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Soil Stabilization by Using Waste Plastic Powder

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Abstract: Urbanization and industrialization was increased day by day, so usage of plastic also increased in all over the world. But the recycling and reuse of the plastic waste is less when compared to its manufacturing. Nowadays waste plastics are dumped in soil and also affect it severely on foundation. So stabilization of this kind of soil is needed to use for any other civil works. Expensive soil like black cotton is also called regur soil. This project involves the comparison of regur and red soil for the better usage in foundation works. The replacement of soil by plastic waste was conducted in the ratio of 2%, 4%, 6%. California bearing ratio (CBR), Standard proctor test, and permeability test were studied.

Keywords: Black cotton soil, CBR, Plastic powder, Red soil, Soil stabilization.

I. Introduction

Soil stabilization is the alteration of soils to enhance their physical properties and it is effective method. The main aim is to upgrade the strength, stiffness of soil, workability and reduce plasticity index. The Red and regur soil are used in this technique. The Large area of the lands is covering by red soil in the range of 10.6% of India's areas [1]. The presence of high iron content is the main reason for the red color. Regur soils are the inorganic clay. It is not suitable for the structural development, if it provides its leads to high rate of swelling and shrinkage. It is carried by utilize plastic wastages. Plastics play a serious impact in our daily life. Worldwide, in each year over 40 crores tones were produced [2-3]. According to Central Pollution Control Board (CPCM) 56 lakhs Tonnes Per Annum (TPA) of the plastic wastages are produced. Polystyrene (PS), Polypropylene (PP), Polyethylene (PE) and Polyethylene Terephthalate (PET) are present in waste. In this study, properties of soil are upgraded by utilize plastic water bottles which are polyethylene (PE). Without replacing a material, some agents such as plastics, fly ash, rice husk, etc. can be added to develop the properties. Standard proctor test, penetrable test and California bearing ratio (CBR) are to be conducted.

II. Methodology

The Test is conducted on red and regur soil. The soils are compared with their properties based on test result. The wastes plastics are melted, dried and crushed into powder form were added in the ratio of 2%, 4% 6% to the soil and blunded thoroughly. Standard proctor test, penetration test and California bearing ratio (CBR) were conducted for both soil sample [4-6].

III. Determination of Dry Density Relationship

The Aim of this experiment is to determine the relationship between the water content and dry density is utilized by standard proctor test. Plastic powder is used as a stabilizing agent at 2%, 4% and 6%. The ratio of 8%, 10% and 12% of water is added then it is compacted in three layers. Each layer has 25 blows then it weighed. The test results and the graphical representation are mentioned below.

Table I: Tabulation for Maximum Dry Density and Optimum Moisture Content of Red Soil and Black Cotton Soil Using Plastic Powder

Plastic Powder Added (%)	Maximum Dry Density (g/cm^3)		Optimum Moisture Content (%)	
	Red Soil	Black Cotton Soil	Red Soil	Black Cotton Soil
0%	1.82	1.74	10	10
2%	1.84	1.77	10	10
4%	1.88	1.68	10	10
6%	1.95	1.73	10	10

Density is increased for both soils with respect to increasing the adding of plastics powder. The optimum moisture content is 10%. Red soil has high density than black cotton soil.

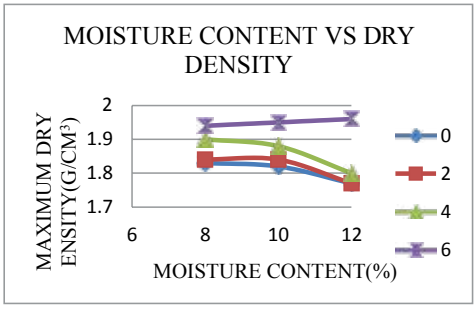

Fig. 1: Graphical Representation Between Maximum Dry Density and Moisture Content of Red Soil

In this graph, x-axis is moisture content and y- axis is maximal dry density. In overall, 6% has the high values than others.

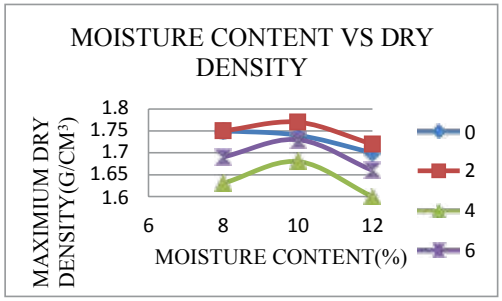

Fig. 2: Graphical Representation Between Maximum Dry Density and Moisture Content of Black Cotton Soil

From this tabulation and graphical representation it is shows that maximal dry density is obtained in red soil than regur soil.

The optimum water content is taken in 10%. When 6% of plastic powder is added with Red soil, the maximal dry density is obtained and when 2% of plastic powder is added with regur soil the maximal dry density is obtained.

