition losses compressive strength. Proper mixing of cement and sludge in appropriate proportions and then with other additives may give better compressive strength. Cement act as a binder of sludge with other additives.

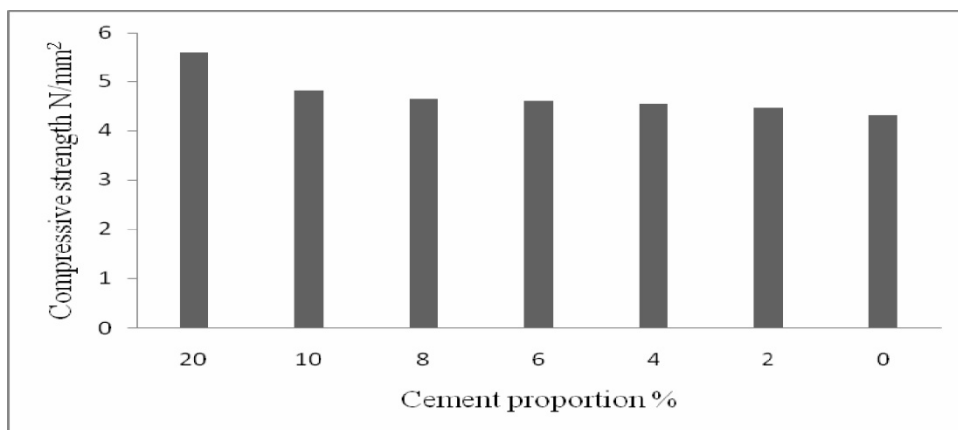


Figure 5: Effect of cement on compressive strength of fly ash sludge bricks

### 3.2.3 Effect of sand

Figure 7 shows the effect of sand on compressive strength of sludge fly ash bricks appropriately. Here increase in sand proportion and decrease in sludge content cause compressive strength to decrease minimum level. Fine mixing of sludge with sand and then with other additives causes good strength. Brick with high proportion of sand may have greater strength.

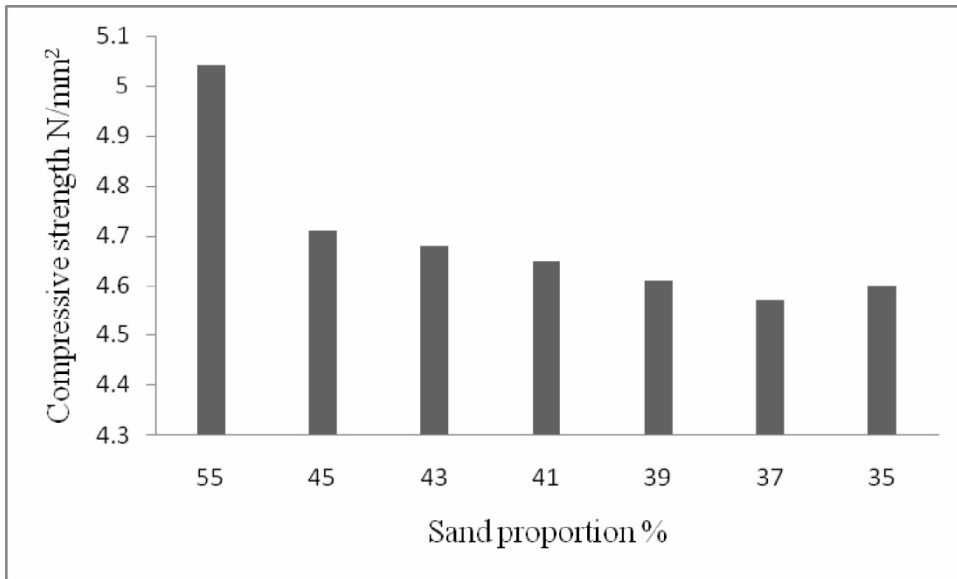


Figure 7 Effect of sand on compressive strength of fly ash sludge bricks

### 3.2.4 Effect of Quarry Dust

Decrease in quarry dust content and increase in sludge content causes strength reduction because of its low binding capacity. Both sludge and quarry dust has low binding capacity. Figure 9 implies the effect of compressive strength of fly ash sludge bricks.



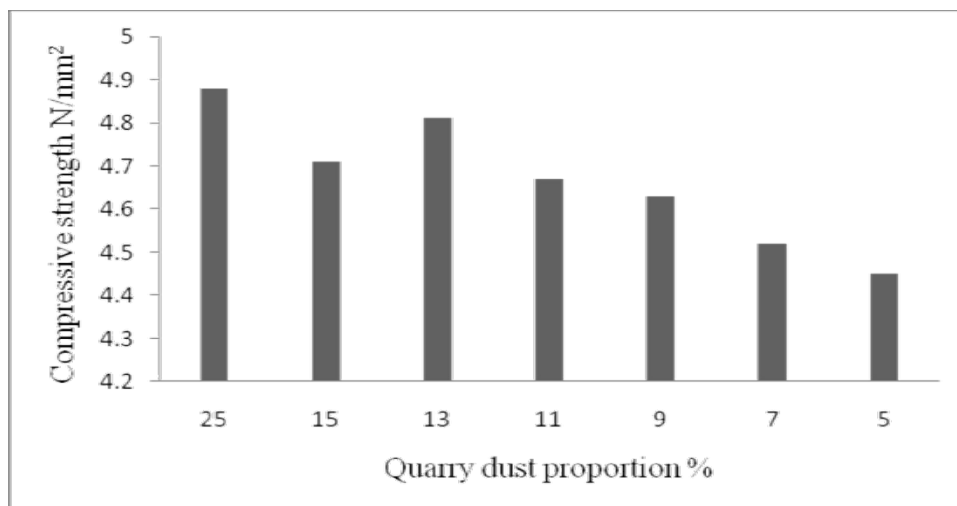


Figure 9: Effect of Quarry dust on compressive strength of fly ash sludge bricks

#### 4 CONCLUSION

From the study on compressive strength and water absorption on various fly ash sludge bricks, the following conclusions are drawn. The maximum compressive strength of grinded sludge fly ash brick and pulverized sludge fly ash bricks obtained was within 2.5 N/mm<sup>2</sup> and 1.5 N/mm<sup>2</sup> which is low when compared with standards of fly ash brick. The compressive strength of pulverized and sieved sludge obtained was about 3.3 N/mm<sup>2</sup> to 4.8 N/mm<sup>2</sup> with varying proportions of sand, cement, quarry dust and fly ash. It satisfies the standards required for the fly ash brick. The water absorption of pulverized and sieved sludge obtained was within 10% which satisfies the standards required for the fly ash brick. Decrease in sludge content and increases in any other additive may give better strength and water absorption. From the present studies, it can be said that up to 20 % of pulverized and sieved sludge with other additives such as fly ash, sand, cement and quarry dust can achieve minimal required compressive strength and water absorption. The study can be further extended as study of chemical nature of the sludge by undergoing several periodic analyses on sludge produced in different chemical processing industries, leachability and toxicity analysis on the sludge and sludge bricks, and other applications which can utilize sludge.

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