"STUDY OF CHARACTERISTICS OF SOIL TO IMPROVE CBR WITH LIME AND RECRON 3S FIBRE"

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ABSTRACT : "Soil forms the base of all structures & and is responsible for taking up the loads ultimately.Hence the strength & stability of soil affects the structure which is built on it.In case of road pavements subgrade plays an important role.Subgrade soil is an integral part of the road pavement structure as it provides the support to the pavement from beneath.The subgrade soil and its characteristics are important in the design of pavement structure.The main function of the subgrade is to give adequate support to the pavement and for this the subgrade should possess sufficient stability under adverse climate and loading conditions. The formation of waves,corrugations,rutting and shoving in black top pavements and the phenomena of pumping,blowing and consequent cracking of cement concrete pavements are generally attributed due to the poor subgrade conditions.When soil is used in embankment construction, in addition to stability incompressibility is also important as differential settlement may cause failures.Compacted soil and stabilized soil are often used in sub-base or base course of highway pavements.The soil is therefore considered as one of the principal highway materials.Investigations were carried out on selected soil samples from Haryana .These samples were tested without admixtures and with admixture of lime and Recron 3s Fibre to determine enhancement in their characteristics.The results of the study show that both lime & Recron 3s fibre are suitable for enhancing characteristics of the soils that are generally available in Haryana."

INTRODUCTION

IMPORTANCE OF TRANSPORTATION

Transportation adds to the economic, industrial, social, and cultural development of the country. The economic prosperity and overall development of any area depends on transportation. It represents the movement of goods as well as individual from one place to other .It is supplementary to trade ,i.e, the raw materials are transmitted from the place of manufacture to the place where the end products are distributed for consuming such as food , clothes, industrial products or medicine etc, in short transportation is needed at all stages. The capability of transportation of a counter shows its economical and social development.The transportation of goods and individual through roads, rails or pipes is termed as land transportation.

NECESSITY FOR THE ENHANCEMENT OF CBR OF SUB-GRADE SOIL .

With advancement in technology heavier axle loads are to be supported by subgrade. Thus their engineering characteristics are modified to meet the design requirements. The further step should be taken whether to;

i) The quality standards are met by making alterations in the design.

ii) A better material is used in place of site material.

iii) A new enhanced material is formed by changing the characteristics of the soil that meet so that the requirements of the design standards are met.

In such a developing world, restrictions over the design requirments are impossible but to replace the whole soil when a large number of quantities are involved, is uneconomical. So the only way to enhance the engineering behavior of these soils is by the method of stabilization by which CBR of the soil can be enhanced.

TEST RESULTS OF PARTICULAR SOILS

Soils from different places in Haryana representing three different types i.e; Bhiwani, Rohtak, Jind so that the usually available soils in Haryana are represented. The varios results are tabulated below.

MDD and OMC of Soil Mixes "Modified Proctor Test":

The relationship between the water content and dry density of the is obtained through modified proctor test. The tests have been conducted on selected soils alone as well as on mixes of soil+lime and soil+Recron 3S Fiber. The lime and Recron 3S Fiber have been mixed in varying

proportion from 4 to 9 % . The results obtained for the tests are shown in Figure 1 to 9.

MDD and OMC of ML Soil Mixes

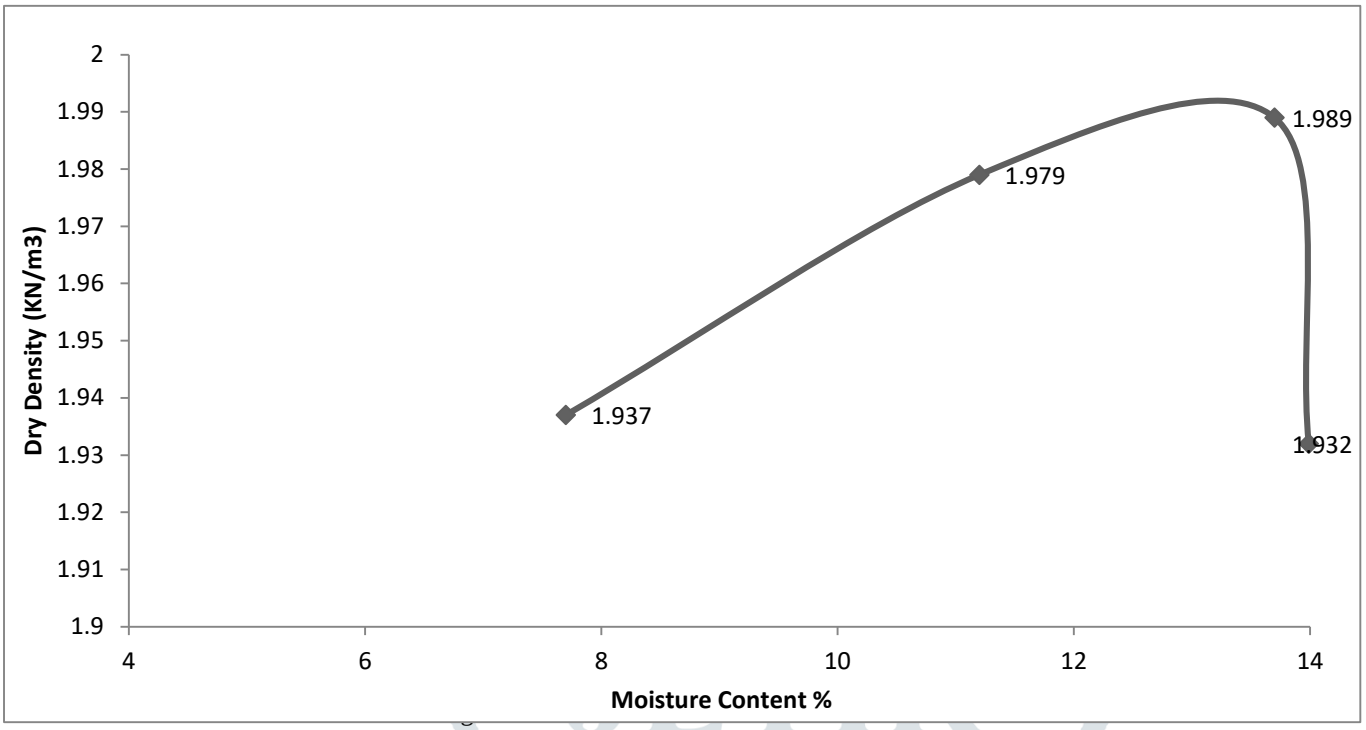

Table 5.8 "MDD and OMC of ML Soil Mixes"

