REVIEW PAPER ON STUDY OF CHARACTERISTICS OF SOIL TO IMPROVE CBR WITH LIME AND RECRON 3S FIBRE

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ABSTRACT : When a structure is built, the load is taken by the underlying soil. Hence the strength of soil affects the stability of the structure. The subgrade plays a vital role in case of road pavements. When a road is designed, subgrade is checked for its strength characteristics as it provides support to the road pavement from beneath. Thus subgrade should be sufficiently strong so as to support the pavement even in adverse climate conditions and heavy loading.

In case of embankment construction, soil should be incompressible or it may cause differential settlement to the structure leading t its failure. Thus compacted and stabilized soils are used for sub-base course of pavements.

The deformations caused in subgrade are reflected to the top black layer of pavement leading to the formation of ruts and wave corrugations. It may also cause the cracking of cement concrete pavements.

Soil samples from Haryana were investigated with and without admixtures of lime and recron 3S fiber to determine their enhanced characteristics. The results of the study show that both these admixtures are suitable for enhancing their properties.

INTRODUCTION

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 isby the method of stabilization by which CBR of the soil can be enhanced. This topic “Study of The Characteristics of Soil to Enhance CBR with Lime and Recron 3S Fiber” aims to conduct the investigation of selected soils collected from various places in Haryana and determine the enhancement in their characteristics by adding lime and Recron 3S fiber in varying proportions. The soil used are from two different areas of Haryana.

The requirements of pavement crust depends on the sub-grade CBR value. By stabilizing clayey soils which are weakest having minimum CBR value, the highway projects can be made economical to a greater extent.e.g, for a subgrade of 2% the pavement crust requirement is 850 mm while for a subgrade of 10% it is 540 mm, the design traffic being 10 msa. Siols which are commonly found in most places of Haryana are selected for the study which are MLsoil (low plastic silts obtained from Bhiwani), CL soil(low plastic soil obtained from Rohtak) and SM soil (silt sand obtained from Jind). These soils are further investigated n the Laboratory.In this study lime in powder form and Recron 3S fiber are used as admixtures. These results can be used for particular soil type and particular ad-mixture but for the soil and admixture having similar characteristics same procedure and method can be used. The characteristics of these soils as “gradation, Atterberg’s limits, specific gravity, OMC, MDD and CBR value” are evaluated in the investigation.These admixtures are mixed with soils at 4%,6% and 9% by mass of dry soil separately. Soil stabilization is necessary when the soil accessible is not suitable for the anticipated purpose. The objective of stabilization include increasing load bearing capacity of soil, to reduce compressibility of sub-grade soil.

Permeability is a very important engineering property of soil. As all the soils are previous to some degree of and it controls the hydraulic stability of soil masses. So the soil stabilization is required to decrease the permeability.

When the soil mass is subjected to a compressive force, its volume decreases.In this process solid particles shift from one position to other by rolling or sliding and thus attain a close packing. With the help of soil stabilization we can reduce the compressibility of sub-grade.

Generally the weaker sub-grade soil can be tackled in two ways . In the first process weaker soil may be replaced by superior soil, this is not an engineered solution of the problem also this may be very expensive especially when fill material is borrowed from a distant place. Second alternative is to enhance the characteristics of that soil by means of stabilization. A number of techniques and methods are available for stabilization . One of the oldest methods is by addition of superior material, which could be cement, lime ,bitumen etc. By soil stabilization load bearing capacity of the sub-grade soil and California Bearing Ratio increases, resulting in thinner pavement requirement for particular design traffic. This brings overall economy in the highway project.

METHODOLOGY

The moderately fine and fine-grained soils combine with lime and their strength is enhanced as per the laboratory analysis. The strength of the mixture is due to the chemical reaction between them. These chemical reactions are both instantaneous as well as time taking. During the first phase an immediate change occurs in the mixture produced by cat-ion exchanges.When the cations react with the free calcium produced by lime, the size of the diffused water layer is decreased cusing a decrease in its overall size due to which the cay particles come closure to each other and thus triggering flocculation and agglomeration of clay particle, and converting it into silt like substance. Generally, soil formed by these processes is more freely mixable, workable and eventually compactable. Once the soil is treated with lime all these soil will go through quick cat-ion exchange and agglomeration/ flocculation reactions.

Lime increases the PH of the whole water. At a PH of 12.4 silica nd alumina present in the soil become solvable and get separated from the clay. During the second stage pozzolonic reaction occurs between lime and soil due to which the strength is gained over time. When the silica and alumina are separated calcium from lime reacts with them and produces cement which toughens in a steady process over a period of time. To make the reaction going in the forward direction enough Ca should be present to react with alumina and silica, also PH should remin high enogh to mke the silica and alumina solvable. The quantity of silica and alumina accessible affect the strength enhancement. Thus for soils like montmorillonite and kaolinite, lime stabilization is quite effective.

