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USE OF PLASTIC BAG AS AN ADDITIVE MATERIAL TO IMPROVE THE CAPACITY OF BLACK COTTON SOIL

Mr. Vivek Bhupatbhai Virani
Department of Civil Engineering
Subharti Institute of Technology and Engineering,
Swami Vivekanand Subharti University,
Meerut, India

Mr. Shaunak Chhaganbhai Vaghani
Department of Civil Engineering
Subharti Institute of Technology and Engineering,
Swami Vivekanand Subharti University,
Meerut, India

ABSTRACT

It is appreciating that black cotton soil is considered as expansive soil. The problem of damage to structure in expansive soil is worldwide.

There are several techniques to improve the properties of soil with use of different method of stabilization of black cotton soil.

Plastic have taken center stage in daily life due to favorable attribute such as low weight, durability and lower cost as compare to other material and it make highly demand of plastic but increase use of plastic in day to day consumer application has resulted in municipal solid waste containing an even growing fraction of plastic material used for a short time and discard. Hence disposal of plastic waste is very serious problem. The plastic is non-recyclable material so the possibility of utilizing plastic waste to reinforce soil to pave way for its use in civil engineering projects. An attempt is made here to utilize the plastic bag waste for soil improvement in black cotton soil and to study the reinforcing capacity of plastic in soil.

INTRODUCTION

Soil is a define as sediments or other accumulation of mineral particles produced by the physical or chemical disintegration of rock plus the air, water, organic matter and other matter and other

substances that may be included. Soil is typically a nonhomogeneous, porous, and earthen material whose engineering behavior is influenced by changes on moisture content and density. Based on the origin, soil can be broadly classified as organic and inorganic.

The geotechnical engineers have been forced to construct at given site with good soil condition. So the soil of that site must be so compacted. If not, bearing capacity must increase by any method. Plastic bags have been in use for many years as an easy and cheap holding container for food and other items. Plastic shopping bags are one of the most common forms of plastic bags. These bags were created as a tree-saving material designed to eliminate paper waste and needless tree destruction. However, the plastic bags did not have the effect that they were designed for. Plastic bags are also bad for the environment because of their chemical properties Ground improvement in granular soils can be achieved by different methods such as compaction piles, compaction with explosives and adding various materials such as waste plastic fiber etc.

Increased use of plastic in day to day consumer applications has resulted in municipal waste containing an ever growing faction of plastic material used for a short time and discarded. Ever since their invitation over 60 years ago, plastics have taken centre stage in daily life due to favorable attributes such as low weight, durability and lower cost as compare to other material types.so it is better to use plastic waste material for increasing bearing capacity of soil. Almost all plastic bags are created from a form of petroleum melted and formed into a type of polymer thermoplastic known as polyethylene. Polyethylene is easily molded to any shape and holds together when stretched thin. It is waterproof; nontoxic to items inside the bags, break-resistant and is resistant to bacteria and other microbial growth. The plastic is mixed with other chemicals to produce a variety of strengths and textures. The properties of plastic bags are such that recycling can sometimes be difficult. Plastic bags create 3,097 tons of CO2 for every 100 million bags created. According to a study conducted by Chapman & Hall in 1995, plastic takes 29 units of energy to create and produces the environmental hazards of SO2, NOx, BOD and CO into the air. Recycling these bags release the same chemicals into the air again.

A series of direct shear test was undertaken on soil plastic composite. In this paper a laboratory has been carried out to evaluate the effect of waste plastic material on compaction and consolidation of reinforced soil.

OBJECTIVE OF THE PROJECT

Use of plastic bags as an additive material to enhance the capacity of black cotton soil.