Soil Mix	MDD(g/cc)	%Decrease in MDD	OMC(%)	%Increase in OMC
ML Soil only	1.984	-	12.56	-
ML Soil + 4% Lime	1.916	3.4	13.35	6.2
ML Soil + 6% Lime	1.876	5.4	13.69	8.9
ML Soil + 9% Lime	1.835	7.5	14.32	14.0
ML Soil + 4% Recron 3S Fiber	1.951	1.6	12.78	1.7
ML Soil + 6% Recron 3S Fiber	1.915	3.4	13.03	3.7
ML Soil + 9% Recron 3S Fiber	1.872	5.6	14.0	11.4

It is observed from figure 1 and table 5.8 that OMC increased and MDD decreased with increase in proportion of lime added to the soil. By adding 4%, 6%, 9% lime in ML type soil decreased the OMC increased from 12.56% to 13.35%, 13.69% and 13.33% respectively and MDD from 1.984gm/cm3 to 1.916 gm/cm3, 1.876 gm/cm3, and 1.825 gm/cm3. In case of Recron 3S Fibre it followed the same trend. The OMC increased from 12.56% to12.78%, 13.03% and 14.0% with 4%, 6% and 9% Recron 3S Fiber respectively whereas the MDD decreased from 1.984 gm/cm3 to 1.951 gm/cm3 , 1.915 gm/cm3 and 1.872 gm/cm3 with 4,6 and 9 Recron 3S Fiber respectively. The decrease in MDD is due to the fact that lime and Recron 3S Fiber are lighter materials having less specific gravity than soil. The OMC increased due to the fact that lime and Recron 3S fiber are finer materials requiring more water for achieving a given level of compaction. Moreever, it is as per the estabilished trend that when OMC increases, MDD decreases.

MDD and OMC of CL soil mixes

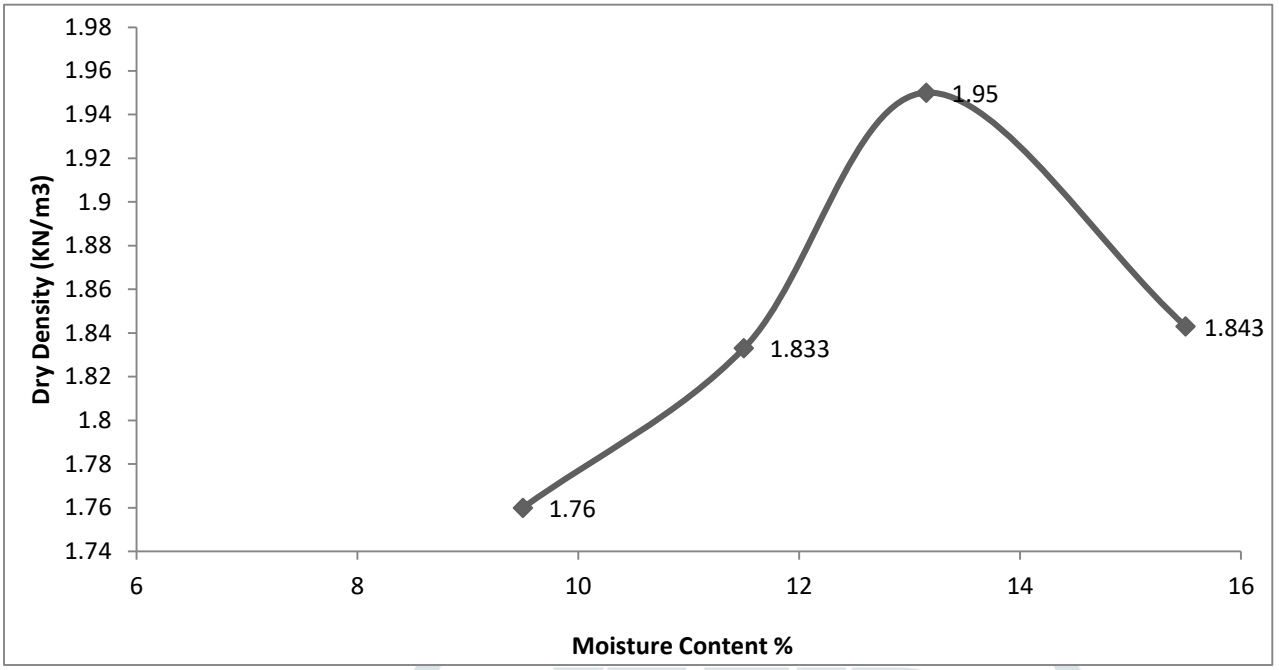

Figure 2: Modified Proctor Test on CL Soil

Table 5.9 "MDD and OMC of CL soil mixes"

Type of Mix	MDD(g/cc)	%Decrease in MDD	OMC(%)	%Increase in OMC
ML Soil only	1.956	-	12.77	-
ML Soil + 4% Lime	1.862	4.8	14.86	16.3
ML Soil + 6% Lime	1.841	5.8	15.10	18.2
ML Soil + 9% Lime	1.813	7.3	16.23	27.0
ML Soil + 4% Recron 3S Fiber	1.896	3.0	13.95	9.2
ML Soil + 6% Recron 3S Fiber	1.873	4.2	14.86	16.36
ML Soil + 9% Recron 3S Fiber	1.841	5.8	16.30	27.6

