Journal of Civil Engineering and Environmental Technology
Print ISSN: 2349-8404; Online ISSN: 2349-879X; Volume 2, Number 4; April-June, 2015 pp. 335-338

http://www.krishisanskriti.org/jceet.html

# Influence of Jute Fibres on the Unconfined and Compressive Strength of Alkaline Soil

**Vinayak Kaushal**

*Final Year Student, Department of Civil Engineering Jawaharlal Nehru Government Engineering College Sundernagar, District Mandi, Himachal Pradesh, India*
*E-mail: vinayakkaushal4449@gmail.com*

**Abstract—***The present study aims to investigate the influence of the addition of jute fibres on the unconfined and compressive strength of alkaline soil sample derived from a local landslide prone area (seismic zone IV). The white jute fibres varied from 1% to 3% proportion by weight of soil were added and various geotechnical tests including grain size analysis, specific gravity, atterberg's limits and standard proctor compaction test were performed to find out the geotechnical characteristics of soil. Further, unconfined and compressive strength (UCS) test was performed on the soil sample to determine the strength characteristics. Further, regression analysis was performed to predict the relationship between the value of axial stresses and strains. The results of the study reveals that unconfined and compressive strength of the soil mix increases with the inclusion of jute fibres and the increase was highest with the inclusion of 3% jute fibres in the soil mix. Potential use of the jute fibres can be done by the site engineers to improve the strength characteristics of soil which could be used in the subbase to decrease the thickness of pavements and to predict the value of stresses and strains by the inclusion of jute fibres in the poorly graded alkaline soil specimen.*

## 1. INTRODUCTION

The term soil stabilization means those techniques which helps to improve the index properties of soils. Soil Stabilization has become a matter of great concern in the civil construction or in the agricultural activities due to the fact that growth of infrastructure is taking place at massive rate. Generally stabilization phenomenon is required to be done on those soils which have low shearing and compressive strength and also such soils are highly compressible and have very low bearing capacity. It becomes very difficult to work with such soils. In other words, these soils are prone to landslides and other natural calamities. Therefore, it becomes necessary to incorporate some techniques so as to stabilize such soils and bring them under proper use for which jute fibres play an important role. The present study envisages the influence of jute fibres (1% to 3%)by weight on unconfined and compressive strength of alkaline soil and to predict the value of stresses and strains by the inclusion of jute fibres.

## 2. LITERATURE

Roslee et.al. concluded in their studies that the slope failures took place when slope materials no longer able to resist the force of gravity and thus decreased the shear strength and increased the shear stress resulting slope failures, which was due to internal and external factors. Further, external factors involved increase of shear stress on slopes, which usually involved a form of disturbance that was induced by man includes removal of vegetation cover, vehicles loading and artificial changes or natural phenomenon. [1].Dash and Sahu (2011) focused on the impact of mining activities on air, water, land, soil quality, vegetation including forest ecosystems, and on human health and habitation. Further, it was observed that magnitude and significance of impact on the environment depends upon the mineral being mined and mining practice, and the potential of the environment to absorb the negative impacts[2].Bhaghanmarndi (2011) aimed at study of stability of slopes using numerical modeling, at the same time study the different failure mechanism and concluded that slope angle plays a major role on slope stability[3]Harushige et al. (2004) aimed to establish new criteria to qualify the seismic stability of slopes in a reinforcement design and a new conventional method was developed to calculate the shear strain of a reinforced slope based on principle of virtual work[4]. Kainthola et al. concluded in their study that increased depth of mines pose serious problem to the stability of mines slope due to variation in rock mass as well as mining method adopted. Further it was seen that the study mainly focused on the numerical examination of a failed black cotton soil bench.[5].Mali and Singh (2014) focused on effect of soil properties due to inclusion of fibres when it was observed that stress- strain behavior of soil improved by incorporating coir fibres in the silty soil. Further, it was also observed that deviator stress increased upto 3.5 times over plain soil. When tyre rubber Fibres were used, the optimum Fibre length was10 mm and the optimum Fibre content was 2% [6]. Prabakara and Sridhar

(2002) found that sisal Fibres reduced the dry density of the soil and the increase in the Fibre length and Fibre content also reduced the dry density of the soil. Further, it was found that the shear stress was increased non-linearly with increase in length of Fibre up to 20 mm and beyond, where an increase in length reduced the shear stress.[7]

## 3. MATERIAL USED

### 3.1.Jute Fibres

White Jute Fibres were procured from Burdwan District of West Bengal,Indiahaving length between 0.05-0.19 inch,20-22µ thickness, specific gravity of 1.48-1.50 and specific heat 0.324 Cal/g/$^{o}$C

### 3.2. Soil

Soil sample used in the study was procured from the local landslide prone area which falls in seismic zone IV and the unwanted materials were removed so that they would not affect the properties of soil.

