**International Journal of Civil Engineering and Technology (IJCIET)**
Volume 9, Issue 1, January 2018, pp. 398–406, Article ID: IJCIET_09_01_038
Available online at http://http://www.iaeme.com/ijciet/issues.asp?JType=IJCIET&VType=9&IType=1
ISSN Print: 0976-6308 and ISSN Online: 0976-6316



# UTILIZATION OF FLYASH AND ETP SLUDGE IN CONCRETE WITH ADDITION OF BANANA FIBER

**C. Mariappan**
Research Scholar, Karpagam Academy of Higher Education, Coimbatore, India

**Dr. M. Natarajan**
Professor, Karpagam Academy of Higher Education, Coimbatore, India

**Sathanandham T**
Assistant Professor, Department of Civil Engineering,
Jay ShriRam Group of Institutions, Tirupur, India

**ABSTRACT**

*The textile industry has a major role and creating an enhancement in the economioc development of the country. The removal of sludge from such industries has become a challenge, thus the reuse or utilization of ETP sludge in construction has been It liberates sludge which creates hazards to human and also environment. The reuse of ETP sludge as a building material in late years many specialist have built up that the utilization of some cementations materials such as fly ash, blast furnace slag, silica fume, and sludge etc., cannot just enhance the different properties of concrete on both fresh and harden. In this paper for structural and non-structural application by partial substitution of concrete by fly ash.up to 30%, and ETP sludge is replaced by fine aggregate upto 20% and addition of banana fiber of 0.25% with aspect ratio of 70mm by the volume of M-30 mix by American Concrete Institute (ACI) method. Concrete mixers were produced tests and completed to assess the mechanical properties forthe test outcomes of compressive strength, split tensile and flextural strength of concrete when constrated with conventional concrete.*

**Key words:** Compressive strength, Fly Ash, Banana Fiber, ETP Sludge, Split Tensile Strength.

**Cite this Article:** C. Mariappan, Dr. M. Natarajan, Sathanandham T, Utilization of Flyash and ETP Sludge in Concrete with Addition of Banana Fiber. *International Journal of Civil Engineering and Technology,* 9(1), 2018, pp. 398-406.
http://www.iaeme.com/IJCIET/issues.asp?JType=IJCIET&VType=9&IType=1

## 1. INTRODUCTION

(Aeslina Binti et al., 2014) ha d studied that the utilization of sludge in fire clay brick has a effect in increase in the strength in fire clay bricks, it also stated that the effect of use of

sludge has no impact in environment and seems no hazard to the environment. Thus, sluge utilization is being a great alternative for disposal of sludge(S.K.Agrawal et al., 2013) has studied that the utilization of textile sludge in bricks has shown an increase in the compressive strength of the brick and the brick is highly water resistant and less water absorbent. (M. Angeline Swarna et al., 2014) had given an detailed report on the use of sludge in manufacturing of bricks. In his results he showed that tannery sludge can be replaced upto 20% and quarry dust can be replaced upto 100% in place of sand.Tannery sludge and quarry sludge has the property of producing a mass like brick without much change in the properties. In this project different proportions of cement, sludge and quarry dust are thoroughly mixed and moulded in the cube size of 7.045 cm X 7.045 cm X 7.045 cm and test were performed for the property of comprehensive strength for 7 days and 14 days of curing and 24 hours of sun drying. (Badr El-Din E. Hegazy et al ., 2012)From the got outcomes,itwas reasoned that by working at the temperature ordinarily honed in the brick kiln , 75%was the most good sludge addition to make come into existence brick from sludge-RHA substances mixed together.The created physical and mechanical properties of the brickswere evaluated based on the Egyptian Standards. The control specimen of bricks were made purely using clay. (J. Balasubramanian et al., 2005)has concluded that a maximum of 30% of ETP sludge can be added to the mix in replacement of cement.

**Figure 2** Banana Fibre

## 2. OBJECTIVE OF STUDY

- To contemplate ETP sludge powder muddled with concrete.
- Conventional concrete (100% cement)
- Concrete made and blended with ETP sludge in different extends. The soilidifying properties of concrete blended with ETP sludge powdersuch as compressive strength, Split tensile strength and Flextural strength.

