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Stabilization of Black Cotton Soil using Plastic Granules

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Abstract: A review paper is presented here to focus on soil stabilization by using waste plastic products. Soil stabilization is the process which improves the physical properties of soil, such as shear strength, bearing capacity which can be done by use of controlled compaction or addition of suitable admixtures like cement, lime, sand, fly ash or by providing geo textiles, geo synthetics etc. The new technique of soil stabilization can be effectively used to meet the challenges of society, to reduce the quantities of waste, producing useful material from non-useful waste materials. Various experiments were conducted and found that there is improved performance when compared to conventional soil.

Keywords: Black Cotton Soil, CBR, OMC, MDD, Plastic fibers, UCS and Stabilization.

I. INTRODUCTION

Industrial development in India has necessitated construction of infrastructure facility such as highways, airports seaports and residential, commercial buildings. There is a need to select a good soil conditions for proper safety consideration of all these projects. Such soils exhibit extreme stages of consistency from very hard to very soft when saturated. Expansive soils contain minerals that are capable of absorbing water. They undergo severe volume changes corresponding to changes in moisture content. They swell or increase in their volume when they imbibe water and shrink or reduce in their volume on evaporation of water.

A. Objectives of using plastic granules:

- To minimize the waste.
- To minimize volumes accumulating and taking over area within the waste dumping yard.
- To reduce the prices of storage and disposal.
- To reduce the extraction of natural sand.
- To reduce the extraction of natural sand.

B. Scope of the work:

- The use of plastic has to be limited by now otherwise there would be harshly Situation that human and environment has to face in near future.
- Since Plastic is a non-decomposable material, the requirement for recycling or re-using it is also increasing there by reducing its wastage.
- Utilizing this Plastic waste for a positive purpose assists in reducing its effect on environment also.
- The proper quantity in soil helps in controlling the compaction factor and also makes it very useful.
- This study indicates that Plastic wastes can be utilized for stabilization of soil which is fulfilled from different tests performed on soil in various percentages of plastic content

II. LITERATURE REVIEW

A. Dr. A.I. Dhatrak: In 2015 after reviewing performance of plastic waste mixed soil as a geotechnical material, It was observed that for construction of flexible pavement to improve the sub grade soil of pavement using waste plastic bottles chips is an alternative method . In his paper a series of experiments are done on soil mixed with different percentages of plastic to calculate CBR. On the basis of experiment that he conducted using plastic waste strips will improve the soil strength and can be used as sub grade. It is economical and eco-friendly method to dispose waste plastic because there is scarcity of good quality soil for embankments and fills.

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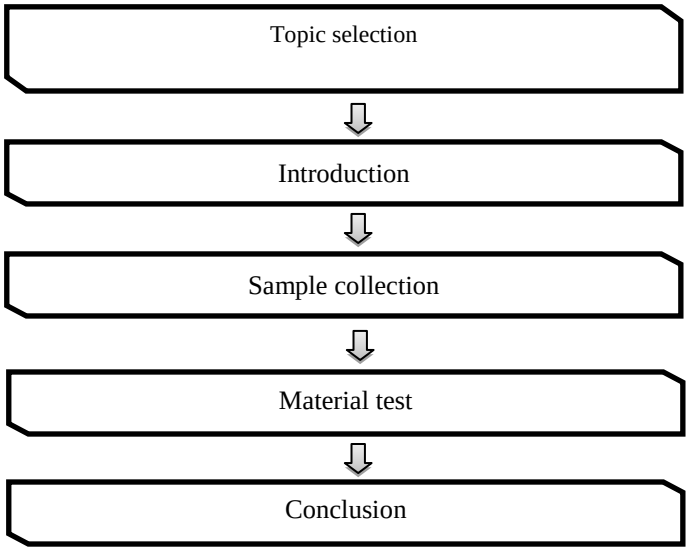
B. Akshat Malhotra and Hadi ghasemain: In 2014 studied the effect of HDPE plastic waste on the UCS of soil. In a proportion of 1.5%, 3%, 4.5% and 6% of the weight of dry soil. HDPE plastic waste was added. They concluded that the UCS of black cotton soil increased on addition of plastic waste.

C. Choudhary, Jha and gill: In 2010 demonstrated the potential of HDPE to convert as soil reinforcement by improving engineering properties of sub grade soil. From waste plastic HDPE strips are obtained and mixed randomly with the soil and by varying percentage of HDPE strips length and proportions a series of CBR tests were carried out on reinforced soil. There results of CBR tests proves that inclusion of strips cut from reclaimed HDPE is useful as soil reinforcement HDPE is useful as soil reinforcement in highway application.

D. Rajkumar Nagle: In 2014 performed CBR studied for improving engineering performance of sub grade soil. They mixed polyethylene, bottles, food packaging and shopping bags etc. as reinforcement with black cotton soil, yellow soil and sandy soil. Their study showed that MDD and CBR value increases with increase in plastic waste. Load bearing capacity and settlement characteristics of selected soil materials are also improved.

