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Estimation of Flexible Pavement by Using Stabilized Soil with Waste Plastic Granules

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Abstract - In construction of road different civil engineering plan on highly-priced soil is volatile due to its excessive compressibility, high permeability and less shear strength. Than plastic stabilization is one of the techniques which is in use of stabilization black cotton soil from the past few decades. Use of plastic reduces the high plasticity of black cotton soil and makes its workable. In this paper, effect of blended waste plastic granules in various per percentages on mass dry density (MDD), optimum moisture content (OMC). The percentage of waste plastic granules by dry weight of soil was taken as 1.25%, 2.5%, 3.75%, 5%, and 6.25%. with the addition of plastic to the sample of soil there is an increase in the cohesion of soil which leads to increase in UCS of the soil but further increase in the plastic content leads to decrease in the cohesion and, there by decrease in the strength.

***Key Words*: Soil stabilization, Waste plastic granules, California Bearing Ratio (CBR), Standard Proctor Test, Estimation of Road, Flexible Pavement Design.**

1. INTRODUCTION

Now, a day there is usage problem of plastic waste in Maharashtra (India). India generates close to 26,000 tonnes of plastic a day according to a CPCB estimate from 2019, worse a little over 10,000 tonnes a day of plastic waste remain uncollected. Uncollected plastic waste eventually ends Up in the natural environment in our seas and oceans or piling up on our lands. And India the world second-most populous country, generate ground 5-6 million tonnes of plastic waste annually, according to government figures. Exposure to a compound commonly found in plastic food containers is according to the first large epidemiological study in human. In order to decompose something, it is buried in soil, where bacteria can break it down. Decomposed organic material is then recycled. The broken down organic compound provide food for plants, enrich the soil and feed other living things. The problem with decomposing plastic is that plastic is not organic. Expansive soils such as black cotton soil create problems in foundation and for this stabilization of soil is requires. The plastic inclusion can improve the strength thus increasing the soil bearing capacity of soil. Use of plastic waste as reinforcement which reduces the disposal problem of the waste material. In future we can combine 2 or more waste product in it by considering this project as a base. We can decrease the amount of construction of road project.

2. LITRATURE REVIEW

Sr. No.	Authors Name	Material Use	Test Conducted
1	Prof. B. S. Hotti	Plastic Pet Granules	Specific gravity, Liquid limit (WL), Plastic limit (Wp), Plasticity index (Ip), Shrinkage limit, Classification of soil.
2	Prof. Sharan Veer Singh	Plastic Waste	California bearing ratio, unconfined compressive strength, protor test, Specific Gravity.
3	Prof. Kirubakaran.K	Pet Bottles	Standard proctor compaction test, Hydrometer test, Unconfined compressive strength, Specific gravity, california bearing ratio.
4	Prof. Subash K	Plastics And Glass	Maximum Dry Density (γd), Optimum Moisture Content (OMC), Unconfined Compressive Strength, (qu) CBR-Unsoaked (%)CBR-Soaked (%), Ultimate Bearing Strength.
5	Prof. Mercy Joseph Powethet	Plastic	Proctor's Test, CBR test, Direct Shear test, Max shear stress.
6	Prof. Ashutosh Bhadoriya	Plastic Fibre Waste, Glass Waste	CBR test, Specific Gravity, unconfined compressive strength, proctor test.
7	Prof. Venkata	Plastic Material	CBR, Specific Gravity, standard

	Srinivas		proctor.

3. SAMPLE COLLECTION

1) Black Cotton Soil:

The Black cotton soil used for the study was collected from Ramnagar (Aurangabad dist., Maharashtra state, India). Major soil deposits in the Ramnagar are Black Cotton Soils. This is very useful for agriculture and also useful for tree planting but not good for civil engineering project or road construction. The road laid on black cotton soil bases develop undulation at the road surface due to loss of strength of the sub grade through sifting during monsoon. Due to its peculiar characteristics, it forms a very poor foundation material for road construction.

Table -1: Properties of Normal Soil

SR.NO.	PROPERTIES OF NORMAL SOIL	VALUE
1	Liquid Limit	48.73%
2	Plastic Limit	22.07%
3	Specific Gravity	2.37
4	Moisture Content	18.48%
5	Dry Density	1.42gm/cc
6	CBR Value	3.48%

2) Waste Plastic Granules (WPG):

Recycled plastic roads could be more environmentally friendly then asphalt Volker Wessel the Dutch new roads from recycled plastic. The plastic road will be a great alternative to conventional roads, which consume too much time, and effort. Waste plastic granules are the products are collected from Kohinoor Plastic's chikalthana MIDC.