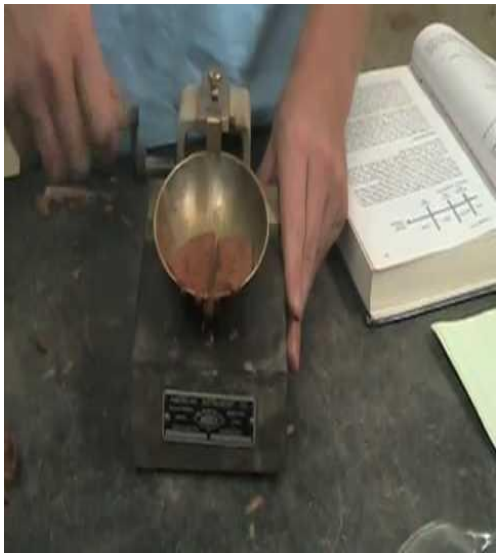
WASTE OF PLASTIC BAG

Soil stabilization can be done in many ways. But the stabilization using waste plastic fibers is an economic method since the stabilizer used here is waste plastic materials, which are easily available. In the investigation the waste plastic materials has been chosen as the reinforcement material and it was randomly included in to the clayey soils with different plasticity indexes at five different percentages of fiber content (0%, 1%,2%, 3%, 4%) by weight of raw soil. The use of plastic fibers in unreinforced soil tremendously increases the CBR value, Shear Strength, Resistance to desiccation cracking, reduces Consolidation and Swelling.

EXPERIMENTAL PROCEDURES

1 Liquid limit

The liquid limit was determined in the laboratory by the help of standard liquid limit apparatus. About 120g of the specimen passes through 425µ sieve was taken. A groove was made by groove tool an IS: 9259-1979 designates. A brass cup was raised and allowed to fall on a rubber base. The water content correspond to 25 blows was taken as liquid limit. The value of liquid limit was found out for swelling soil.

1Liquid Limit

2 Plastic limit

The plastic limit was determined in the laboratory by the help of standard plastic limit apparatus The value of plastic limit was found out for swelling soil as per IS: 2720(part-V)1986.

2 Plastic Limit

3 Optimum moisture content and maximum dry density

The Optimum moisture content and dry density of swelling soil was determined by performing the "standard proctor test" as per IS: 2720(part VII) 1965. The test consist in compacting soil at various water contents in the mould, in three equal layers, each being given 25 blows of 2.6kg rammer dropped from a height of 31cm. The collar removed and the excess soil is trimmed of to

make it level. The dry density is determined and plotted against water content to find OMC and corresponding maximum dry density.

4 Unconfined compression test

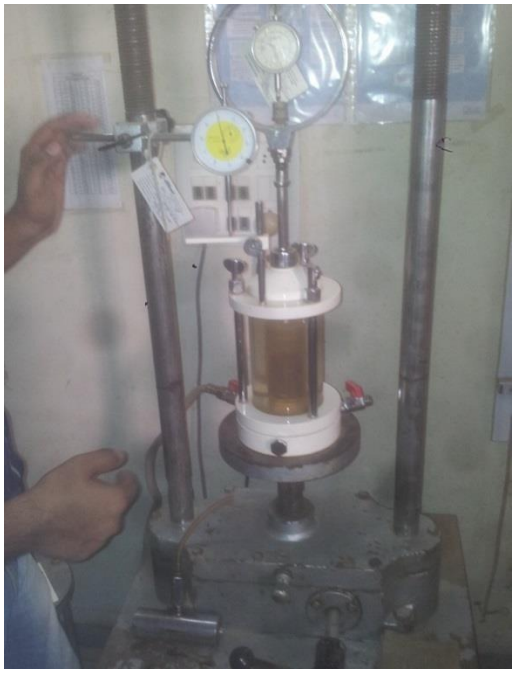
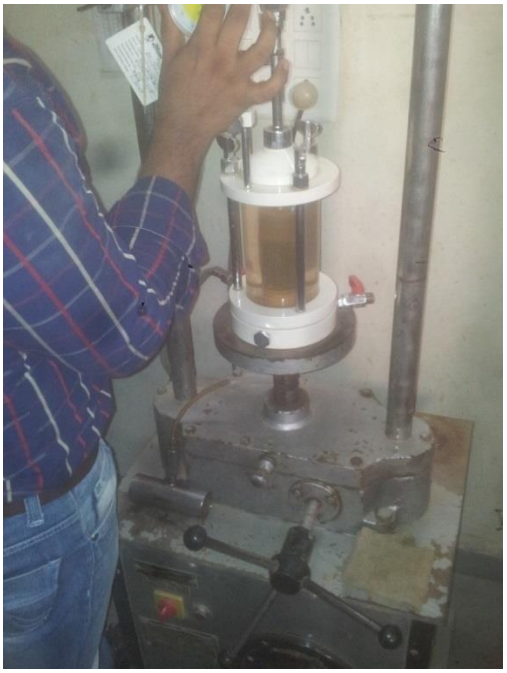
This test was conducted on various samples as given below with prepared at OMC, subjected to unconfined compression test.

