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Amendment of Sub-Grade Strength Using E-Waste and Rice Husk Ash

Zeeshan Ahmad[1], Ankit Verma[2]

M.Tech Scholar, Transportation Engineering, Babu Banarasi Das University, Lucknow, India
[2]Assistant Professor Department of Civil Engineering, Babu Banarasi Das University, Lucknow, India

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Abstract – *The Study aims to improve soil as a supporting material for Sub-Grade by utilizing waste products like E-Waste and Rice Husk Ash RHA. Due to its higher compressibility and poor bearing capacity, the accessible soil in various regions may not be acceptable as a building material and supporting material for substantial multi-story homes, highway structures, or as a filling material. Good soil cannot be substituted because it is pricey and raises project expenses. By enhancing the soil's characteristics that will be employed in infrastructure projects, this conundrum can be resolved. Numerous studies have been done on the utilization of waste materials to improve soil qualities and use waste resources more sustainably. Industrial trash, including E-waste and agricultural waste rice husk ash as soil stabilizers can offer affordable, long-lasting, and eco-friendly solutions for enhancing the soil.*

***Key Words*: Rice Husk Ash, E-Waste, Sub-grade Strength, Bearing Capacity, Stabilization.**

1. INTRODUCTION

Soil stabilization was recognized long before the Christian era and has been practiced for millennia. Many ancient cultures, like the Chinese, Romans, and Incas, used a variety of strategies to improve soil suitability, some of which were so strong that many of the buildings and streets they built are still standing and in use today. The sub grade is the natural soil layer beneath covering structures such as buildings and pavement, and it is critical for providing the foundation and support for the pavement structure.

Strengthening a sub grade entails increasing the engineering qualities of the soil to withstand the weight of overlying structures. The use of E-waste and Rice husk ash (RHA) as soil stabilisers is an environmentally responsible and inexpensive method of increasing the strength of the sub-grade.

The process of enhancing the qualities of the soil to withstand the weight of roads or other infrastructure is referred to as sub-grade strengthening. Soil can be thought of as an auxiliary element derived from a continuous geological cycle in nature. Compacted soil is utilised in a variety of geotechnical and engineering project.

2. LITERATURE REVIEWS

Subgrade Stabilization using Rice Husk Ash-based Geopolymer (GRHA) and Cement Kiln Dust (CKD) :Emmanuel Adeyanju, Chukwyeloka Austin Okeke,Isaac Akinwumi ,Ayobami Busari(2020) The goal of this study is to examine how two wastes—rice husk ash (RHA) and cement kiln dust can be used to improve a subgrade's mechanical strength. It provides experimental insight into soil stabilisation using CKD and CKD + RHA-based geopolymers.For activator reduction, CKD was used as a supplemental component to the RHA-based geopolymer.For CKD stabilisation, the stabilisers were blended with the soil in varied quantities ranging from 7.5 to 15%. Following that, the optimal percentage of CKD (4-10%) was mixed with RHA and activated with sodium hydroxide (Na-OH).

COMPARATIVE STUDY OF SOIL STABILIZATION WITH GLASS POWDER, PLASTIC AND E-WASTE : AMIT KUMAR RAI, GAURAV SINGH , ATUL KUMAR TIWARI (2020) Some soils in the Indian subcontinent have a relatively low California Bearing Ratio (CBR) and shear strength. Heavy loads cannot be supported by such soils. To address such issues, soil remediation is required. As a result, the found motion of buildings and sugared roadways may become unstable. As a result, we must search for novel additive materials, including modern wastes. This review study aims to offer two solutions: the first is a comparative analysis of contemporary wastes such as glass powder, plastic, and electronic waste in soil stabilisation, and second is a solution to the disposal problem of these wastes.

SOIL STABILIZATION USING E-WASTE: J.Kiran Kumar, Praveen Kumar (2019) This study provides an overview of soil stabilisation research and develops a platform for introducing waste materials to improve soil qualities, hence lowering the environmental impact of wastes. One such waste is electronic trash, and its use for soil stabilization has received little attention. This paper will serve as the foundation for achieving soil stabilization through the use of electronic waste sub grade soil.

