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1) *Clay Soil Stabilization Using Plastic (Polythene) Waste as Admixture*

Mayank Dave[1], Deepanshu Solanki[2], Dr. D.G.M Purohit[3]
[1, 2] *M.E Scholar, Dept. of Civil Engineering, M.B.M Engineering College, J.N.V University, Jodhpur, Rajasthan, India*[1]
[3] *Professor, Dept of Civil Engineering, M.B.M Engineering College, J.N.V University, Jodhpur, Rajasthan, India*[2]

Abstract : The object of the present pape ris to investigate the strength charactersticks of clay soil of western rajasthan stabilized by readily available material of plastic (polythene) waste. Standard proctor test, California bearing test, Direct shear tests were conducted for assessing the suitability of clay soil mixed with polythene strips. This is also a way to reuse of polybag waste with reinforcing the clay soil. It will help in plastic waste removal and management. These materials cannot be disposed of properly and their disposal is not economical. These wastes impose hazardous effect on environment and human health.
Keywords: CBR, Clay, Direct shear, Expansive, Polythene, Stabilization

I. INTRODUCTION

Soil is the main part in the life of geotechnical engineer. Soil is the layer which supports the structure and substructure. Soil stabilization is the process which comprises of every physical, chemical, physio-chemical methods employed to make soil serve better in engineering purposes. Utilization of polythene and plastic wastage is very necessary, soil can be mixed with plastic wastage and can be utilized for the further construction purposes.

Clay soil is not suitable for sub grade as it is expansive in nature, cheaply available polythene can be used as admixture for stabilization has a great scope.

The soil properties are thus improved along with utilization of polythene. The problem of disposal of plastic waste can be solved by using this waste in soil stabilization.

II. MATERIAL USED FOR STUDY

A. Clay Soil

The clay soil sample was collected from the town Bhadrajun which is situated in Jalore district in Rajasthan State. It is about 48 Km north east of Jalore district. Clay soil has poor properties for large scale construction because of swelling properties.

B. Polythene Strips

Polythene was collected and cutted into small strips, The material has low strength. Polythene softening point is 80 degree Celsius and melting point is 105-115 degree Celsius. Polythene is a good electric insulator, it contains long ch-2 chains and hence termed as polythene.Polythene burns slowly with a blue flame having yellow tip and gives odour of paraffin, It consists of high molecular hydrocarbons and the chemical behavior is similar to paraffin.

Figure 1 – Polythene Strips

C. Clay Soil-Polythene Strips Mix

The mixture of clay soil and polythene strips was mixed manually by hand mixing. The strips were mixed in dry clay manually so that it can totally distribute throughout the sample. Water was added afterwards.

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III. EXPERIMENTAL PROGRAMME

The following test programme was conducted:

A. Standard Proctor Test to determine the different dry densities of clay soil

B. CBR to determine CBR values for clay soil with different mix composition with polythene waste in unsoaked and soaked conditions.

C. Direct Shear Test to determine the shear strength of clay soil with different composition mix.

Figure 2 – Direct Shear Box with Mixed Specimen, CBR Test Mix Composition in Mould

IV. TEST RESULTS

A. Standard Proctor Test Results

The OMC and Maximum Dry Density of the plain soil without plastic are obtained as O.M.C is 16 and M.D.D is 1.83 gm/cc and also the other dry densities at water content 10 and 22 are 1.78 gm/cc and 1.69 gm/cc respectively

TABLE 1

S. No.	% WATER ADDED (BY WEIGHT)	DRY DENSITY (gm/cc)
1	8	1.76
2	10	1.78
3	12	1.79
4	14	1.81
5	16	1.83
6	18	1.74
7	20	1.71
8	22	1.69
9	24	1.65
10	26	1.64

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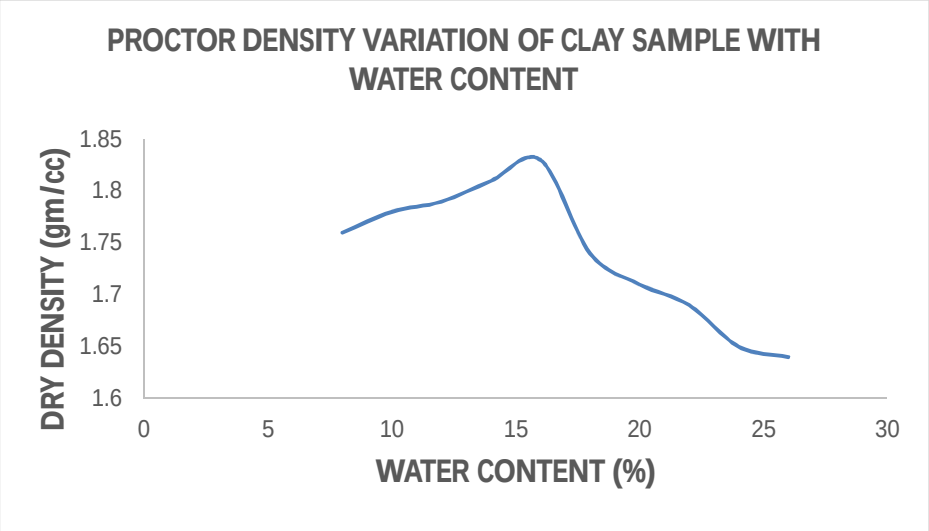

