International Research Journal in Global Engineering and Sciences. (IRJGES)
ISSN : 2456-172X | Vol. 4, No. 1, Mar. - May, 2019
Pages 40-45 | Cosmos Impact Factor (Germany): 5.195
Received: 06.03.2019 Published : 29.03.2019

SOIL STABILIZATION BY USING E-WASTE

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Abstract: Soil stabilization may be defined as the alteration of the properties of an existing soil to meet specified engineering requirements. The main properties that may required to be altered by stabilization are strength, volume stability, durability and permeability. Eventually, all the structure rest on soil foundation where the main objective is to increase the stability of soil and to reduce the construction cost. Now–a-days, the utilization of waste product with soil has gained attention due to the increasing problems of waste management. In India, 44.7 million ton of e-waste was generated as per 2016 survey. E-waste was generated at the rate of 2.2 million ton per year. Usually, e-waste should be managed by 5Rs approach. In our project, e-waste is reused as soil stabilizer. The soil sample was collected from Darasuram, Thanjavur District. This soil was classified as well graded soil from particle size distribution curve. Different dosage of e-waste i.e., 1%, 2% and 3% were used to stabilize the soil. The performance of e-waste stabilized soil was evaluated using index and strength properties tests namely: specific gravity, sieve analysis, liquid, plastic and shrinkage limit, standard proctor test and California Bearing Ratio. From the result, the CBR value is increased up to 2% beyond this percentage the value is decreased.

Keywords: E-waste, soil stabilization, SPC and CBR.

1. INTRODUCTION

Soil stabilization is the alteration of soils to enhance their physical properties. Stabilization can increase shear strength of soil and /or control the shrink–swell properties of a soil, thus improving the load bearing capacity of sub grade to support pavements and foundations. The main objective is to increase the strength of soil and to reduce the construction cost by using making best use of the locally available materials

Methods of stabilization may be grouped under two main two types:
(a) Modification or improvement of a soil property of the existing soil without any admixture

(b)) Modification of the properties with help of admixtures.

In our project soil sample is collected from Ammapet, Darasuram. The soil is classified as well graded soil i.e., it has good representation of particles of all sizes. E- waste is obtained from WPCB (Waste Printed Circuit Boards). The soil is stabilized by using e-waste at different percentages of 1%, 2% and 3%.Generation of solid waste and its safe disposal have become a challenging task for developing and developed countries. Among the solid waste, electronic waste (E-waste) shows an alarming growth. E-waste is nothing but waste consists of discarded electrical and electronic products. For the past few decades, the developed and developing countries totally ignored this waste. The major reasons are complexity of waste, lack of recycling infrastructure, recycling in informal sector, lack of awareness among people, and so forth. Now, the E-waste generation receives the attention of the developed countries but their way of recycling the E-waste is different; that is, they have started exporting this harm to developing countries. In developing countries, after recovering the precious metals and useful materials from the E-waste in informal manner, the waste is being disposed in land, water body, or in open incineration. Most of the developing nations have framed the laws to restrict the import of E-waste and recycling in informal manner but the rules are in print without spirit. Generally developing countries are used as waste dumper of e-waste from developed countries. In India, the rate of e-waste is 3.3 million ton per year at the end of 2018. It was expected that 52.2 million ton at 2020.

2. LABAROTORY TESTS

A. SPECIFIC GRAVITY
B.

It is conducted to determine the void ratio and degree of saturation.

TABLE I. Data and observation sheet for specific gravity

Material	**G**
Soil	2.273
E-waste	1.294

B. SIEVE ANALYSIS

It expresses quantitatively µproportion by mass of various sizes of particle present in the soil.
TABLE II. Data and observation sheet for sieve analysis of soil

S. No	Aperture size of sieve (mm)	Weight of soil retained(g)	% of weight retained	Cumulative % retained	% finer
1	4.75	512	51.2	51.2	48.8
3	1.18	140	14	79.5	20.5
4	0.6	75	7.5	87	13
5	0.425	44	4.4	91.4	8.6
6	0.3	18	1.8	93.2	6.8
7	0.15	44	4.4	97.6	2.4
8	0.09	10	1	98.6	1.4
9	0.075	0	0	98.6	1.4
10	Pan	4	0.6	99.2	0.8

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TABLE III.Data and observation sheet for sieve analysis of e-waste