IMPROVEMENT OF SUBGRADE SOIL CHARACTERISTICS BY UTILIZING LIME AND RICE HUSK ASH :Veeresh A.Salimath Farooq Ahmed Maniyar (2019) Obtaining a large amount of conventional components is necessary for the construction of Subgrade of avenue is turning out to be challenging in many areas due to remarkable challenges. Then, as a result of increased financial development and industrialization, a big quantity of waste substances generated need land for disposal, and so on. Generally causes issues with public fitness and the environment. Since want has evolved into the exchange of garbage. Materials. This study reveals the effect of siliceous compound convenient in shapeless shape in consumed rice. When different prices are merged with feeble soil, husk ash extends the high-quality properties of the subgrade soil.

IMPROVEMENT OF A SUB GRADE STRENGTH BY LIME & RICE HUSK: NAVEEN KUMAR,MR. S. S KAZAL(2015) The intention of this study is to improve expansive soil as a component of construction by utilising waste products as fly ash and rice husk ash (RHA).The goal of this study was to assess the influence of Fly Ash and Rice Husk Ash on soil performance. In this work, soil is treated with fly ash (5%, 10%, 15%, 20%, 25%) and rice husk ash (10%, 15%, 20%, 25%, 30%) and then cured for 28 days

3. OBJECTIVES

- Enhancing locally available soil utilizing low-cost waste products i.e.;

  E –WASTE and RICE HUSK ASH

- Evaluation of the strength characteristics of virgin and blended soils using varied ratios of E-WASTE and RICE HUSK ASH respectively.
- Determine the right soil,E WASTE and RICE HUSK ASH ratios to get the desired strength from the mixture.

4. METHODOLOGY

- Collection of material (Soil, E-waste material and RHA)
- Crushing of collected E-waste material in Crushing machine.
- Finding basic properties of Soil, E-waste material and RHA.
- Experimental work on soil,E-waste material and RHA.
- C.B.R on different proportion of E-Waste and RHA and virgin soil.

MATERIALS-The used materials are E-Waste and Rice Husk Ash.

E-Waste- Electronic garbage, e-scrap, and end-of-life electronics are all phrases used to describe worn electronics that have reached the end of their useful life and are discarded, donated, or delivered to a recycler.

Rice Husk Ash- Rice husk ash (RHA) RHA is a byproduct of burning rice husk at temperature 700 °C. The technique yields about 25% ash with 85% to 90% amorphous silica and around 5% alumina, making it very pozzolanic.

IS SIEVE (mm)	Mass Retained	Mass Retained (%)	Cumulative Mass Retained (%)	Finer (%) (100-cumula.M.R.)
4.75	0	0	0	100
2.36	40	4	4	96
1.18	40	4	8	92
0.6	30	3	11	89
0.425	34	3.4	14.4	85.6
0.3	100	10	24.4	75.6
0.15	570	57	81.4	18.6
0.075	64	6.4	87.4	12.2
PAN BASE	110	11	98.8	1.2

4.1 DETERMINATION OF SIEVE ANALYSIS OF SOIL

$Cc = D30^2 / D60*D10$ $= 2.0854$

$Cu = D60/D10$ $= 4.98233$

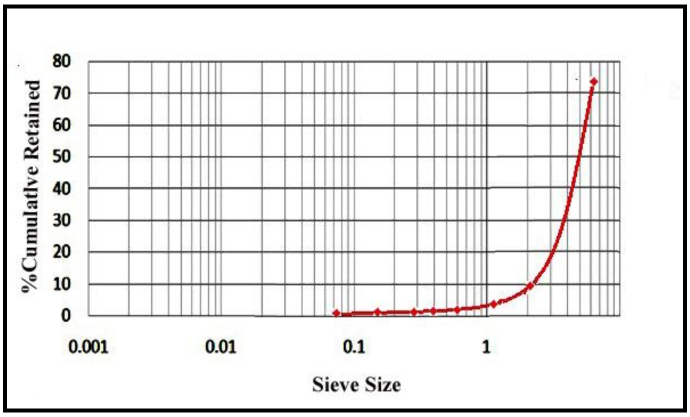
Hence it is poorly graded sand.

4.2 CRUSHING AND SIEVE ANALYSIS OF E-WASTE

Fig-1: E -WASTE BEFORE GRINDING E-WASTE AFTER GRINDING

Sieve Analysis test have been performed.

