International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 03 | Mar 2019 www.irjet.net p-ISSN: 2395-0072

SOIL STABILIZATION BY USING JUTE FIBRE

Sunil[1], Akash batra[2], Pappu Sharma[3] , Sohan lal[4]

[1]Student, Dept. Of Civil engineering, Indus Institute of Engg. and Tech., Kinana, Haryana, India
[2]Assistant Professor, Dept. Of Civil engineering, Indus Institute of Engg. and Tech., Kinana, Haryana, India
[3]Assistant Professor, Dept. Of Civil engineering, Indus Institute of Engg. and Tech., Kinana, Haryana, India
[4]Assistant Professor, Dept. Of Civil engineering, Indus Institute of Engg. and Tech., Kinana, Haryana, India

---

Abstract - *The main focus of this research was to improve the engineering properties of soil by using jute fibre treating with the sand. Jute fibre is treated with the sand to enhance the engineering properties in case of pavement and earthen slopes.*

The aim of the present investigation is to determine the jute geo textile as soil reinforcement or soil stabilizer. This analysis discusses the potential of fine sand stabilization with jute is cut into approximately 20mm lengths as admixture.

Present work has been taken up by addition of 20mm jute pieces as admixture. The varying percentage 0.25%, 0.50%, 0.75%, 1% of jute pieces of jute geo-textile were mixed with fine sand of different densities and moisture content. All the Unconfined Compressive Strength Tests were conducted at different mix compositions of square pieces of plastic waste and fine sand of different dry densities as arrived from Standard Proctor Test.

On the basis of the experiments performed, it is determined that the stabilization of fine sand using 20mm pieces of jute as admixture improves the strength characteristics of the fine sand so that it becomes usable as construction of embankment.

Key Words: **Jute Fibre, Soil Stabilizer, Unconfined Compressive Strength, SPT**

1. INTRODUCTION

Soil being the cheapest and readily available construction material, has been Popular with the civil Engineers, even though it being poor properties. It has been the constant endeavor of research workers to put forth innovative ideas to improve its mechanical properties to suit the requirements of engineering students.

Various soil improvement methods have been suggested in the past, by means of which matrix of soil can be modified by physically or chemically binding the soil particles together in such a way as to increase the overall performance of the soil. The various methods for improvement and strengthening of soil are given below:-

- Lime Stabilization
- Cement Stabilization
- Chemical Stabilization
- Soil- Fly ash stabilization
- Mechanical soil stabilization
- Soil-bitumen stabilization
- Complex stabilization
- Electrical stabilization
- Stabilization by Geo-textile and Fibre
- Reinforced Earth
- Stabilization by grouting
- Stabilization using jute fibre

1.1 Objectives of Study

- The objective of study is to increase the strength of soil by using jute fibre. Experimental studies are carried out to understand the strength behavior of soil mixed with different ratios of jute fibre by weight in terms of UCS and CBR value.
- The CBR value and UCS value is find to be increase when soil is added with different ratios of jute fibre.
- The objective of the present work is to arrive the optimum percentages of waste materials that may be effectively utilized as admixtures in locally available soils to get an improved quality of composite material to be used in highways and other soil structures.
- The improvement in CBR and UCS of sub-grade material will result in lower thickness of pavement and at the same time gainful use of waste material is achieved.

1.2 Future Scope of Study

In view of this, in the present study, an attempt is made to study how jute may be effectively utilized in combination with locally available soils to get an improved quality of composite material which may be used in highways and other soil structures. The scope of work is limited to laboratory investigations of the soil collected from industrial area, Ludhiana. The study deals with the testing of soil properties of soil sample. The soil is mixed with jute fibre and the strength enhancement in terms of UCS and CBR of the soil is studied. Present work can improve the strength parameter of soil and hence effectively reduce the thickness of pavement of using jute fibre, reducing environmental hazard and on the other hand solve the problems related to low strength or satisfactory soils to some extent while improving the strength

2. REVIEW OF LITERATURE

The analysis, design and construction of roads have undergone remarkable changes in the past three decades. The increased demand for complex roadway alignments advances in construction technology and availability of computers for design of pavements are some of the developments that have taken place in the recent past over the years, a number of methods of analysis of pavement design have been evolved. The present work gives a brief review of the various types of pavement for soil stabilization.