- Soil + plastic strips of size 6mm X 15mm (0.1%, 0.2% & 0.3%)
- Soil + plastic strips of size 12mm X 30mm (0.1%, 0.2% & 0.3%)

The test so conducted with reference to IS: 2720 part-10(1991) & 4330-5(1970).

Determine the amount of soil to be used from the optimum moisture content, dry density of the soil (obtained prior to the experiment from the standard Proctor test), and the size of the mold to be used in the experiment. The mold should have a height-to-diameter ratio (L/D) of between two and three.

Using a proctor hammer, begin to compact the soil into the mold. This should be done in 5 layers. After one layer is done, the top of that layer is grooved with a spatula. This is repeated for the remaining 4 layers. Use the specimen extruder to remove the sample from the mold. Carefully wrap the specimens in saran wrap and place them in the moisture room to cure for a week. This step is not necessary if no lime is used. After the curing process, take the first sample and place it on the tri-axial machine and make sure it is centered. Place the tri-axial cell over the sample. The data from the acquisition system can then be used to determine the unconfined compression strength (q_u) of each sample.

4 Unconfined Compression test

5 C.B.R test

C.B.R test were determined as per IS: 2720-16(1961) for the sample given below.

- Soil + plastic strips of size 6mm X 15mm (0.1%, 0.2% & 0.3%)
- Soil + plastic strips of size 12mm X 30mm (0.1%, 0.2% & 0.3%)

In this method calculate the mass of wet soil at required moisture content to give a desired density when compacted in a standard test mould as given below

Volume of mould = 2250cc.

Weight of dry soil (W) = 2250 x MDD.

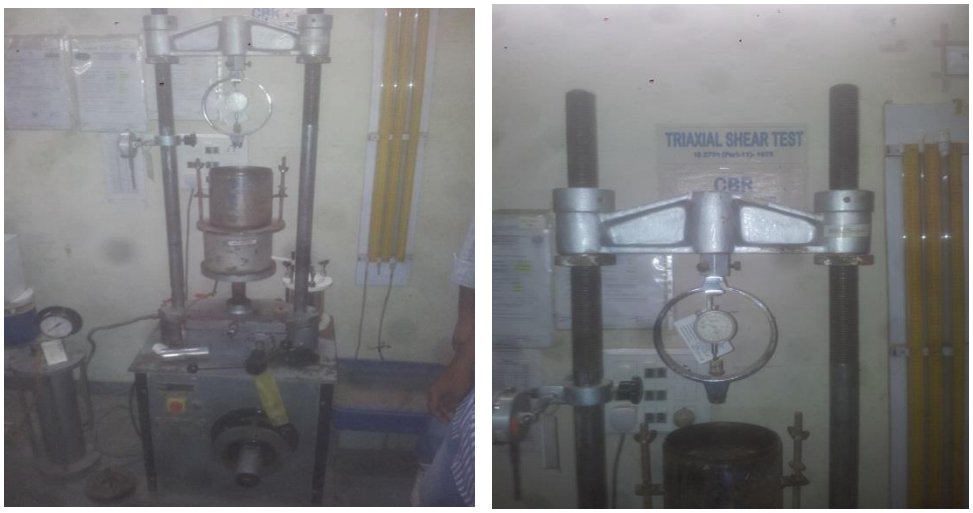
Weight of wet soil =1+ 0.01 x W

Weight of water = Weight of wet soil - Weight of dry soil.

m = Optimum moisture content obtained from the laboratory compaction test.