It is observed From table 5.9 that with the increase in proportion of lime, MDD decreased and the OMC increased. By adding 4%, 6%, 9% lime in CL type soil OMC increased from 12.77% to 14.86%, 15.10% and 16.23% respectively while MDD decreased from 1.956gm/cm3 to 1.862 gm/cm3, 1.841 gm/cm3, and 1.813 gm/cm3 respectively. In case of Recron 3S Fibre it followed the same trend. The OMC increased from 12.77% to13.95 %, 14.86% and 16.30% with 4%, 6% and 9% Recron 3S Fiber respectively while MDD decreased from 1.956 gm/cm3 to 1.896 gm/cm3 , 1.873 gm/cm3 and 1.841 gm/cm3 with 4%, 6% and 9% Recron 3S Fiber respectively. The decrease in MDD is due to the fact that lime and recron 3s fiber are lighter materials having less specific gravity than soil. OMC increased due to the fact that lime and recron 3s fiber are finer materials requiring more water for achieving given level of compaction.

"MDD and OMC OF SM Soil Mixes"

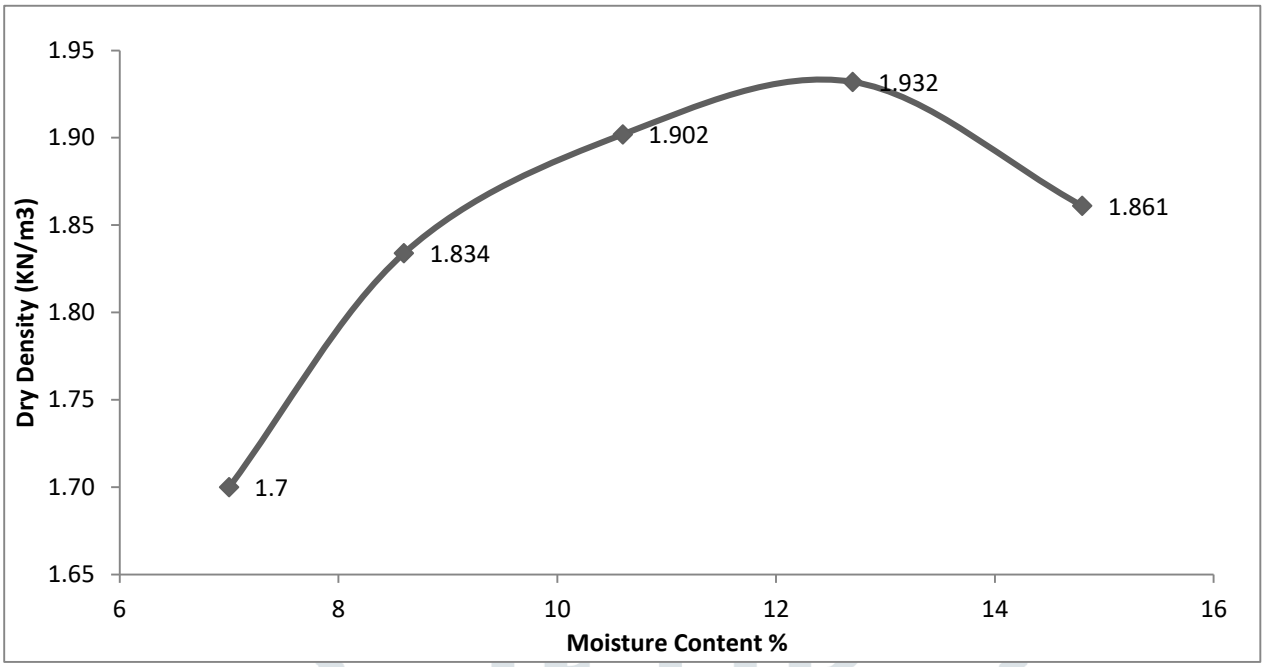

Figure 3: Modified Proctor Test On SM Soil

The values of MDD and OMC obtained from figure 7 to 9 are given in table 5.10

TABLE 5.10 "MDD & OMC OF SM SOIL MIXES"

Type of Mix	MDD(g/cc)	%Decrease in MDD	OMC(%)	%Increase in OMC
ML Soil only	1.942	-	12.41	-
ML Soil + 4% Lime	1.921	1.0	13.06	5.2
ML Soil + 6% Lime	1.891	2.6	13.57	9.3
ML Soil + 9% Lime	1.856	4.4	14.43	16.2
ML Soil + 4% Recron 3S Fiber	1.931	0.5	14.96	20.5
ML Soil + 6% Recron 3S Fiber	1.902	2.0	15.78	27.1
ML Soil + 9% Recron 3S Fiber	1.876	3.3	16.0	28.9

It is observed from figure 3 and table 5.10 that OMC increased and MDD decreased by increasing the proportion of lime added to soil. By adding 4%, 6%, 9% lime in SM type soil OMC increased from 12.41% to 13.06%, 13.57% and 14.43% while MDD decreased from 1.942gm/cm3 to 1.921 gm/cm3, 1.891 gm/cm3, and 1.856 gm/cm3 respectively. In case of Recron 3S Fibre it followed the same trend. . The OMC increased from 12.41% to14.96 %, 15.78% and 16.0% with 4%, 6% and 9% Recron 3S Fiber respectively. The MDD decreased from 1.942 gm/cm3 to 1.931 gm/cm3 , 1.902 gm/cm3 and 1.876 gm/cm3 with 4%, 6% and 9% Recron 3S Fiber.