E. Mercy joseph poweth: In 2013 investigated on safe and productive disposal of quarry dust, type waste and wastes-plastic by using them in the pavements sub grade. In their paper a series of CBR and SPT test were carried out for finding the optimum percentages of waste plastics, quarry dust in soil sample. The results shows only quarry dust should be mixed with the soil plastic mix, to increase its maximum dry density and is suitable for pavement sub grade. Types alone are not suitable for sub grade. They concluded that Soil plastic mixed with quarry dust maintains the CBR value within the required limit. Soil type mixed with quarry dust gives lesser CBR value than soil plastic quarry dust mix but it can be used for pavement sub grade.

III. METHODOLOGY



IV MATERIALS USED

Material specification for plastic granules has been mentioned below,

A. Black cotton soil

Though black cotton soils are very fertile soils, they are not good as road or construction foundation. Black cotton soils are expansive clays with high potential for shrinking or swelling as a result of changing moisture content. Due to intensive shrink-swell processes, surface cracks resulting in openings during dry seasons. These openings are usually more than 50mm wide and several millimeters deep. Cracks disappear during wet season but an uneven soil surface stays as a result of irregular swelling and heaving. The black cotton soils have low strength and are susceptible to excessive volume changes, making their use for construction purposes very difficult. Instability of these soils cause more damage to structures, than any other natural hazard, including earthquakes and floods, unless proper black cotton soil stabilization performed.

B. Plastic granules

LDPE is the low density version of PE. This has less hardness, stiffness and strength compared to HDPE, but better ductility. It is opaque and only thin foils can be transparent. LDPE is defined by a density range of 0.910â€“0.940 g/cm3. It is not reactive at room temperatures, except by strong oxidizing agents, and some solvents cause swelling. It

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can withstand temperatures of 80 Â°C continuously and 95 Â°C for a short time. Made in translucent or opaque variations, it is quite flexible and tough. LDPE has more branching (on about 2% of the carbon atoms) than HDPE, so its intermolecular forces (instantaneous-dipole induced-dipole attraction) are weaker, its tensile strength is lower, and its resilience is higher.

C. Mixing

In this method, the maximum dry density and optimum moisture content of soils is obtained by using the 5%,10%,15% of plastic granules results of one point on a standard proctor curve to enter a family of curves from which the maximum dry density and optimum moisture content can be determined.

IV. TESTS CONDUCTED

We have compared the results of black cotton soil using plastic granules made by conducting following tests.

A. Test carried out for the black cotton soil:

- Specific gravity
- Liquid limit
- Plastic limit
- Sieve analysis

Soil with plastic granules

- Compaction test
- SBR test

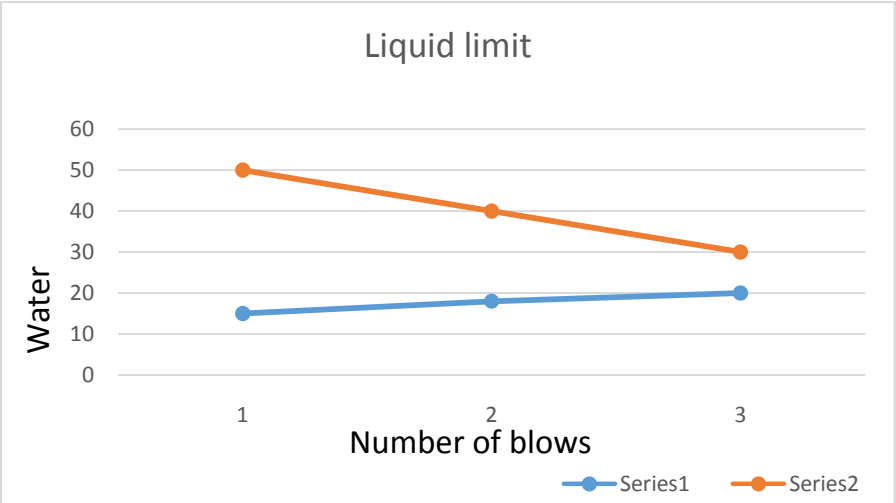
V. MATERIAL TEST RESULTS

A. Sieve Analysis:

Sample	W1 in gms	W2 in gms	W3 in gms	W4 in gms	Specific gravity
1	616	1015	1674	1426	2.7

B. Liquid limit

Sl no	Description	1	2	3
1	No of blows	80	55	35
2	Container number	1	2	3
3	Wt of container+wet soil	21.1	19.2	21.1
4	Wt of container+dry soil	20.6	18.9	21.0
5	Wt of water	0.5	0.3	0.2
6	Wt of container	12	12	12
7	Wt of dry soil	8.6	6.9	9.0
8	Moisture content	0.058	0.043	0,022
9	Moisture content in percentage	5.8%	4.3%	2.2%



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C.Plastic limit

Description	Trial1	Trial2	Trial3
Wt. of empty	12	12	12
Wt. of pan+wet soil	21.1	19.2	21.2
Wt. of pan+dry soil	20.6	18.9	21.0

