Enhancing the Properties of Soil using Plastic Waste

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Abstract— Soil stabilization is the methods of improvement of the engineering property of the soil and thus making more stable. Soil is not suitable for construction purpose. In its broadest Sense, stabilization includes compaction, preconsolidation, drainage and many other such processes. Soil stabilization is generally restricted to the processes which alter the soil material itself for improvement of its properties. The construction work is needed for all time low cost material and environment sociable and suitable for construction work. Road are such as important key of connectivity in India and Highway Roads are always a need low cost material and maintenance free roads. Due to smaller availability of fund use of waste material from industries and agricultural fields is much in use. This practically work in brief describes the use of locally available waste plastic in soil stabilization. Stabilization of soil using plastic waste strips is an economically and easy methods to dispose the plastic waste. Due to increase of population and urbanization and also increase the production of plastics material but recycling of these plastics is a smaller amount compared to its production. In present work the plastics is made in to strips mixed with black cotton soil is studied carrying different test on black cotton soil. The plastics strips are added by different proportion by dry weight (1.0% to 5 %) of the soil. The soil sample used is clay which requires to be strengthened due to presence of high plasticity, this soil sample is strengthened by using varying proportion of plastic. Various tests were conducted to analyze the effect of plastic strips on optimum moisture content, maximum dry density, unconfined compressive strength and California bearing ratio. From the results increase the maximum dry density and decrease the optimum moisture content, Along with increase in unconfined compressive strength and California bearing ratio, from the observations it can be seen that 3% of plastic strips results in maximum improvement in desired soil properties. Due to its low cost and effectiveness in increasing the California bearing ratio of soil this method of soil stabilization is strongly recommended In this practical work the increase the strength and CBR value of added a plastic strips. These methods are useful for different pavement and most usefully for village road and also reduced pavement thickness of the road.

Key words: Plastic Waste, CBR, Properties of Soil

I. INTRODUCTION

Civil engineers have to deal with soils in their diverse roles. In all civil engineering structures like a building, a bridge or culvert, an embankment, a road pavement, a tower, a railway line, a tunnel or a dam, has to be founded on the soil and shall transmit to dead load and live load to the soil stratum. Soil is a ultimate foundation material which carry the load of the any structure but in civil engineers are face to many difficulty to done the constriction. In India various types of soil like hard, soft, strong, week soil. The technique to improvement of the property of the soil is known as soil stabilization. The soil stabilization by different methods such like as admixture, heat treatment, proportioning, modifiers, water retaining agent, water repelling agent, water proofing agent etc. All technique are used in many project but mainly used in road pavement construction. Lime and cement are broadly used material but increased the cost so option is to use the locally available material. The most locally and easily available waste material is plastic waste

A plastic is to the organic products. The productions of plastic material are natural products like coal, salt, crude oil, cellulose etc. The plastic products are used broadly day by day and increase the problem of environments. Plastic waste material disposal are the big challenge without the harmful of environments. Previous research works have shown that plastic waste material have the increasing the engineering properties of soil for using as sub-grade in pavements in road constructions.

This thesis concentrates on obtaining the optimum amount of plastic waste Strips for practical work by observations of effect of plastic waste on engineering properties of soil. Soil stabilization with plastic waste strips is a method to improve paving base. It has change the properties of soil use in construction of road pavement. In our Vidisha district region is black cotton soil is good fertile and suitable to agriculture but not suitable for civil engineering work or structure.

II. METHODOLOGY

A. Liquid limit (wL)

Liquid limit is the water content corresponding to the arbitrary limit between liquid and plastic state of consistency of a soil. It is defined as the minimum water content at which the soil still in the liquid state, but has a small shearing strength against flowing which can be measured by standard available means. With reference to the standard liquid limit device, it is defined as the minimum water content at which a part of soil cut by a groove of standard dimension will flow together for a distance of 12 mm (½ inch) under an impact of 25 blows in the device.

B. Plastic limit

The moisture content at which soil has the smallest plasticity is called plastic limit. Plastic limit is the water content corresponding to an arbitrary limit between the plastic and the semi-solid states of consistency of a soil. The plastic limit is defined as the minimum water content at which a soil will just begin to crumble when rolled into a thread of approximately 3 mm in diameter.

C. Soil Compaction

Compaction is the process by which the soil particles are artificially rearranged and packed together into a closer state of contact by mechanical means in order to decrease the porosity (or voids ratio) of the soil and thus increase its dry density. The compaction process may be accomplished by rolling, tamping, or vibration.

