USE OF SEWAGE SLUDGE AS PARTIAL ELEMENT FOR MANUFACTURING COMMERCIALLY VIABLE PAVER BLOCKS

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Abstract : Sludge is an unavoidable by product of the waste water treatment process. This sludge ends up being deposited in the landfills or mix with the water bodies, creating a harmful effect on the environment. The objective of the study is to find out an alternative solution for the disposal of sludge produced in Waste Water Treatment Plants. The problem of sludge disposal is closely related to the ever-increasing population, as the rate of generation of sludge is increasing and the landfills are getting exhausted simultaneously. This study includes the use of dry sewage sludge in manufacturing samples of interlocking paver blocks.

Index Terms **- sludge, disposal of sludge, partial replacement of cement, paver blocks**

I. INTRODUCTION

Sewage sludge is a byproduct; it is one of the final products of water treatment plant (WWTP) at sewage treatment plant (STP). The waste water treatment plants (WWTPS) equipment concentrate impurities in waste water into solid form and separate this solid from liquid. The remaining solid is known as sludge.

The source of sludge in water treatment plant varies according to the plant type and its method of operation. The main source of sludge is primary sedimentation basins and secondary clarifiers. A small amount comes from chemical precipitation, screening, grinder and filtration devices. So, sludge may be classified according to its source, the three main groups are as follows:

- Sludge originating from treatment of urban waste water which involves domestic waste water or the mixture of domestic waste water with industrial waste water and/ or runoff of rain water
- Sludge originating from treatment of industrial wastewater such as water used in industrial processes
- Sludge originating from water treatment before its treatment for drinking. For drinking, the generated sludge of this type is lower than the sludge generated from water treatment plant

The population of Mumbai is increasing with an alarming rate as compared to the availability of the land. Population of Mumbai generates a large quantity of waste in this society which has adverse effects on environment and health of the residents. Wastewater sludge is defined as the residual material removed from the wastewater treatment plants. It is mandatory to find an alternative solution for the suitable treatment and disposal for sustainable health and environment.

Worldwide wastewater sludge is disposed by the following methods:

1.Landfill application

2.Incineration

The limited area available for landfills in turn increases the load on existing landfills. The various problems associated with sludge disposal in recent times are as follows:

1.Difficulty in exploring new landfill sites due to scarcity of reclaimed land and disposal cost

2.Ground water reservoir pollution has adverse effects on human health and environment

3.The crops, leaves and other vegetation is affected by the fly particles as it contaminates soil by increasing the concentration of nitrates

The four types of pathogens present in Waste Water Sludge viz., bacteria, protozoa, viruses and helminths pose threat to human health as they spread disease. Incineration causes air pollution and is regarded as a volume reduction technique y many authors. The residue of incineration also ends up being deposited in the landfills.

Figure 1: Sludge

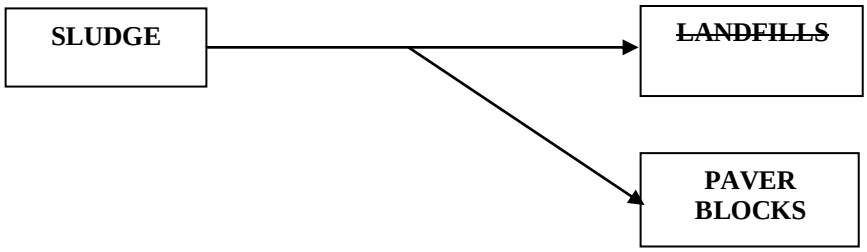


Figure 2: Concept of Project

II. NEED OF STUDY

This work was directed towards establishing towards waste water sewage sludge in concrete mixes and nonstructural elements. The environmental and health problems will be reduced with successful use of sludge in concrete mixes and in nonstructural elements such as paver blocks. The improper handling at the sludge disposal sites are the causes of these environmental and health problems. There are 5-6 landfills in Mumbai with are already overflowing and there is no scope of exploring new lands for construction of landfills. The process of waste water treatment will become cheaper as the cost involved in the transportation of sludge to landfill will be reduced.

The sludge has an adverse effect on the environment due to the harmful pathogens present in it which tend to pollute the ground and surface water.

Figure 3: Need of Study
Source: Mid-Day

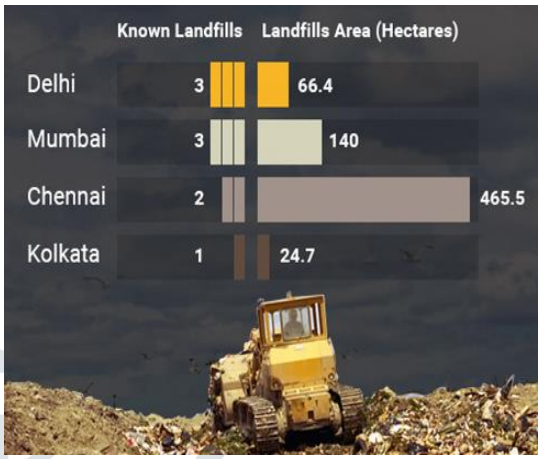


Figure 4: Statistical Data of Landfills In India

"India's landfills are bursting at the seams and overflowing with items that shouldn't be thrown in the trash. More than 70% of collected urban waste is dumped straight into the landfills. As a result, most of them are brimming and are way past their limit."