S. No	Aperture size of sieve (mm)	Weight of soil retained(g)	% of weight retained	Cumulative % retained	% finer
1	25	0	0	0	100
2	20	4	0.4	0.4	99.6
3	12.5	20	2	2.4	97.6
4	10	70	7	9.4	90.6
5	6.3	668	66.8	76.2	23.8
6	4.75	28	2.8	79	21
7	Pan	206	20.6	99.6	0.4

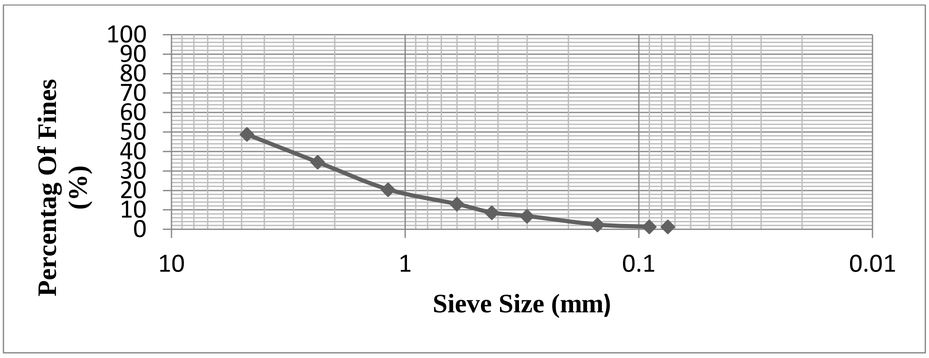

Fig. 1. Particle Size Distribution Curve of Soil

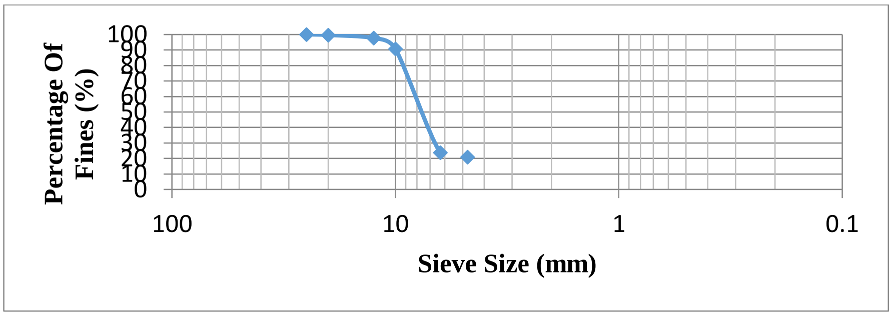

Fig. 2. Particle Size Distribution Curve of E-waste

1. The uniformity co-efficient of soil (C_u) = 14.67
2. The co-efficient of curvature of soil (C_c) = 1.25
3. The uniformity co-efficient of e-waste (C_u) = 19.13
4. The co-efficient of curvature of e-waste (C_c) = 0.99

C. ATTERBEG'S LIMIT:

It is conducted to determine the critical water content.

TABLE IV. Data and observation sheet for atterbeg's limit of soil

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Liquid limit W_L	38.5%
Flow index I_f	23.08
Plastic limit W_P	33.13%
Plasticity index I_P	5.33
Toughness index I_t	0.23
Shrinkage index	24.115%
Shrinkage ratio S_r	2.07
Volumetric shrinkage	47.36%

D. FIELD DENSITY:

Core cutter method is used to determine the field density. Permeability of soil depends on its unit weight.

The field bulk density of soil is 1.48g/cm^3
The field dry density of soil is 1.25g/cm^3

E. STANDARD PROCTOR COMPACTION:

Compaction is the process of densification of soil mass, by reducing air voids under dynamic loading. The degree of compaction of a soil is measured in terms of its dry density. The degree of compaction mainly depends upon its moisture content during compaction, compaction energy and the type of soil. For a given compaction energy, every soil attains the maximum dry density at a particular water content which is known as optimum moisture content (OMC)