### 2.1. Scope of the Project

The extend of this work is to built the mechanical strength of the concrete structure by the textile industry sludge into it. The expansion of material sludge is 6different proportion addition of banana fiber is based on aspect ratio70. In this mix proportion strength of concrete is reduce compare with conventional concrete. If the textile sludge used not more than 20%.

## 3. LITERATURE REVIEW

This examination attempts to discover an eco-friendly solution for the administration of the textile sludge. In this investigation, sludge samples were gathered from treatment plant of different textile units situated at Savar, Gazipur and Narsingdi.An electrical incinerator were composed, created and introduced for the burning of textile sludge. The properties of ceramic items such as firing shrinkage, Bulk density, leaching of heavy metals and the compressive

strength were assessed.Textile sludge administration in Bangladesh is an testing assignment for the Industries which are delivering waste water treatment deposits like sludge. In this outcome compressive strength is diminished with the increment in addition of ETP (Salma, A. et al., 2014).

The substation of fine aggregate alongside the sludge in the standard concrete mix influences the workability and density of concrete. The compressive strength somewhat lessens with the substitution and later it falls underneath value when fine aggregate supplanted by the textile mill sludge is after 32%. The fly ash is added to supplant cement alongside 32% sludge. Textile mill sludge(32%) and fly ash(20%) can be effectively utilized as building material by including it in M20 grade of concrete. Workability of concrete (measured in terms of slump values and compaction factor) goes on reducing as percentage of sludge increases. To increase the compressive strength of sludge based concrete silica fumes from glass industry can be added. To increase workability of concrete with increase in sludge percentage plasticizer can be used (Dwivedi, A.K. et al., 2012).

Thus in this way the transfer of textile sludge has turned in to a genuine techno-economic issue. This issue alongside with the shortage of cement and its expanded cost can be corrected to some stretch by supplsnting certain amount of cement in concrete along with the sludge. Since we are replacing cement with textile sludge, the emission of carbon dioxide to the atmosphere can also be reduced. This is an essential advantage of this study as carbon dioxide is a Greenhouse gas which creates various adverse effects to the environment such as global warming. Our present study manages with the experimental investigation in determining compressive strength, splitting strength and modulus of elasticity of various hardened concrete specimens containing different percentage of textile sludge content in it(i.e, 0%, 10%, 15% and 20%) at two diverse water cement ratios (0.4 & 0.5). Based on the trial investigation directed and consequent investigation of test outcomes the following conclusions are made. Addition of textile sludge to concrete affects the strength characteristics of concrete. (Sreedevi Lekshmi, Sheeba Sasidharan 2015).

The main purpose of this observation is to find a use of another hotspot for fine aggregate. In this undertaking, concrete was examined with water-cement ratio of 0.45. Fine aggregate is not completely replaced using sludge with various percentages like 5, 10, 15, 20 and 25.Chemical composition was discovered using SEM and EDX. The mechanical properties such as compressive strength, flexural strength and split tensile strength were examined for 7, 14 and 28 days. The compressive strength became smaller when the addition of sludge is over 20%.Flexural strength is expanded when made comparison with control mix. The most extreme compressive strength and flexural strength attained were 41.2 MPa and 7.5 MPa separately for OPC 43 grade cement. The most extreme compressive strength and flexural strength acquired were 44.5 MPa and 8.5 MPa separately for OPC 53 grade cement. Among all the mixes was examined $4^{th}$ mix which contained 20% of sludge indicated better outcomes in which the split test were attained as higher value is also additionally higher for that mix (Srinivasan, K. et al., 2016).

# 4. MATERIAL USED

## 4.1. Cement

For this experimental investigation OPC 43 grade cement has been used and the cement is tested as per IS 4031- 1988.

**Table 1** Physical (www.sciencedirect.com) property of cement

| S. No | Test conducted | Results | Requirements as per IS:8112-1989 |
|---|---|---|---|
| 1. | Normal consistency | 25% | Not specified |
| 2. | Initial setting time | 30 minutes | Shall not be less than 30 minutes |
| 3. | Final setting time | 300 minutes | Shall not be less than 600minutes |
| 4. | Specific gravity | 3.12 | 3.15 |

## 4.2. Fine Aggregate

For the present experimental work, locally available river sand has considered. The different tests conducted on fine aggregate and the results obtained are tabulated in table 2, the tests are conducted as per IS: 2386 (part 3) 1963(7).

