International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 03 | Mar 2021 www.irjet.net p-ISSN: 2395-0072

# STUDY ON STRENGTH OF CONCRETE CONTAINING EFFLUENT TREATMENT PLANT WASTE

**S.K.Gowtham[1], G.L.Bharanitharan[2]**

[1]*Assistant Professor, Department of Civil Engineering, Nandha Engineering College, Tamilnadu, India*
[2]*PG student, Department of Civil Engineering, Nandha Engineering College, Tamilnadu, India*

---

**Abstract -** In recent years many resembles have tried to use different materials into concrete and it have been successful. Leaving the waste material to the environment directly cause environmental problem. Waste can be used to produce new products or can be used as the admixtures so that natural resources are used more efficient and the environment is protected from waste deposits. Large quantities of sludge and are produced in India and disposed of by landfilling or dumping in and around sites. The creation of non-decaying waste materials, combined with a growing consumer population has resulted in a waste disposal crisis leading to an economic and environmental problem. These wastes that produced today will remain in the environment for hundreds, perhaps thousands of years. The magnitude of environmental problems like air, surface and ground water pollution and economic problem like landfilling maintenance cost etc. is very high for both these wastes.

In this study, waste ETP sludge powder have been used as a replacement to the concrete ingredient i.e. cement and the mechanical properties like compressive strength, Split tensile strength and flexural strength will be measured. For checking strength of replacement of cement by ETP sludge waste powder, the cement is replaced at 5%, 10%, 15% and 20% and ETP sludge waste powder having particle size of 90 micron was used.

***Key Words: Sludge, ETP, CETP, TNPCB, High strength concrete,***

## I. INTRODUCTION

The huge amount of industrial by-products or wastes which is becoming a major problem for client for increasing environmental pollution & generation of a huge amount of unutilized resources. With a view to the above, this research is aimed at finding out utilization of such things/ materials/ industrial by-products for value added applications & also helps to solve the environmental problems. The present piece of my research work aims at, to provide a valued input/utilization to industrial by-product/ waste. It is envisaged to create a new composite material which can be derived from the already existing non degradable and hazardous waste materials. The new composite material is a combination of Ordinary Portland cement and Dyeing Industry Effluent Treatment plant Sludge (DIETPS). It is the method of extracting wealth from the waste. Textile industry produces waste at a rate of 70-90g/ person equivalent/ day.

As per Tamil Nadu State Pollution Control Board (TNPCB) records, there are about 830 large units engaged in textile industrial processes These industries have established eight Common Effluent Treatment Plants (CETPs) and many individual Effluent Treatment Plants (ETP), which are subjected to treat about 75,000 m3 of effluent per day generated by textile industries. On the other hand, the sludge that retained due to the solids separation process in the treatment plants create lot of environmental problems due to lack of disposal methods

## 2. SCOPE OF THE INVESTIGATION

- To study the effect on workability and strength properties of concrete mix with varying percentage replacement by textile sludge.
- To find out the optimum percentage of cement replacement by textile sludge for which the concrete yield superior mechanical properties.
- To reduce the quantity of wastes dumped into the land; this improves the quality of land
- To reduce the demand of construction materials in future generation
- To make effective utilization of the textile sludge

## 3. OBJECTIVES OF THE STUDY

1 To study about the performance of the new composite material using industrial specific wastes.

2 To explore the utilization of textile sludge for the possibility as replacement of cement in building materials.

3 To assess the mechanical properties of concrete containing textile sludge.

4 To assess the durability properties of concrete containing textile sludge

5 To reduce the use of conventional building materials and saving the environment from environment pollution.

## 4. LITERATURE REVIEW

### GENERAL

The main purpose of these literature collections is to provide the information about the work that has been conducted around the world in the field of study. In this chapter a brief review of literature about the utilization of textile sludge in various construction materials are reported and discussed.

### UTILIZATION OF TEXTILE SLUDGE AS CONSTRUCTION MATERIAL

 **Chandrasekaran K et.al (2001)** has carried out the studies on management of sludge from hosiery knitwear dyeing wastewater treatment plants and reported that the bricks made from 10% sludge and 90% clay soil is suitable for use in construction of load bearing walls.