3.1 EXPERIMENTAL ANALYSIS

In this project we have to obtain the graphical relationship of the "dry density" to "moisture content" in the form of "compaction curve", for determining the values of Optimum Moisture Content (OMC) and Maximum Dry Density (MDD).

OMC & MDD observations:

Table -2: Observation Table for OMC & MDD

SR. NO.	MATERIAL	OMC	MDD
1	Plain Soil	18.48	1.42
2	Soil+1.25% Plastic Waste Granules.	18.09	1.55
3	Soil+2.5% Plastic Waste Granules.	17.81	1.68
4	Soil+3.75% Plastic Waste Granules.	17.18	1.73
5	Soil+5% Plastic Waste Granules.	17.01	1.85
6	Soil+6.25% Plastic Waste Granules.	18.09	1.62

The percentage of waste plastic granules by dry weight of soil was taken as 1.25%, 2.5%, 3.75%, 5%, and 6.25%. with the addition of plastic to the sample of soil there is an increase in the cohesion of soil which leads to increase in UCS of the soil but further increase in the plastic content leads to decrease in the cohesion and, there by decrease in the strength.

CBR value observations:

Table -3: Observation Table for CBR Value with Soil & Plastic Waste Granules

SR.NO.	MATERIAL	CBR VALUE OF SOIL AND SOIL+ WPG
1	Plain Soil	3.48
2	Soil+1.25% Plastic Waste Granules.	4.46
3	Soil+2.5% Plastic Waste Granules.	5.27
4	Soil+3.75% Plastic Waste Granules.	5.87
5	Soil+5% Plastic Waste Granules.	6.42
6	Soil+6.25% Plastic Waste Granules.	5.65

3.2 Graphical Analysis of CBR, Specific Gravity, Standard Proctor Test, and OMC, MDD.

1. Liquid Limit: - determine liquid limit of soil specimen by Casagrande method the liquid limit of soil is the water content at which the soil behaves practically like a liquid, but has small shear strength. It flows to close the groove in just

25 blows in casagrandes liquid limit. and the value of liquid is 48.73%.

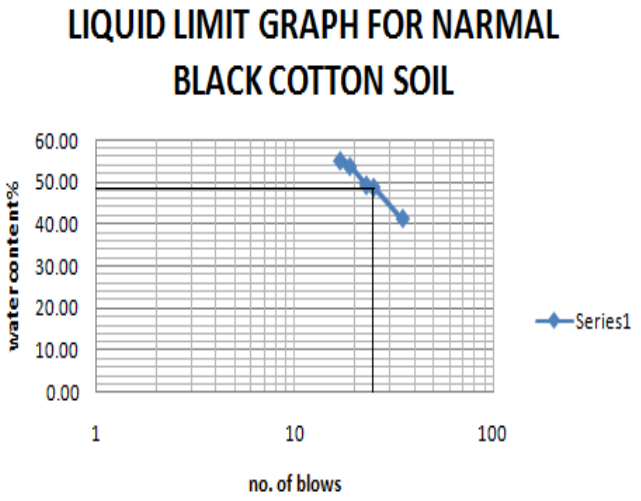

Chart -1: Liquid Limit Graph for Normal Black Cotton Soil

2. OMC and MDD with Soil and Waste Plastic Granules: - Compaction is the process of packing soil particles closely to gather thereby reducing voids and removing g air from voids by dynamic load. There is an optimum amount of mixing water for a given soil and compaction process, which will give a maximum weight of soil per unit volume. This process increases dry density of soil.