- Coefficient of uniformity(Cu)=4.02
- Coefficient of curvature(Cc)=2.1
- As mentioned in the following graph, It meets the Specified criteria of IS2720 Part 4.Hence it is well Graded.

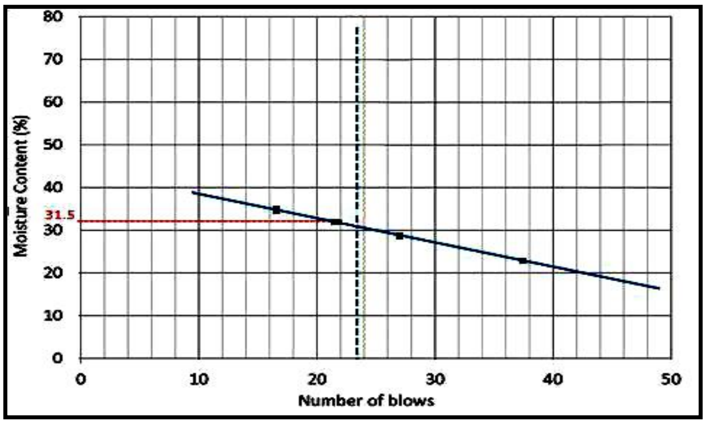


Graph-1:%Cumulative Retained Vs Sieve size for E-Waste

4.3DETERMINATION OF LIQUID LIMIT

Determination Number	1	2	3	4
Number of Blows	17	23	27	34
Container Number	I	II	III	IV
Weight of Container Wcg	20.18	21.37	24.28	20.42
Weight of Container Wet soil W1g	38.24	36.10	40.14	39.58
Weight of Container +Oven- dry Soil W2g	33.52	32.46	36.43	35.32
Weight of Water (W1-W2)g	4.72	3.64	3.71	4.26
Weight of Oven- dry soil (w2-Wc)g	13.34	11.09	12.15	14.90
Water Content $w = \frac{w1-w2}{W2-Wc} x\ 100\%$	35.38	32.82	30.52	28.59

Hence Liquid Limit=31.5%

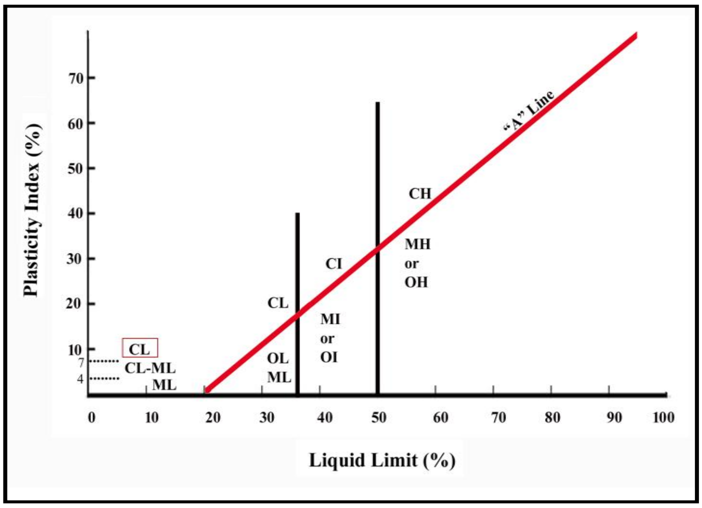


Graph-2:Liquid limit

4.4DETERMINATION OF PLASTIC LIMIT

Determination Number	1	2	3
Container Number	I	II	III
Weight of Container Wcg	26.10	21.36	23.91
Weight of Container Wet soil W1g	32.29	34.74	30.15
Weight of Container +Oven- dry Soil W2g	31.20	32.52	29.06
Weight of Water (W1-W2)g	1.09	2.23	1.09
Weight of Oven- dry soil (w2-Wc)g	5.10	10.65	5.15
Water Content $w = \frac{w1-w2}{W2-Wc} x\ 100\%$	21.37	20.94	21.17

