

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 6, Issue 10, October 2017

Engineering Properties of Bentonite Stabilized With Plastic (Polythene)

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ABSTRACT: The object of the present paper is to investigate the reinforcing effects of randomly distributed, polythene strips on the behaviour of bentonite. Standard proctor compactions tests and CBR tests are performed to evaluate the mechanical response of reinforced soil in terms of compaction characteristics, and penetration resistance. Plastic strips were cut into different sizes and was mixed with bentonite clay. This study is intended to find out the effect of inclusion of small amount of polythene strips on the shear strength and penetration resistance (CBR) on Bentonite.

KEYWORDS: Bentonite, CBR, Expansive, Polythene, Stabilization.

I. INTRODUCTION

Soil is both a complex and highly variable material. Soil for a geotechnical engineer is the weathered material of earth crust, with or without organic matter. The bonding property of soil depends upon its particle size and is decreasing as the particle size increases. In general, higher clay contents in a soil cause higher plasticity, greater shrinkage and swell potential, higher compressibility and lower shear strength. 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. Stabilization of soil are techniques for improving the mechanical and engineering properties of soil. Improvement of the engineering strength properties of soil using the technique of soil reinforcement involves introducing elements that increase its tensile strength characteristics in order to make up for the limited ability of soil to resist generated tensile loads and shear stresses.

II. RELATED WORK

The stabilization of soil the process by which soil gradation is change and hence its properties like strength are improved, there are various related work in progress regarding this study. The work includes stabilization of bentonite using rubber tyre waste, ldp sheet strips, ceramic tiles waste, glass bottle waste etc.

These are various tools used as admixture for the stabilization of the bentonite clay, Further work is done for the stabilization of dune sand, clay soil etc using different admixtures.

III. MATERIAL USED FOR STUDY

2.1 BENTONITE

Bentonite was collected form a factory situated in the Basni area of Jodhpur district. Bentonite is a clay which consists of montmorinollite mineral. It was named after Wilbur c knight in 1898 after the cretaceous Benton. The different types of bentonite are each named after the respective dominant element, such as potassium (K), sodium (Na), calcium (Ca), and aluminium (Al). Experts debate a number of nomenclatorial problems with the classification of bentonite clays. Bentonite usually forms from weathering of volcanic ash, most often in the presence of water. However, the term

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bentonite, as well as a similar clay called tonstein, has been used to describe clay beds of uncertain origin. For industrial purposes, two main classes of bentonite exist: sodium and calcium bentonite.

2.2 POLYTHENE STRIPS

Polythene was collected and cutted into small strips, Polyethylene absorbs almost no water. The gas and water vapor permeability (only polar gases) is lower than for most plastics; carbons, oxygens. PE can become brittle when exposed to sunlight, carbon black is usually used as a UV stabilizer. Polyethylene is a good electrical insulator. It offers good tracking resistance; however, it becomes easily electrostatically charged (which can be reduced by additions of graphite, carbon black or antistatic agents) Polyethylene is of low strength, hardness and rigidity, but has a high ductility and impact strength as well as low friction. It shows strong creep under persistent force, which can be reduced by addition of short fibers. It feels waxy when touched.



Figure 1 – Polythene Strips

2.3 BENTONITE-POLYTHENE STRIPS MIX

The mixture bentonite 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.

IV. EXPERIMENTAL PROGRAMME

The following test programme was conducted –

- 1- Standard Proctor Test to determine the different dry densities of clay soil
- 2- CBR to determine CBR values for clay soil with different mix composition with polythene waste in unsoaked and soaked conditions.

V. TEST RESULTS

STANDARD PROCTOR TEST RESULTS

The OMC and Maximum Dry Density of the plain soil without plastic are obtained as O.M.C is 24 and M.D.D is 1.35 gm/cc and also the other dry densities at water content 18 and 26 are 1.25 gm/cc and 1.29 gm/cc respectively

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TABLE 1 – Dry density variation with water content for bentonite clay

S. No.	% WATER ADDED (BY WEIGHT)	DRY DENSITY (gm/cc)
1	8	1.13
2	10	1.15
3	12	1.16
4	14	1.2
5	16	1.22
6	18	1.25
7	20	1.3
8	22	1.31
9	24	1.35
10	26	1.29