Figure 3: Proctor Density Variation of Clay Sample with Water Content

B. Cbr Test Results

Various CBR test was conducted on sample. Polythene and clay soil was mixed in different percentage. Polythene was mixed in 0.05,0.075,0.25,0.50,0.75,1.0. percentage. Polythene and clay were mixed in above mentioned percentage.

The unsoaked CBR test has three main dry densities for which the data are obtained experimentally. These dry densities are the maximum dry density 1.83 gm/cc, and the other two are 1.78 gm/cc and 1.69 gm/cc.The tabular form of the results of variation of % CBR with mixture of sand and percentage of plastic strip content in unsoaked condition for each dry density. Figure provides the curve between the different percentages of strip content and % CBR values for all the three different dry densities.

TABLE 1: Mix Compositions and Symbols for Unsoaked CBR Test at MDD 1.83 gm/cc

MIX NO.	MIX COMPOSITION	SYMBOL
1	0.05% Plastic + Clay	CB1
2	0.075% Plastic + Clay	CB2
3	0.25% Plastic + Clay	CB3
4	0.50% Plastic + Clay	CB4
5	0.75% Plastic + Clay	CB5
6	1.0% Plastic + Clay	CB6

TABLE 2: Mix Compositions and Symbols for Unsoaked CBR Test at Dry Density 1.78 gm/cc

MIX NO.	MIX COMPOSITION	SYMBOL
1	0.05% Plastic + Clay	CB7
2	0.075% Plastic + Clay	CB8
3	0.25% Plastic + Clay	CB9
4	0.50% Plastic + Clay	CB10
5	0.75% Plastic + Clay	CB11
6	1.0% Plastic + Clay	CB12

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TABLE 3: Mix Compositions and Symbols for Unsoaked CBR Test at Dry Density 1.69 gm/cc

MIX NO.	MIX COMPOSITION	SYMBOL
1	0.05% Plastic + Clay	CB13
2	0.075% Plastic + Clay	CB14
3	0.25% Plastic + Clay	CB15
4	0.50% Plastic + Clay	CB16
5	0.75% Plastic + Clay	CB17
6	1.0% Plastic + Clay	CB18

The CBR values according to test results for unsoaked condition at MDD 1.83 gm/cc with plastic content 0.05%, 0.075%, 0.25%, 0.50%, 0.75% and 1.0% of the clay are 5.961, 6.199, 6.676, 5.722, 5.484 and 4.768 respectively. For mix composition at 1.78 gm/cc dry density with plastic content mix 0.05%, 0.075%, 0.25%, 0.50%, 0.75% and 1.0% of clay weight the CBR values in percentage are 4.768, 5.245, 5.722, 5.007, 4.768 and 4.530 respectively. For mix composition at 1.69 gm/cc dry density with plastic content 0.05%, 0.075%, 0.25%, 0.50%, 0.75% and 1.0% of the clay, CBR values in percentage are 5.722, 6.199, 6.676, 5.961, 5.484 and 5.007 respectively.

