Soil Stabilisation By Municipal Solid Waste

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Abstract- *Solid waste management issue is the biggest challenge to the authorities of both small and large cities in developing countries. This is mainly due to the increasing generation of such solid waste and the burden posed on the municipal budget. MSW is a type of the solid waste material available in environment. They are increasing exponentially day by day. Disposal of these waste materials is essential as they are causing hazardous effects on the environment. Disposal requires too much land. In this paper, MSW (municipal solid waste) was under taken for the stabilization of soils and its different proportion was mixed with laterite soil. Laboratory tests such as pycno meter, compaction, and unconfined compressive strength test were performed to measure the engineering characteristics of the stabilized material and influence of MSW on various parameters and unconfined compressive strength of soil evaluated.*

Keywords- Municipal Solid Waste(MSW), Mechanically Biologically Treated Waste(MBT), Urban Local Bodies(ULBs), Solid Waste Management(SWM), Anaerobic Digestion, Bio drying

I. INTRODUCTION

Solid waste management (SWM) is a major problem for many urban local bodies(ULBs) in India, where urbanization, industrialization and economic growth have resulted in increased municipal solid waste (MSW) generation per person. Effective SWM is a major challenge in cities with high population density. Achieving sustainable development within a country experiencing rapid population growth and improvements in living standards is made more difficult in India because it is a diverse country with many different religious groups, cultures and traditions. The main requirement of soil stabilization is adequate strength and it depends on character of soil. In case of cohesion less soils the strength could be improved by providing confinement or by adding cohesion with a cementing or binding agent. In case of cohesives oil, the strength could be increased by drying, making soil moisture resistant, altering the clay electrolyte concentration, increasing cohesion with a cementing agent and adding frictional properties. Stabilisation improves the strength of the soil, thus, increasing the soil bearing capacity. It is more economical both in terms of cost and energy to increase the bearing capacity of the soil rather than going for deep foundation or raft foundation. We add Mechanically Biologically Treated (MBT) MSW waste in order to enhance these properties.

Municipal Solid Waste(MSW)

Domestic waste or Household waste generated by community from several sources, not only by individual consuer household. It consists of both Garbage & Rubbish that is it includes Dust, leafy matter, building debris etc.. from various municipal activities, Construction and demolition. We use Mechanically Biologically Treated (MBT) MSW waste.

Fig.1.1 MSW

II. OBJECTIVESANDSCOPEOFSTUDY

This study will contribute in improvement of soil properties by using MBT waste. As soil and waste is variable material in characteristics from place to place, this experimental research work will be applicable for particular region soil with particular type of Municipal solid waste. For different area's soil and different waste, we can have different optimum percentage of waste which will enhance soil properties. Use of solid waste as stabilizing material, is cheap as well as eco-friendly method of soil stabilization, which will solve the waste disposal problems as well as enhances soil properties.

III. MATERIALSANDMETHODOLOGY

Materials

1) Soil: Laterite soil is choosen.

2) MBT Waste: MBT waste is collected from MBT treatment plant in Thrissur. MBT stands for Mechanical Biological Treatment. It is a process that could help in diverting biodegradable municipal solid waste from land fill to help protect the environment and reduce the amount of green house gas emitted from landfill sites. It consists of mainly two parts. A mechanical sorting part and a biological processing part.

The mechanical part is designed to have further mechanical screening at the end of the process to take out further contaminants and or reduce particle size, especially if the residues are going to be used for a purpose other than land fill Mechanical separation process can include size reduction / shredding of the waste, separation of ferrous and nonferrous metals, heat / steam treatment and screening and/or size reduction of outputs.

Biological processing is a combination of three process an aerobic digestion, composting and bio drying.

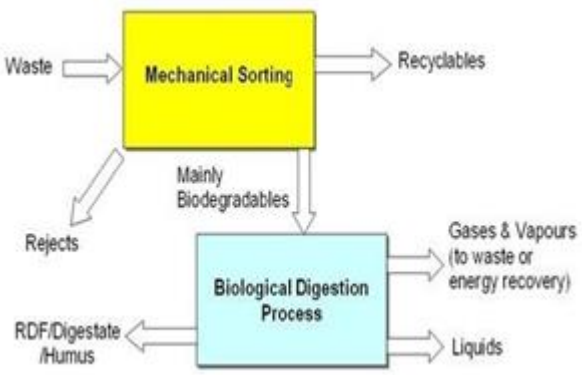

Fig.3.1 MBT Steps

Methodology

After the collection of soil and MBT waste, tests are carried out in two stages:

1) Preliminary test sons oil: Preliminary tests are done to check the soil properties .It includes Sieve Analysis, Specific Gravity, Atterberg Limits, Heavy Compaction, and Unconfined Compressive Test. UCS is our main test.

UCS: Place the sampling soil specimen at the desired water content and density in the large mould. Push the sampling tube in to the large mould and remove the sampling tube filled with the soil. Saturate the soil sample in the sampling tube by a suitable method. Coat the split mould lightly with a thin layer of grease. Weigh the mould. Extrude the sample out of the sampling tube in to the split mould, using the sample extractor and the knife. Trim the two ends of the specimen in the split mould. Weigh the mould with the specimen. Remove the specimen from the split mould by splitting the mould in to two parts. Measure the length and diameter of the specimen with Vernier calipers. Place the specimen on the bottom plate of the compression machine.

Adjust the upper plate to make contact with the specimen. Adjust the dial gauge and the proving ring gauge to zero. Apply the compression load to cause an axial strain at the rate of ½ to 2% per minute. Record the dial gauge reading, and the proving ring reading every thirty seconds Take the sample from the failure zone of the specimen for the water content determination.