IV. Determination of Permeability Test

The aim of this experiment is to determine the yield of water bearing strata of red and regur soil by conducting constant head method. Same amount of plastics powder is to be added which is followed in CBR test. For constant head method, makes the steady flow of water at regular interval. Before that the water tube shall be connected to the top of the inlet and bottom inlet is opened. The readings and graphical representations are mentioned below.

Discharge and permeability is decreased for both soil with respect to increasing of plastics powder. Black cotton soil has less values than the red soil.

Table II: Tabulation for Co-efficient of Permeability and Discharge of Red Soil and Black Cotton Soil Using Plastic Powder are Compared

Plastic Added (%)	Discharge (ml)		Co-efficient of Permeability	
	Red Soil	Black Cotton Soil	Red Soil	Black Cotton Soil
0%	230	100	2.9	1.26
2%	180	90	2.21	1.10
4%	100	70	1.60	1.12
6%	80	40	0.73	0.70

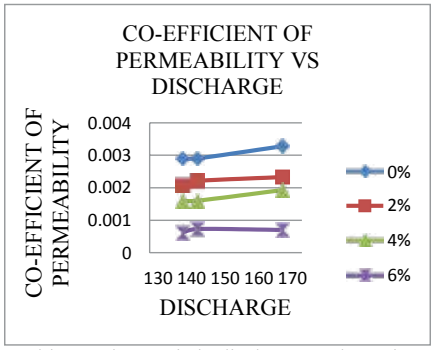

Fig. 3: Graphical Representation Between Discharge and Co-efficient of Permeability of Red Soil

In this graph, x-axis is discharge and y-axis is permeability. In comparison shows that 6% is less permeability.

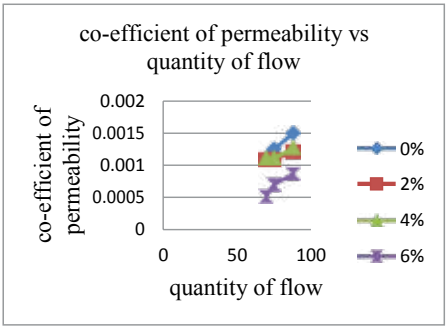

Fig. 4: Graphical Representation Between Discharge and Co-efficient of Permeability of Black Cotton Soil

From Table II, Fig. 3 & 4 shows that penetrable decrease for both soils. Depends on penetrable quantity of flow are decreases.

V. Determination of California Bearing Ratio

The aim of the experiment is to determine California bearing ratio by conducting a load penetration test. Plastic powders are used as stabilizing agent at 2%, 4%, 6% and mix thoroughly. Then soil is filled in the mould and tested. The readings and graphical representation are tabulated below.

TABLE III: TABULATION FOR 2.5MM AND 5.0MM PENETRATION OF RED AND REGUR SOIL ARE COMPARED

Plastic Added (%)	Penetration (mm)			
	Red Soil		Black Cotton Soil	
	2.5	5.0	2.5	5.0
0%	1.5	2.20	0.9	1.40
2%	2.10	2.61	1.40	2.41
4%	2.41	2.81	1.5	1.60
6%	2.62	2.86	1.40	2.61

In penetration, 2.5mm and 5mm are the constant values to be note the readings. Red soil has high penetration than regur soil.

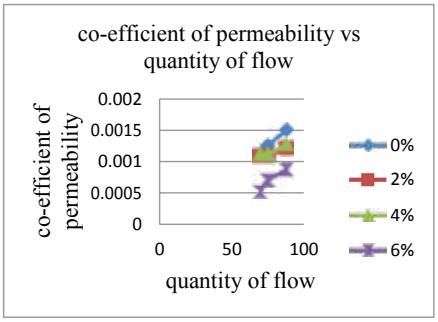

Fig. 5: Graphical Representation Between 2.5mm and 5.0mm Penetration of Red Soil

In this graph, x-axis is load and y-axis is penetration. It shows that 6% is having high penetrations.

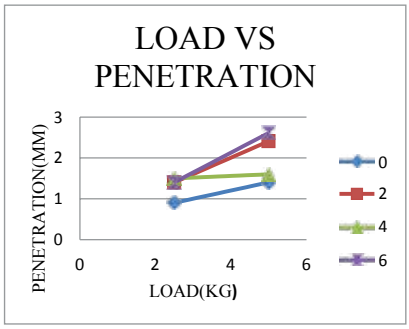

Fig. 6: Graphical Representation Between 2.5mm and 5.0mm Penetration of Regur Soil

VI. CONCLUSION

According to the soil, tests are carried and stabilized. In include of 0%, 2%, 4%, 6% of plastics powder result that 6% is having the better properties than 0%, 2%, 4%. When adding percent is increased, their properties also increased. Permeability and discharge are decreased with respect to the increase of plastics powder. This technique is suitable for the place which soil is contaminated by plastics. CBR values are increased by using plastics bottles while adding 6% of plastic powder.

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