 **Palanivelu K et.al (2001)** studied the characteristics of sludge generated from Common Effluent Treatment Plant (CTEP) and Effluent Treatment Plants (ETP) put by the textile industry. They determined the leach ability of the sludge by Toxicity Characteristics Leaching Procedure (TCLP) and German Leach method.

 **Balasubramanian J et.al (2005)** has studied the potential reuse of textile effluent treatment plant (ETP) sludge in building materials. The physio-chemical and engineering properties of a composite textile sludge sample from the southern part of India. The water absorption percentage of tiles is less than the maximum of 10% .

 **Reddy babu G (2005)** conducted the feasibility study of usage of sludge from sand beneficiation treatment plant in the production of bricks. At 5% to 10% of replacement, the quality of bricks is superior to the brick made from brick earth alone and can be used for superior work of permanent nature.

 **Hilary Nath et.al (2006)** has produced block bricks from the primary sludge generated in the garment washing process.. Thus by using textile sludge as a material land pollution, dust pollution and the space required for storage are reduced.

 **Jewaratnam et.al (2006)** did a detailed work on sludge from a waste water treatment plant, the sludge in this work was dried and powdered and added to clay in various proportions. The fired samples were evaluated for the thermal conductivity and sound barrier characteristics were evaluated.

 **Ramesh Kumar et al (2009)** have done extensive study on dye effluents in Perundurai. Colouring of hosiery fabric takes place in the presence of high concentration of sodium sulphate or sodium chloride (30 – 75 kg/$m^3$) in dye solutions.

 **Safiuddin et al (2010)** investigated the potential use of various solid wastes for producing construction materials. The investigation is based on the compressive review of available literature on the construction materials including different kinds of solid wastes. Their investigation shows the applications of solid waste based construction materials in real construction, and identifies the research needs.

## 5. METHODOLOGY

The constituent materials used were obtained locally and were Ordinary Portland Cement (O.P.C), M-sand as fine aggregate and crushed granite as coarse aggregate. Potable water was used for mixing and curing. The tests were carried out as per IS Standards.

### MATERIALS TO BE USED

### INGREDIENTS OF CONCRETE

Concrete is a construction material composed of Portland cement and water combined with sand, gravel, crushed stone, or other inert material such as expanded slag or vermiculite. The cement and water form a paste which hardens by chemical reaction into a strong, stone-like mass. The inert materials are called aggregate, and for economy no more cement paste is used than in necessary to coat all the aggregate surfaces and fill all the voids. The concrete paste is plastic and easily moulded into any form or trowel to produce a smooth surface. Hardening begins immediately, but precautions are taken, usually by covering, to avoid rapid loss of moisture since the presence of water is necessary to continue the chemical reaction and increases the strength. Too much water, however, produces a concrete that is more porous and weaker.

**CEMENT**

Cement is a binding material in concrete.In this study, we used Ordinary Portland Cement (OPC) for our entire experimental works. Many tests were to be conducted to cement like specific gravity, consistency, initial and final setting test, fineness test.

**FINE AGGREGATE**

Manufactured sand is an alternative for river sand. Due to fast growing construction industry, the demand for sand has increased tremendously, causing deficiency of suitable river sand in most part of the word. Due to the depletion of good quality river sand for the use of construction

**COARSE AGGREGATE**

It is a construction component made of rock quarried from ground deposits.They are irregular in shape**.** Coarse aggregate maximum size of 20 mm have to be used in concrete.

