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## Use of PET and Condor SS in Black Cotton Soil

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### Abstract

For rapid developments in the engineering field have various effects on human beings but day to day improvement of humanity is challenging to the environment. Use of polypropylene PET and Plastic get increasing by person to person due to this waste of such type create major problems for the world. Some harmful gases being produced by such waste leads towards environmental related problems. So, implementation of this in engineering has most difficult jobs for engineers. Engineers are take lead to use of these wastes in large quantity. Use of such kind of wastes in improvement of Soil properties for stabilization helps to minimize the effect, risk of natural demolition which is caused due to rainfall or other aspect and also it support in decreasing the waste in an wide range. Plastic is dangerous pollutant of environment as it does not decay or destroyed so use of this for some superior occasion helps to decrease its effect also. This involve in stabilization of soil using waste plastic strips is an profitable method where use of misuse materials such as plastic and other cheaply accessible material of plastic can be used which is found accessibly..

**Keywords:** OMC, MDD, PET, Condor SS, UCS

### 1. INTRODUCTION

Soil is considered by the engineer as a complex material produced by the weathering of the solid rock. The formation of the soil is as a result of the geologic cycle continually taking place on the face of the earth. The cycle consists of weathering or denudation, transportation, deposition and upheaval, again followed by weathering, and so on. Weathering is caused by the physical agencies such as a periodical temperature changes, impact and splitting action of flowing water, ice and wind and splitting actions of ice, plants and animals. Cohesion less soils are formed due to physical disintegration of rocks. A large part of central India and a portion of South India are covered with Black Cotton soils. These soils are residual deposits formed from basalt or trap rocks. Black cotton soils are clays of high plasticity. They contain essentially the clay mineral montmorillonite, which is the most unstable clay mineral, thus the soil have high shrinkage and swelling characteristics. The shearing strength of the soil is extremely low, is highly compressible and has very low bearing capacity. It is very difficult to work with this soil, as do not possess sufficient strength to support the loads imposed upon them either during construction or during the service life of the structure. For better performance of structures built on such soils, the performance characteristics of such soils need to be improved.

### 2. RELATED WORK

From last decades many researchers doing work on Black cotton soil some of the work are as

#### 2.1. PET based:

**Babu G.L. Shivkumar(1)** : performed work by providing polyethylene fiber as reinforcement for consolidated undrained test shows increase in strength due increase in friction between soil and plastic waste.

**Dr. Ravi Kumar Sharma, et.al. [2]** For compaction test 0.3% Plastic Strips increase slightly MDD and thereafter reduced the Dry Density. For CBR test, it is observed that un-soaked and soaked CBR Value of mix initially increases and then decreases with addition of plastic strips. Maximum value of CBR obtained with addition 0.3% plastic strips.

**Arpan Laskar and Sujit Kumar Pal [3]** MDD of plastic mix soil decreases with increasing fiber content, OMC 17.10% which is independent of amount of fibers. With increase of plastic fibers in soil, Compression Index (Cc) and coefficient of volume change (Mv) of soil decreases upto 0.50% fiber content. Coefficient of consolidation increases with the increases of fiber in soil for aspect ratio 2, 4, and 8.

**Pragyan Bhattarai, et.al.[ 4]** Increasing CBR of the soil, when aspect ratio increase then strength parameter also increase but use of more aspect ratio also decreases the CBR.CBR at AR 4 and 0.5% plastic strips decreases whereas in AR 3and 0.5% plastic strips it had increased. And concluded that plastic strips can be used as reinforcement in soil in right proportion.

**Mercy Joseph Poweth et. al.[5]** has carried no. of test and studied that the Max dry density is obtained when 0.25% plastic was added in to the soil and OMC corresponding to 0.25% is less than that of soil without plastic. CBR value decreased when 0.5% of plastic is added. It is increased when 0.75% of plastic is added. The shear stress is maximum when 0.25% of plastic is added. The plastic should be uniformly mixed with soil for an effective result.

**G. Shravani, et.al. [6]** performed OMC and MDD, UCS and CBR with waste plastic as reinforcement in soil, found that increase in OMC and decrease in MDD with increase in % of plastic, for UCS there is decrease in value of UCS with increase in % of plastic, for CBR test maximum value of CBR obtained at 0.5% of plastic in soil.

## 2.2 Liquid Based:

**Babu G.L. Shivkumar[5]:** has worked with condor SS at Bagalkot District Karnataka for Stabilizing the soil and obtained great result with use of CSS.

## 3. METHODOLOGY

### 3.1 Genral:

PET with varying percentage ranging from 0.25, 0.5, 0.75 used and also use Condor SS with PET in percentage of 0.25, 0.5, 0.75 were used.