## 4. EXPERIMENTAL SETUP AND TESTS

Various geotechnical testswere performed as per Indian Standard Codes as shown in Table 1 which includes(i) grain size analysis,(ii) specific gravity(iii) atterberg's limits (iv) standard proctor compaction (v) pH value test.Further, Unconfined Compressive Strength (UCS) Test was performed in order to determine the unconfined compressive strength of soil samplewhich is then used to calculate unconsolidated undrained shear strength under unconfined conditions.

**Table 1: Indian Standard Codes Used**

| Sr. No. | Tests Performed | IS Code Followed |
|---|---|---|
| 1. | Grain Size Analysis | IS 2720 Part IV (1985) |
| 2. | Atterberg's Limit Test | IS 2720 Part V(1985) |
| 3. | Specific Gravity | IS 2720 Part III (1980) |
| 4. | Standard Proctor Compaction Test | IS 2720-29 (1975) |
| 5. | Classification and Identification of Soils for General Engineering Purposes | IS 1498-1970 |

### 4.1 Preparation of sample

After knowing the geotechnical properties of soil sample taken for investigation, soil sample weighing 300g was taken and optimum water content was added for making soil paste. The inside of split sampler was provided with oil or grease so as to ease in removing of the sample after compaction. Then prepared soil sample was taken in split sampler as shown in Fig. 1and compact it with the help of hydraulic extractor in three layers. Then sample from split sampler was removed carefully. The resulting specimen was cylindrical as shown in Fig. 2in shape. After preparation of cylindrical sample from hydraulic extractor, it was taken for UCS test. Before starting the test, the proving ring and dial gauge was set to zero. Then UCS machine as shown in Fig. 3 was started. When proving ring started touching the specimen, dial gauge and proving ring showed deflections.The readings were noted until they started going back. From these readings the unconfined shear strength of specimen was calculated.

**Fig. 1: Split Sampler**

**Fig. 2: Prepared soil sample**

## 5. OBSERVATIONS AND RESULTS

### 5.1 Geotechnical Properties

Table 2 shows the experimental values of the geotechnical properties of an soil sample procured from a landslide prone area which comes under sesimic zone IV.The results reveal that the soil under investigation was poorly graded sand.

**Table 2: Results of Geotechnical Properties of Soil Sample.**

| Sr. No. | Soil Properties | Soil Sample |
|---|---|---|
| 1.(a) | Medium Sand(%) | 25.875 |
| (b) | Fine Sand(%) | 15.75 |
| (c) | Silt(%) | 58.25 |
| (d) | Clay(%) | 0.125 |
| 2. | Specific Gravity(G) | 2.24 |
| 3 | Liquid Limit (%) | 16.22 |
| 4. | Plastic Limit (%) | 13.20 |
| 5. | Plasticity Index (%) | 2.92 |

| | | |
|---|---|---|
| 6. | Optimum Moisture Content (%) | 8.52 |
| 7. | Maximum Dry Density (g/cc) | 0.248 |
| 8. | pH | 10.22 |

### 5.2 Soil sample mixed with Different Proportions of Jute Fibres

Table 3 shows that by the inclusion of Jute fibres,there was change in the values of axial stresses and strains.It also reveals that as the percentage of jute fibres goes on increasing from (0%-3%) there was increase in the value of axial stresses,but value of axial strain first increases and then decreases.For example,when 0% of jute was added to the soilspecimen, the value of axial stress and strain was observed to be 136248.9 Pa and 1.101% but when the percentage of jute was increased to 1% the value of axial stress and strain was found to be 409843.3 Pa and 1.286% axial strain. Further, by the inclusion of 2% Jute Fibres value of axial stress and strain was observed to be 660521.2 Pa and 0.4494%.Fig. 4 reveals that with the increase of jute percentage the unconfined compressive strength of soil specimen increases.