2.1 Review of Past Works

Savastano et al. (2000) used waste jute fibre as reinforcement for cement-based composites in construction work instead of concrete. For studying, the effect of coconut fibre on expansive soil, the coconut fibre was added from 0.25% to 1% at an increment of 0.25%.These tests were conducted on expansive soils and the soil containing the jute fibre as per IS code: Compaction characteristics, Soaked California Bearing Ratio Test, Un-soaked California Bearing Ratio.

Kumar et al.(2001) Based on the present investigation it is concluded that CBR value of soil increases with the inclusion of Jute fibre. When the Jute fibre content is increases, the CBR value of soil is further increases and this increase is substantial up to fibre content of 5 %.

Hamid et al. (2002) The CBR values of plain soil and soil reinforced with different combinations of jute fibre determined in the laboratory are shown in figure 7. Based on the present investigation, it is concluded that CBR value of soil increases with the inclusion of jute fibre. When the jute fibre content is increased, the CBR value of soil further increases and this increase is remarkable at fibre content of 0.75%. It is also concluded that there is significant effects of length of fibre on the CBR value of soil. The CBR value of soil also increases with the increase in length of fibre.

3. MATERIAL AND METHODS

The main objective of test program is to study the strength characteristics of soil with replacement of jute fibre. The main parameters that are studied include U.C.S and C.B.R. To carry out this, the equipment's used are tested soil, experimental procedure adopted and the parameter studied have been elaborated in this chapter.

3.1 MATERIAL USED

- **Soil:** In the present experimental investigation, the soil sample was taken from industrial area, Ludhiana for this experimental programme. The load carrying capacity of the selected soil is very low. The soil sample was collected from a depth of 60 cm after removing the top surface soil from natural ground surface
- **Jute:** The jute fibre used was procured from the local market. The diameter of the jute fibre used was 2mm. These fibre were cut in the lengths of 30mm, 60mm and 90mm for conducting our research. Jute fibre are generally available in the threaded form. These are mechanically woven fibre with very fine threads.
- **Water:** The water should be neat, clean and without any suspended material.

3.2 PROPERTIES OF SOIL

The physical properties of soil as determined in laboratory by conducting different types of tests. According to Indian standard of soil classification, the soil was classified as clay soil of low compressibility and other properties of soil are given below in the table:

Table -1: Properties of Soil

S.No	Properties of soil	Laboratory
1	Atterberg Limits (%) Liquid Limit Plastic Limit Plasticity Index	 22.4 15.6 6.8
2	Indian Standard Classification	CL(clay of Low Compressibility)
3	Modified Proctor Test Results Maximum Dry Density Optimum Moisture Content (OMC) in %	 2.04 11.8

3.3 DIFFERENT TEST

The following are the various tests performed for the present study:

- Sieve analysis
- Liquid Limit test
- Plastic Limit test.
- Optimum Moisture Content (OMC) and Maximum Dry Density (MDD) by Modified Proctor test.
- California Bearing Ratio (CBR) test in soaked and un-soaked conditions.
- Unconfined compressive strength test.

3.3.1 Sieve Analysis of soil

Soil sample for grain size analysis are prepared as per standard method I.S. 2720 (1) and the grain size analysis is done as per standard procedure of I.S. 2720 (4). The percentage of soil retained on each sieve is obtained, therefore the percentage finer than each sieve is calculated.
Dry sieving through 75 micron is difficult, so washing of the material retained on 75 micron sieve is done. The soil retained on the sieve after washing is dried and sieved again. This gave accurate determination of soil retained on 75 micron, sieve. The results are given in chapter 4.