Table 5.11 "Decrease in MDD of Soils with Lime and Recron 3S Fiber"

Type of Soil	%Decrease in MDD					
	Lime%			Recron 3S Fiber %		
	4%	6%	9%	4%	6%	9%
ML	3.4	5.4	7.5	1.6	3.4	5.6
CL	4.8	5.8	7.3	3.0	4.2	5.8
SM	1.0	2.6	4.4	0.5	2.0	3.3

Table 5.11 shows for selected soils with varying proportion of lime and Recron Fibre, there is a percentage decrease from 4 to 9% . The MDD of selected soils is found to decrease wiyh the addition of lime and Recron 3S Fiber. The decrease in MDD is due to the fact that lime and Recron 3S Fibre are lighter ,materials having less specific gravity than soil. It is observed that by adding Lime there is a maximum decrease inMDD of CL type soil (clays of low plasticity), whereas, least de crease is observed in SM type soil (silty sands). The MDD value decrease more in case of heavier soils like CL. Similar trend in value of MDD is observed in case of addition of Recron 3S Fiber with the soils

Table 5.12 "Increase in OMC of soils with Lime and Recron 3S Fiber"

Soil	%Increase in OMC					
	Lime%			Recron 3S Fiber %		
	4%	6%	9%	4%	6%	9%
ML	6.2	8.9	14.01	1.7	3.7	11.4
CL	16.3	18.2	27.0	9.2	16.36	27.6
SM	5.2	9.3	16.2	20.5	27.1	28.9

Table 5.12 shows that in selected soils with varying proportion of Lime and Recron 3S Fiber, there is a percentage increase in OMC from 3% -9% . It ios observed that by adding Lime there is maximum increase in OMC of CL type soil (clay of low plasticity) , whereas least increase is observed in SM type soil (silty sands). The in crease in OMC takes place as the Lime and Recron 3S Fiber particles are finer than thesoil particles and retain more water to lubricate their surface to re-arrange them to new orientation to give maximum dry density. The finer soils like CL result in more increase in OMC on addition of additives.

CBR test results under soaked condition

The CBR value of ML,CL and SM type soils mixed with Lime and Recron 3S Fiber separately in varying proportions are determined in the study. The ;load penetration curves for obtaining soaked CBR values of various soil Mixes is shown in figure 4 to 12.

"CBR Test Results of ML soil mixes"

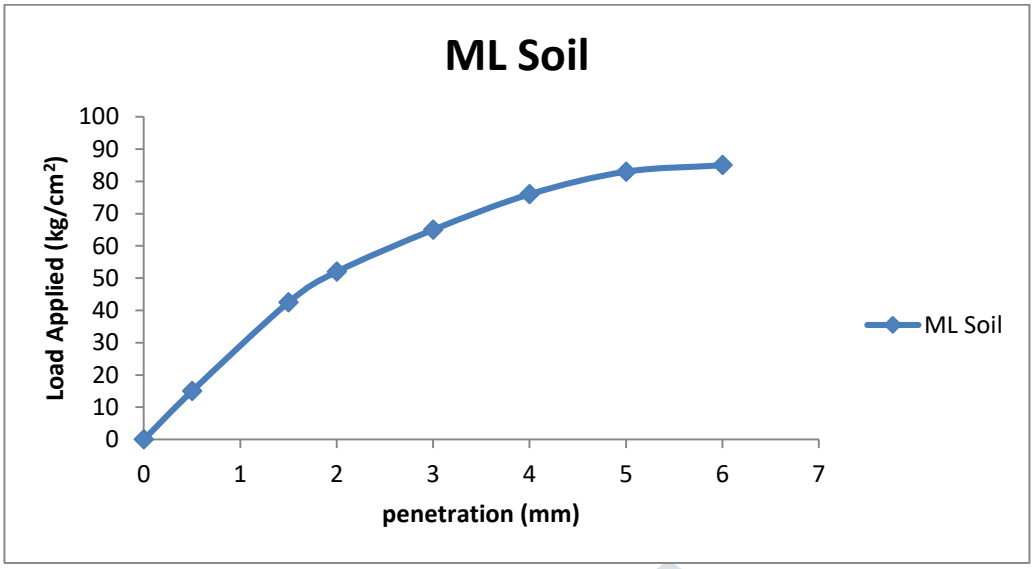

Figure 4: Load Penetration Curves for CBR Value of ML Soil

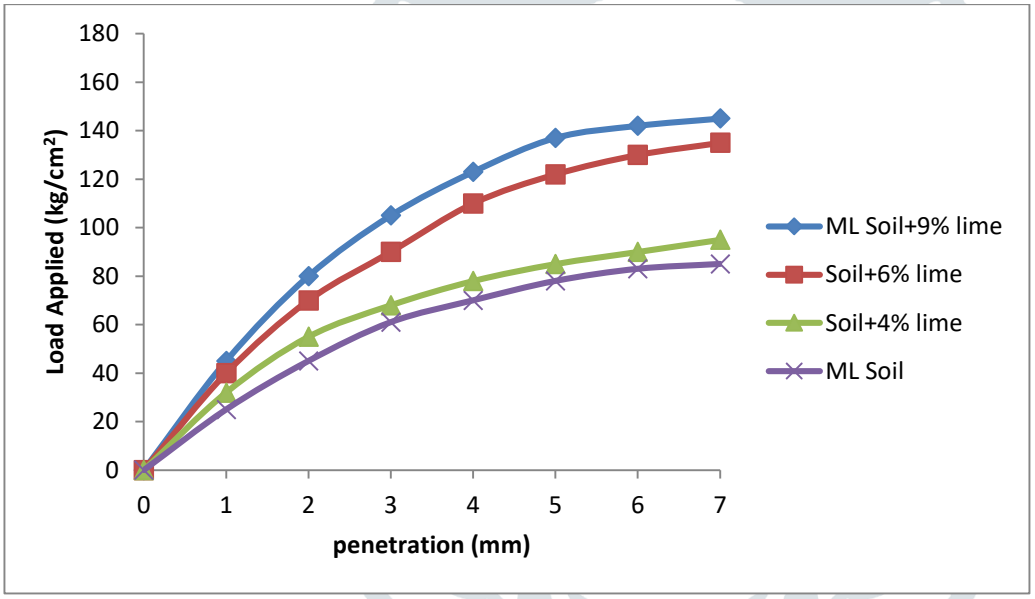

Figure 5 : "Load Penetration Curves for CBR Value of ML Soil+ Lime Mixes"