**Table 3: Comparison of stresses and strains due to Addition of Different % of Fibres**

| % of Fibres | Stress(Pa) | Strain(%) |
|---|---|---|
| 0 | 136248.9 | 1.101 |
| 1 | 409843.3 | 1.286 |
| 2 | 660521.2 | 0.4494 |
| 3 | 960440.5 | 0.308 |

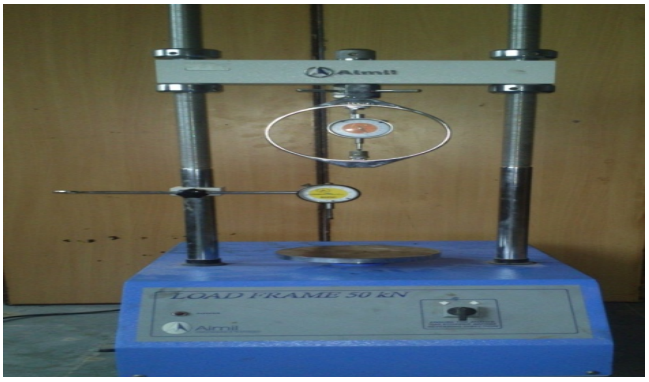


**Fig. 3:** U.C.S. Test Apparatus

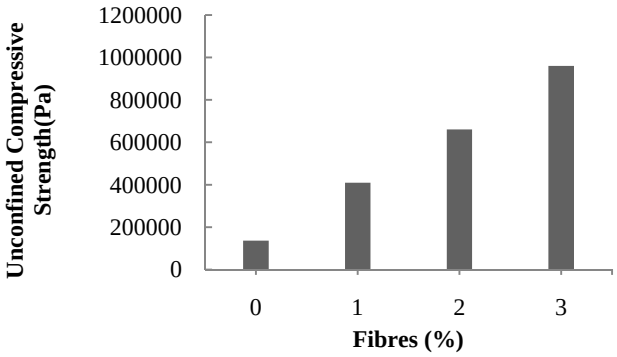


**Fig. 4: Comparison of UCS with the addition of Fibres (%)**

## 6. REGRESSION ANALYSIS

Regression Analysis has been done with the help of DATAFIT9 to enable the site engineers or analyzers find out the values of Axial Stress (Pa) and Axial Strain (%) directly of Soil Specimen mixed with different percentage of jute fibres.

