J. Soils and Crops 32 (1) 76-79, June 2022

ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)

STUDY ON SOIL STABLIZATION USING SODA - LIME AND COIR HUSK ASH IN KAREWA SOILS

Minsa Ali[1] and Ashish Kumar[2]

ABSTRACT

The present investigation was carried out on Karewa soils at National Highway NH-1A at lethpora bypass, Pulwama , J&K in the year 2021 with the aim to quantify the effect of soda- lime (waste) and coir husk ash on dry density, optimum moisture content, shear strength, liquid limit, plastic limit and plasticity index of the soil. The treatments consisted of five samples with soda-lime (0%, 2.5%, 5.0%, 7.5% and 9.0%) and five samples with coir husk ash (0%, 0.5%, 1.0%, 1.5% and 2.0%).The experiment was laid out with six replications. The optimum moisture content increased with the addition of both soda-lime and coir husk ash but was more prominent on addition of small percentages of coir husk ash. Maximum dry density decreased on increasing the percentages of both additives. The liquid limit, plastic limit and the plasticity index decreased with the addition of soda-lime, whereas plastic limit showed increment with the addition of coir husk ash. This result might be due to reduction in thickness of double layer as the electrolyte concentration increased in sample. The unconfined compressive strength showed a drastic increased with the addition of soda-lime. The study found that optimum percentage of soda-lime was 7.5% of dry soil and for coir husk it was 1.5% of dry soil. So, the waste materials with Karewa soils had significant effect on the strength of the soil. Reduction in liquid limit will tend to reduce the compressibility and swelling characteristics of the soil in turn improves the subgrade soil and reduces the failures on the slopes.

(Key words : Coir husk ash, soda-lime, Karewa soil samples and shear strength)

INTRODUCTION

The process of improving the properties of soil so that it can be used for a variety of purposes is known as soil stabilization. It can be done with or without the addition of any additives.The soda-lime waste and coir husk additives were selected because of the clayey nature of this soil. Also these are cost effective and environmentally friendly. The coir fiber addition on clayey soils has been reported as 0.5% optimum for clayey soils of Tamil Nadu region at which maximum improvement of strength was found (Subramani and Udayakumar, 2016).The soda-lime used in kaolinite soils decreased the permeability and found its suitability in drainage process (Amri *et al*., 2018).It is found these soils loose resilience properties with time. Major slope failures occur on these soils. Geotechnical engineers need to pay attention to surface drainage and particularly the shear strength in assessing the slope stability. It was reported CBR value increased to 22.5% for unsoaked condition and 10.4% for soaked condition at 10% of glass powder (Javed and Chakraborty 2020).So, these waste materials improve the shear strength of clayey soils and can help in reducing the damage due to failures. The main objective of the investigation was to analyze the optimum percentages of soda-lime and coir husk ash in Karewa soil by the investigation of different index and engineering characteristics of the soil.

MATERIALS AND METHODS

The Karewa soil used in the project work was taken from the National Highway NH-1A at Lethpora bypass . On visual inspection, the soil sample collected at depth of two meters from the natural ground surface. Various tests and analysis were done to see the effect of soda lime and coir husk ash on the Karewa Soil. Grain size distribution (IS: 460-1962) was done in which gravel (0), sand (8.4) and silt and clay (91.6) was found. Specific gravity of virgin soil was found as 2.68. Consistency of clay (Atterberg limits IS 2720-5, optimum moisture content, maximum dry density were determined by standard proctor test (IS-2720-PART-7-1980) as 16.80% and 1.79 g cc^{-1}. Unconfined Compressive strength test (IS-2720:1991) was found 172.69 kpa. Based on these tests, the optimum quantity of soda lime and coir husk ash required for effective stabilization of Karewa soil was determined. The experimental work of the project was done in two phases. In the initial phase, the basic tests of plain soil sample were done as per relevant IS codal provisions. In the second phase, the same tests were

1. M.Tech. Scholar,RIMT University Mandi Gobindgarh-147301, Punjab (INDIA)
2. Asstt.Professor of Civil Engineering ,RIMT University Mandi Gobindgarh-147301, Punjab (INDIA)

repeated on the addition of various percentages of soda-lime and coir husk ash and the deviations from the initial phase were noted and plotted on graphs. Coconut fibers were obtained locally and properly dried. Then the fibers were burnt at a temperature of 600^0C – 700^0C until the fibers turned into ash. The ash was then allowed to cool, collected and made to pass through the 150 micron sieve.