SOURCE: www.swachhindia.ndtv.com

III. OBJECTIVE

The following are the objectives for using sludge in building materials:

1. To find the optimum proportion of dry sludge to cement ratio in mixes used for manufacturing paver blocks.
2. To observe the effect of dry sludge on interlocking paver blocks and its usability in practical world.
3. To find a suitable method to study the influence of dry waste water sludge with different proportions in manufacturing of paver blocks and ecofriendly method for disposal of sludge.
4. To reduce the cost of construction by replacing cement in some proportions with sludge.

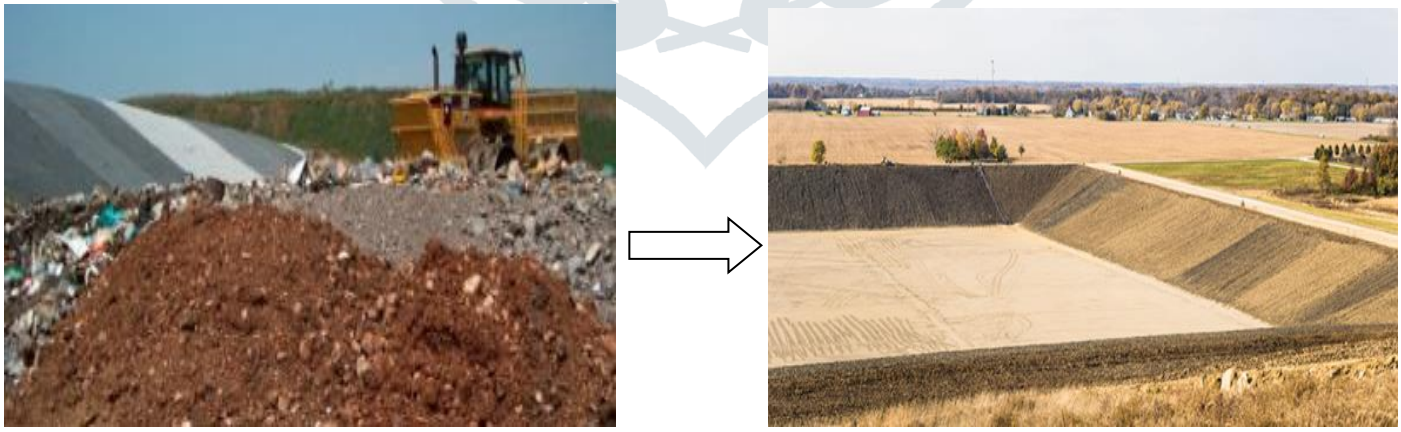


Figure 5: Objective of Study

IV. METHODOLOGY

The procedure of using dry sewage sludge as one component of interlock paver blocks is summarized with the experimental program designed for evaluation of feasibility to use waste water sludge. Several properties of sewage sludge viz. moisture content and size distribution are presented. The WWTP sludge sample was collected and oven dried for calculating the moisture content and size distribution. The sludge was dried before using the sludge as a component in the mix of interlocking paver blocks. The calculations were done to find out the quantity of cement, stone chips, sludge and sand. Casting was done with the

help of PVC moulds of Zig Zag type with vermilook finish. The test to find out compressive strength at 7, 14 and 28 days was carried out after curing the sample.

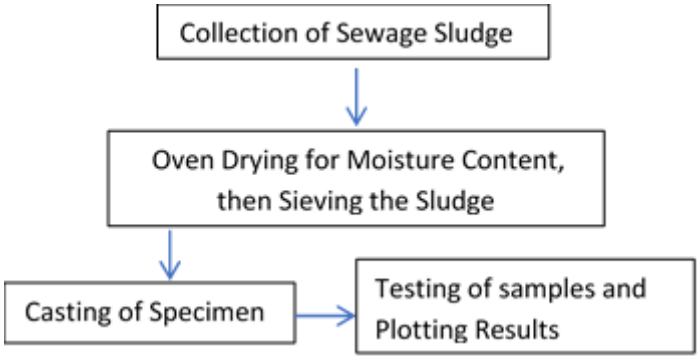


Figure 6: Adopted Methodology

V. MATERIALS

Paver blocks of M30 graded were to be cast for the study. The proportion of M30 paver blocks was 1:1.54:1.70 (Cement: Sand: Stone Chips). The w/c ratio for this mix was 0.40. OPC cement of 43 grade was used.