**Table 2** Physical property of sand

| S. No | Test Conducted | Result |
|---|---|---|
| 1. | Specific gravity | 3.335 |
| 2. | Fineness Modulus | 1.025 |

## 4.3. Coarse Aggregate

The rations from 80 mm to 4.75 mm are named as coarse aggregate. The coarse aggregate from crushed basalt rock, conforming to IS; 383 is be utilized. The flakiness and Elongation index were kept well under15%.

**Table 3** Physical property of coarse aggregate

| S. No | Test Conducted | Result |
|---|---|---|
| 1. | Specific Gravity | 2.87 |
| 2. | Fineness Modulus | 9.4 |
| 3. | Impact Value | 4.90% |
| 4. | Crushing | 5.19% |

## 4.4. ETP Sludge

The textile sludge was gained from the veerapandi effluent treatment plant, Tirupur town, Tirupur district, Tamilnadu state, India. The sludge was accumulated from the sludge drying beds and land filling areas by systematic testing methodology**.** The sludge has about 30% humidity. The collected sludge was sundried to evacuate the dampness content present in the specimen. The dried specimen was squashed and after that sieved through 90 micron sieve.

**Table 4** Chemical Property of ETP Sludge

| S. No | Test Conducted | Result |
|---|---|---|
| 1. | Iron | 0.2 mg/l |
| 2. | Chromium | 0 mg/l |
| 3. | COD | 320 mg/l |
| 4. | BOD | 58 mg/l |
| 5. | Nitrate | 0.74 mg/l |
| 6. | Ammonia | 1.932 mg/l |
| 7. | Turbidity | 0.6 NTU |

### 4.5. Fly Ash

For the most fly ash quality is evaluated on the key parameters like pozollanic, material retain on 45 micron sieve, misfortune on ignation and other chemical parameters. It if fit that to qualify a source of flyash and all the examinations showed according to IS should be coordinated first and key parameters can be striven for each bunch to ensure an anticipated nature of fly ash.

### 4.6. Banana Fiber

Banana fiber is a characteristics fibre. The natural banana fibre displays some of the important advantages like low thickness, stiffness and mechanical properties and high sustainability and disposal.

**Table 5** Mechanical Property of Banana Fiber

| S. No | Test conducted | Result |
|---|---|---|
| 1. | Tenacity | 29.98 g/denier |
| 2. | Fineness | 17.15 |
| 3. | Moisture regain | 13% |
| 4. | Elongation | 6.54 |

## 5. RESULT OF THE EXPERIMENTAL INVESTIGATION

### 5.1. Compressive Strength

The compressive strength of the concrete is observed to be decrease with the expansion of textile sludge. At 10% and 20% the replacement of cement with the textile sludge. This test were done as per IS 516 – 1999 guidelines conducted on concrete specimen of size 150 x 150 x 150mm. The samples which are submerged in fresh water for the following 7, 14, 28 days testing and the samples are kept in dry with the goal that the water is depleted well to improve the intrepretations.

The compressive strength calculate by using formula

$Fc = P/A$

$F\ c$ = Compressive strength $N/mm^2$

$P$ = Ultimate load KN

$A$ = Loaded area $mm^2$


**Figure 3** Testing on Compressive Strength

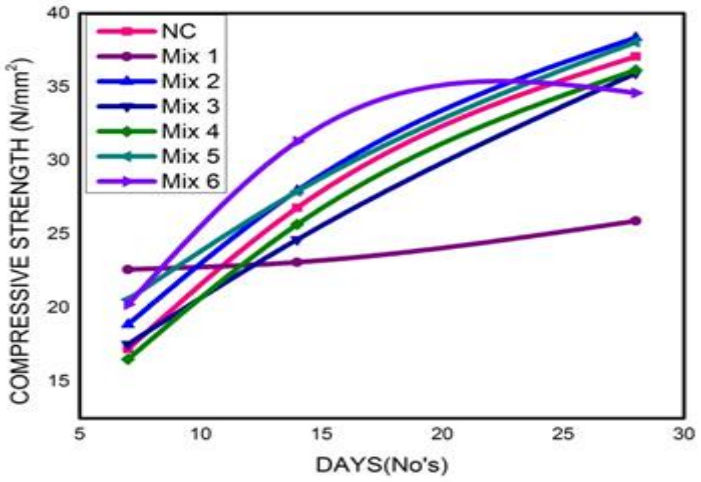


**Figure 4** Result of Experimental investigations showing the compressive strength of concrete with different percentage replacement of textile sludge.