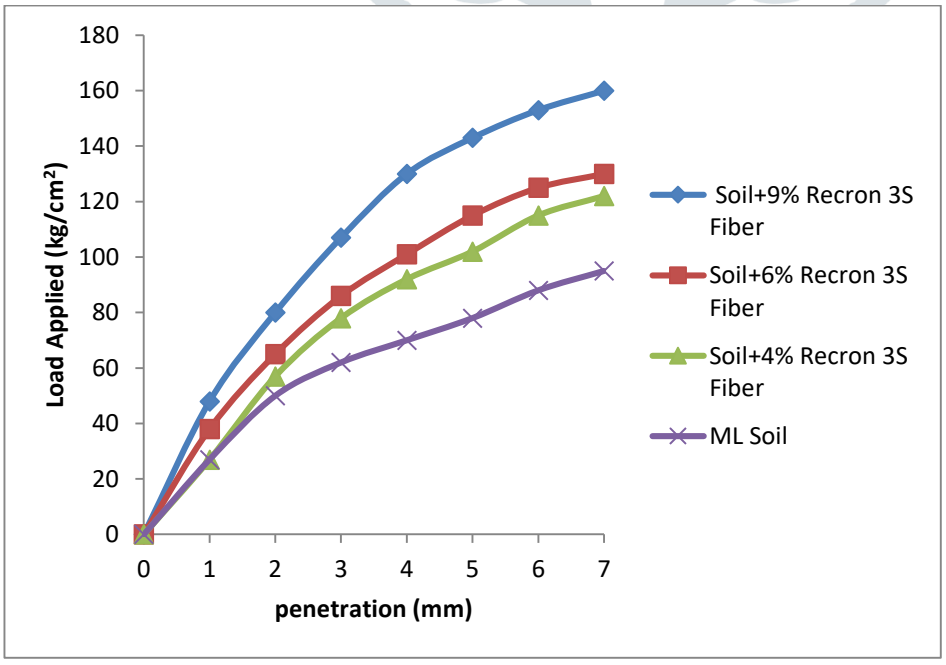

Figure 6 :"Load Penetration Curves for CBR value of ML Soil + Recron 3S Fiber"

It is observed from figure 4 to 6 that the CBR value increased by adding more Lime and Recron 3S Fiber in the soil. The addition of 2%, 4% and 9% Lime and Recron 3S Fiber (by weight of dry soil) in ML type soil increased the CBR value from 3.8% to 4.9%% , 6.0% and 7.2% in case of Lime and from 3.8% to 4.7%, 5.4%, and 6.6% in case of Recron 3S Fiber.

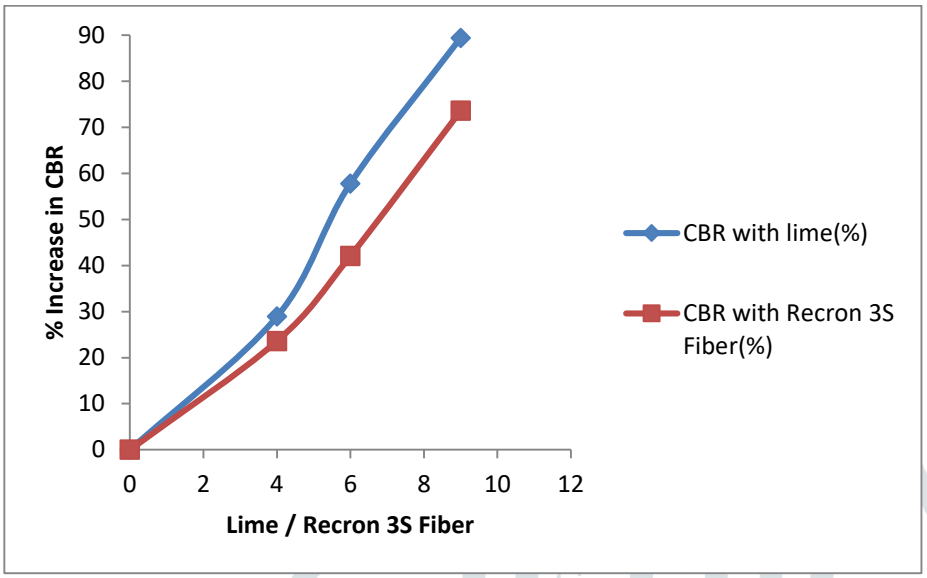

Figure 7: Increase in CBR of ML Soil with Lime and Recron 3S Fiber

"CBR Test Results of CL Soil Mixes"