### 3.2 Material:

**3.2.1 Soil:** Soil sample was collected from Village Sonaj, Tal- Malegaon Dist: Nashik ( MH). Black Cotton soil is very expensive and having ability to hold water for long time. It decreases its resistance while it is in swelling and shrink condition, due development of tensile stresses in it and cause to failure of its. Black cotton soil is not suitable for construction activity and hence needed to treat it for suitability of its.

**Table I- Engineering Properties of B.C.**

Sr. No.	Properties	Black Cotton Soil	IS Classification
1	S.G.	2.61	IS 2720 Part 3
2	LL	52.30	IS 2720 Part 4
3	PL	29.20	
4	IS Classification	CH	

### 3.2.2 Plastic:

Drinking water bottle were collected from various Hotels from nearby area. And cut it into strips of Aspect ratio 1:1, 1:2, 1:3 were used for experiment with 0.25, 0.50, and 0.75 percent.



Fig. 1 Waste Plastic Bottles

**Table II -Properties of PET**

Sr. No.	Properties	Unit
1	Young's Modulus	2850 – 3150 Mpa
2	Elastic Limit	50-150%
3	Tensile Strength	50-80Mpa
4	Density	1.36 g/cm <sup>3</sup>

### 3.2.3. Aeonian Earth Solution (Condor SS) :

Liquid Chemical was obtained from Aeonian Earth Solution Mumbai, this solution were tested by G.L. Shivkumar Babu for stabilization of soil available at Bagalkot District Karnataka. having potential to neutralize the soil and having ability absorb less water and increase its resistance against load. Its value in percentage is constant with 1% by dry weight of soil.

### 3.3 Test:

For experiment with properties of black cotton soil, soil samples were tested for Modified Proctor Test and UCS with variation with percentage of waste plastic and plastic with Aeonian Earth Solution (Condor SS).

## 4. RESULT AND CONCLUSION

From the above study following results were obtained as follows:

**MDD and OMC:** OMC and MDD were conducted with 0.25%,0.5%,0.75% with and without CSS.

**Table III- OMC and MDD of B.C. without Condor SS.**

Sr. No.	Length of Strip	Percentage of Strips (0%)		Percentage of Strips (0.25%)		Percentage of Strips (0.50%)		Percentage of Strips (0.75%)	
		OMC (%)	MDD (kg/cm <sup>2</sup> )	OMC (%)	MDD (kg/cm <sup>2</sup> )	OMC (%)	MDD (kg/cm <sup>2</sup> )	OMC (%)	MDD (kg/cm <sup>2</sup> )
1	10 mm x	19.02	1.63	18.65	1.66	18.17	1.70	16.48	1.69
2	10 mm x			15.26	1.668	14.30	1.73	13.76	1.715
3	10 mm x			16.99	1.64	16.01	1.695	15.15	1.68

**Table IV- OMC and MDD of B.C. with Condor SS.**

Sr. No.	Length of Strip	Percentage of Strips (0%)		Percentage of Strips (0.25%)		Percentage of Strips (0.50%)		Percentage of Strips (0.75%)	
		OMC (%)	MDD (kg/cm <sup>2</sup> )	OMC (%)	MDD (kg/cm <sup>2</sup> )	OMC (%)	MDD (kg/cm <sup>2</sup> )	OMC (%)	MDD (kg/cm <sup>2</sup> )
1	10 mm x	15.32	1.647	13.79	1.685	13.61	1.728	13.17	1.71
2	10 mm x			14.28	1.69	13.73	1.75	13.62	1.735
3	10 mm x			13.98	1.67	12.54	1.73	12.32	1.718

From the above experimental calculation it is concluded that, A.R. 2 with 0.50% have maximum value of OMC and MDD for both the cases of with or without Condor SS, above table shows the maximum value of MDD 1.73 without Condor SS and the value get increases upto 1.75 with the help of Condor SS.. From the study it is observed that the Principal of Condor SS to Neutralized the soil by ionization get works and increases the MDD with decreasing water content.

### UCS:

UCS was conducted for 0, 7, and 28 days.

