Effect of Jute Fibres on Engineering Properties of Lime Treated Black Cotton Soil

Harshita Bairagi[1], R. K.Yadav[2], R. Jain[3]
[1] *M.E. Student, Civil Engg. Deptt., Jabalpur Engineering College, Jabalpur, India.*
[2] *Associate Professor, Civil Engg. Deptt., Jabalpur Engineering College, Jabalpur, India*
[3] *Associate Professor, Civil Engg. Deptt., Jabalpur Engineering College, Jabalpur, India*

***Abstract*-- Expansive soil are those soil, which have high swelling and shrinkage characteristics and CBR value and shear strength. Hence, there is need for improvement of these properties. At present construction is managed by using granular or lime stabilized soils. The concept of reinforcing soil masses with natural fibres like coir fibre, banana fibre, sisal fibre etc. is a relatively new development to improve the properties of soil. The use of natural and artificial fibres is a suitable method for homogeneous soil reinforcing. The present study attempts to investigate the effect of Jute fibres on engineering and strength properties of lime treated black cotton soil. The properties of stabilized soil such as shrinkage limit, unconfined compressive strength and California bearing ratio were evaluated and their variations with content of jute fibres are evaluated. Soil samples containing 0%, 1%, 2% to 5% of jute fibre were prepared and index properties were evaluated as per relevant IS code of practise.The test results showed significant decrease in the expansive behaviour of the black cotton soil. The shrinkage limit increases from 13.75% to 28.68% if black cotton soil is mixed with 5% lime and jute fibres from 0% to 5% by weight of black cotton soil. There is significant increase in California bearing ratio and unconfined compressive strength.**

Keywords: black cotton soil, stabilization, jute fibres, index properties.

I. INTRODUCTION

Innovative methods of soil stabilization are in great demand all over the world. The term soil stabilisation is used for the techniques which improve the index properties and other engineering characteristic of expansive soils. In India expansive soil cover about $0.8x10^6$ km^2 area which is approximately one-fifth of its surface area. This soils cover about 51.8 million hectares of the land area. They are predominant in the states of Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra and in parts of Tamil Nadu and Uttar Pradesh. These soils contain montmorillonite mineral; due to this they swell and shrink excessively when they are wet and dry state. Such tendency of soil is due to the presence of fine clay particles which swell, when they come in contact with water, resulting in alternate swelling and shrinking of soil due to which differential settlement of structure takes place. Expansive soils can be stabilised by the addition of a small percentage, by weight, of lime, that is, it enhances many of the engineering properties of the soil. This produces an improved construction material and so the technique has been used for many construction purposes, notably in highway, railroad and airport construction to improve subgrades and sub-bases.

II. EXPERIMENTAL PROGRAMME

The black cotton soil used in the present investigation was collected from Bilheri area of Jabalpur. The properties of Black Cotton Soil are as under
Fines (-75µ) = 88.73%
Specific Gravity = 2.6
Liquid limit = 51.75%
Plastic Limit = 24.85
Plasticity Index = 16.9%
Shrinkage Limit = 8.66
Differential Free Swell = 66.04%
Optimum water Content = 22.1%
Maximum Dry Density = 1.61 g/cc
California Bearing Ratio = 1.8

In the present study jute thread is collected from grain market Jabalpur. The length of the jute thread is 5cms uniformly selected.

The black cotton soil was mixed with 5% lime and soaked for a period of 4 days. After oven drying the lime and soil mixture was again mixed with different percentage of jute thread. The mix specifications are as under
(a) CL0F0 - Clay with 0% lime and 0% jute fibres.
(a) CL5F0 - Clay with 5% lime and 0% jute fibres.
(b) CL5F1 - Clay with 5% lime and 1% jute fibres.
(c) CL5F2 - Clay with 5% lime and 2% jute fibres.
(d) CL5F3 - Clay with 5% lime and 3% jute fibres
(e) CL5F4 - Clay with 5% lime and 4% jute fibres
(f) CL5F5 - Clay with 5% lime and 5% jute fibres

The consistency limits (liquid limit and plastic limit) tests were conducted as per IS: 2720 the differential free swell tests were also conducted as per IS 2720 (Part XL) 1977.