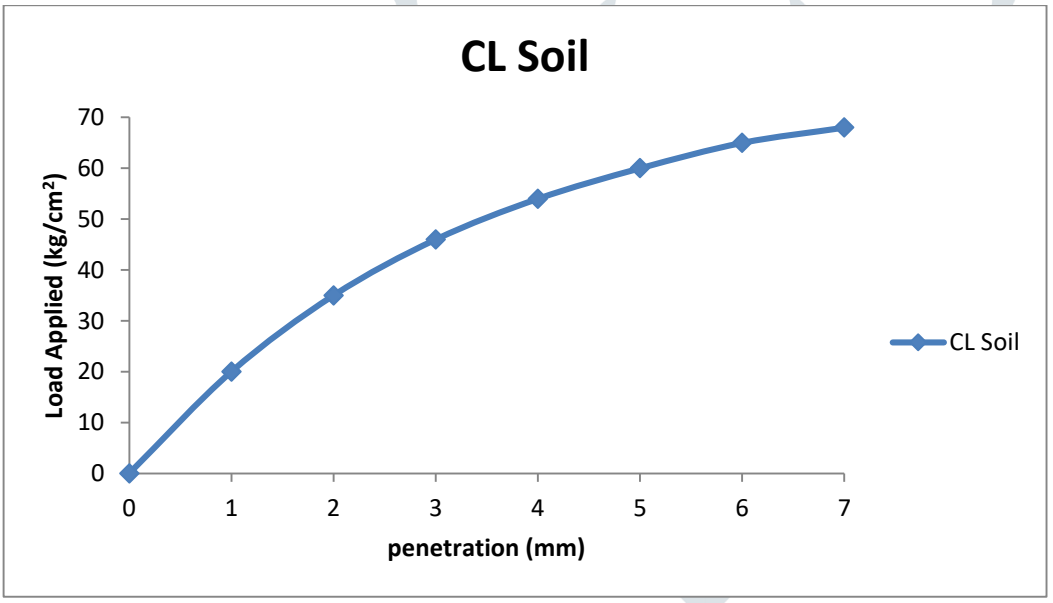

Figure 8: "Load Penetration Curves for CBR Value of CL Soil"

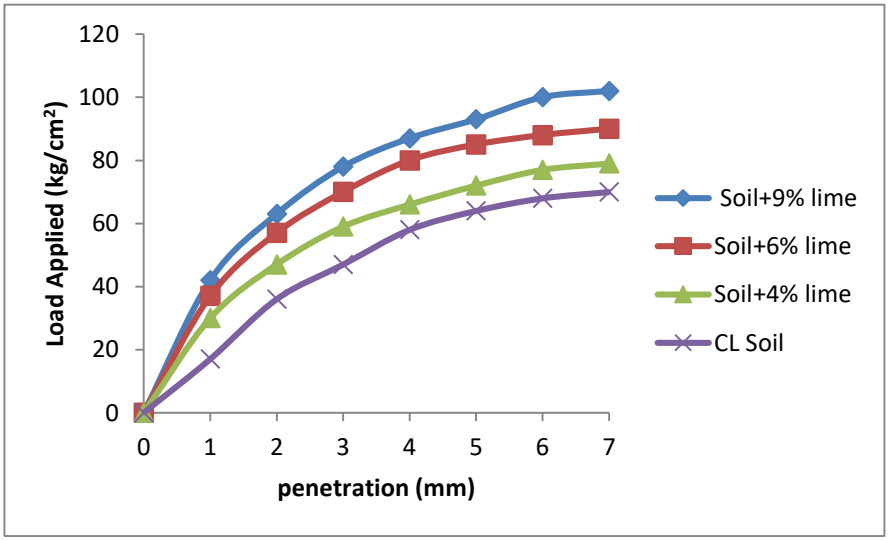

Figure 9 :Load Penetration Curves for CBR Value of CL+ Lime Mixes

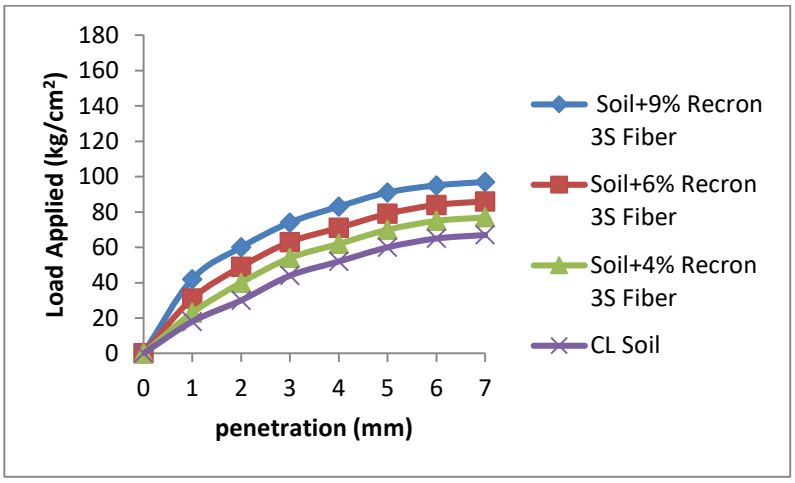

Figure 10 :Load Penetration Curves for CBR Value of CL Soil+ Recron 3S Fiber

From Figure 8 to 10 the CBR value increased by adding more Lime and Recron-3S Fiber in soil. The addition of 2%, 4% and 9% Lime and Recron 3S Fiber in CL soil increased the CBR value from 2.4% to 3.2% 3.9% and 4.5% in case of Lime and from 2.4% to 3.1%, 3.5%, and 4.2% in case of Recron 3S Fiber

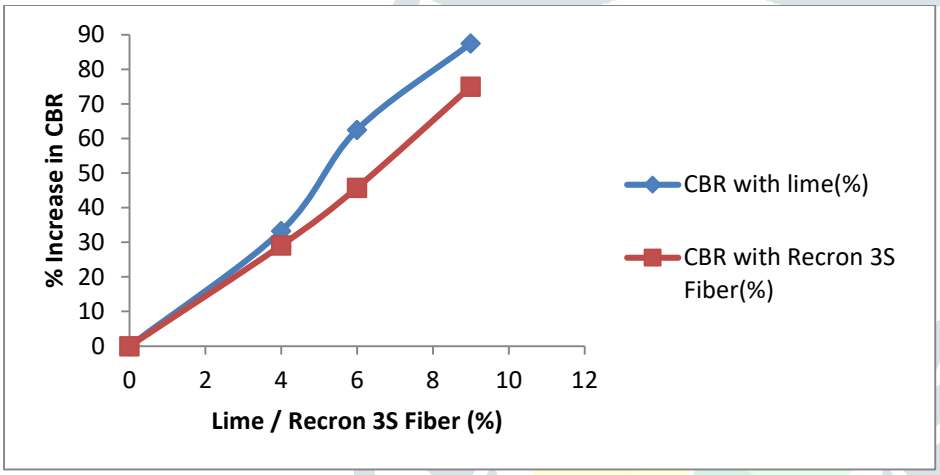

Figure 11 : Increase in CBR of CL Soil with Lime and Recron 3S Fiber Mixes

"CBR Test Results of SM Soil Mixes"