3.3.2 Liquid Limit

The fraction of soil passing through I.S. 425 micron is used for the test. The tentative procedure I.S. 2720 (5) is followed for the testing of the soils. The water content of the sample should be steadily and gradually increased for better results and sufficient points for curve. A plot of water content percentage versus number of blows (on log scale) called flow curve should be obtained. The water content against 25 nos. of blows on the flow curve is liquid limit.

3.3.3 Plastic Limit

The portion of the soil passing through I.S. 425 micron is used in the test. The moisture content at which soil has the smallest plasticity is called plastic limit. Just after plastic limit the soil displays the properties of a semi solid. For determination purpose, the plastic limit is defined as the water content at which a soil will just begin to crumble when rolled into a thread of 3mm in diameter. The difference in moisture content or interval between the liquid and plastic limit is termed the plasticity index.

4. RESULTS AND DISCUSSIONS

In these results soil is added with different weights of jute. The main parameters that are studied include compressive strength and C.B.R. Jute increases the U.C.S and C.B.R values in this investigation. The experimental results are carried in the laboratory.

4.1 GRAIN SIZE DISTRIBUTION

Soil sample as received from the field shall be dried in the air or in sun. In wet weather a drying apparatus may be used in which case the temperature of the sample should not exceed 60° C. The clods may be broken with a wooden-mallet to hasten drying. The organic matter, like tree roots and pieces of bark should be removed from the sample. Similarly, matter other than soil, like shells should also be separated from the main soil mass. A noting shall be made of such removals and their percentage of the total soil sample noted.

Table -2: Grain Size Distribution of Soil

S. No.	Sieve (mm)	Wt. of retain Soil (gm)	Retain %	Cumulative retained %	% Finer
1	4.75	0	0	0	100
2	2.36	2.0	2.75	2.75	97.25
3	1.18	1.4	4.8	7.55	92.45
4	0.6	1.65	6.1	13.65	86.35
5	0.425	2.73	9.05	22.7	77.3
6	0.075	59	70.1	92.8	7.2
7	0.063	76	7.2	100	0

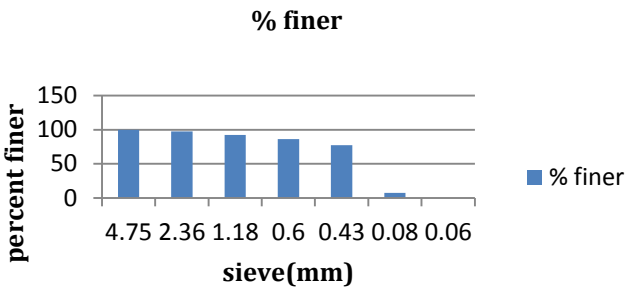

Fig -1: Graph of Grain Size Distribution of Soil

4.2 ATTERBERG LIMITS

By consistency is meant the relative ease with which soil can be deformed. This term is mostly used for fine grained soils for which the consistency is related to a large extent to water content. Consistency denotes degree of firmness of the soil which may termed as soft, firm , stiff or hard . In 1911atterAtterberg divided the entire range from liquid to solid state into four stages liquid state, plastic state, semi - solid state and solidstate. Thus the consistency limits are the water contents at which the soil mass passes from one state to the next.

4.2.1 LIQUID LIMIT
LIQUID LIMIT FOR SOIL

Table -3: Liquid limit for soil

No. of Blows	Water content %
12	22
16	25

25	21.2
30	20
38	19

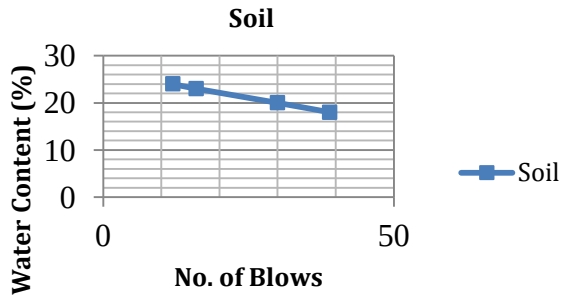

Fig. -2: No. of blows v/s water content

Liquid limit of soil on 25 blows = 21.2%

4.2.2 PLASTIC LIMIT

Plastic limit (W_P): Plastic limit is the water content corresponding to an arbitrary limit between the plastic and the semi-solid states of consistency of a soil. It is defined as the minimum water content at which a soil will just begin to crumble when rolled into a thread approximately 2.75mm to 3mm in dia. Three samples of soil of 15g were taken from the field for determination of plastic limit and the results are as follows:

Table -4: Plastic Limit Determination

Water Content (%)	Diameter of thread (mm)
14.3	2.75
15.1	2.79
15.5	2.84

Plasticity Index=Liquid Limit– Plastic Limit =21.2%-14.3% = 6.9%
Plasticity Index=Liquid Limit– Plastic Limit=21.2% - 15.1% = 6.1%
Plasticity Index=Liquid Limit– Plastic Limit =21.2% - 15.5% = 5.7%
Then from plasticity chart (A-line chart)the soil is classified.

5. CONCLUSIONS AND SCOPE FOR FURTER STUDY

On the basis of investigations the following conclusions and recommendations have been drawn:

- It is concluded from the test results that the CBR values of clay soil increases considerably up to 1% jute fibre.
- The Stress-Strain behavior of sub-grade soil under static load conditions improved considerably, when1% jute was mixed with soil by weight.
- The California Bearing Ratio and Unconfined Compressive Strength increases by providing the Jute mix.
- It is concluded from the results that strength of native soil is better than soil-jute fibre mix.

Scope for further study:

- The study was confined to clay soil of low compressibility. Further study can be carried out for other groups of clay and other types of reinforcement.
- The further study can be made on properties of soil such that cohesion, angle of internal friction for the suitability of soil for other purposes.
- The present work has been performed in the laboratory can be correlated to the field work.
- A variety of geo-synthetic materials are available and their best suitability for a particular type of soil can be ascertained by conducting further research. The study can be done on coarse grained soils with geo-synthetic materials.

REFERENCES

[1] Aggarwal,P. and Sharma, B. (2010), Application of Jute Fibre in the Improvement of Sub-grade Characteristics (SP), ACE 2010, Paper ID-41.
[2] Chandra,S., Viladkar, M.N. and Nagrrale, P.P. (2008), Mechanistic Approach for fibre reinforced flexible pavements Journals of Transportation Engineering ,Vol. 134,15-23Akinci, A. (2009), Mechanical and morphological properties of basalt filled polymer matrix composites, *Science Journal*, 35, 29-32.
[3] Pooja,H.D. (1995), Probabilistic analysis of randomly distributed fibre soil. Ph.D. Dissertation, Dept. of Civil Engg. I.I.T Roorkee, Roorkee, India
[4] Fatani, N.M., Bauer, G.H. and Al-Joulani, N.(1999) . Reinforcing soil with aligned and randomly oriented metallic, Journal of ASTM Geo-tech Testing (1), pp 78-87.
[5] Gray, D.H. and Ohashi, H. (1983), Mechanics of fibre reinforcing in sand, Journal of Geotechnical Engineering ,ASCE 112(8):335-353.
[6] Gray, D.H. and Al-Refeai, T.(1986), Behaviour of fabric-versus fibre-reinforced sand, Journal of Geotechnical Engineering, ASCE, 112(8): 804-820.
[7] Gosavi, M., Patil, K.A, Mittal, S. and Saran, S. (2004). Improvements ofproperties of black cotton soil sub-grade through synthetic reinforcement, Journal of Institution of Engineers (India), 84,257-262.
[8] IS: 2720, Part XVI, 1965, Laboratory determination of CBR, Bureau of Indian Standards; New Delhi.
[9] IS: 2720, Part VII, 1965, Determination of Moisture content –Dry density Relation using Light Compaction, Bureau of Indian Standards; New Delhi.
[10] Lawton,E.C. Khire, M.V. and Fox, N.S. (1993). Reinforcement of soils by multi-oriented geo-synthetic