2)Tests after adding MBT waste: MBT waste are added in different proportion 1%, 2%, 3% UCS is our main test. After adding waste UCS is conducted for different % waste. Graphs are plotted and results are analyzed.

IV. RESULTSANDDISCUSSIONS

Basic Properties of Soil

Table4.1 Properties of Soil

Specific Gravity	2.4
Coefficient of Uniformity	14.11
Coefficient of Curvature	0.564
Relative density g/cc	2
Liquid Limit %	24
Plastic Limit %	18
Shrinkage Limit %	16

UCS Results

UCS test with different proportion of waste is done. And the obtained results are plotted below graphs paper.

From Fig4.1, we got maximum compressive stress as 2.038 kpa

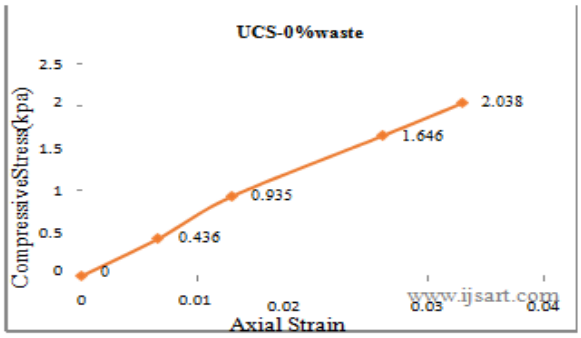

Fig4.1:UCS-0% waste

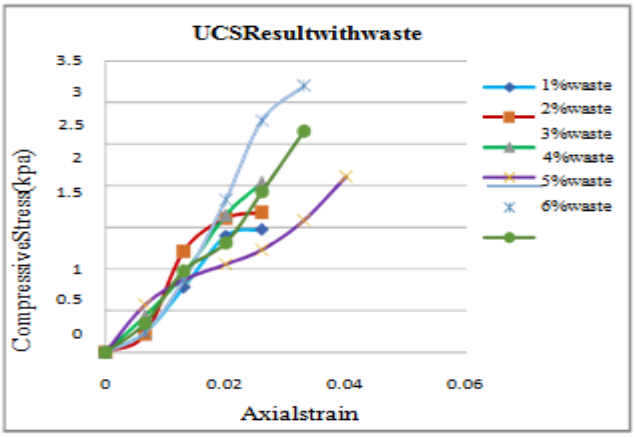

Fig4.2:UCS-0% waste

From the fig 4.2,it is clear that the maximum compressive stress is obtained in 5% waste.

Therefore 5 % is taken as optimum waste content. At 5% the soil shows maximum strength and improvement soil properties.

Comparison graph of compressive stress between 0% and 5% waste (optimum%) is plotted.

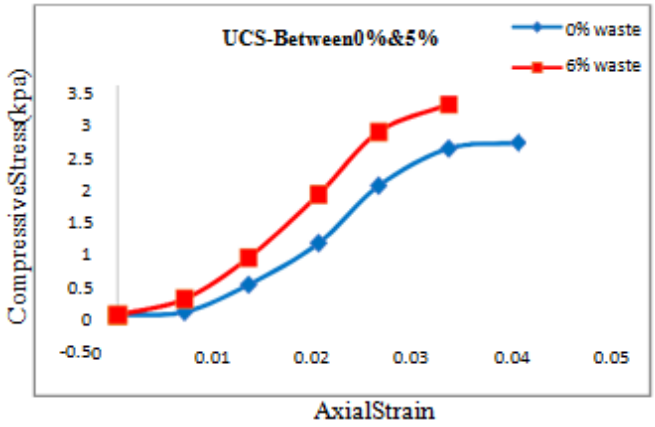

Fig4.3:UCS-0% waste

The fig 4.3 shows the Compressive stress between 0% waste and 5% waste.

And it is proven that when 5% waste added compressive stress increases.

Then the undrained shear strength for different % of waste with maximum compressive stress is calculated.

From fig 4.4 we can understand that maximum undrained shear strength is obtained for 5% waste that is 326kN/mm².

So by adding MBT waste the strength of soil increases.

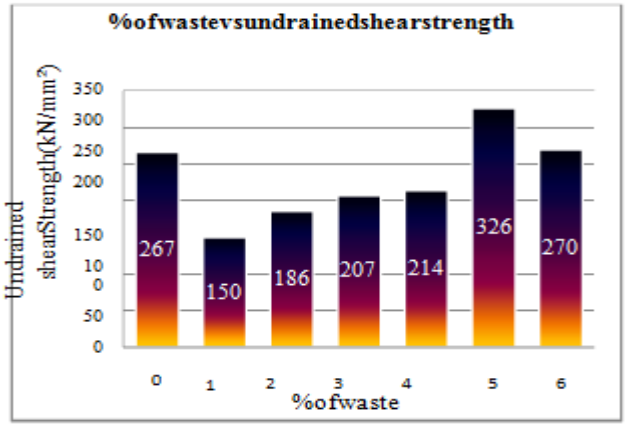

Fig4.4:% of waste vs maximum undrained shear strength.

V. CONCLUSIONS

In this study strength of soil with & without adding MBT waste is checked .According to the UCC results, Compressive strength of soil increases by adding MBT waste. Experimental study of soil stabilization with Municipal solid waste shows use of Municipal solid waste in 5% with soil enhances soil properties, strength. This study shows instead of having simply disposal of MSW, which is also not possible due to lack of land availability; we can improve soil properties by MBT waste. For different area's soil and different waste, we can have different Optimum percentage of waste which will enhance soil properties. Using waste as stabilizing material is cheap as well as eco-friendly method of soil stabilization, which solves the waste disposal problems as well as enhances soil properties.

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