

## Utilization of STP by-Product as a Raw Material in concrete

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**Abstract** - This study is carried out to determine the compressive strength of concrete and split tensile strength of concrete using sewage sludge ash (SSA) as a combination of cement and fine aggregate replacement. The SSA suggested replacing the cement in the concrete because it has similar pozzolanic properties of ordinary Portland cement. The particle size of SSA after the incineration process is similar to the fine aggregate that used in the concrete. The incineration process is carried out at a certain temperature. The sieving process will take place after incineration process and the dried Sewage sludge will be used as a fine aggregate replacement in concrete. The remaining dried sewage sludge will be grinded to convert it into powder form and is used partially cement replacement in concrete. In this study, the compressive strength and split tensile strength will be calculated.

may be used in cementitious materials as a pozzolonic material, partly substituting for cement or as a filler replacing or partly replacing sand. Numerous studies, some of which are older, have investigated the use of SSA in cement mortars and concrete. This project reviews the advantageous and deleterious effects of SSA on cementitious materials.

### 2. MATERIALS AND METHODS

Materials used are SSA( sewage sludge ash), cement(OPC), fine aggregate, Coarse aggregate(20mm passing).

Methodology used are:-

1. Collecting the relevant information and documents related to waste water treatment plant in PCMC and their quality and quantity.
2. Undertaking a comprehensive literature review focused on using sewage sludge in construction field.
3. Site visit to the STP to obtain information and collect samples.
4. Develop a suitable experimental program to study the use of waste water sludge in concrete mixtures.
5. Analyze the experimental test results and draw conclusions.

### 1. INTRODUCTION

Sludge is an inevitable by-product of wastewater treatment. The disposal of sludge is a complex problem that can affect air, land & environment. Thus, the large scaled disposal of sludge is one of the concerns of any municipality. Currently, the most common methods of sludge disposal are ocean dumping, land filling & agricultural use. All these disposal alternatives has varying degrees of environmental impact. Due to limited landfill space available & stringent environmental regulations and the potential for the ground water contamination generated from landfill leach ate, many waste water treatment plants using sludge incineration process to develop an efficient, economic & environmentally sound alternatives for utilizing ash as residues .Due to large volume of sludge, prohibition of sludge dumping in the ocean & lack of suitable land space, municipalities are turning to incineration. These incineration processes reduces the volume of sludge to about 90% of its original volume. Digested and dewatered sludge, after incineration at a high temperature, yields a hard, cellular, porous mass with low unit weight. The solution to the problem of ash seems to be directed towards utilization of ash in Portland cement concrete roadways (i.e. for highways & airport runways), concrete building materials, channel stabilization materials & other alternatives. There is significant potential for Sewage sludge ash (SSA) to be used in concrete although the conditions, methods and quantities that can be substituted depend on a number of factors . SSA(Sewage Sludge Ash)



Fig 1. Procedure for SSA sample

### 3. Mix Design.

The standard procedure for the mix design of concrete has designed for M25 is done by the concept of IS code 10262(2009) "Concrete Mix Proportioning"

#### 3.1 Specifications of material :-

1. Grade designation:- M25
2. Type of cement :- OPC 43 grade.
3. Specific gravity of cement :- 3.15
4. Max nominal size of aggregate :-20 mm down
5. Water cement ratio:-
6. Method of concrete placing:- Manually

#### 3.2 Chemical Composition of Sewage sludge.

Name of test	Test results in %
Silica content	40.2
Aluminium Oxide	7.90
Calcium Oxide	4.10
Magnesium Oxide	1.29
Sulphate as SO <sub>3</sub>	0.78
Loss on ignition	37.0
Iron content	4.10
Chloride content	BDL

## 4. TESTS AND RESULTS

#### 4.1 Compressive Strength of Concrete

The compressive strength test was carried out on hardened concrete cube specimen. The compressive strength is determined for various mixes by testing the specimen in a digital compression machine of 1000KN capacity operated at a loading rate of 2.5 KN/sec. Cubes specimen of size 150\*150\*150 mm are used to assess the compressive strength. Fig below indicates cubes specimen subjected to compression testing.



Fig 2. Compression Testing of SSA concrete cube.

Table 1: Compressive Strength Test results.

% of Sewage Sludge Ash in concrete mix.	Compressive Strength test in MPa after curing days.		
	7	14	28
0%	17	22.5	25
5%	6.736	12.76	15.744
10%	5.184	8.076	17.21
15%	4.316	6.251	10.916

#### 4.2 Split tensile strength test on concrete cylinder:

In this project, SSA concrete cylinders of size 150mm in diameter and 300 mm in height were tested. The Tensile strength of concrete is one of the important properties. Splitting tensile strength test on concrete cylinder is a method to determine tensile strength of concrete. The concrete is very weak in tension due to its brittle nature and is not expected to resist direct tension. Thus it is necessary to determine tensile strength of concrete.



Fig 3. Split Tensile Strength of SSA concrete cylinder.

**Table 2.** Split Tensile Strength Test results.

% of Sewage Sludge Ash in concrete mix.	Split Tensile Strength of SSA concrete cylinder after curing period (in days).		
	7	14	28
0%	2.31	2.68	3.39
5%	2.685	4.125	5.06
10%	1.191	2.021	5.44
15%	1.508	2.346	3.46

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## 5. CONCLUSION

This study proves that domestic sewage sludge can be successfully used in concrete in minor amount as a partial replacement of sand and cement. The optimum percentage of SSA in concrete was 5% according to the sample taken from PCMC Sewage Treatment Plant. Use of sewage sludge as a raw material in concrete is an effective means for its management and may lead to saving of economy. The results from Split tensile strength test also displays higher results than expected . Hence, it may prove safe environmentally consistent method of disposal of sewage sludge.

## 6. REFERENCES

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