For 1 paver block,
Volume: 0.0015114 cu. m.

For Sludge:
05% of Cement= 0.0382 kg
10% of Cement= 0.0763 kg
15% of Cement= 0.115 kg
20% of Cement= 0.153 kg

Qty. of Cement (kg)	Qty. of Sand (kg)	Qty. of Stone chips (kg)
0.763	1.846	2.271

Table 1: Quantity of Materials

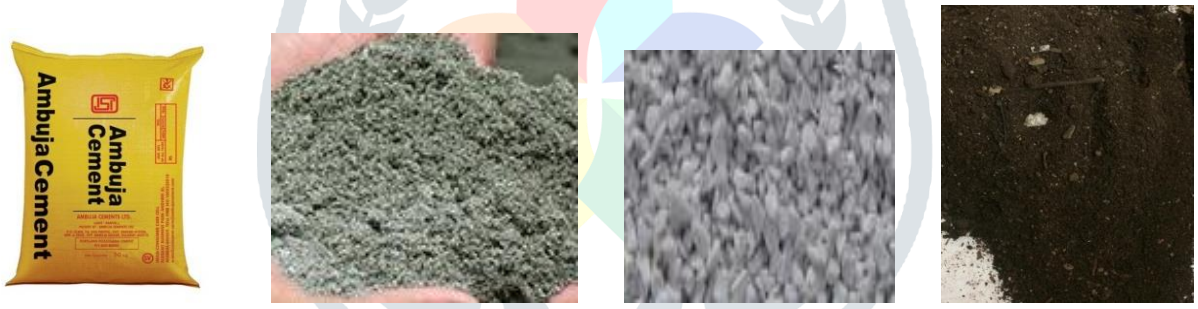


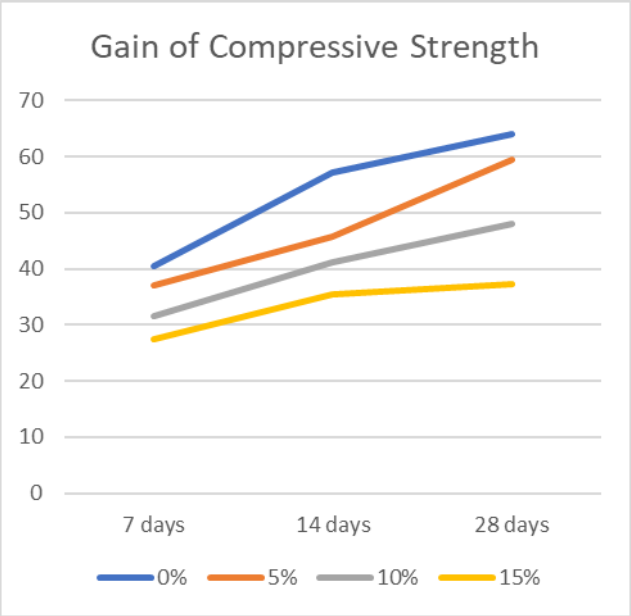
Figure 7: Raw Materials (Cement, Sand, Stone Chips, Sludge)

Figure 8: PVC Paver Block Mould

Figure 9: Casting of Paver Blocks

VI. RESULTS AND DISCUSSION

The following results were obtained after testing the samples:



Graph 1: Compressive Strength v/s No. of Days

No. Of Days ⇩	Sludge % ⇨	0%	5%	10%	15%
7 Days		40.38 MPa	37.12 MPa	31.56 MPa	27.48 Mpa
14 Days		57.06 MPa	45.82 MPa	41.08 MPa	35.36 MPa
28 Days		64.12 MPa	59.36 MPa	48.04 MPa	37.25 MPa

Table 2: Compressive Strength of Specimen

When the graph was plotted, it was observed that the specimen with 5% sludge showed behavior similar to paver block with no sludge. Although, the process of gain of strength was slow between 7 to 14 days and rapid after 14 days as compared to specimen with no sludge. The specimens with 10% and 15% sludge replacement showed much variation in strength and were found to be practically of a little use because of the retarded process of gain of strength.

VII. SUMMERY AND CONCLUSION

The following observations were made during the study:

An alternative solution for utilization of sludge in construction industry can be practiced. Load on landfills will reduce if this change is observed. The cost of disposal will go down; hence it will result in reduction in cost of operation of Waste Water Treatment Plants. The strength of the interlocking paver block is reduced slightly. Cost of construction may reduce. Less cement will be consumed; hence less heat of hydration will be evolved. This will be a step towards eco-friendly construction and environment.

The specimens with 5% replacement can be used in less important areas with extremely low traffic conditions or sidewalks of buildings and lawns undergoing less abrasion.

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