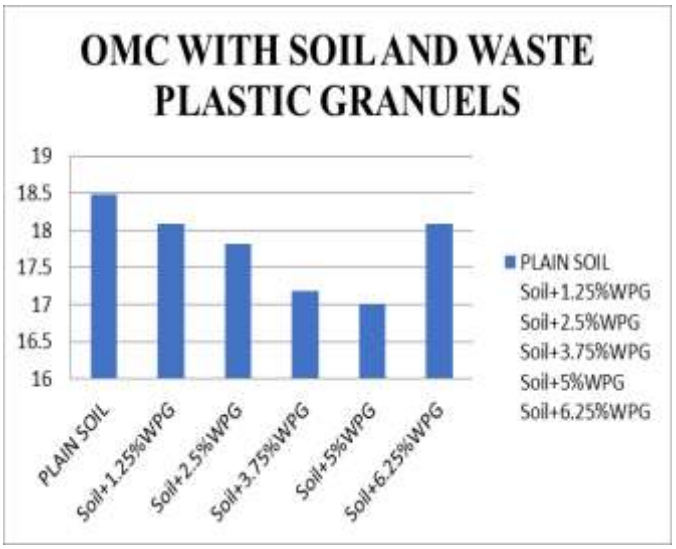

Chart -2: OMC Graph with Soil & Plastic Waste Granules

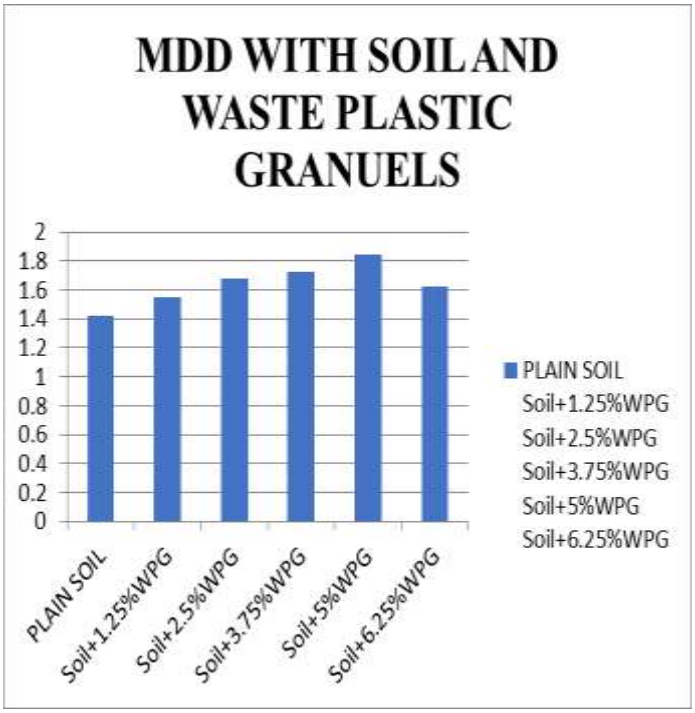

Chart -3: MDD Graph with Soil & Plastic Waste Granules

3. CBR Value of Soil and With Waste Plastic Granules: - Tests are carried out on natural or compacted soils in water soaked or un-soaked conditions and the results so obtained are compared with the curves of standard test to have an idea of the soil strength of the subgrade soil.