**SLUDGE**

Initially sludge is a waste material collected in the effluent treatment plant. It's mostly collected from the industries like textile industries, paper manufacturing process, and solid waste treatment plants, etc. The sludge has a roughly 30 % moisture content. The sample of the sludge will be dried at the temperature of 105 °C until the net weight will be constant. The dried sample is grinded in a rice grinder and it is sieved in 90 microns sieve. pH value is 9.4. Specific gravity is generally in the range of 2.2 to 2.3

**6. CONCRETE MIX DESIGN AND**

**MIX PROPORTIONS**:

M40 grade concrete was designed as per IS 10262- 2009. Quantity of materials per cubic meter of concrete and dosages of carbon fibers used are listed in Table. A constant water cement ratio of 0.36 was used.

| Contents | Values (kg/m$^3$) |
|---|---|
| Cement | 439 |
| Fine Aggregate | 662 |
| Coarse Aggregate | 1256 |
| ETP Sludge | 220 |
| Water Cement Ratio | 0.36 |

**TABLE 1: QUANTITY OF MATERIALS USED PER CUBIC METER OF CONCRETE**

**7. DISCUSSION ON EXPERIMENTAL STUDIES CONDUCTED**

**7.1 TESTS CONDUCTED ON FRESH CONCRETE**

Slump Test: Worldwide this test is used extensively in concreting works. It is very useful in detecting variations in the uniformity of a mix of given nominal proportions. Slump cone of size 30cm in height, 10cm and 20cm diameters of openings at top and bottom. The tests were conducted in accordance with IS 1199-1959.

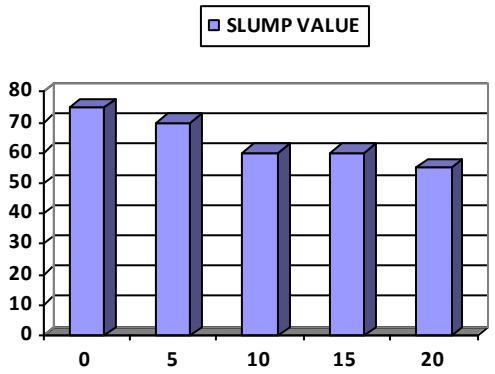


**FIGURE :1 SLUMP VS DIFFERENT DOSAGES OF ETP SLUDGE**

**7.2 TEST CONDUCTED ON HARDENED CONCRETE**

The results obtained from experimental tests conducted on hardened concrete for conventional and ETP Sludge reinforced concrete with varying ETP dosages of 5%, 10%, 15% and 20% are tabulated in Tables 4 Test details and results are discussed in sections 5.2.1

### 7.2.1 COMPRESSIVE TEST

Cube specimens of size 150mm x 150mm x 150mm were casted for different percentage of replacement of ETP sludge waste as 5%, 10%, 15% and 20%. Results are tabulated in table 2 and plotted in Figure 2.

**TABLE 2. COMPRESSIVE STRENGTH RESULTS**

| ETP SLUDGE (%) | 7 DAYS | 28 DAYS |
|---|---|---|
| 0 | 24.32 | 41.15 |
| 5 | 25.16 | 43.25 |
| 10 | 28.67 | 46.34 |
| 15 | 21.23 | 40.19 |
| 20 | 29.18 | 38.23 |

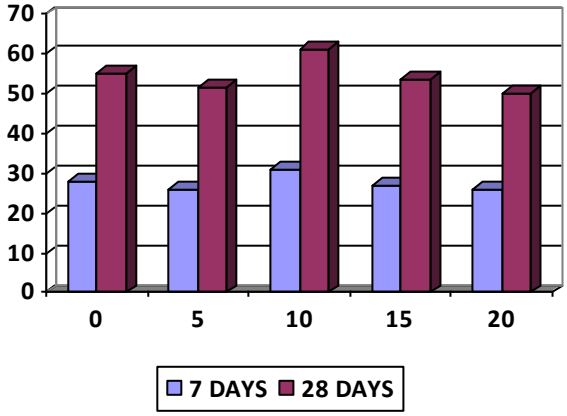


**FIGURE: 2 COMPRESSIVE STRENGTH FOR DIFFERENT PERCENTAGE OF ETP SLUDGE WASTE.**

### 7.2.1 SPLIT TENSILE STRENGTH TEST

Cylinder specimens of size 150mm x 300mm were casted for different percentage of replacement of ETP sludge waste as 5%, 10%, 15% and 20%. Results are tabulated in table 2 and plotted in Figure 2.