Hence Plastic Limit=21.16%



Graph 3: Liquid Limit Vs Plasticity Index

4.5DETERMINATION OF MAXIMUM DRY DENSITY

Moisture Content (%)	Dry Weight of Mold+ Soil (g)	Dry Weight of Mold (g)	Moisture Content (g)	Dry Weight of Soil (g)	Dry Density (g/cm^3)
12	4200	2500	700	820	1.63
14	4220	2500	720	1720	1.65
16	4250	2500	750	1750	1.68
18	4280	2500	780	1780	1.71
20	4320	2500	820	1820	1.75

Hence,Maximum Dry Density=1.75

4.6DETERMINATION OF SPECIFIC GRAVITY OF SOIL

Sample ID	Mass of Dry Soil (g)	Mass of Pyrometers + Water+ (g)	Mass of Pycnometer +Water+ Soil (g)	Volume of Pycnometer + Water (mL)	Volume of Pycnometer + Water + Soil (mL)	Specific Gravity
1	23.45	87.23	106.67	50.00	63.22	2.14
2	18.69	75.32	93.56	50.00	63.27	2.00
3	21.84	81.49	1.3.01	50.00	63.59	2.06
4	22.13	83.62	105.31	50.00	63.59	2.09
5	19.76	77.12	96.88	50.00	63.31	2.03

Hence,Specific Gravity of soil=2.17

4.7DETERMINATION OF C.B.R WITH ADDITIVES AND WITHOUT

Sample ID	ADDITIVES type and amount	Maximum load (KN)	Penetration at maximum load (mm)	CBR value (%)
1	5% RHA + 5% E-waste	120	2.3	6.2
2	10% RHA + 5% E-waste	145	1.8	8.5
3	5% RHA + 10% E-waste	130	2.1	7.1
4	Soil	90	3.5	3.1

RESULT-

Hence, CBR is 8.5% with 10% of RHA and 5% of E-Waste.

CONCLUSION-

In brief, stabilizing expansive soil with Rice Husk Ash and E-Waste is a trustworthy choice because it enhances the geotechnical characteristics of the soil. According to the investigations, there has been a noticeable improvement in qualities. The production of electronic waste and rice husk ash, which are hazardous to the environment in the current global context, can be used as economical and environmental friendly stabilisers.Four separate soil samples, including one control sample and three with Rice husk ash and E-waste added were analyzed. 10% RHA + 5% E-waste on a load of 145KN and a penetration of 2.1mm gives maximum CBRof 8.5%. RHA and E-waste were present in variable degrees in the other two samples. The CBR values for the samples including Rice Husk Ash and E-waste were higher than those for samples containing only virgin soil, indicating that the additions strengthened the soil

REFERENCES

[1]Emmanuel Adeyanju, ChukwuelokaAustin Okeke, Isaac Akinwumi, Ayobami busari: Subgrade Stabilization using Rice Husk Ash-based Geopolymer (GRHA) and Cement Kiln Dust (CKD)2020.

[2] Naveen Kumar, Mr. S. S Kazal: Improvement of a Sub Grade Strength by Lime & Rice Husk 2015.

[3]Asif Farooq,Fayaz Mir: SUBGRADE STABILIZATIONUSING NON-BIODEGRADABLE WASTE MATERIAL 2020.

[4] Amit Kumar Rai, Gaurav Singh , Atul Kumar Tiwari: Comparative study of soil stabilization with glasspowder, plastic and e-waste 2020.

[5] J.Kiran Kumar, Praveen Kumar: Soil stabilization using E-waste 2019.

[6] Veeresh.A.Salimath,Farooq Ahmed Maniyar: Improvement of Subgrade Soil Characteristics by Utilizing Lime and Rice Husk Ash 2019.

[7] Arghadeep Biswas,Amar Dighade, Sabyasachi Biswas: Utilization of Rice Husk with Lime in Subgrade Soil for a Rural Road 2012.

[8]Anjani KumarYadav, Kumar Gaurav, Roop Kishor, S.K. S uman: Stabilization of alluvial soil for subgrade using rice husk ash, sugarcane bag asse ash and cow dung ash for rural roads 2017.

[9] Rebecca Belay Kassa,Tenaw Workiez,Alyu Abdela, Mikiyas Fekade, Mubarek Saleh, Yonas Dejene: Soil Stabilization Using Waste Plastic Materials 2020.

[10] Dr.K.Prabin, Anil Kumar: Study On Soil And Stabilization Using E-Waste 2022.