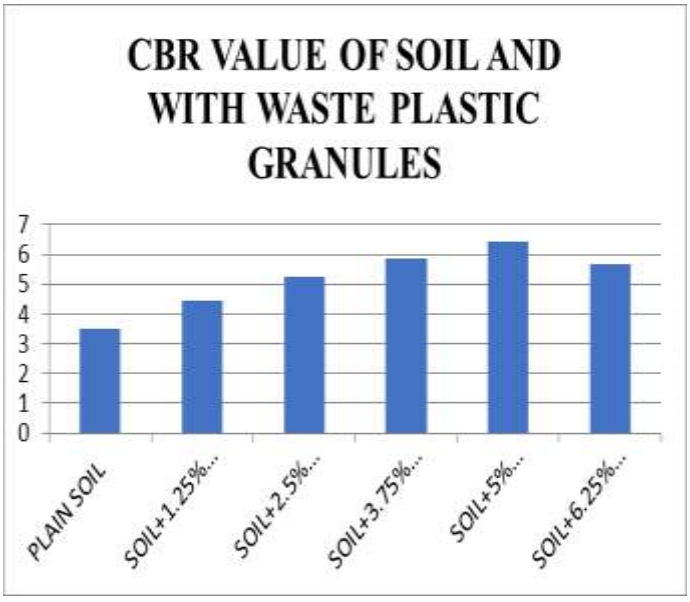

Chart -4: CBR Value Graph of Soil and Plastic Waste Granules

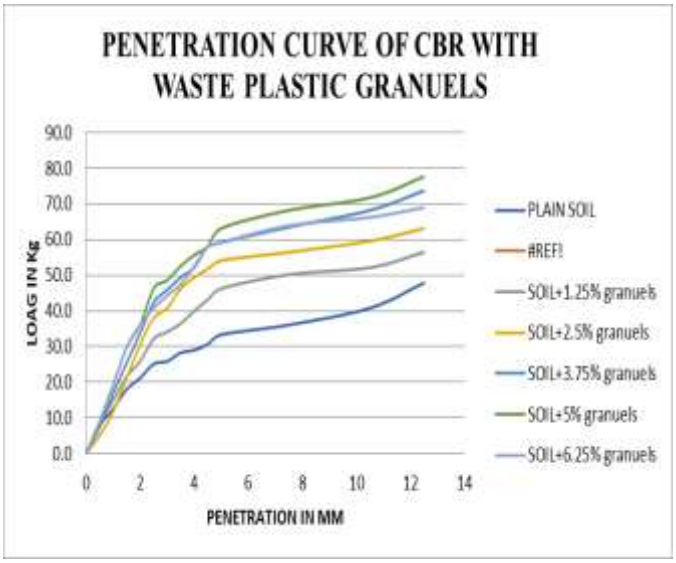

Chart -5: Penetration Curve of CBR with Waste Plastic Granules

4. Flexible Pavement Design as per IRC-37-2001

Traffic Count Survey: - The Calculation of vehicles is done with the traffic data and axle load survey as per IRC 37:2001. The design procedure given by IRC makes use of the CBR value, million standard axle concept, and vehicle damage factor.

Table -4: Data Required For Road Pavement Design

Sr. No.	Available Data	Value
1	Design of CBR of Subgrade Soil	6.42%
2	Design Life of Pavement (n)	15 year
3	Annual Growth rate (r)	7.5%
4	Distribution of Commercial vehicle (D)	0.75
5	No. of years between the last count and the year of completion of construction (x)	1

4.1 Design Calculation of Pavement thicknesses: - Similarly the thickness of different material with soil can be calculated as below,

Table -4 Total Thickness of Pavement with Different Material

Sr. No.	1	2
Material	Soil	Soil +5% Plastic granules
Design CBR (%)	3.48	6.42
Total Pavement Thickness (mm)	760	580
Wearing Course (mm)	40	40
Binder Course (mm)	100	90
Granular Base (mm)	250	250
Granular Sub-base (mm)	370	300

4.3 ESTIMATION OF ROAD:-

1. The surface of earth under construction is plane i.e. no cutting and filling is required or cutting and filling is already done.
2. The depth of black cotton soil is up to 200 mm. hence the depth of excavation is 200 mm.
3. The pavement is considered as single lane, therefore the width of carriage way is 3.75 m and the width at subgrade is 4.75m.
4. The length of pavement is 1km and thickness of each layer is considered as per stabilized material.

In normal soil there is CBR value 3.8 with respect to CBR there is a thickness of pavement is 760mm and its total road estimate is 8215175/- and when addition of 5% waste plastic granules pavement thickness is 580mmAnd its total road estimate is 7309334/- when waste plastic granules is added in construction of road then deducted construction cost is 12.39% from Total road estimate cost.

3. CONCLUSIONS

1) Addition of waste Plastic granules in varying percentages resulted in overall increase in MDD. The MDD of 1.85gm/cc was obtained at 5% waste Plastic granules mixed with the soil.

2) Addition of waste Plastic granules in varying percentages showed a similar trend in the variation of OMC. The OMC curve shows an overall increase in the OMC. The maximum value of OMC was obtained as 17.01 % at 5% of waste Plastic granules mixed with the soil.

3) The maximum CBR value was obtained as 6.42%, nearly about 2 times the CBR value of the normal black cotton soil. This maximum CBR value was obtained with 5% waste Plastic granules by dry weight of soil and hence was taken as the optimum percentage of waste Plastic granules for stabilizing the soil. The addition of waste Plastic granules into soil increased the CBR value from 3.48% to 6.42% i.e., 2 times the CBR value obtained for normal black cotton soil.

4) In normal soil there is CBR value 3.8 with respect to CBR there is a thickness of pavement is 760mm and its total road estimate is 8215175/- and when addition of 5% waste plastic granules pavement thickness is 580mm

And its total road estimate is 7309334/- when waste plastic granules is added in construction of road then deducted construction cost is 12.39% from Total road estimate cost.

REFERENCES

[1] D. Kornack and P. Rakic, "Cell Proliferation without Prof B. S.Hotti1, Aishwarya s Kadabi2, Bhimashankar Kuchabal3, Karthik koganur4, Vinaykumar Padaganur5 1Department of civil Engg, BLDEA college of Engg& Technology,

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