D. California bearing ratio Test

In 1928 California division of highways in the USA developed CBR method for pavement. The majority of design curves developed later are based on the original curves proposed by O.J. porter. At the beginning of the Second World War, the corps engineer of USA made survey of the exiting method of pavement design and adopted CBR method for designing military airport pavement. One of the chief advantages of CBR method is the simplicity of the test procedure.

The CBR tests were carried out by the way California State highway department on exiting pavement layers including sub grade, sub-grade and base course, based on the extensive CBR test data collected on pavement which behaved satisfactorily and those which failed, an empirical design chart was developed correlating the CBR value and the pavement thickness. The basis of the design charts is that a material with a given CBR requires a certain thickness of pavement layers as a cover. A higher load needs a thicker pavement layers to protect the sub –grade. Design curves correlating the CBR value with total thickness pavement cover were developed by the California state highway department for wheel loads of 3175 kg and 5443 kg representing light and heavy traffic. Later the design curve for 4082kg wheel loads was obtained by interpolation for medium traffic. The design curves are shown in fig.

Studies carried out by the US. Corps of engineers has shown that there exists a relationship between pavement thickness, wheel load, tyre pressure and CBR value within a range of 10 to 12 percent. Therefore it is possible to extend the CBR design curves for various loading conditions, using the expression,

$$T = p[1.75/CBR - 1/pr]1/2$$

$$T = p[1.75/CBR - A/r]1/2$$

However these expressions are applicable only when the CBR value of sub-grade is less than 12 percent.