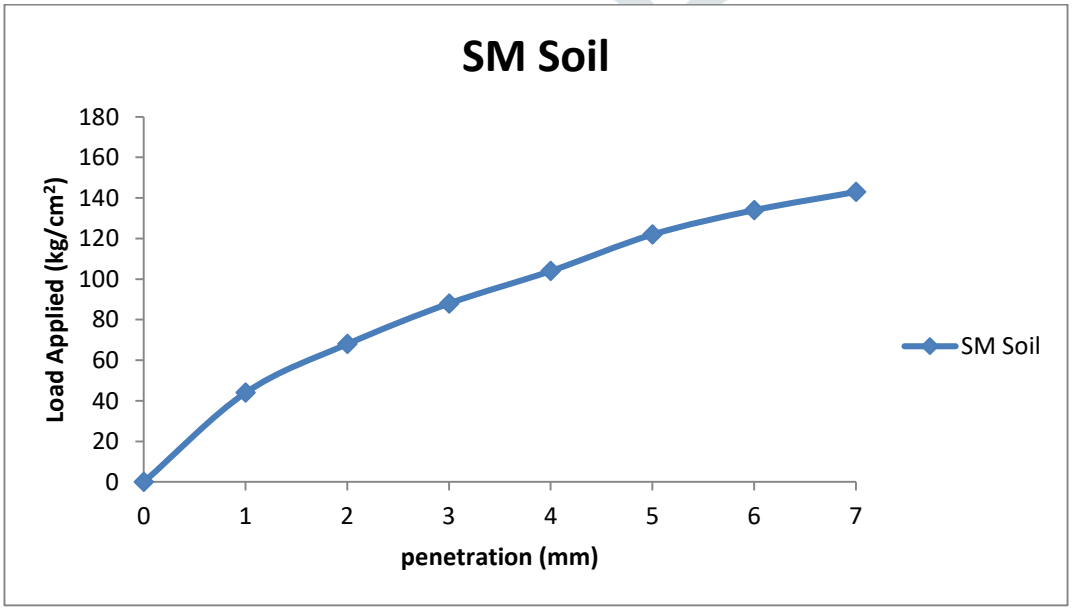

Figure 12 :Load Penetration Curves for CBR Value of SM Soil

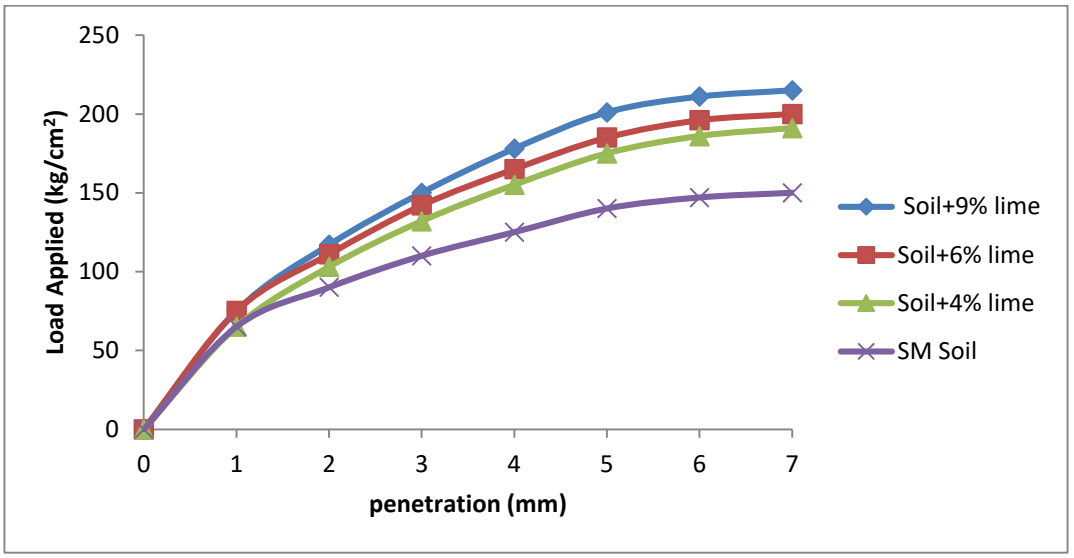

Figure 13 :"Load Penetration Curves for CBR Value of SM Soil+ Lime Mixes"