RESULTS AND DISCUSSION

In this chapter we studied the obtained results of the test which have been conducted on locally available Karewa soil (CI) stabilized using soda lime and coir husk ash are given below:

Soda-lime

The optimum moisture content increased from 21.30% to 26.90% with the addition of soda lime concentration. Increased in OMC implies the soil to be still workable and non sticky, so it can be compacted for water contents higher than that of OMC. (Javed and Chakraborty, ,2020). MDD decreased from 1.81 g cc^{-1} in normal soils to 1.62 g cc^{-1}. Decrease in MDD will prove beneficial in soil retaining structures because of reduced lateral earth pressures. The optimum dosage of soda-lime in Karewa soils was at a concentration of 7.5% of dry soil.The Unconfined compressive strength increased with the increase in soda-lime concentration .It increased the value from 1.671 kpa in normal soils to 2.970 kpa at 7.5% soda-lime concentration. The UCS value then decreased with the further addition of soda-lime to 9% to 2.051 kpa. In kaolinite soils shear strength parameters increased similarly by increasing the bearing capacity of soil. (Amri *et al*., 2018). The liquid limit, plastic limit and the plasticity index decreased with the addition of soda-lime. The liquid limit decreased from 35.86% to 21.20% with the addition of soda-lime from 2.5% to 9.0%. The plastic limit decreased from 21.58% to 14.40% and the plasticity index decreased from 14.28% to 6.8% respectively. Similar decrease was found by Javed and Chakraborty (2020) at 10% glass powder.

Coir husk ash

The different percentages of coir husk ash i.e., 0.5%, 1.05, 1.5% and 2.0% were added to the Karewa soils. The addition of coir husk ash increased OMC from 16.87% in normal soils to 27.20% with the addition of coir husk ash and the dry density decreased from 1.81 g cc^{-1} to 1.66 g cc^{-1}. The reason behind such behavior might be due to Coir fiber being light in weight and it has high water absorbing properties because of the presence of calcium oxide. So, OMC increased with the increase in the content of coir husk ash (Deepakraja and Charumol, 2015). The unconfined compressive strength value increased with the addition of coir husk ash. The maximum value of UCS was found at 1.5% of coir husk ash in Karewa soils. It increased the value from 1.671 kpa in normal soils to 2.609 kpa at 1.5%. It then again got decreased to 2.051 kpa with the further addition of coir husk ash to 2.0%. Thus, showing the optimum at 1.5%.The addition of 1.5% fibers increased the CBR value by 85% in expansive soils as reported by (Deepakraja and Charumol, 2015). In montmorillonite soils similar increase in CBR was found by (Maurya *et al*., 2015).The liquid limit decreased from 35.86% to 27.66% with the replacement of soil with coir husk ash from 0.5% to 2.0%. The plastic limit increased from 21.58% to 24.80% with the addition of coir husk ash. The plasticity index again got decreased from 14.28% to 2.86% respectively.