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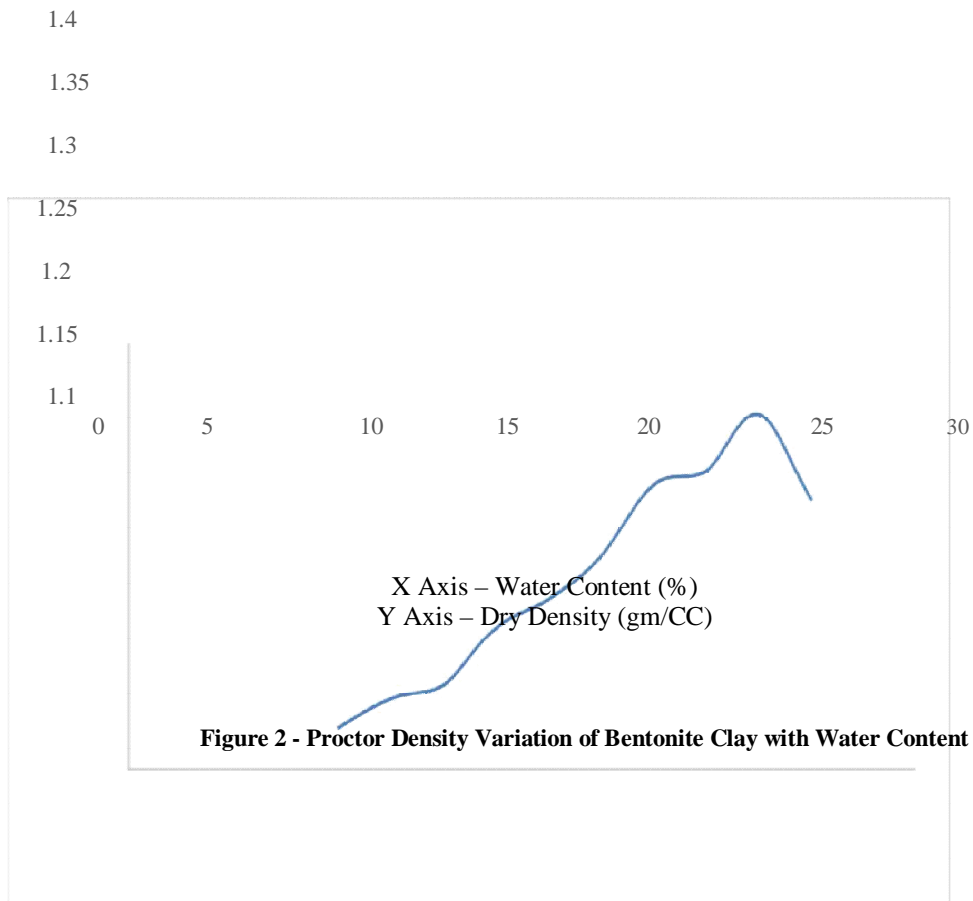
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The proctor density variation of bentonite clay with water content obtained by the standard penetration tests results are shown in the graphical form and a graph is drawn.

PROCTOR DENSITY VARIATION OF BENTONITE CLAY WITH WATERCONTENT



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CBR TEST RESULTS

UNSOAKED CBR TEST AT MDD 1.35 gm/cc
The results of the CBR tests conducted at MDD 1.35 gm/cc

TABLE 2 - Mix Compositions and Symbols for Unsoaked CBR Test at MDD 1.35 gm/cc

MIX NO.	MIX COMPOSITION	SYMBOL
1	0.05% Plastic + Bentonite Clay	CC1
2	0.075% Plastic + Bentonite Clay	CC2
3	0.25% Plastic + Bentonite Clay	CC3
4	0.50% Plastic + Bentonite Clay	CC4
5	0.75% Plastic + Bentonite Clay	CC5
6	1.0% Plastic + Bentonite Clay	CC6

**TABLE 3 - Variation of Unsoaked Percentage (%) CBR Value of Bentonite Clay with
Each Mix Composition at MDD 1.35 gm/cc**

S. No.	MIX COMPOSITION	% CBR VALUE
1	CC1	3.314
2	CC2	4.001
3	CC3	4.143
4	CC4	3.412
5	CC5	3.132
6	CC6	2.810

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UNSOAKED CBR TEST AT DRY DENSITY 1.25 gm/cc

The result of the CBR tests conducted at dry density 1.25 gm/cc are represented.

Mix Compositions and Symbols for Unsoaked CBR Test at Dry Density 1.25

TABLE 4 - Mix Compositions and Symbols for Unsoaked CBR Test at Dry Density 1.25gm/cc

MIX NO.	MIX COMPOSITION	SYMBOL
1	0.05% Plastic + Bentonite Clay	CC7
2	0.075% Plastic + Bentonite Clay	CC8
3	0.25% Plastic + Bentonite Clay	CC9
4	0.50% Plastic + Bentonite Clay	CC10
5	0.75% Plastic + Bentonite Clay	CC11
6	1.0% Plastic + Bentonite Clay	CC12

**TABLE 5 - Variation of Unsoaked Percentage (%) CBR Value of Bentonite Clay with
Each Mix Composition at Density 1.25 gm/cc**

S. No.	MIX COMPOSITION	% CBR VALUE
1	CC7	3.019
2	CC8	3.189
3	CC9	3.891
4	CC10	2.901
5	CC11	2.431
6	CC12	2.656

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UNSOAKED CBR TEST AT DRY DENSITY 1.29 gm/cc

The result of the CBR tests conducted at dry density 1.29 gm/cc are represented.

