Industrial Engineering Journal
ISSN: 0970-2555
Volume : 54, Issue 8, No.1, August : 2025

STABILISATION OF EXPANSIVE SOIL WITH PLASTIC WASTE AND E-WASTE

S. Jyothirmayee Assistant Professor, Department of Civil Engineering, JNTUA College of Engineering Pulivendula, Anantapuramu.
P. Rajamohan Reddy Former UG Scholar, Department of Civil Engineering, JNTUA College of Engineering Pulivendula, Anantapuramu.
K. Lakshmi Mamatha Former UG Scholar, Department of Civil Engineering, JNTUA College of Engineering Pulivendula, Anantapuramu.
D. Vedavathi Former UG Scholar, Department of Civil Engineering, JNTUA College of Engineering Pulivendula, Anantapuramu.
U. Nagarjuna Former UG Scholar, Department of Civil Engineering, JNTUA College of Engineering Pulivendula, Anantapuramu.
B. Charan Kumar Former UG Scholar, Department of Civil Engineering, JNTUA College of Engineering Pulivendula, Anantapuramu.

ABSTRACT
Soil stabilization which ameliorates the properties of soil which can be done by adding some suitable alloys like cement, lime and waste materials such as fly ash, phosphogypsum, plastic etc. The price of these alloys has also gone up, which has considerably aided the development of various soil additives like plastics and e- waste in recent years. The cutting-edge soil stabilisation techniques can be actively employed to address societal concerns, reduce waste production, and produce valuable resources from non-useful waste. The use of plastics, including polythene materials, is expanding quickly and contributing to a number of environmental issues. As a result, the waste ejection which did not pose any environmental risks—has evolved into a genuine provocative act. Because there is a dearth of good quality soil for embankments, using trash as a soil stabiliser is therefore an economical solution.
Here, we tried to look into how the strength characteristics of expansive soil are affected due to plastic waste and electronic waste. On expansive soil containing varied amounts of plastic garbage and e-waste, tests for moisture-density relationships, unconfined compression strengths, and California Bearing Ratio (CBR) are performed. Lastly, we draw the conclusion that using plastic trash and e-waste in combination will weaken expanding soil to varying degrees.

Keywords:
Soil Stabilization, California Bearing Ratio (CBR), The Moisture-Density Relationship Test, Plastic and E- Waste, Unconfined Compressive Strength.

I. Introduction

In construction industry, the foundation of any structure need soil having good strength characteristics. The soil below any foundation should have sufficient strength to bear the loads acting on the structure. The Engineering properties of soil are very important in design of the foundation. The main function of soil is to support the foundation without causing failure. In developing countries like India, plastic is used in large scale. Use of plastic products suggest polythene covers, bottles, etc. is growing rapidly leading to environmental concerns. Therefore, decompose of the waste without threating any ecological problems has become a real demand.

The indiscriminate disposal of plastics on land and open-air burning can lead to the release of toxic chemicals into the air causing public health hazards. Plastic does not disintegrate and as a result, an economically practicable way to utilize these waste products is to go for construction pavements. Waste materials are also used in ground improvement techniques to enhance the geotechnical qualities of soil. Disposed plastic waste is essential since it causes various hazardous to the environment. Expansive soil has no enough stability in greater loads.

The aim of this study was to review on stabilization of soil using low-cost methods. The

stabilization of soil can be done by adding admixtures like lime, fly ash, sand dust, granite dust, Bagasse ash, rice husk ash, plastic waste or e-waste etc. Increased soil properties and improved engineering properties of in-situ soil are the primary goals of soil stabilisation. Making most use of materials that are readily available locally, soil stabilisation is also employed to lower the cost of building. Here we made an attempt to increase engineering expansive soil's qualities by incorporating plastic and electronic garbage.

II. Literature

Onkar Nath Mishra et al in 2020 investigated the behaviour of the soil with the addition E-waste. The black cotton soil was mixed with varying amounts of E-waste up to 8%, and the soil was tested. The findings indicated that soil characteristics rose up to a 5% rise in the e-waste dosage before decreasing as the e-waste dosage was increased further.

A.Iravanian And A B Haider in 2020 involves the research on using of waste plastic bottle fibres in soil stabilization reported that PET fibres increase the shear strength, bearing capacity, reduction in the cracks and swelling up to 5% of PET fibres.

Tarun Kumar in 2018 research reported that CBR and OMC values increases, and MDD values decreases with the increase in usage of plastic strips up to 1%.

Sk. Mehruddin et al in 2017 reported that OMC value decreases and CBR percentage increases up to 4% of plastic waste while mix up with soil and then it decreases while increase in plastic waste.