Test Performed	CL 5F0	CL5 F1	CL 5F2	CL 5F3	CL 5F4	CL5 F5
1..Liquid Limit(%)	40.05					
2. Plastic limit(%)	22.95					
3. Shrinkage limit(%)	13.75	16.34	19.63	23.08	26.44	28.68
4.Plasticity Index(%)	17.395					
5. Differential free swell(%)	10.86					
6.Modified procter test						
(a)OMC(%)	16.20	16.9	17.5	18.2	18.8	19.6
(b)MDD(g/cc)	1.68	1.67	1.65	1.63	1.61	1.58
7.C.B.R.(%)	3.10	3.27	3.72	4.18	4.60	4.95
8.Unconfiend compression test(Kg/cm^2)	1.18	1.24	1.29	1.38	1.46	1.54

III. RESULTS AND DISCUSSION

The test results are summarized in Table 1.

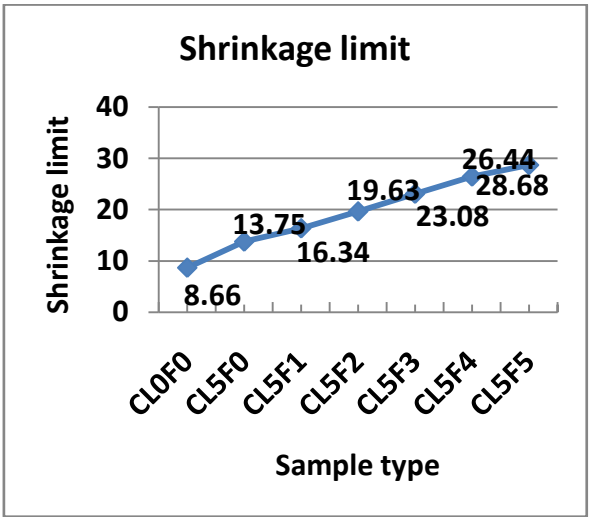

Fig 1 – Variation of shrinkage limit

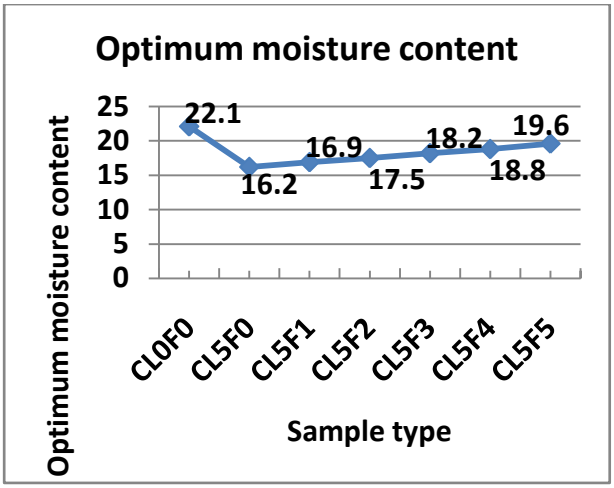

Fig. 2 –Variation in optimum moisture content

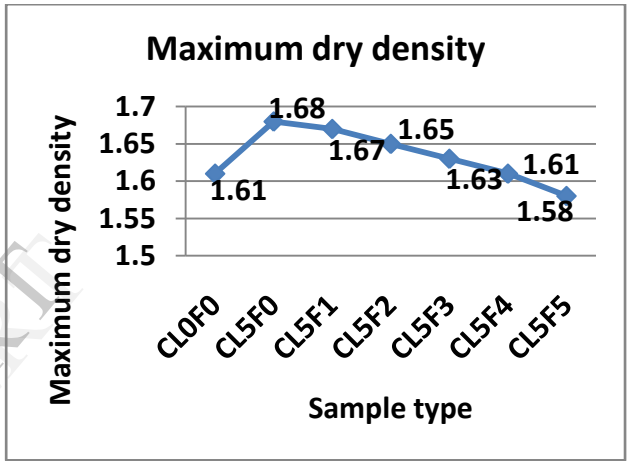

Fig. 3 – Variation in maximum dry density

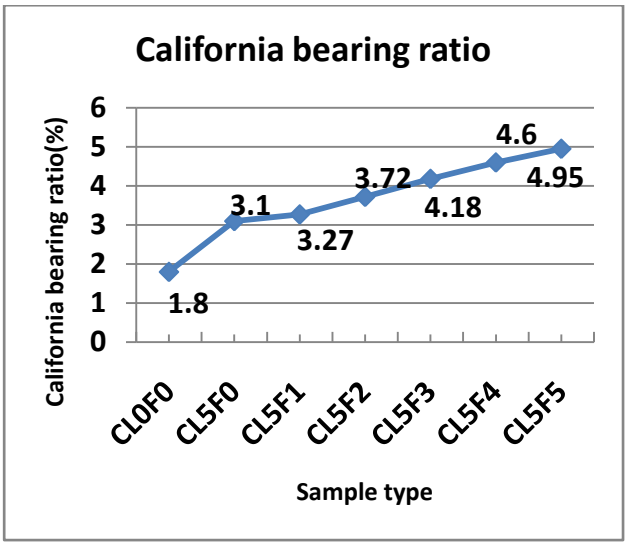

Fig. 4 – Variation in C.B.R. value

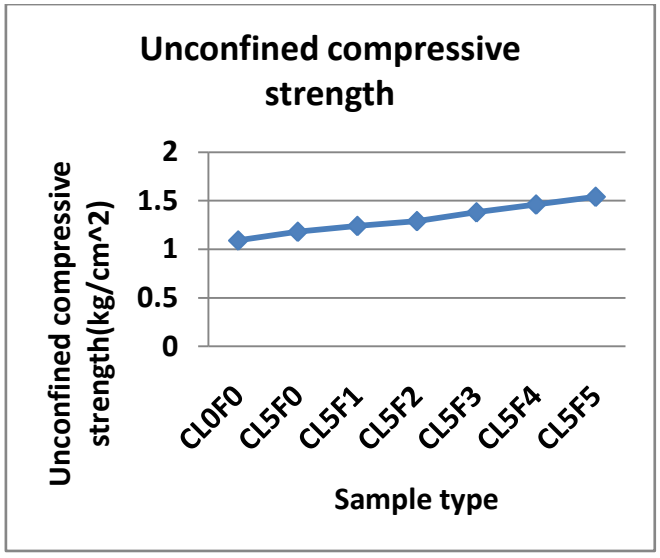

Fig. 5 – Variation of Unconfined compressive strengh

IV. CONCLUSIONS

From the series of tests conducted on black cotton soil mixed with lime and jute fibres, the following conclusions are drawn :

1. The shrinkage limit values increases from 13.75% to 28.68% with increase in the jute fibres percentage (fig.1).
2. The Optimum moisture content values increases from 16.20 to 19.60.The Maximum dry density are also decreased from 1.68 to 1.58(fig.2 & fig.3).
3. There is significant increase in California bearing ratio and unconfined compressive strength values. The C.B.R. increases from 3.10% to 4.95% and unconfined compressive strength from 1.09 kg/cm^2 to 1.35 kg/cm^2. The variation is presented in figure 4 and 5.
4. From the test results it can be concluded that the addition of jute fibres to lime stabilized BC soil decreases its swelling behaviour and increase the C.B.R. and unconfined compressive strength properties.

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