Take oven dried soil sample of calculated weight and thoroughly mix with water (OMC) as obtained from the above equation. Record the empty weight of the mould with base plate, with extension collar removed (m1). Place the correct mass of the wet soil in to the mould in five layers. Gently compact each layer with the spacer disc. Place a filter paper on top of the soil followed by a 5cms displacer disc. Compact the mould by pressing it in between the platens of the compression testing machine until the top of the spacer disc comes flush with the top of the

mould. Hold the load for about 30 seconds and then release. Samples were made for each concentration of Plastic strips, one sample tested at OMC (unsaturated) and other was tested at saturation after four days soaking.



5 CBR Test Apparatus

RESULT AND DISCUSSION

1. IDENTIFICATION TEST'S RESULTS FOR BLACK COTTON SOIL

1.1 Grain size distribution of B.C. Soil

1.1 Mechanical Sieve Analysis of B.C Soil

Sieve Size (mm)	Retaining (g)	%age of Retain	Cum Retain %age	%age of finer
4.75mm	4.09	2.045	2.045	97.955
2.00mm	4.02	2.01	4.055	95.945
425 micron	6.38	3.19	7.245	92.755

1.2 Liquid limit test of B.C. Soil

1.2 Liquid Limit test of B.C. Soil

Sr No.	Empty wt (g)	Wet soil+ can wt (g)	Wet wt (g)	Dry wt (g)	Wt. of water (g)	Water content (%age)
1	31.24	64.91	33.67	26.09	11.89	45.57

1.3 Plastic limit test of B.C. Soil

1.3 Plastic limit test of B.C. Soil

Sr No.	Empty wt (g)	Wet soil+ can wt (g)	Wet wt (g)	Dry wt (g)	Wt. of water (g)	Water content (%age)
1	25.31	29.21	3.9	3.17	0.73	23.02

1.4 Shrinkage limit test of B.C. Soil

1.4 Shrinkage limit of B.C. Soil

Sr No	Description	Sample(g)
1	Mass of empty shrinkage dish	65.75
2	Volume of the shrinkage dish	278.9
3	Mass of shrinkage dish+ wet soil	104.05
4	Mass of wet soil(M1)	38.3
5	Mass of shrinkage dish+ dry soil	87.97
6	Mass of dry soil(Ms)	22.22
7	Volume of shrinkage dish(V1)	24.55
8	Volume of dry pat(V2)	12.53
9	Shrinkage ratio(SR)	1.71
10	Shrinkage limit	11.36

1.5 Proctor compaction test of B.C. Soil

1.5 Proctor compaction Test of B.C. Soil

Determination no.	1	2	3	4	5	6
Wt. Of mould+Comp. Soil:w(g)	7382	7549	7633	7757	7747	7704
Wt.of mould:W_m(g)	5821	5821	5821	5821	5821	5821
Wt. Of comp. Soil	1561	1728	1822	1936	1926	1883
Water added(%)	12	18	23	28	34	37
Wet density:γ_m(g/cc)	1.561	1.728	1.812	1.936	1.926	1.883
Moisture content (oven drying)						
Crucible no.	1	5	11	7	9	4
Wt. Of crucible:(g)	28.02	22.52	26.99	24.08	22.76	23.47
Wt.of crucible + wet soil:(g)	76.18	59.09	66.19	58.25	56.77	56.66
Wt. Of crucible + dry soil:(g)	70.52	53.25	59.17	51.31	49.25	49.28
Moisture content (w) (%)	13.32	19	21.82	25.49	28.39	28.94
Dry density: γ (g/cc)	1.37	1.45	1.48	1.54	1.5	1.46