**TABLE 2. SPLIT TENSILE STRENGTH RESULTS**

| ETP SLUDGE (%) | 7 DAYS | 28 DAYS |
|---|---|---|
| 0 | 2.15 | 3.7 |
| 5 | 2.49 | 3.79 |
| 10 | 3.34 | 4.1 |
| 15 | 2.87 | 3.89 |
| 20 | 2.64 | 3.54 |

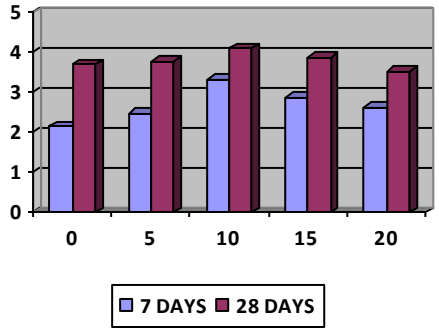


**FIGURE:2 SPLIT TENSILE STRENGTH FOR DIFFERENT PERCENTAGE OF ETP SLUDGE WASTE**

## 8. CONCLUSIONS:

The following important conclusions were drawn based on the results obtained from the experimental studies:

• With an increase in ETP sludge percentages from 5% to 20%, the workability decreases. However, the slump values for conventional and concrete with ETP sludge waste was found to be more or less same.

• Compressive strength for M40 grade of concrete for different dosages of ETP sludge waste at 5%, 10% and 15% & 20% have been done. The maximum percentage increase in compressive strength was achieved at 10% of ETP sludge waste.

## REFERENCES

1. Balasubramaniyan, J, Subomon, P C, John U Lazar & Ilangovan, R 2005, 'Reuse of textile effluent plant sludge in building materials', Waste management Vol. 26, pp.22-28.

2. Chandrasekaran, K, 2001, 'Reuse of textile ETP sludge as construction material' Journal of Hazardous materials, Vol. 84, pp. 117-140.

3. Gobinath, R, 2013, 'A Review on Re-Use of Textile Sludge In Manufacturing Brick'. World journl of environmental journals, Vol. 1, pp. 215-226.

4. Hema Patel & SunnelPandey 2009, 'Exploring the reuse of potential of chemical sludge from textile waste treatment plants in India a hazardous waste', American Journal of Environmental Sciences, Vol.1, pp. 106-110.

5. Hilary Nath 2006, 'Sludge Bricks Development', Research Journal, brandixinspired solutions, Issue 3, pp. 6-9.

6. IS 1489 (part 1) – 1991 'Portland-Pozzolana Cement specification' fly ash based (Third revision).

7. Jevaratnam & Jegalakshmi 2006, 'Waste recovery from industrial sludge' University of Malaya, Engineering e-Transaction, Vol. 2, pp 5-8.

8. Palanivelu, & K, Rajkumar, R 2001, 'Characterization and Leachability studies on textile effluent treatment plant sludge', Environmental Pollution Control Journal. Vol. 3, pp. 116-118.

9. Ramesh Kumar, M & K. Saravanan 2009, 'Recycling of Woven Fabric Dyeing Wastewater Practiced in Perundurai Common Effluent Treatment Plant', CCSE Journal, April 2009, Vol. 3, pp. 146 - 152.

10. Raghunathan. T, Gopalsamy. P, 2010, 'Study on Strength of Concrete with ETP Sludge from Dyeing Industry' Vol. 1, pp.379-389.

11. Reddy Babu, G, 2005 'Feasibility study of usage of sludge in building materials' International Journal of civil and Structural Engineering, Elsevier Ltd., online paper, pp.379-389.

12. Safiuddin,M, MohdZaminJumaat, Salam, M.A, Islam, M.S & Hashim, R, 2010, 'Utilization of solid waste in construction materials' International Journal of the Physical Sciences, Vol. 5, pp.1952 – 1963.

13. Shetty, M.S, 2005 'Concrete technology theory and practice', S. Chand publications.