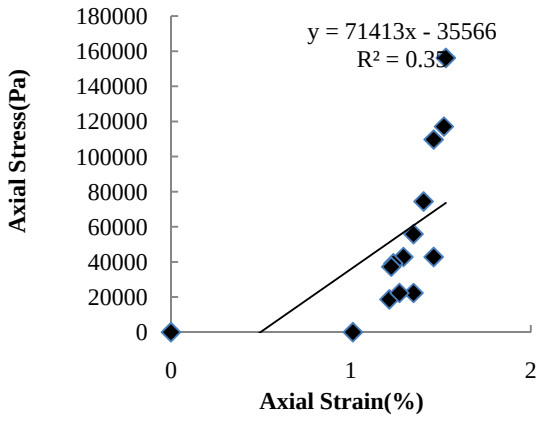


**Fig. 5: Soil sample mixed with 0 % fibres**

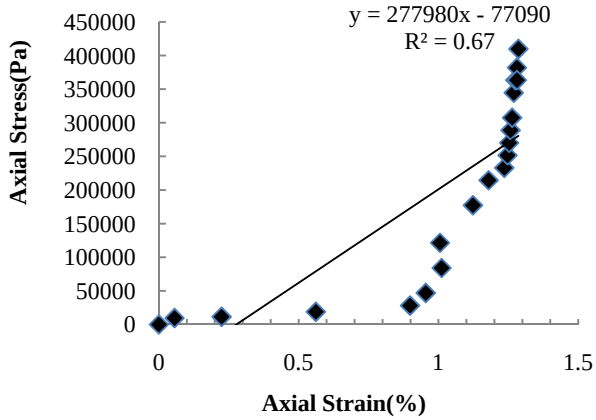


**Fig. 6: Soil sample mixed with 1 % of fibres**

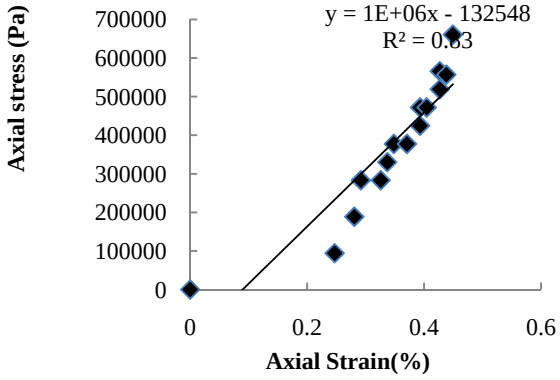


**Fig. 7: Soil Sample mixed with 2 % of fibres**

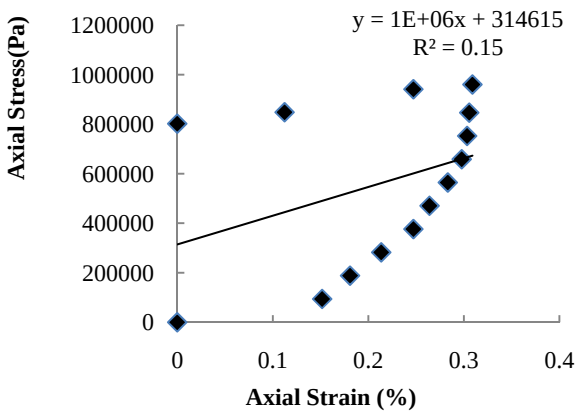


**Fig. 8: Soil Sample mixed with 3 % of fibres**

## 7. SUMMARY

Various geotechnical tests as per Indian Standard Codes were performed to find out the geotechnical characteristics of soil derived from the local landslide prone area(seismic zone IV) which includes grain size analysis,specific gravity,atterberg's limits,standard proctor compaction and pH value test. Further, Unconfined Compressive Strength (UCS) Test was performed in order to determine the unconfined compressive strength of soil sample mixed with white jute fibres procured from the burdwan district in West Bengal in different proportions by weight. Maximum value of unconfined compressive strength was observed on the inclusion of 3% of jute fibres.Regression analysis was done with the help of DATAFIT9 to enable the site engineers or analyzers find out the values of Axial Stress (Pa) and Axial Strain (%) directly of Soil Specimen mixed with different percentage of jute fibres.

## 8. CONCLUSION

It can be concluded that by the addition of naturally occurring white jute fibres in the constructional use, there was increase in the unconfined compressive strength to improve engineering properties of the subbase and to decrease the thickness of pavements. Further, poorly graded alkaline soil can be brought into constructional use by the addition of jute fibres which enhance the durability of construction. Study also reveals that naturally occurring white jute had excellent inherent properties in it because of which it was brought into use directly without any chemical treatment and which also encouraged not to use any synthetic polymer which are non eco friendly in nature.

## 9. ACKNOWLEDGEMENT

Author is thankful to the Director, Prof .L.K. Awasthi,Head,Civil Engineering Department, Dr.S.P. Guleria, Assistant Professor, Textile Engineering Department,Er. Vivek Sharma and the Administration of Jawaharlal Nehru Government Engineering College Sundernagar, Himachal Pradesh,India for every support.

## REFERENCES

[1] Rosleeet.al. "Survey of Slope Failures (SFS) along the BunduTuhanKundasang Highway, Sabah, Malaysia"
[2] Dash and Sahu (2011). "Land Degradation due to Mining in India and its Mitigation Measure", International Conference on Environmental Science and Technology, Vol.6
[3] Bhaghanmarndi (2011). "Stability of Slopes in Iron Ore Mines", Department of Mining Engineering, National Institute of Technology Rourkela-769008 2011".
[4] Harushige et al. (2004)."Seismic stability of reinforced slopes", Paper No. 3267.
[5] Kainthola et al. "Computional Analysis for the Stability of Black cotton soil Bench in an open cast coal mine in Wardha Valley coal field ,Maharashtra", International journal econ. Geo. Vol. 2(1) 11-18"
[6] Mali and Singh(2014). "Strength behaviour of cohesive soils reinforced with fibres", International Journal of Civil Engineering Research ISSN 2278-3652 Vol. 5,Number 4.
[7] Prabakara, J., Sridhar, R., (2002) "Effect of random inclusion of sisal fibres on strength of soil", Construct Build Mater 16:123-131.