1.6 Unconfined compressive strength test of B.C. Soil

1.6 Unconfined compressive strength test of B.C. Soil

Sr No	Observation				Calculation		
	Dial Gauge		Providing Ring		Corrected area (cm^2)	Strain (ε)	Compressive strength(σ1) (N/mm^2)
	reading	deformation (mm)	reading	load (KN)			
1	0	0	0	0	11.341	0	0
2	38	0.3	0.5096	2	11.398	0.5	0.0447
3	76	0.6	0.6371	2.5	11.456	1	0.0556
4	114	0.9	0.7645	3	11.514	1.5	0.0663
5	152	1.2	1.0198	4	11.572	2	0.0881
6	190	1.5	1.2742	5	11.632	2.5	0.1095
7	228	1.8	1.6564	6	11.692	3	0.1416
8	266	2.1	1.9113	7.5	11.752	3.5	0.1626
9	304	2.4	2.2935	9	11.814	4	0.1941

10	342	2.7	2.5484	10	11.875	4.5	0.2146
11	380	3	2.6758	10.5	11.938	5	0.2241
12	418	3.3	2.9306	11.5	12.001	5.5	0.2452
13	456	3.6	3.1855	12.5	12.065	6	0.264
14	494	3.9	3.4403	13.5	12.129	6.5	0.2836
15	532	4.2	3.6953	14.5	12.195	7	0.303

1.7 California bearing ratio test of B.C. Soil

1.7 CBR test for B.C. Soil

Sr No	Plunger penetration (mm)	Dial reading	App. Load (Kg)	C.B.R stress (kg/cm^2)	Stand load intensity (kg/cm^2)	Total Standard load(Kgf)	CBR intensity (%age)
1	0	0	0	0			
2	0.5	2	13.245	0.6767			
3	1	3	20	1.0218			
4	1.5	4	26.49	1.3535			
5	2	4.5	29.801	1.5225			
6	2.5	5.25	34.768	1.7763	70	1370	2.5375
7	3	6.25	41.39	2.1148			
8	3.5	7	46.357	2.3686			
9	4	8	52.98	2.707			
10	4.5	8	52.98	2.707			

2. TEST RESULTS FOR COMBINATION OF BLACK COTTON SOIL & PLASTIC STRIPS OF 6MM X 15MM

2.1 Unconfined Compressive Strength Test's Results

2.1.1 Combination of B.C. Soil + 0.1% Plastic strips of size of 6mm X 15mm

Unconfined compressive strength test of B.C. Soil + 0.1% Plastic strips of size of 6mm X 15mm

Sr No	Observation				Calculation		
	Dial Gauge		Providing Ring		Corrected area (cm^2)	Strain (ε)	Compressive strength(σ1) (N/mm^2)
	reading	deformation (mm)	reading	load (KN)			
1	0	0	0	0	11.341	0	0
2	38	0.3	0.6371	2.5	11.398	0.5	0.0558
3	76	0.6	1.6564	6.5	11.456	1	0.1445
4	114	0.9	2.1661	8.5	11.514	1.5	0.1881
5	152	1.2	2.6758	10.5	11.572	2	0.2312
6	190	1.5	2.8032	11	11.632	2.5	0.2409
7	228	1.8	2.8032	11	11.692	3	0.2397

2.1.2 Combination of B.C. Soil + 0.2% Plastic strips of size of 6mm X 15mm

Unconfined compressive strength test of B.C. Soil + 0.2% Plastic strips of size of 6mm X 15mm