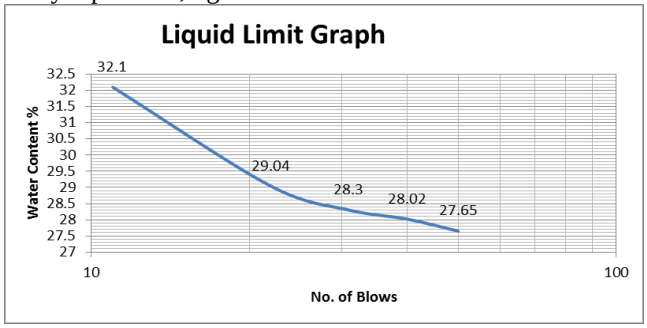
Here,

T = pavement thickness, cm

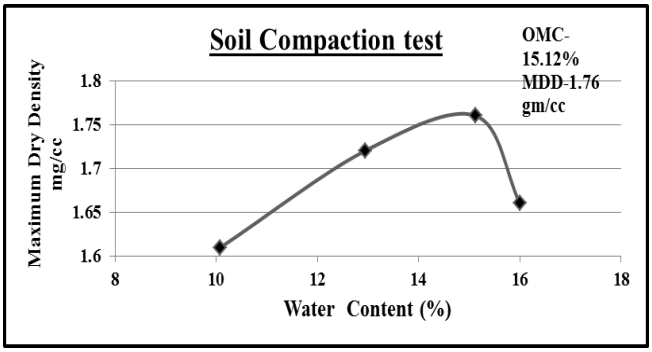
P = wheel load, kg

CBR= California bearing ratio, percent

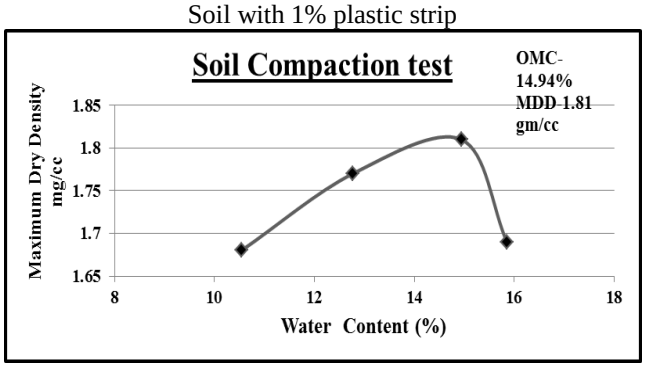
P = tyre pressure, kg/cm2



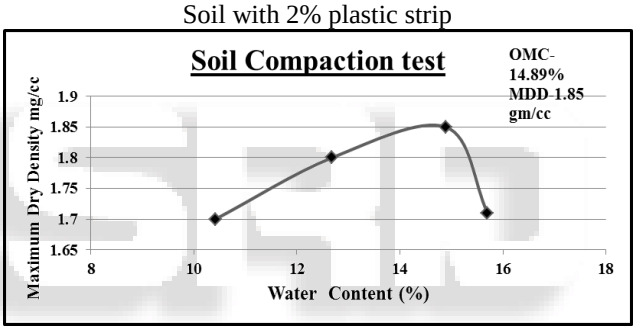
Ordinary Soil



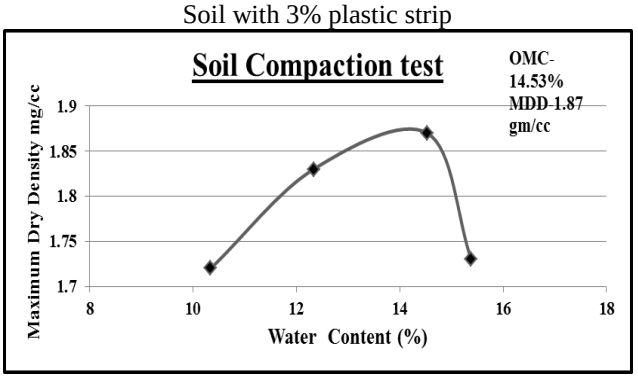
Soil with 1% plastic strip



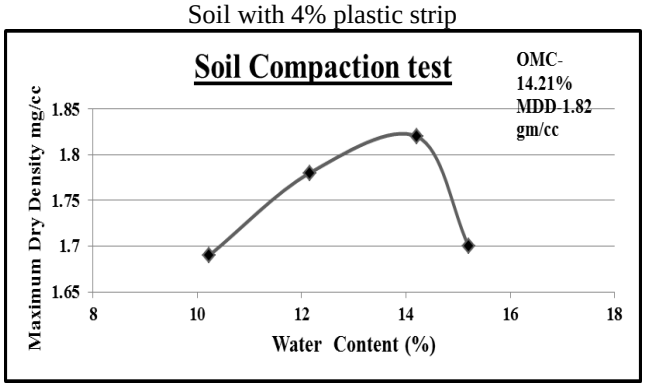
Soil with 2% plastic strip



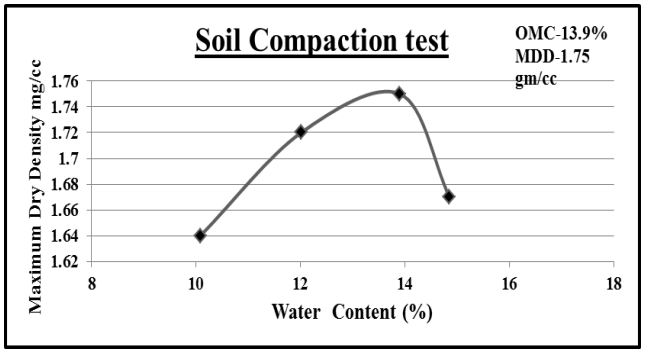
Soil with 3% plastic strip



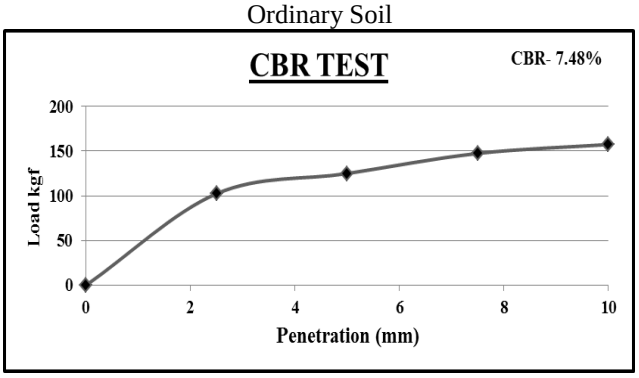
Soil with 4% plastic strip



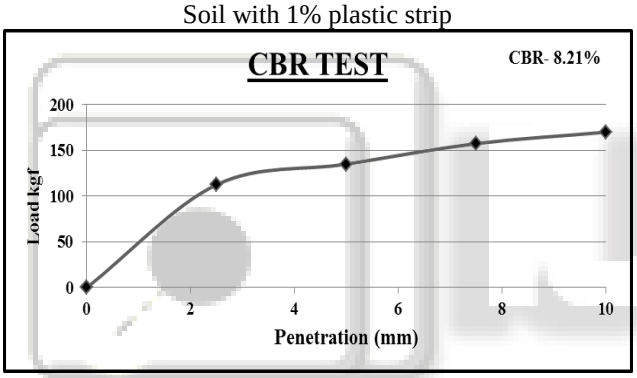
Soil with 5% plastic strip



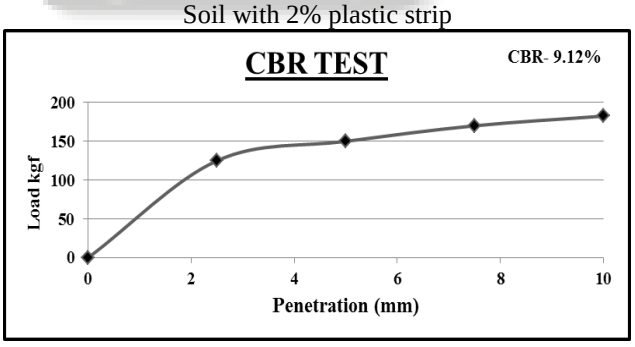
Ordinary Soil



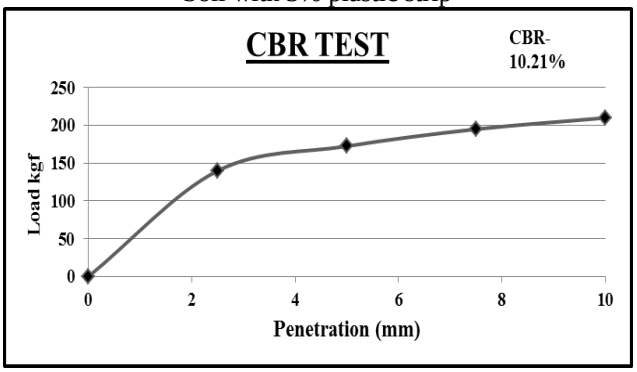
Soil with 1% plastic strip



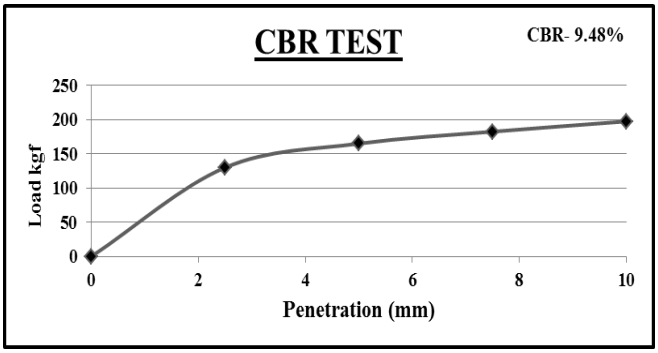
Soil with 2% plastic strip



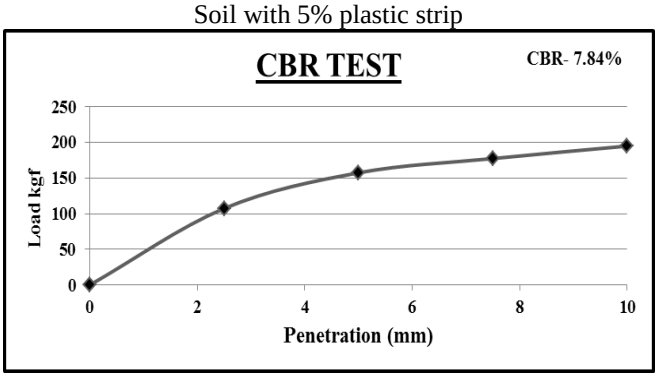
Soil with 3% plastic strip



Soil with 4% plastic strip



Soil with 5% plastic strip



III. Conclusion and Result

In this test results showed that there is increase in maximum dry density of soil and decrease in optimum moisture content with increase in plastic content. This test results shows that in increase the soaked CBR value with 3% plastic and then more plastic is decrease the CBR value. Plastic strips waste helped in reducing the cost of road construction with including of plastic strips. Some other soil stabilizer is more costly than plastic are easy available and very low cost and economical for road construction. Plastic waste material are easy available in any location in any city in our country. Environmental hazards are a very big problem for disposal of plastic waste. In this problem solve with the use of plastic waste as soil stabilization. This practically study is use of plastic waste to reduce the amount of plastic waste and made useful product for rural roads construction.

Test results for soil sample

Sample Description	MDD (gm/cc)	OMC %	CBR %
Soil	1.76	15.12	7.48
Soil With 1% Plastic	1.79	14.94	8.21
Soil With 2% Plastic	1.85	14.89	9.12
Soil With 3% Plastic	1.87	14.53	10.21
Soil With 4% Plastic	1.82	14.21	9.48
Soil With 5% Plastic	1.75	13.90	7.84

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