Stabilization of Black Cotton Soil of Canal Road Althan using Waste Plastic Bags

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Abstract— In geotechnical engineering there are number of solutions available for stabilizing the soil mass. Stabilization of soil can improve the bearing capacity of soil. But stabilizing the soil by using plastic waste is a green approach as disposal of plastics is great problem. Plastic waste is very big element of municipal solid waste and industrial waste and its disposal is also big issue for Municipal Corporation. Plastic waste is available in form of plastic bags, shopping bags, plastic bottles, packing strips etc. In this project work strips made out of plastic bags were used to stabilize the soil collected from canal road near Althan, in Surat city. The advantage of this material is its less weight and easy availability. In this project work strips made out of plastic bags were used to stabilize the black cotton soil that is mostly common in Surat region.

Key words: Green Approach, Plastic Strips, CBR, Soil Stabilization, Plastic Waste

I. INTRODUCTION

Soil is defined as mineral particles produced by the physical or chemical disintegration of rocks. Soil is also a parent rock. Soil is a non-homogeneous, porous material. Based on origin it can be briefly classified as organic and inorganic. Organic soil is form from decaying on plants excreta of animals and humans. Inorganic soil formed from physical and chemical disintegration.

BC soil is clayey soil seen greyish and black in colour. It contains montmorillonite clay mineral which contains very high expensive characteristics. BC soil possesses low shrinkage limit and high optimum moisture content. BC soil is such a soil which has tendency to swell or shrink when it comes in contact to water. This property of swelling or shrinking leads to gigantic loose to the structure. BC soil is connected directly to engineering structure.

In road construction main objective of stabilization is to increase stability of soil and to reduce it cost by the use of locally available materials. In developing countries like INDIA had great paralyze system to provide network of road system inadequate capital available to build it by conservative method only. Hence it became necessary to move forward with suitable method of low capital construction. This should also be followed strictly to meet up the rising demands of road traffic. Hence apart of this initial construction capital of lower layers of the pavement like sub-base course should be likely to promote low cost roads without involving appreciable wastage, utilized this principle of pavement construction in systematic stages.

Construction cost could be significantly decrease by selecting specific local materials including local soils for this construction of lower layers of the pavement such like sub-base course. In such case if stability of local soil is not satisfactory for sustaining the loads of wheels, properties should be improved or new techniques could be implemented.

Stabilization of course-grained soils with no fines can frequently be accomplished by use of waste materials. For silt and clay soils the OMC strength is up to 4-8 percent which is below optimum for maximum density. For granular soils OMC for maximum strength is 1-3 percent below optimum moisture for density. Thus it becomes critical to controlled moisture content during construction phase. Moisture content is basically measured using a nuclear density measurement instrument.

The increase rate of urbanization, development and population has led to increasing plastic waste. Municipal solid waste is increased due to increase in population and development.

Plastic bags have caused a lot of problems in recent times, as they are present in large quantities and due to their improper disposal which causes the degradation of the environment. Even though they are very cheap and easy to produce in large quantities, they have become a major threat to the environment.

The average time period for a plastic bag to completely decompose is about a thousand years, where over the course of time it breaks into small pieces and remains into the soil. Also, recently it has been specified that the minimum thickness of plastic bags should be kept 40 micron instead of previously specified 20 micron, as the thickness of the bag determines the strength of the bag to break into smaller pieces. If the bag is thin the probability of breakdown is higher and causes deterioration of the soil.

Flora and Fauna are greatly deteriorated along with the land and water. It is the main cause of clogs in the sewage system and environmental disruption.

Due to lightweight nature of the plastic bags, the get carried away by the wind and get entangled with the trees causing interference in the photosynthesis process. Plastics were the main cause of the blockage of the drainage system and were the main reason for the Mumbai Floods in 2005. This also has affected some countries like Bangladesh and Manila in a similar way, hence the plastic bags were banned in these countries after the floods.

II. METHODOLOGY AND OUTCOMES

The method and tests performed in this project are described as follows.

Sr No.	Properties Of Soil Sample	Value
1	Free Swell Index	51
2	Liquid Limit	41
3	Plastic Limit	19

Table 1: Properties of Soil

The materials like soil and plastic waste were mixed in different proportions to form a sample upon which the tests were conducted. The soil used in this project was collected

from canal road of Althan region in Surat, India. From above Information the soil can be classified as clay with medium plasticity. The Maximum Dry Density (MDD) and Optimum Moisture Content (OMC) of the soil were found t be 1.86 g/cc and 12.71% respectively.