Karmacharya And Acharya in 2017 researched on a possible use of waste plastic bottles as soil reinforcement elements reported that an improvement in shear strength of the soil of different usage of plastic fibres 0.5% to 1.5%.

III. Materials and Methodology

3.1 Expansive Soil

A Type of soil with high swelling properties and whose characteristics can be changed based on water content. Expansive soil has low bearing capacity and low shear strength. Due to the presence of montmorillonite mineral, it undergoes swelling and shrinking frequently. This type of soil is not suitable for heavy structures. Expansive soil is highly clayey soil. The black colour is due to the presence of titanium oxide in small concentration. These types of soils are high in settlement and high in water observation.

3.2 E-Waste

Electronic waste or e- waste is a discarded piece of electronic devices. Used electronics which are destined for reuse, resale, salvage, recycling and disposal are also considered as E-Waste. In developing countries, E-Waste can lead to bad human health issues and environmental problems.

3.3 Plastic Waste

A type of waste which cannot be decomposed naturally. It takes nearly thousands of years to completely mix into the soil. The burning of these types of waste causes drastic damage to the environment which results in air pollution. Organic polymers such as polythene, PVC, Nylon, etc are used for manufacturing of plastic. Plastic can be mould into different shapes when it is soft and later it remains rigid when it cools.

IV. Methodology

In the preliminary phase of work, the laboratory test to be done to determine the properties include Atterberg limits. The standard Proctor test is to be done to find out the optimum moisture content needed for the Unconfined Compression Test (UCC) and for the California Bearing Ratio (CBR) test specimens.

In the next phase of work, the plastic waste is added to the soil such as 0%,2%,4%, 6% and 8% by the weight of soil and e-waste is added at a percentage of 0%,2%,4%,6% and 8%. Standard proctor tests, UCC tests, and CBR ratio tests were carried out on natural soil after partial replacement, while soil

mixed with e-waste and plastic refuse is compared by experimental work, with the results being analysed for an increase in effective strength.

Table:1 Index Properties of Expansive Soil

S.No.	Test Conducted	Test Value
1	Liquid Limit	74.89%
2	Plastic Limit	37.50%
3	Plasticity Index	37.39%
4	Specific Gravity	2.42
5	Standard Proctor Compaction Test(SPCT)	OMC =26.5% MDD =1.446g/cc
6	California Bearing Ratio (CBR)	C.B.R at 2.5 mm =4.9 C.B.R at 5 mm = 3.94
7	Unconfined Compressive Strength	UCS Value=0.153kg/cm^2 Shear strength value=0.079kg/cm^2

Table:2 Properties of Expansive Soil after addition of Admixtures

S.No.	Test Conducted	2%E-Waste & 2% Plastic Waste	4%E-Waste & 4% Plastic Waste	6%E-Waste & 6% Plastic Waste	8%E-Waste & 8% Plastic Waste
1	SPCT	OMC= 19.6% MDD=1.32g/cc	OMC=14.6% MDD =1.52g/cc	OMC=18.75% MDD=1.42g/cc	OMC= 38.89% MDD= 1.2g/cc
2	CBR	1.8	1.5	1.3	--
3	UCS	0.08kg/cm^2	0.07kg/cm^2	0.121kg/cm^2	--

COMPARISON GRAPHS FOR STANDARD PROCTOR TEST:

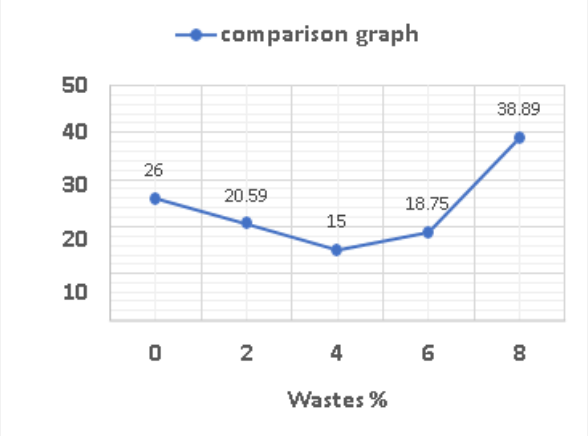

Fig: 1 Contrasting MDD with various % Wastes

VARIATION OF UCS OF SOIL WITH VARYINY PERCENTAGE OF PLASTIC AND E-WASTES

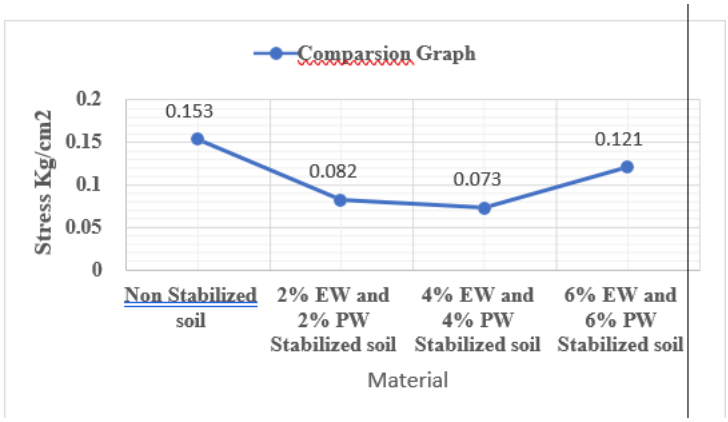

Fig: 2 Contrasting MDD with various % Wastes

VARIATION OF CBR OF SOIL WITH VARYING PERCENTAGE Of PLASTIC AND E-WASTES:

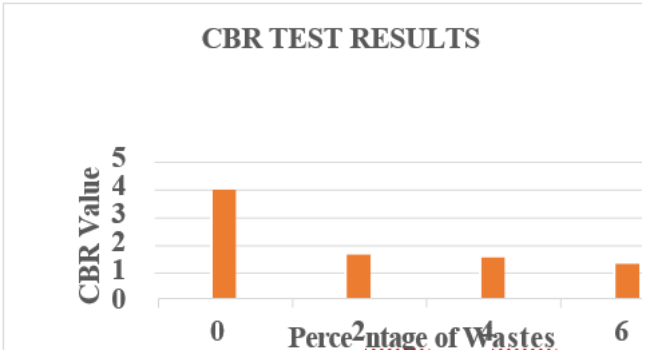

Fig: 4 Variation Of Cbr Of Soil

V. CONCLUSION:

- It is observed that OMC value decreases and MDD value increase with increase of plastic and E-waste
- The unconfined compressive strength of soil observed that gradually decreased compared to natural. So, we conclude that usage of plastic and E-waste combinedly will decrease the compressive strength of soil.
- The UCS is decreased by 20% compared to natural soil and CBR value is decreased by 73.46% compared to natural soil.
- From the above tests we concluded that the combine effect of waste and E-waste will decrease the OMC and increase the MDD up to certain percent.
- The bearing capacity and compressive strength of natural soil were decreased. So, we cannot use combinedly both the wastes.

REFERENCES:

[1] "Stabilization of Expansive soil using plastic waste" SK. Mehruddin, Dr. Srinivas, P.Ranga Ramesh IJRAR May 2017 : e-ISSN 2348-1269 | p-ISSN 2349-5138
[2] "Reinforcing effect of mixed plastic strips in soil" Tarun Kumar IRJET May 2018: e-ISSN: 2395-0056 | p-ISSN: 2395-0072
[3] "Improvement of Expansive soil Properties using E-Waste and Lime" Anket Ravindra Indole, Rasheed Ullah Khan, Sharique Ullah Khan, Suraj Hemant Oza, Umer Raza Hafizullah Khan Rizvee, Chetan Anilrao Yerawar IJRCT March 2018: ISSN: 2320-2882
[4] "Soil Stabilization using E-Waste" Onkar Nath Mishra, Vishal Singh, Dr. Bipin Prajapati IRJET Sep 2020: e-ISSN:2395-0056 | p- ISSN 2395-0072

[5] "Stabilization using Waste Plastic Materials" Rebecca Belay Kassa, Tenaw Workie, Alyu Abdela, Mikyas Fekade, Mubarek Saleh, Yonas Dejene Journal October 2020: ISSN: 2164-3172 | ISSN Print: 2164-3164
[6] "Use of Waste Plastic to Improve Geotechnical Properties of Soil" Vijay Kumar Patidar, Dr. Suneet Kaur June 2016: e-ISSN:2395- 0056 | p-ISSN: 2395-0072
[7] "Stabilization using Plastic Waste" S. S Lande, V.P.Urkude, O.S. Gaikwad, R.P. Borkar September 2020: ISSN:2320-2882
[8] "Soil Stabilization using Plastic Waste" K. D Mayee, V.D. Gawande, C.S.Humane, R.P Borkar August 2020: ISSN:2320-2882
[9] "Use of Plastic as Soil Stabilizer" Wasim Ahmad Rather, Suhail Ahmad Bhat January 2021: ISSN:2320-9364.