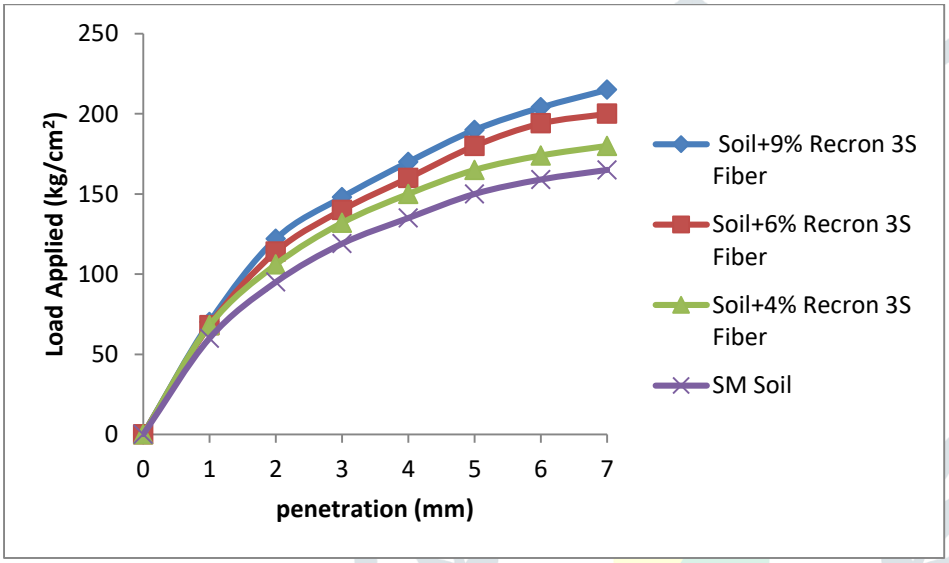

Figure 14: "Load Penetration Curves for CBR value of SM Soil + Recron 3S Fiber Mixes"

From Figure 12 to 14 the CBR value increased by adding more Lime and Recron-3S Fiber in soil. The addition of 2%, 4% and 9% Lime and Recron 3S Fiber in SM soil increased the CBR value from 6.5% to 7.8% ,8.4% and 9.0% in case of Lime and from 6.5% to 7.6%, 8.1%, and 8.8% in case of Recron 3S Fiber

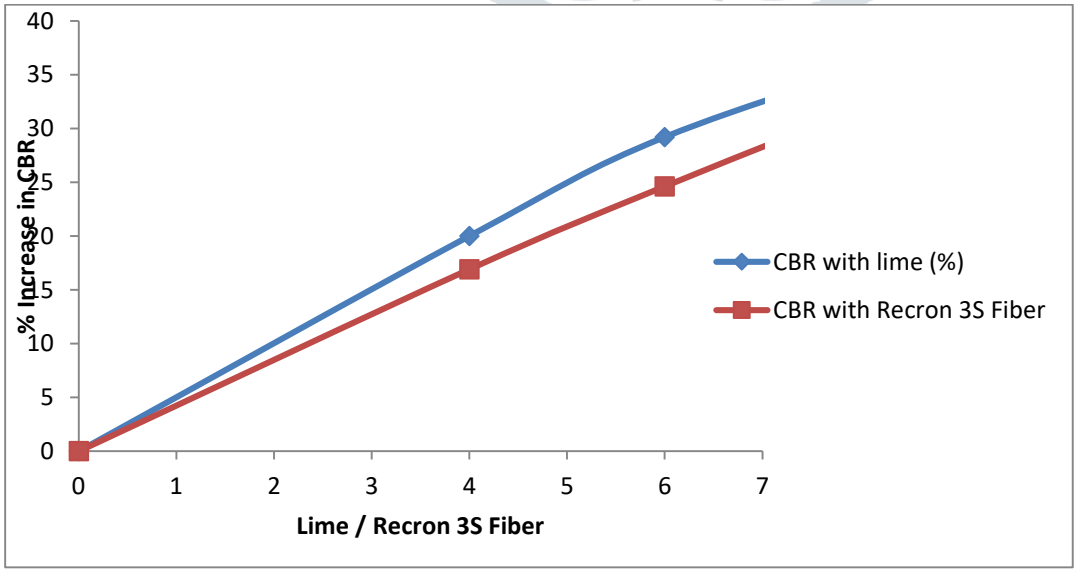

Figure 15 :Increase in CBR of SM Soil with Lime and Recron 3S Fiber

CONCLUSION

a) By adding these admixtures the max. dry density of these particular soils decreases and the OMC increases. By increasing the quantity of these admixtures, max. dry density decreases and OMC gets increased.

b) The amount of sand in these three soils is 27.2%, 18.6% and 52.7% as per the test results . These soils fit in ML,CL and SM category. The Plasticity Indices of ML-soil is 5.9% , CL-soil 7.5% and SM-soil is Non plastic

c) CL type of soil shows max. drop in MDD while SM type of soil show lowest reduction by adding these admixtures.

d)The liquid limit and plastic index of these soils gets reduced by adding lime and Recron 3S fiber. With increase in quantity of these admixtures in the soil PI and LL is decreased.

e)The CL soils show more increase in OMC followed by ML and SM soils by adding same quantity of these admixtures.

f) The behaviour of MDD was found out to be same for both lime and Recron 3S fiber.

g)In distinction to Omc of soils, MDD of soils increase by adding of Lime aswell as the Recron3S Fiber. The OMC increases with increase in quantity of admixtures in soil.

h) However the OMC varied more in case of li me than Recron 3S fiber keeping the quantities to be same.

i) Lime caused more decrease in MDD of the soils than Recron 3S fiber keeping the quantities to be same.

j) By adding these admixtures with the soils, the CBR value of all the three soils is found to be increased.

k) By adding Lime and Recron 3S Fiber, the CBR-value increases by maximum amount for CL soil and mimimum for SM soils.

l)Lime is found to cause more increase in CBR of all the three soils than Recron3S Fiber

m)The proportion of Lime and Recron 3S Fiber to be added for desired enhancement in CBR value may be obtained from results of the study

n)Thus to enhance the characteristics of the soils generally found in Haryana, both lime and Recron 3S fiber can be used.

SCOPE FOR FURTHER RESEARCH

• The study can be carried out using other additives such as cement ,rice husk ash , fly ash etc.

•The study is carried out through Proctor compaction and CBR tests. It can be extended with tests such as Unconfined Compressive Tests and Tri-axial Tests

• The study is carried out with Lime and Recron3S Fiber admixtures separately. It can be conducted by combination of Lime and Recron 3S Fiber.

• The study can be conducted by adding different varying percentages of Lime and Recron3S Fiber that is 15%, 20% , 25 % etc.

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