Inspite of pozzolonic reactions , long term strength is achieved by carbonation in those soils that are stabilized with lime. This is beneficial for the mixture as the carbonation and development of cementations bring about long-term strength increase. When lime combines with CO2 from atmosphere, a relatively unsolvable compound is formed called calcium carbonate, this process is called carbonation. To prevent pre-mature carbonation of lime before mixing, contact of lime with the air must restricted through known procedure and advanced construction methods.

LITERATURE REVIEW

KUMAE ET AL. (2008) “The black cotton soil was reinforced with polyester synthetic having characteristics as specific gravity =2.72, LL=68% PL=49.65% OMC=29.4% and MDD=1.32gm/cc. This examination was performed on unconfined compression of randomly distributed fibres, lime and flyash on the geotechnical features of expansive soil. Also fly ash and lime are supplemented to the soil. The outcome obtained indicates that the fibre is more effective when soil is put under tension rather than compression.”

CHANDRA ET AL. (2008) “In this study influence of polypropylene fibre was detected. Three diverse types of soils; clay, silt and sand were mixed with polypropylene fibre of 0.3mm dia. Fibre was break in pieces of length 15, 25, 30 mm and aspect ratio of 50, 80 and 100 respectively. The quantity of fibre was 0.75, 1.5, 2.25, and 3% by dry weight of soil. Stagnant triaxial test of unreinforced and reinforced soil were done and the results displayed uniaxial compressive strength of 3.82, 4.83 and 9.73 Mpa respectively.”

S.C. PATODI , C.B. KULKARNIY. (2012) “The author found that matrix having 0.3% of Recron and 0.7% of Steel Fibre volume portion was found :

> More stable in terms of strength and post- peak ductility

> Best resistance against impact and mechanism and toughness

> For overall better performance

>Advantages in improving CBR

GURUATHAN KET AL. (2014) "The author discussed that the addition of poly propylene Fibre, Recron 3S Fibre and Silica fume in different soils marginally enhance the compressive strength at 28 days . The minimum percentage of Recron and Silica fume were added in soil so that the performance of the soil increases. Their is an increase from 3-4% in split tensile strength for all fibre mixes when compared with that of control mix. Then from results the author concluded that the volume fraction of soil Fibre mix gives better CBR or strength values on par with control mix."

VISWANANDHAN 2009"In this study the objective was to show the demonstrate the effect of randomly distributed fibres : (a) restraining cracking affinity of clay barrier subjected to differential settlement b) reducing swelling affinity of moist-compacted soil . here in this study polyester fibers were used named as recron 3s. it is concluded that using recron 3s is a very effective method . it helps to hold back cracking of clay barrier of differential settlements. It is here advised to use homogeneous mix of geofiber- reinforced soil (GRS) as substitute fill material where expansive soil deposits are at the construction sites. Separate fibers are normally added and mixed with soil like as cement, lime etc and compacted well."

SHARAN ALOK (2011) "In this study the focus is on geo-engineering characteristics of compacted pond ash with fibre Recron 3s inclusions in the strength characteristics of pond ash through direct shear test. UCS and CBR test. In the mix proportions the fibre was varied as 0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6,0.7,0.8,0.9,1% of dry weight of pond ash. 6mm and 12mm fibres were used in this study. The undrained cohesion of reinforced specimens was increased with the fibre content. Also 12mm showed higher strength than of 6mm sized fibers."

SHARMA R. K.(2012) "In this study author stated that the expansive soil causes no. of civil engineering structural damages , especially to the low rise building. Laboratory work done here is on Recron 3s of length 6mm and 12mm, lime and soil. Characteristics like grain size distribution, moisture- density relation and CBR for soil mixed with lime in range of 20-80%. Ratio 70% soil and 30% lime was used further for addition of Recron 3s fibre in range of 0.5-1.5% are studied. From CBR test best proportion was 70: 30: 0.5%."

CONCLUSIONS

The study /of soil characteristics has been done on soil samples usually found in Haryana to see the enhancement in CBR of soil with lime and Recron 3S fiber. The soils used for study are low-plastic silt from Bhiwani (ML soil), low-plastic clay from Rohtak (CL soil) and silty-sands from Jind (SM soils). The soils have been mixed with varying proportion of lime and Recron 3S fiber to determine their effect on various characteristics of soils. The test results give the conclusion which is given below:

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.

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