**Table IV- UCS without Condor SS**
**For UCS Value for untreated soil with CSS( 0 Days)**

Sr. No.	Plain Soil	Percentage of Strips	UCS value of reinforced soil with CSS		
			Size of Strips		
			10 mm x 10mm	10mm x20mm	10mm x 30mm
1	2.152	0.25%	2.40	3.2	2.565
2		0.50%	2.725	3.70	2.958
3		0.75%	2.645	3.64	2.855

**Table V- UCS without Condor SS**
**For UCS Value for untreated soil with CSS ( 7 Days)**

Sr. No.	Plain Soil	Percentage of Strips	UCS value of reinforced soil with CSS		
			Size of Strips		
			10 mm x 10mm	10mm x20mm	10mm x 30mm
1	2.45	0.25%	2.66	3.635	2.85
2		0.50%	3.21	4.615	3.315
3		0.75%	3.10	4.459	3.198

**Table VI- UCS without Condor SS**
**For UCS Value for untreated soil with CSS( 28 Days)**

Sr. No.	Plain Soil	Percentage of Strips	UCS value of reinforced soil with CSS		
			Size of Strips		
			10 mm x 10mm	10mm x20mm	10mm x 30mm
1	3.05	0.25%	3.55	3.725	3.27
2		0.50%	4.135	4.95	3.73
3		0.75%	3.995	4.65	3.625

**Table VII- Results for UCS with Condor SS**
**For UCS Value for treated soil with CSS ( 0 Days)**

Sr. No.	Plain Soil	Percentage of Strips	UCS value of reinforced soil with CSS		
			Size of Strips		
			10 mm x 10mm	10mm x20mm	10mm x 30mm
1	2.50	0.25%	2.64	3.475	2.715
2		0.50%	2.93	4.015	3.256
3		0.75%	2.865	3.925	3.145

**Table VIII- Results for UCS with Condor SS**
**For UCS Value for treated soil with CSS( 7 Days)**

Sr. No.	Plain Soil	Percentage of Strips	UCS value of reinforced soil with CSS		
			Size of Strips		
			10 mm x 10mm	10mm x20mm	10mm x 30mm
1	2.70	0.25%	2.995	3.918	3.115
2		0.50%	3.42	4.8725	3.655
3		0.75%	3.317	4.69	3.515

**Table IX- Results for UCS with Condor SS**
**For UCS Value for treated soil with CSS (28 Days)**

Sr. No.	Plain Soil	Percentage of Strips	UCS value of reinforced soil with CSS		
			Size of Strips		
			10 mm x 10mm	10mm x20mm	10mm x 30mm
1	3.415	0.25%	3.935	4.235	3.625
2		0.50%	4.512	5.215	4.215
3		0.75%	4.3792	4.975	4.105

## 5. CONCLUSION

There are many natural wastes being sent out to environment, plastic waste is one such waste. Quantities, the cost towards the application is very less. After the experimental study made it was found that the plastic waste can be used as stabilizer in improving the properties of Black Cotton soil, which helps to minimize effect of waste.

- Maximum Value of MDD occurs at Aspect Ratio 2 at 0.5% of PET in both cases of test without CSS and with CSS
- OMC get decrease with increase in the % of PET and MDD increase upto 0.5% PET and there after get decreased in both the cases of test without CSS and with CSS.
- The unconfined compressive strength for BC soil is increased due to inclusion of plastic waste strips the strength of the soil is increased up to addition of plastic strips. This reduction in strength due to loss of integrity in soil fibers. It can be conclude that 0.5% of plastic strips optimum % to be used as stabilizing agent for sizes 10 x 10mm, 10 x 20mm and 10mm x 30mm.

## REFERENCES

- [1] Babu, G.L. Shivakumar, et.al. "Strength and Compressibility Response of plastic waste mixed soil". *Indian Geotechnical Conference-Dec 2010, GEOTrendz, IGS Mumbai and IIT Bombay.*
- [2] Dr. Ravi Kumar Sharma, et.al. "Compaction and subgrade characteristics of clayey soil blended with Beas Sand, Fly Ash and Waste plastic strips" *Journal of Indian Highways June 2013.*
- [3] Arpan Laskar and Sujit Kumar Pal, "Effect of Random Inclusion of waste plastic fibers on engineering behavior's of reinforced soil". *Proceedings of Indian Geotechnical Conference, 22-24 Dec. 2013, Roorki.*
- [4] Pragyana Bhattarai, et.al. "Engineering Behaviour of soil reinforced with plastic strips". *International Journal of Civil, Structural, Environmental and Infrastructure Engineering Research and Development, Vol. 3, 2 June 2013 83-88.*
- [5] Mercy Joseph Poweth, Femeeda Muhammed Haneef, Melvin T Jacob, Remya Krishnan, Sheetal Rajan, "Effect of Plastic Granules On The Properties Of Soil", *International Journal Of Engineering Research And Applications, ISSN: 2248-9622, Vol. 4, Issue 4 (Version 1), April 2014*
- [6] G. Sravani, B. Bhargava, K.P. Bharathi, V.B. Silpitha, "International Journal of Engineering Research- Online ISSN: 2321-7758
- [7] G.L. Shivkumar Babu, "Report of Stabilization of expensive Soil using Condor SS" for Client Sunil Rastogi, Director Aeonian earth solution (P) Ltd.