## 5.2. Split Tensile Strength

In these proportion conventional concrete strength is increase when compare to the cement replacement with textile sludge is decrease. If the textile sludge is not used to more than 20% strength will reduce gradually.

Split tensile strength= $2P/(\pi dl)$ in $N/mm^2$

Where, P - Crushing load in N

d - Diameter of the specimen in mm

l - Length of the specimen in mm

**Figure 5** Testing image on split tensile strength

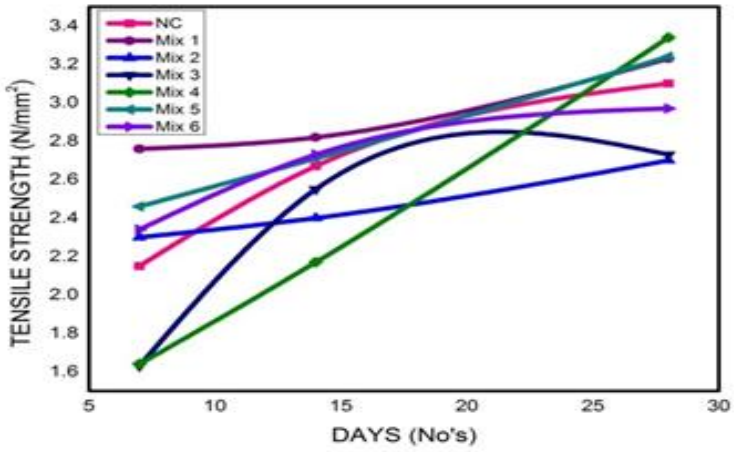


**Figure 6** Result of Experimental investigation showing the split tensile strength of concrete with different percentage replacement of textile sludge.

## 5.3. Flexural Strength

Flexural strength tests were carried out on 100 mm x100 mm x 500 mm beams on the 28th day using a 100kN capacity Universal Testing Machine (UTM) apparatus. The system of loading used in finding out the flexural tension istwo point loading as per IS 516–1959.

Flexural strength $f_{cr}$= Pl/bd$^2$ in N/mm$^2$

Where, P – Ultimate load applied to thespecimen in N

l – Length of specimen between supports in mm

b – Breadth of the specimen in mm.

**Figure 7** Testing Image on Flexural Strength

Flextural quality otherwise called modulus of rupture or bond strength, is a material property, characterized as stress in the material before it yields in the flextural test. The transverse twisting test is most much of the time utilized in which an specimen having either round or rectangular cross – sectional area is bowed until the break or yielding utilizing the three point flextural test starategy.

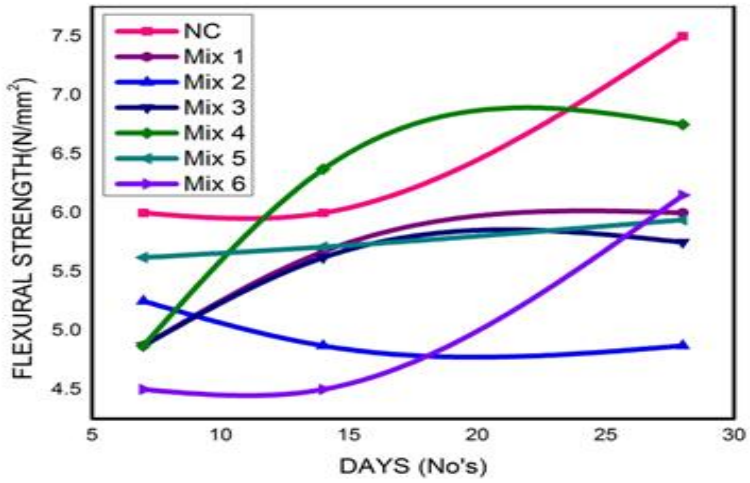


**Figure 8** Result of Trialanalysis showing the flexural strength of concrete with different proportion replacement of textile sludge.