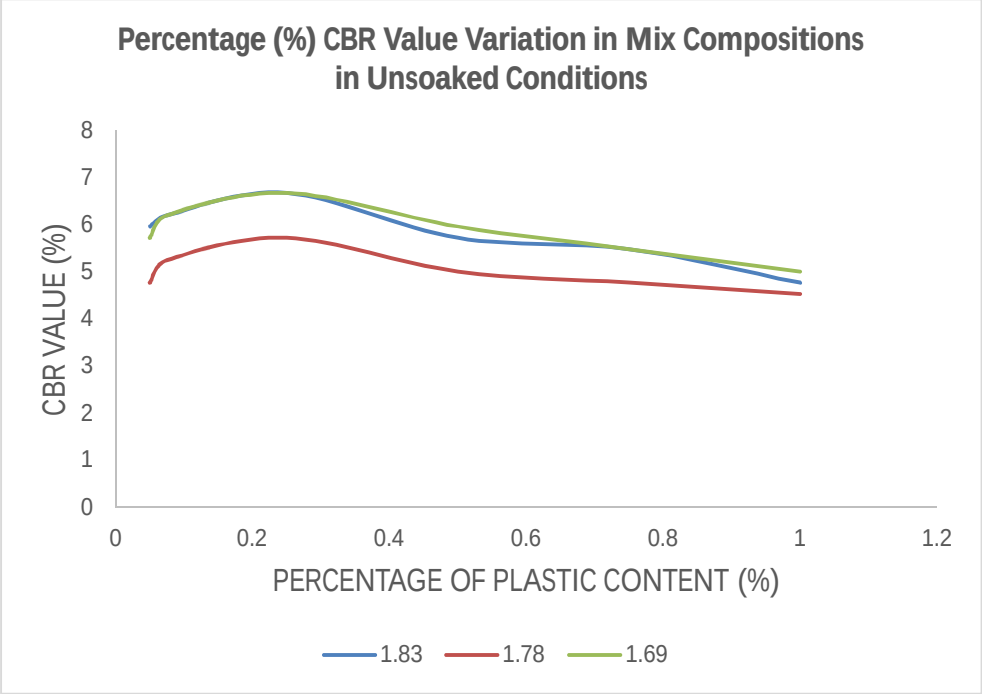

Figure 4: Percentage (%) CBR Value Variation in Mix Compositions in Unsoaked Conditions

C. Direct Shear Test Results

Direct shear test was conducted on the clay soil and polythene mix. The percentage rubber used are 0.5,0.075,0.25,0.50,0.75,1.0.Results of direct shear test at MDD 1.83 gm/cc clay sample are shown in tabular form.

TABLE 4 - Mix Compositions and Symbols for D.S.T. at MDD 1.83 gm/cc Clay

MIX NO.	MIX COMPOSITION	SYMBOL
1	0.05% Rubber + Clay	DB1
2	0.075% Rubber + Clay	DB2
3	0.25% Rubber + Clay	DB3
4	0.50% Rubber + Clay	DB4
5	0.75% Rubber + Clay	DB5
6	1.0% Rubber + Clay	DB6

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TABLE 5 - Variation of φ with Percentage of Plastic at MDD 1.83 gm/cc Clay Sample

S. No.	MIX COMPOSITION	Φ (DEGREE)
1	DB1	14.06°
2	DB2	16.45°
3	DB3	15.15°
4	DB4	13.96°
5	DB5	12.96°
6	DB6	12.99°

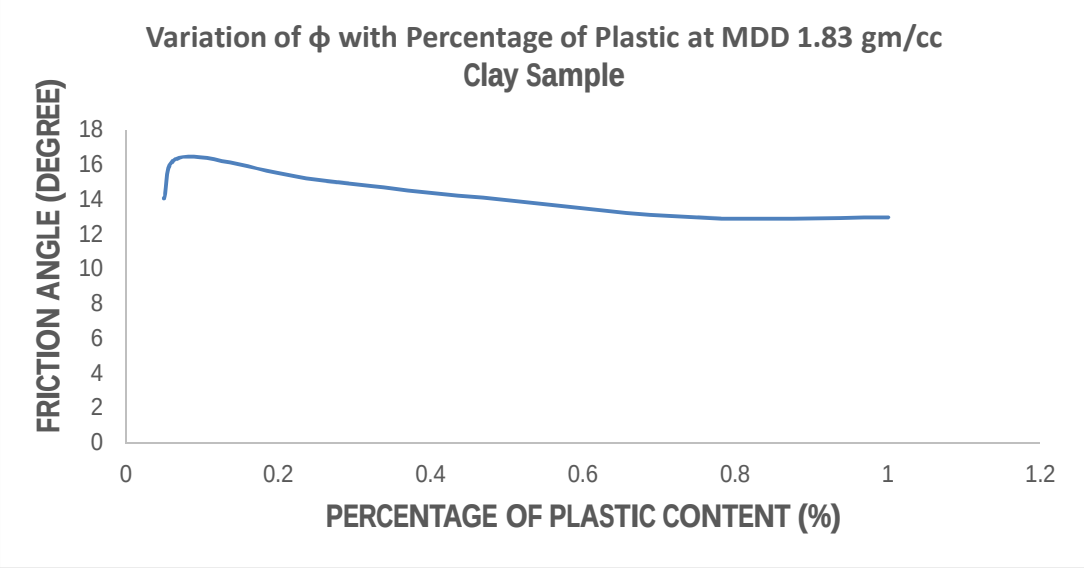

Figure 4: Variation of φ with Percentage of Plastic at MDD 1.83 gm/cc Clay Sample