D.Sieve analysis

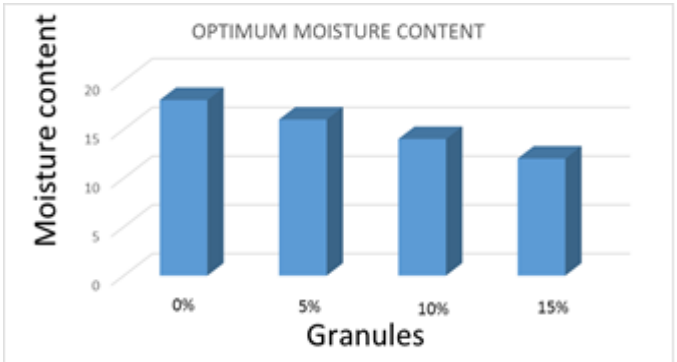
SI NO	SIEVE IN mm	WT OF SOIL RETAINED	% WT	CUMULATIVE % RETAINED	%
1	4.7	0.782	26.067	26.06	73.94
2	2	0.222	7.4	33.46	66.54
3	3.35	0.085	2.83	36.29	63.71
4	1.8	1.353	45.1	81.39	18.61
5	0.71	0.229	7.63	89.39	10.98
6	0.3	0.186	6.2	95.22	4.78
7	0.75	0.083	2.76	97.98	2.02
8	Pan	0.06	2.02	100	0

E. Discussion about the result

Sl no	Description	Soil	Black cotton soil
1	Specific gravity	2.41	2.7
2	Liquid limit	17%	23%
3	Plastic limit	4.53	5
4	Sieve analysis V	25	50.41
	D10	0.5	0.71
	Cu	1.66	0.69
	Cc	0.926	2.25

F. Standard proctor compaction test

Sl no	Specimen	Optimum moisture content (%)	Maximum dry density(gm/cc)
1	Soil	18	1.6
2	Soil+5% plastic granules	16	1.95
3	Soil+10% plastic granules	14	2.15
4	Soil+15% plastic granules	12	2.35



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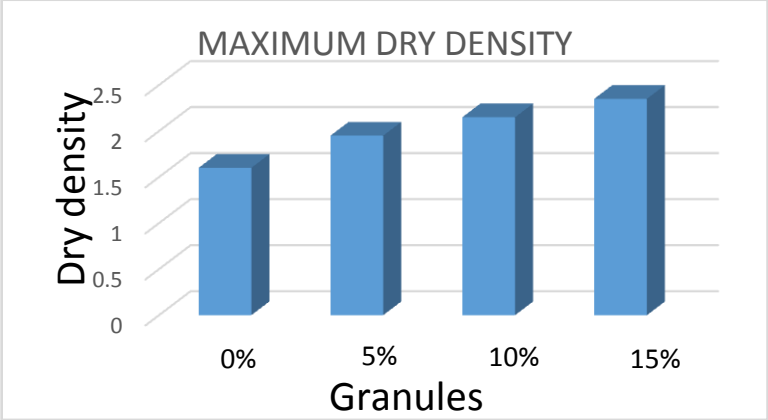
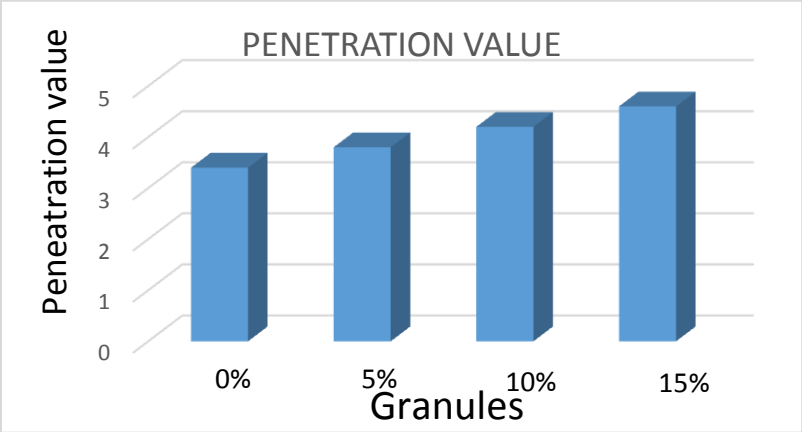


G. CBR TEST

Sl no	Specimen	Penetration value (%)
1	Soil	3.4
2	Soil+5% plastic granules	3.8
3	Soil+10% plastic granules	4.2
4	Soil+15% plastic granules	2.35



VI. CONCLUSION

From our investigation on soil, the CBR value of the soil is improved due to the addition of plastic strips. Plastic can be utilized as one of the material that can be used as a soil stabilizing agent but the proper proportion of plastic must be there, which helps in increasing the CBR of the soil. It can be concluded that CBR percentage goes on increasing up to 4% plastic content in the soil and thereon it decreases with increase in plastic content .Optimum moisture content will be increased 2%.in a standard proctor compaction test to using the plastic granules. And also increase the dry density in CBR test the penetration value will be increased to using the plastic granules.

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