a. Optimum moisture content = 6%
b. Maximum dry density = 1kN/m^3

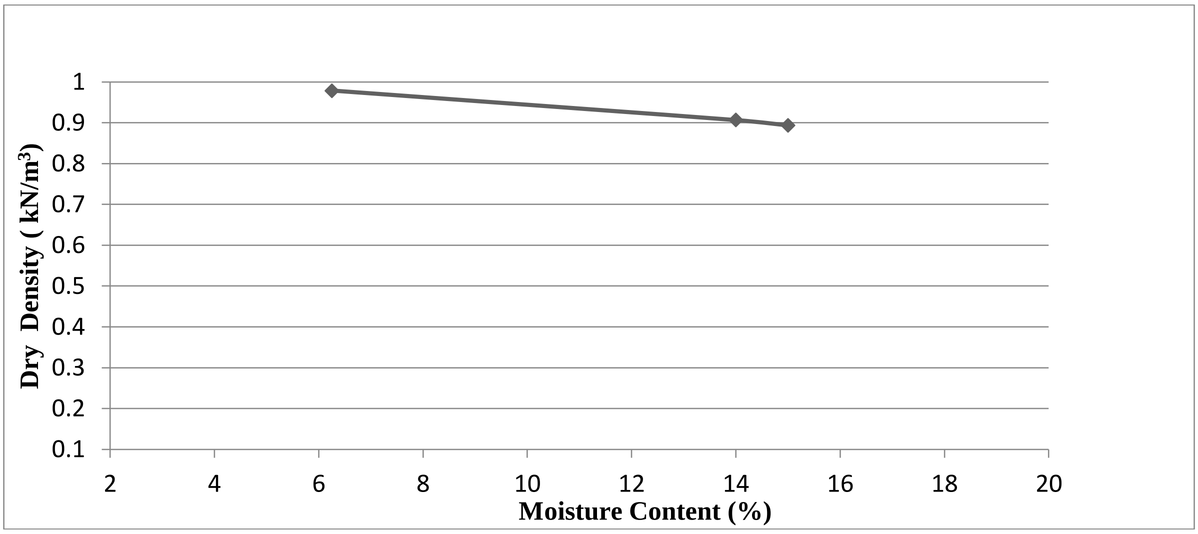

Fig. 3. OMC Vs MDD

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F. CALIFORNIA BEARING RATIO:

CBR test is penetration test meant for the evaluation of sub grade strength of roads and pavements.

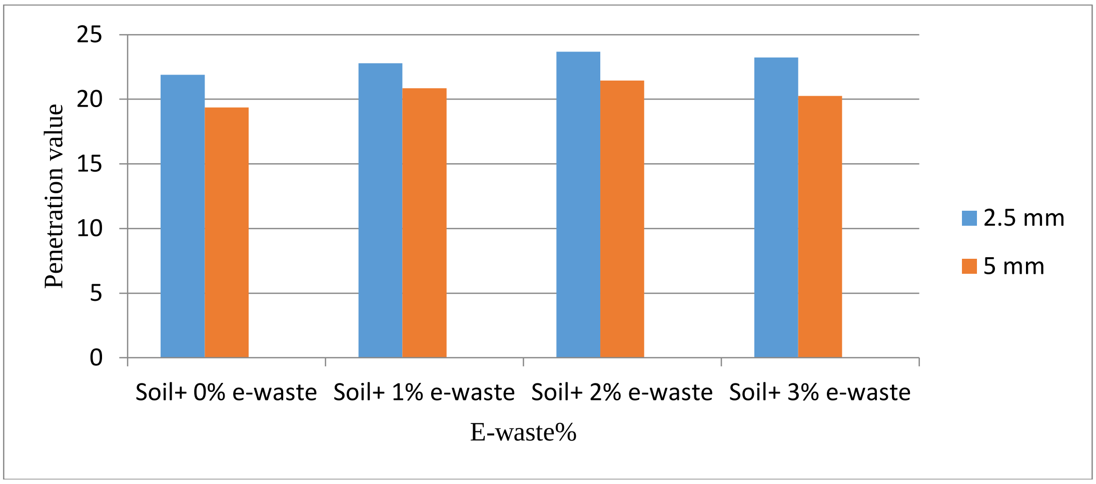

Fig. N. CBR Value

3. CONCLUSION

In this project soil stabilization can be done by using e-waste materials. By utilizing e-waste as a soil stabilizer, the waste generation can be reduced. It is observed that usage of e-waste has good performance on index as well as strength properties. Based on composition of waste materials in soil, strength can be achieved. From this project it is clear that e-waste is suitable for construction purpose. As disposal of waste is a major problem in the today's world due to limited landfill space as well as hazardous to human health by utilization of waste in various engineering applications, waste generation can be reduced. From our project, the following points are observed

1. E-waste is added at different dosage 1%, 2% and 3%.
2. The optimum value of e-waste is 2% for CBR value.
3. As CBR value is increased, the compressive strength will also be increased.
4. E-waste stabilized soil can be used in pavement for highways.
5. The durability property can be studied in our future project.
6. Thus, e-waste can be used as a construction material.

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