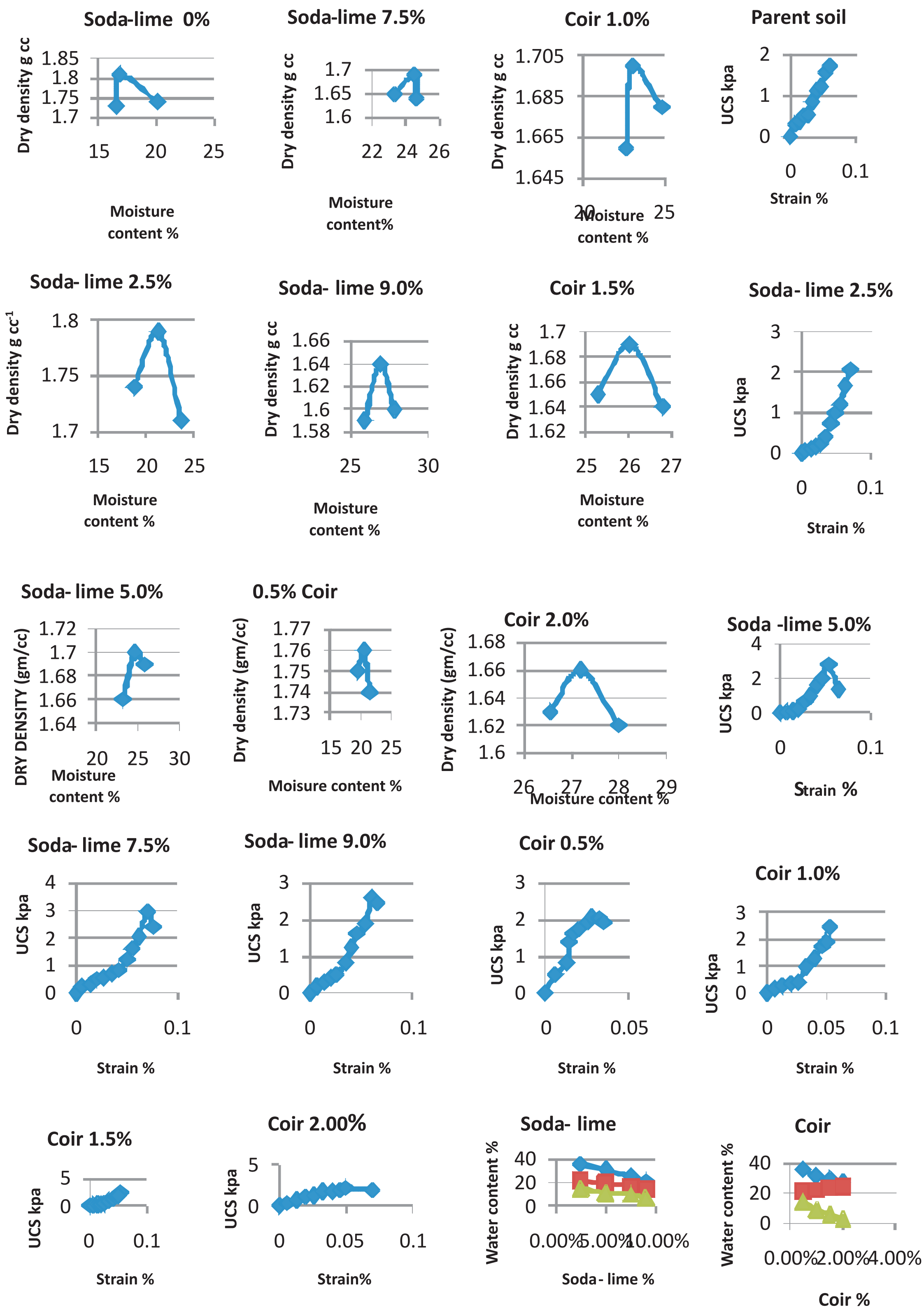
Many of the engineering properties of soils can be enhanced by addition of soda-lime and coir husk ash. The properties of such soil-soda lime and soil-coir husk ash mixtures vary and depend upon the type of soil as well as the concentration of soda-lime and coir husk respectively. In this study, a series of experiments were performed on Karewa soils through variation of parameters, based upon which the following conclusions were drawn:

The optimum moisture content increased and the maximum dry density decreased with the increased percentage of soda-lime content and coir husk ash in Karewa soil samples.The unconfined compressive strength increased with the increase in soda-lime concentration with the optimum at 7.5% of dry soil. The unconfined compressive strength value increased with the addition of coir husk ash with the optimum at 1.5% of dry soil. The liquid limit, plastic limit and the plasticity index decreased with the addition of soda-lime. This result is obtained due to reduction in thickness of double layer as the electrolyte concentration increased in the pore fluid. The plastic limit got increased but the liquid limit and plasticity index decreased with the addition of coir husk ash. The Karewa soil is of CI character as evident from the results of liquid limit and plastic limit .The compaction characteristics of Karewa soils vary significantly at low soda lime content. The maximum dry density decreased with the increase in soda-lime content.

The further scope of study is to find out the variation in resilient modulus of soil by the addition of waste materials. Also, further studies can be conducted to characterize the static and dynamic energy absorption capacities by cyclic loading tests.