Sr No	Observation				Calculation		
	Dial Gauge		Providing Ring		Corrected area (cm^2)	Strain (ε)	Compressive strength((σ1) (N/mm^2)
	reading	deformation (mm)	Reading	load (KN)			
1	0	0	0	0	11.341	0	0
2	38	0.3	1.2742	5	11.398	0.5	0.1117
3	76	0.6	2.5484	10	11.456	1	0.2224
4	114	0.9	3.5677	14	11.514	1.5	0.3098
5	152	1.2	4.8419	19	11.572	2	0.4184
6	190	1.5	5.3416	21	11.632	2.5	0.46
7	228	1.8	5.0968	20	11.692	3	0.4358
8	266	2.1	5.0968	20	11.752	3.5	0.4336

2.1.3 Combination of B.C. Soil + + 0.3% Plastic strips of size of 6mm X 15mm

Unconfined compressive strength test of B.C. Soil + 0.3% Plastic strips of size of 6mm X 15mm

Sr No	Observation				Calculation		
	Dial Gauge		Providing Ring		Corrected area (cm^2)	Strain (ε)	Compressive strength($\sigma 1$) (N/mm^2)
	reading	deformation (mm)	Reading	load (KN)			
1	0	0	0	0	11.341	0	0
2	38	0.3	1.1467	4.5	11.398	0.5	0.1006
3	76	0.6	1.9113	7.5	11.456	1	0.1668
4	114	0.9	2.5484	10	11.514	1.5	0.2213
5	152	1.2	3.1855	12.5	11.572	2	0.2752
6	190	1.5	3.5677	14	11.632	2.5	0.3067
7	228	1.8	3.5677	14	11.692	3	0.3051

2.2 California bearing ratio Test's Results

2.2.1 Combination of B.C. Soil + 0.1% Plastic strips of size of 6mm X 15mm

CBR test for B.C. Soil + 0.1% Plastic strips of size of 6mm X 15mm

Sr No	Plunger penetration (mm)	Dial reading	App. Load (kg)	C.B.R stress (kg/cm^2)	Stand load intensity (kg/cm^2)	Total Standard load (kgf)	CBR intensity (%age)
1	0	0	0	0			
2	0.5	1	6.6225	0.3383			
3	1	2.5	16.556	0.8459			
4	1.5	3.5	23.178	1.1842			
5	2	4.25	28.145	1.4379			
6	2.5	5.5	36.423	1.861	70	1370	2.6585
7	3	7	46.357	2.3686			
8	3.5	8	52.98	2.707			
9	4	8	52.98	2.707			

2.2.2 Combination of B.C. Soil + 0.2% Plastic strips of size of 6mm X 15mm

CBR test for B.C. Soil + 0.2% Plastic strips of size of 6mm X 15mm

Sr No	Plunger penetration (mm)	Dial reading	App. Load (kg)	C.B.R stress (kg/cm^2)	Stand load intensity (kg/cm^2)	Total Standard load (kgf)	CBR intensity (%age)
1	0	0	0	0			
2	0.5	1.5	9.9337	0.5075			
3	1	2.25	14.9	0.7613			
4	1.5	3	19.867	1.015			
5	2	4	26.49	1.3535			
6	2.5	6	39.735	2.0302	70	1370	2.9
7	3	7	46.357	2.3686			
8	3.5	8	52.98	2.707			
9	4	9	59.602	3.045			
10	4.5	9	59.602	3.045			

2.2.3Combination of B.C. Soil + 0.3% Plastic strips of size of 6mm X 15mm

CBR test for B.C. Soil + 0.3% Plastic strips of size of 6mm X 15mm

Sr No	Plunger penetration (mm)	Dial reading	App. Load (kg)	C.B.R stress (kg/cm^2)	Stand load intensity (kg/cm^2)	Total Standard load (kgf)	CBR intensity (%age)
1	0	0	0	0			
2	0.5	1	6.6225	0.3383			
3	1	2	13.245	0.6766			
4	1.5	3	19.867	1.0151			
5	2	3.5	23.178	1.1843			
6	2.5	4	26.49	1.3535	70	1370	1.9335
7	3	5	33.112	1.6918			
8	3.5	6	39.735	2.0302			