Plastic bags are made from thin, flexible, plastic film, nonwoven fabric or plastic textile. Plastic bags are made with a different type of plastics films. Polyethylene (LDPE, LLDPE, etc.) is the most common.

PET (PolyEthene Terephthalate) type of code 1 plastic is used in this project. The plastic strips used for stabilization is made from polythene shopping bags of 40 micron thick. The size of strip is 3cm x 1 cm (Aspect ratio=3).

The tests carried out on the samples prepared were using 0%, 0.10%, 0.15%, 0.20%, 0.25%, 0.30%, 0.35%, 0.40%, 0.45% and 0.50% of weight of strips to the weight of the soil in the mould. CBR tests were performed on all the samples and conclusions were drawn from the results of these tests.

III. Results

The CBR tests performed in accordance to IS: 2720 (PART 16) – 1987 on the samples generated load penetration curves. These load penetration curves are used to determine the CBR value of the sample at 2.5 mm penetration. The CBR values of all the different soil sample with different proportions of plastic strips are as follows.

Sr No.	Percentage Of Plastic Strips	Cbr Value
1	0	3.85
2	0.1	8.9
3	0.15	9.7
4	0.2	10.3
5	0.25	11.4
6	0.3	12.5
7	0.35	14.8
8	0.4	15.7
9	0.45	15.5
10	0.5	14.75

Table 2: CBR Value at Different Proportion Of Plasatic Strips

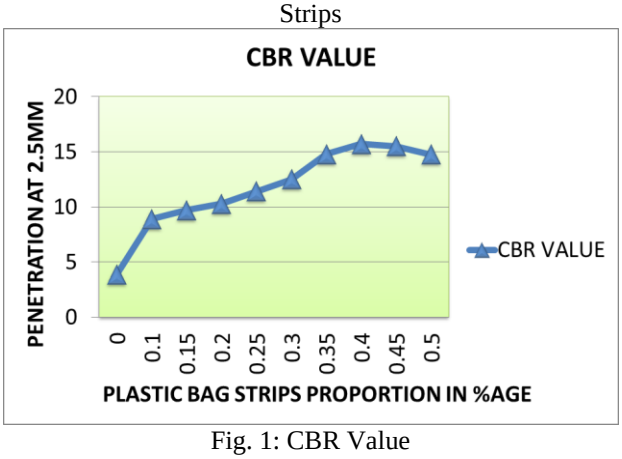

Fig. 1: CBR Value

IV. Conclusions

From this study, we can conclude that plastic strips can be used to increase the CBR value of a soil considerably. We can conclude from the results obtained after performing the test with plastic bags strips that 0.4% of the total weight of the soil is the optimum proportion of strips cut from plastic bags to be added to the soil for reinforcement. But it decreases when further amount of plastic bag strips is added.

References

[1] K. shyaam Chamberlin, Assistant Professor, Dept of Civil Engineering, KL University, Vijayawada, AP India. Stabilization of Soil by Using Plastic Wastes.
[2] Pragyan Bhattarai, A. V. A Bharat Kumar, K. Santosh, T. C. Manikanta& K. Tejeswini. Engineering behaviour of soil reinforced with plastic strips.
[3] Kalumba D., Chebet F. C. University of Cape Town, South Africa. Utilisation of polyethylene shopping bags waste for soil improvement in sandy soils.
[4] Rajkumar Nagle, Geotechnical Engineering M.E. Student, Dept. of Civil Engineering, Jabalpur Engineering College, Jabalpur, India .
[5] Prof. R.Jain, Prof. A.K. Shinghi, Prof, Dept. of Civil Engineering, Jabalpur Engineering College, Jabalpur, India. Comparative study of CBR of soil, reinforced with natural waste plastic material.
[6] IS: 2720(Part-16) -1987 Methods of test for soil part-16, laboratory determination of CBR.
[7] IS: 2720(Part-V) -1985 Methods of test for soil part-5, determination of liquid and plastic limit.
[8] IS: 2720(Part-XXIX) -1975 Methods of test for soil part-29, determination of dry density of soils in-place by the core-cutter method.
[9] IS: 2720(Part-IV) -1985 Methods of test for soil part-4, grain size analysis.
[10] IS: 2720(Part-40)-1970 Methods of test for soil part-40, determination of free swell index of soil.