TABLE 6 -Mix Compositions and Symbols for Unsoaked CBR Test at Dry Density 1.29 gm/cc

MIX NO.	MIX COMPOSITION	SYMBOL
1	0.05% Plastic + Bentonite Clay	CC13
2	0.075% Plastic + Bentonite Clay	CC14
3	0.25% Plastic + Bentonite Clay	CC15
4	0.50% Plastic + Bentonite Clay	CC16
5	0.75% Plastic + Bentonite Clay	CC17
6	1.0% Plastic + Bentonite Clay	CC18

TABLE 7 - Variation of Unsoaked Percentage (%) CBR Value of Bentonite Clay with Each Mix Composition at Dry Density 1.29 gm/cc

S. No.	MIX COMPOSITION	% CBR VALUE
1	CC13	3.812
2	CC14	3.789
3	CC15	4.609
4	CC16	3.813
5	CC17	3.167
6	CC18	2.183

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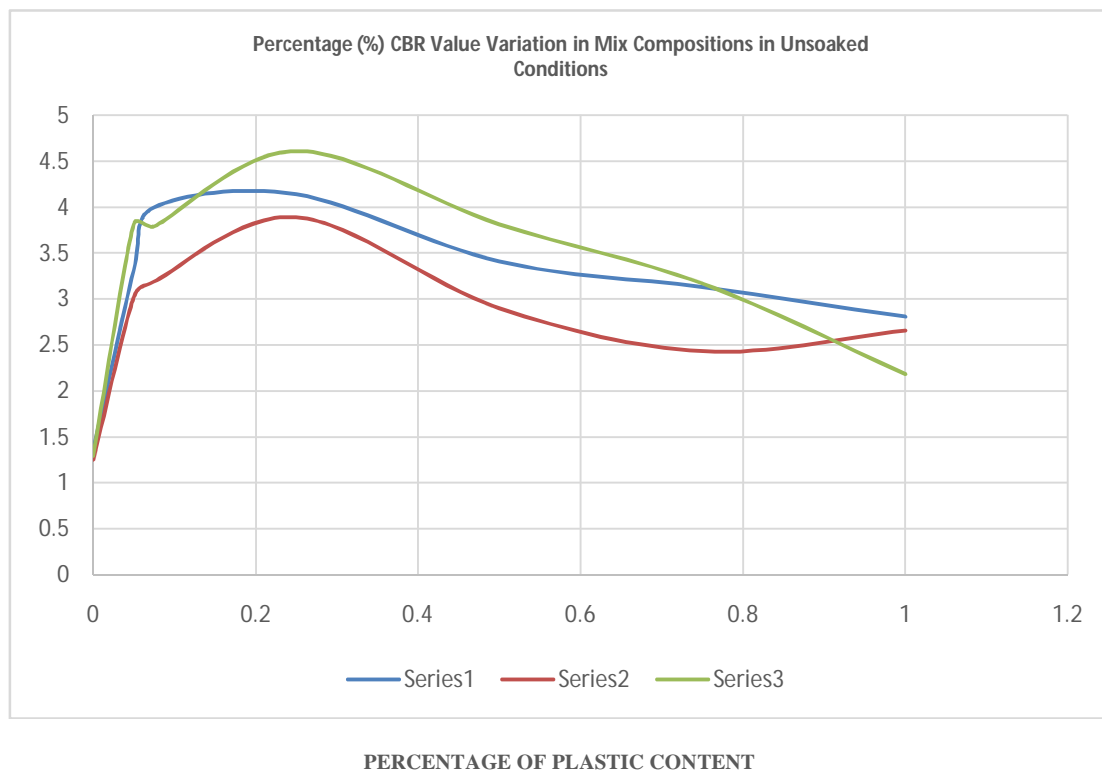
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The tabular form is shown for the various percentage cbr value compositions in unsoaked conditions. For 1.35 gm/cc dry density clay mixed with 0.05,0.075,0.25,0.75,1.0 plastic content are 3.314, 4.001, 4.143, 3.412, 3.132, 2.180. respectively .For 1.25 gm/cc dry density clay mixed with 0.05,0.075,0.25,0.75,1.0 plastic content are 3.019, 3.189, 3.891, 2.901, 2.431, 2.656 respectively. For 1.29 gm/cc dry density clay mixed with 0.05,0.075,0.25,0.75,1.0 plastic content are 3.812, 3.789, 4.609, 4.609, 3.813, 3.167, 2.183 respectively.

The various mix compositions in unsoaked conditions. CBR values are drawn in graphical form in different dry densities. Earlier the tabular form was given to shown the cbr value for the different mix compositions in the dry densities and they were given different symbols.



Series1 – 1.35
Series 2 – 1.25
Series3 – 1.29

Figure 3– Percentage CBR value in in mixed compositions in unsoaked conditions

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VI. CONCLUSION

After the analysis of the CBR results of the bentonite mixed with polythene strips.

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

Shear strength of the soil was increased as indicated by the cbr test. The void ratio was reduced and overall improvement in the strength of the soil.

Plastic waste can be used as alternative and as a stabilizer and can help in reducing environmental problem related to dumping of plastic waste.

Size effects the strength behaviour of the soil.

There is decrease in the plasticity and swelling properties of the bentonite.

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