9	4	7	46.357	2.3686			
10	4.5	7	46.357	2.3686			

3. TEST RESULTS FOR COMBINATION OF BLACK COTTON SOIL & PLASTIC STRIPS OF 12MM X 30MM

3.1 Unconfined compressive strength Test's Results

3.1.1 Combination of B.C. Soil + 0.1% Plastic strips of size of 12mm X 30mm

Unconfined compressive strength test of B.C. Soil + 0.1% Plastic strips of size of 12mm X 30mm

Sr No	**Observation**				**Calculation**		
	Dial Gauge		Providing Ring		Corrected area (cm^2)	Strain(ε)	Compressive strength(σ1) (N/mm^2)
	reading	deformation (mm)	reading	load (KN)			
1	0	0	0	0	11.341	0	0
2	38	0.3	2.2935	9	11.398	0.5	0.2012
3	76	0.6	3.8226	15	11.456	1	0.3336
4	114	0.9	5.0965	20	11.514	1.5	0.4426
5	152	1.2	5.8613	23	11.572	2	0.5065
6	190	1.5	6.371	25	11.632	2.5	0.5477
7	228	1.8	7.1355	28	11.692	3	0.6102
8	266	2.1	7.6452	30	11.752	3.5	0.6505
9	304	2.4	7.9001	31	11.814	4	0.6687
10	380	3	8.6646	34	11.938	5	0.7257
11	418	3.3	8.6646	34	12.001	5.5	0.7219
12	456	3.6	8.6646	34	12.065	6	0.7181

3.1.2 Combination of B.C. Soil + 0.2% Plastic strips of size of 12mm X 30mm

Unconfined compressive strength test of B.C. Soil + 0.2% Plastic strips of size of 12mm X 30mm

Sr No	Observation				Calculation		
	Dial Gauge		Providing Ring		Corrected area (cm^2)	Strain(ε)	Compressive strength(σ1) (N/mm^2)
	reading	deformation (mm)	reading	load (KN)			
1	0	0	0	0	11.341	0	0
2	38	0.3	2.0384	8	11.398	0.5	0.1788
3	76	0.6	4.8412	19	11.456	1	0.4225
4	114	0.9	6.6248	26	11.514	1.5	0.5753
5	152	1.2	6.8796	27	11.572	2	0.5945
6	190	1.5	6.8796	27	11.632	2.5	0.5914

3.1.3 Combination of B.C. Soil + 0.3% Plastic strips of size of 12mm X 30mm

Unconfined compressive strength test of B.C. Soil + 0.3% Plastic strips of size of 12mm X 30mm

Sr No	Observation				Calculation		
	Dial Gauge		Providing Ring		Corrected area (cm^2)	Strain (ε)	Compressive strength(σ1) (N/mm^2)
	reading	deformation (mm)	Reading	load (KN)			
1	0	0	0	0	11.341	0	0
2	38	0.3	1.0192	4	11.398	0.5	0.0894
3	76	0.6	2.4206	9.5	11.456	1	0.2242
4	114	0.9	2.6754	10.5	11.514	1.5	0.2323
5	152	1.2	3.822	15	11.572	2	0.3302
6	190	1.5	4.5864	18	11.632	2.5	0.3942
7	228	1.8	5.3508	21	11.692	3	0.4576
8	266	2.1	6.37	25	11.752	3.5	0.542
9	304	2.4	6.8796	27	11.814	4	0.5823
10	342	2.7	7.3892	29	11.875	4.5	0.6222
11	380	3	7.8988	31	11.938	5	0.6616
12	418	3.3	8.1536	32	12.001	5.5	0.6794
13	456	3.6	8.1536	32	12.065	6	0.6757