## 6. CONCLUSIONS

- ETP sludge based concrete performs and fulfills the basic properties of conventional concrete for the optimized water to binder ratio (0.45) and strength gaining mechanism is not uniform as like conventional concrete at initial period of time but it is as good as conventional concrete after 28 days.
- In this addition of textile sludge is replacement with more than 20% strength will reduce gradually.
- From the experimental results shows it can be concluded that up to 10% of cement can be replaced by textile ETP sludge without any unfavorable effect.

## REFERENCES

[1] Aeslina Binti, Abdul Kadir, Ahmad Shayuti, and Bin Abdul Rahim (2014) 'An Overview of Sludge Utilization into Fired Clay Brick', International Journal of Environmental, Chemical, Ecological, Geological and Geophysical Engineering, Vol.8, No.8, pp.567-571.

[2] Agrawal, S.K. watile, R.K. mohata, P.V. and makwan, S.C. (2013) 'Utilization of Textile Apparel Waste in Clay Brick', International Journal of Advanced Research in Engineering and Technology (IJART), Vol.4, No.7, pp. 48-52.

[3] Angeline Swarna, M. and Venkatakrishnaiah, R. (2014) 'Manufacturing of Bricks Using Tannery Effluent Sludge', International Journal of Recent Development in Engineering and Technology, Vol.3, Issue.4, pp.33-36.

[4] Badr El-Din Hegazy, E. Hanan Fouad, A. and Ahmed Hassanain, M. (2012) 'Brick Manufacturing from Water Treatment Sludge and Rice Husk Ash', Australian Journal of Basic and Applied Sciences, Vol.6, No.3, pp.453-461.

[5] Balasubramanian, J. Sabumon, P.C. John Lazar, U. and Ilangovan, R. (2006) 'Reuse of Textile Effluent Treatment Plant Sludge in Building Materials', Waste Management, Vol.26, pp.22-28.

[6] Balasubramanian, J. Sabumon, P.C. John Lazar, U. and Ilangovan, R. (2005) 'Reuse of Textile Effluent Treatment Plant Sludge in Building Materials', Elsevier, Waste Management, Vol.26, pp.26-28.

[7] Baskar, R. Meera Sheriffa Begum, K.M. and Sundaram, S. (2006) 'Characterization and Reuse of Textile Effluent Treatment Plant Waste Sludge in Clay Bricks',

(link.springer.com) Journal of the University of Chemical Technology and Metallurgy, Vol.41, No.4, pp.473-478.

[8] Bektas, and Fatih (2007) 'Use of Ground Clay Brick as a Supplementary Cementitious Material In Concrete Hydration Characteristics, Mechanical Properties, and ASR Durability'

[9] Coutts, R.S.P. (1990) 'Banana Fibres as Reinforcement for Building Products', Journal of Materials Science Letters, Vol. 9, pp.1235-1236.

[10] Daniel De Almeida Lima, and Charles Zulanas, (2016) 'Use of Contaminated Sludge in Concrete', Precede Engineering, Vol. 145, pp. 1201–1208.

[11] Sreedevi Lekshmi and Sheeba Sasidharan(2015) 'Experimental Investigation on the use of Textile Sludge in Concrete', International Journal of Advances in Engineering & Technology, Vol.8, No.4,pp.559-565.

[12] Srinivasan, K. Vazhviniyan, R. MohanKumar, L. and Palpandi, K. (2016) 'Replacement of Fine Aggregate Using Sludgein Concrete', International Research Journal of Engineering and Technology, Vol.3, No.5, pp.1989-1993.

[13] Myneni Madhu Bala, M. Srinivasa Rao and M Ramesh Babu Sentiment Trends on Natural Disasters using Location Based Twitter Opinion Mining International Journal of Civil Engineering and Technology, 8(8), 2017, pp. 09-19