Table 6-Variation of Shear Stress with Normal Stress for All Mix Composition at MDD 1.62 gm/cc

Shear Stress (kg/cm^2) for each mix composition at	Normal Stress (kg/cm^2)		
MDD 1.66 gm/cc	0.5	1.0	1.5
Clay + 0.05% Plastic Content (DB1)	0.3391	0.4491	0.5866
Clay + 0.075% Plastic Content (DB2)	0.3483	0.4858	0.6416
Clay + 0.25% Plastic Content (DB3)	0.3575	0.5133	0.6325
Clay + 0.50% Plastic Content (DB4)	0.339	0.4583	0.5866
Clay + 0.75% Plastic Content (DB5)	0.3666	0.4766	0.5958
Clay + 1.0% Plastic Content (DB6)	0.3758	0.5316	0.6146

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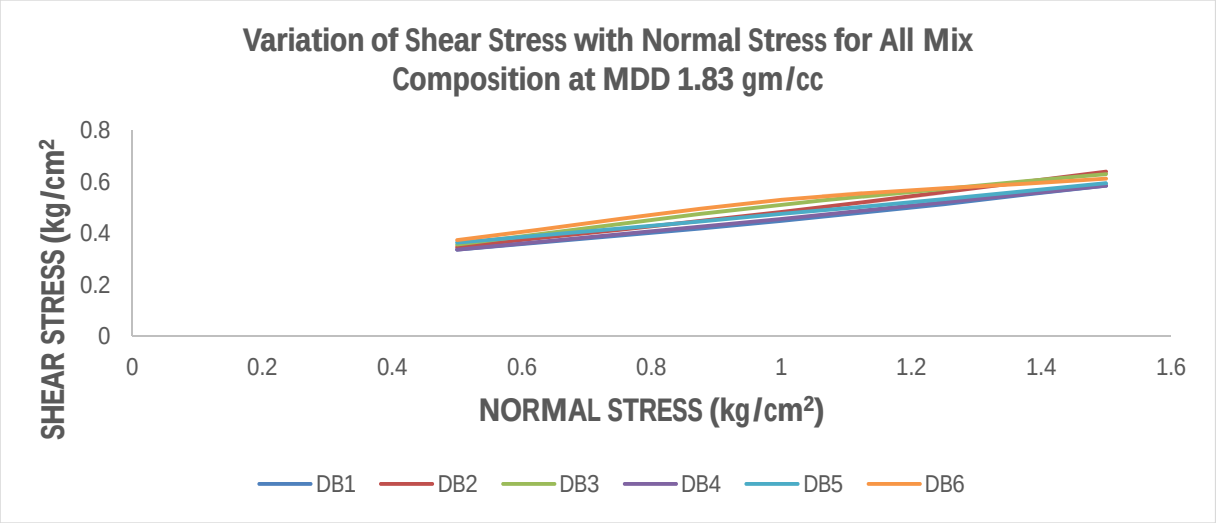

Figure 5: Variation of Shear Stress with Normal Stress for All Mix Composition at MDD 1.83 gm/cc

V. CONCLUSION

In this study, we used polythene waste as a admixture to stabilized clay soil. The clay soil was collected from Bhadrajun town of Rajasthan State (India). It is clearly seen that geotechnical properties of clay soil can be improved by mixing polythene strips as admixture.

According to test results it can be seen that on increment of dry density, the CBR value of the mix composition increases. On increasing the percentage of plastic content firstly the CBR value of the mix composition also increases and then starts to decrease for more percentage of plastic content. The maximum results have been obtained at low percentage of plastic content (0.25%) and minimum results at 1.0% plastic content for all the three dry densities. Hence it can be concluded that to use the mix compositions in base and sub base construction, the CBR values can be increased or decreased as needed.

Shear strength increases with increasing amount of polythene strips. The results of CBR test indicates that the proper mixing of polythene strips in soil with appropriate amount improved strength and deformation behavior of subgrade soil. It is appropriate to say that the reason behind the above conclusion is, the interaction between soil and strips which causes the resistance to penetration of the plunger resulting into higher % CBR Values.

The values of friction angle increases as the dry density of clay increases. The increase in strength in soil is due to increase in friction between soil and polythene waste and development of tensile stress in the polythene.

There is significant improvement in the strength of clay with use of polythene strips. This increase in strength is due to increase in the friction between caly and polythene waste. Tensile strength also developed in the waste content. Better results can be obtained by changing the percentage of the polythene content.

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