3.2 California bearing ratio Test's Results

3.2.1 Combination of B.C. Soil + 0.1% Plastic strips of size of 12mm X 30mm

CBR test for B.C. Soil + 0.1% Plastic strips of size of 12mm X 30mm

Sr No	Plunger penetration (mm)	Dial reading	App. Load (kg)	C.B.R stress (kg/cm^2)	Stand load intensity (kg/cm^2)	Total Standard load (kgf)	CBR intensity (%age)
1	0	0	0	0			
2	0.5	7	46.357	2.3686			
3	1	13	86.092	4.3988			
4	1.5	18	119.2	6.0907			
5	2	22	145.69	7.4442			
6	2.5	26	172.18	8.7977	70	1370	12.5681
7	3	30	198.67	10.1512			
8	3.5	34	225.16	11.5047			
9	4	37	245.03	12.5199			
10	4.5	39	258.27	13.1966			
11	5	41	271.52	13.8734	105	2055	13.2127
12	7.5	41	271.52	13.8734	134	2680	10.3532

3.2.2 Combination of B.C. Soil + 0.2% Plastic strips of size of 12mm X 30mm

CBR test for B.C. Soil + 0.2% Plastic strips of size of 12mm X 30mm

Sr No	Plunger penetration (mm)	Dial reading	App. Load (kg)	C.B.R stress (kg/cm^2)	Stand load intensity (kg/cm^2)	Total Standard load (kgf)	CBR intensity (%age)
1	0	0	0	0			
2	0.5	8	52.98	2.707			
3	1	15	99.337	5.0756			
4	1.5	21	139.07	7.1058			
5	2	27	178.8	9.1361			
6	2.5	32	211.92	10.828	70	1370	15.4685
7	3	38	251.65	12.8582			
8	3.5	44	291.39	16.9187			
9	4	50	331.12	21.9944			
10	4.5	55	364.23	18.6106			
11	5	60	397.35	20.3025	105	2055	19.3357

12	7.5	67	443.7	22.1853	134	2680	16.5561
13	10	72	476.82	24.2908	162	3180	14.9943
14	12.5	72	476.82	24.2383	183	3600	13.2449

3.2.3Combination of B.C. Soil + 0.3% Plastic strips of size of 12mm X 30mm

CBR test for B.C. Soil + 0.3% Plastic strips of size of 12mm X 30mm

Sr No	Plunger penetration (mm)	Dial reading	App. Load (kg)	C.B.R stress (kg/cm^2)	Stand load intensity (kg/cm^2)	Total Standard load (kgf)	CBR intensity (%age)
1	0	0	0	0			
2	0.5	4	26.49	1.3535			
3	1	10	66.225	3.3837			
4	1.5	16	105.96	5.414			
5	2	21	139.07	7.1058			
6	2.5	28	185.43	9.4745	70	1370	13.535
7	3	35	231.78	11.8432			
8	3.5	44	291.39	14.8885			
9	4	55	364.23	18.6106			
10	4.5	64	423.84	21.656			
11	5	69	456.95	23.348	105	2055	22.2362
12	7.5	71	470.19	23.5098	134	2680	17.5446
13	10	74	490.06	24.9655	162	3180	15.4108
14	12.5	74	490.06	24.9116	183	3600	13.6128

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CONCLUSION

1. After conducted the Unconfined Compressive Strength test with adding plastic strips of size 6mm X 15mm we saw that the unconfined compressive strength is increase with the increase in percentage of plastic strips and while adding plastic strips of size 12mm X 30mm then compressive strength is more increased with increase in percentage of plastic strips than the previous size strips..

2. Result of California Bearing Ratio (CBR) test using plastic strips of 6mm X 15mm in BC soil sample used better performance. Moreover it is also observed based in same test that if soil sample along with plastic strips of size 12mm X 30mm shows excellent strength than the previous size strips.

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