Table 1. Effect of additives in different percentages on omc, mdd and ucs

	Soda lime					Coir husk ash				
	S_0	$S_{2.5}$	$S_{5.0}$	$S_{7.5}$	$S_{9.0}$	S_0	$S_{0.50}$	$S_{1.0}$	$S_{1.5}$	$S_{2.0}$
OMC	16.87	21.30	24.63	26.90	24.51	16.87	23.00	23.00	26.03	27.20
MDD	1.81	1.79	1.70	1.64	1.69	1.81	1.76	1.70	1.69	1.66
UCS	1.722	2.073	2.82	2.970	2.61	1.722	1.92	2.05	2.47	2.21
LL	36.86	35.86	30.80	25.56	21.20	38.86	35.86	31.58	29.90	27.66
PL	23.58	21.58	19.58	16.50	14.40	23.58	21.58	22.60	24.00	24.80
PI	15.28	14.28	11.22	10.06	6.80	15.28	14.28	8.98	5.90	2.86


Soda-lime 0%
Dry density g cc
Moisture content %
Soda-lime 7.5%
Dry density g cc
Moisture content%
Coir 1.0%
Dry density g cc
Moisture content %
Parent soil
UCS kpa
Strain %
Soda- lime 2.5%
Dry density g cc-1
Moisture content %
Soda- lime 9.0%
Dry density g cc
Moisture content %
Coir 1.5%
Dry density g cc
Moisture content %
Soda- lime 2.5%
UCS kpa
Strain %
Soda- lime 5.0%
DRY DENSITY (gm/cc)
Moisture content %
0.5% Coir
Dry density (gm/cc)
Moisure content %
Coir 2.0%
Dry density (gm/cc)
Moisture content %
Soda -lime 5.0%
UCS kpa
Strain %
Soda- lime 7.5%
UCS kpa
Strain %
Soda- lime 9.0%
UCS kpa
Strain %
Coir 0.5%
UCS kpa
Strain %
Coir 1.0%
UCS kpa
Strain %
Coir 1.5%
UCS kpa
Strain %
Coir 2.00%
UCS kpa
Strain%
Soda- lime
Water content %
Soda- lime %
Coir
Water content %
Coir %

REFERENCES

Amri,Shi To, Ramli Nazir and Ali Dehghanbanadaki, 2018. Experimental study of geotechnical characteristics of crushed glass mixed with kaolinite soil. Int. J. Geomate. **45**(14): 170-176.

Chaple, A., M. Parag and Dhatrak, 2010.Performance of coir fiber reinforced clayey soil. Int. J. engr. and Sci.**4** (3): 54-64.

Deepakraja, S. and T.G. Charumol, 2015.Study on soil stablization using cement and coir fiber. Int. J Sci. and Res. **6** (2): 1285-1289.

Javed, Syed Aaqib and Sudipta Chakraborty, 2020.Effect of waste Glass Powder and subgrade soil improvement. Int. SDci. J. **3**(4): 30-42.

Kharade Amit and S. Suryavanshi ,2014. Waste product bagasse ash from sugar industry can be used as stablized material in expansive soils. Int. J. Res. in Engr. and Tech. **3**(3): 124-128.

Disfani, M.M. , A. Arulrajah and V. Suthagaran, 2009. Geotechnical characteristics of recycled glass-biosolid mixtures. Int. J. Soil Mech. and Geotech. Engr. **2**(7): 201-204.

Maurya, Stuti, A.K. Sharma and P.K Jain, 2015. Review on stablization of soil using coir fiber. Int. J. Engr. Res. **4** (6): 296-298.

Polito, Carmine, 2001.Plasticity based on liquifaction criteria. Int. C. Rec. adv. in Geotech. Engr. and Soil Dyn. **3** (3) :1.33-1.35.

Sharma, Ram Prasad, 2010 .Soil improvements techniques for mitigation of seismic hazards.Int. C recent adv. in Geotech . Engr. and Soil Dynamics. Missouri: Scholars mine, **3** (3) : 1065-1072.

Subramani,T. and D. Udayakumar,2016.Experimental study on stablization of clay soil using coir fiber. Int. J. Inno. in engr. and Mngmt. **5** (5): 192-203.

Tiwari ,Amit and H.K.Mahiyar, 2014. Experimental study on stablization of black cotton soils by Flyash, cocnut coir fiber and crushed glass. Int. J. Engr .Tech. and Adv. Engr. **4**(11): 102-107.

Wah, Al., G.B. Heckel , 1995. Static and Dynamic strength properties of a Fibre-reinforced compacted cohesive soil. Int.C.recent adv. in Geotech. earthquake engr and soil dynamics. Missouri: Scholars Mine **5** (3) : 1065-1072.

Rec. on 01.10.2021 & Acc. on 16.10.2021