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Stabilization of Soil Using the Household Plastic Waste

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Abstract:

Soil stabilization are often applied in some ways. But the stabilization the use of waste plastic strips is an economic approach because the stabilizer used here is waste plastic materials, which are easily and cheaply available. This paper provides the numerous assessments performed on fiber strengthened soil with varying fiber content and exceptional ratio and their results are analyzed such it are often utilized in the fields. Therefore, it is of maximum importance thinking about the appearance and creation technique to want care of and enhance the performance of such pavements. at some stage in this paper, plastic like household waste plastic bags kinds are to use as a reinforcement to carry out the CBR research at the same time as mixing with soil for enhancing engineering, overall performance of sub grade soil. Plastic strips obtained from waste plastic were blended randomly with the soil. A series of California Bearing Ratio (CBR) assessments had been administered on randomly reinforced soil by means of varying the proportion of plastic strips with varying lengths and proportions. Series of test have been validated with the inclusion of waste plastic strips in soil with suitable quantities improved energy and deformation properties of sub grade soils substantially. The proposed approach are often accustomed reduce the thickness of sub base soil for construction

Keywords: Soil, Stabilisation, Plastic, CBR, Aspect Ratio, Load etc.,

I INTRODUCTION

1.1 Soil Stabilization

The term soil stabilization shows that the improvement of the soundness or bearing power of the soil by way of the employment of managed compaction proportioning and or the addition of suitable admixture or stabilizer. These days due to the short increase of populations and development activities it discharges the giant wastes. Disposal of these absolutely completely wastes created from unique industries and urban regions has turn out to be a serious downside. These materials most of which are non-biodegradable exhibit environmental danger by means of polluting the near community. The calculable municipal solid waste production in Asian country up to the year 2000 was of the order of thirty-nine million tons p.a. from this plastics constitute around 4 percent of the total waste. India itself produces a waste of plastic of around 40 million ton per year. Identical case is there for china and different countries the assembly is ample however the management of this is often terribly restricted that has created several adverse effects. There are totally different techniques that are being enforced currently for the management of those deeds however still there's no exceptional improvement during this method. With the few reasons noted on pinnacle of its essential that we find out approaches that to re-make use of those plastic wastes. Therefore the investigation and try has been created to illustrate the ability of reclaimed plastic wastes as soil reinforcement for to significant overall performance of the sub grade soils. The examine can describe the collection of checks to pull off the early stage classes of soil and its properties. Then CBR test have become carry out with varied issue ratio of plastic strips with specific proportions combined uniformly with the soil .the outcomes received from the exams are given and mentioned.

1.2 Methodology

The following technique to be followed in our work is given in fig1.

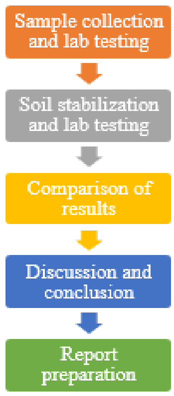

Figure 1: Methodology

2 EXPERIMENTAL INVESTIGATIONS

The experimental work consists of the following steps:

1. Specific gravity of soil
2. Particle size distribution by sieve analysis

3. Determination of the moisture content by oven dry method
4. Preparation of reinforced soil samples.
5. Determination of the CBR for the ordinary soil and reinforced soil sample.

2.1 Materials

Strength and Index properties are given in Table 1.

Table 1. Index and Strength Parameters of Plastic Fiber

Behaviour parameters	Values
Unit weight	0.91g/cm^3
Average diameter	0.034mm
Breaking tensile strength	350 Mpa
Modulus of elasticity	3500 Mpa
Fusion point	165^{0}c
Burning point	590^{0}c
Alkali resistance	Very good
Dispersibility	Excellent

Different sizes of plastic strip collected is given in fig.2.

Figure 2: Plastic Strips of Different Size

2.2 Preparation of Sample

Following steps are carried out while mixing the fiber to the soil:-

- Content of fiber in the soils is herein decided by the following equation

$$pf= \frac{Wf}{W}$$

Where,

ρf= ratio of fiber content

Wf = weight of the fiber

W= weight of the air-dried soil

- The different values adopted in the present study for the percentage of fiber reinforcement are 0, 0.05, 0.15, and 0.25.
- In the preparation of samples, if fiber is not used then, the air-dried soil was mixed with an amount of water that depends on the OMC of the soil.

3 RESULT & DISCUSSIONS

Particle Size Distribution of the Soil is given in Table2.

Table 2 **.Particle Size Distribution of the Soil**

Sieve Size	Retained (g)	Retained (%)	Cumulative (g)	Cumulative (%)
20	0	0	0	100
10	83.98	9.94	9.94	90.06
6.25	126.41	14.96	24.90	74.40
4.75	64.15	7.59	32.49	60.39
2	447.58	52.97	85.46	22.00
1	18.94	2.24	87.70	12.3
0.425	29.91	2.83	90.53	9.471
0.15	9.76	1.16	91.69	8.32
0.075	5.96	0.7	92.39	7.61
<0.075	64	7.57	99.96	0.04

The graph was draw between particle size vs percentage of finer is given in fig.3.

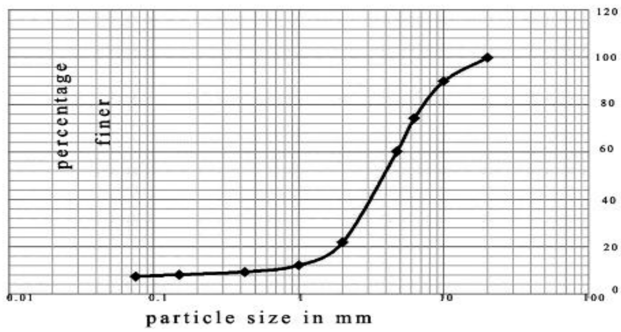

Figure 3: Particle Size Distribution Graph

3.1 CBR Test For Soil Without Strip

Load and Penetration for Unreinforced Soil is given in Table3.

Table 3. Load and Penetration for Unreinforced Soil

Penetration(mm)	Load(kg)	Penetration(mm)	Load(kg)
0	0	4.5	12.06
0.5	3.0	5	13.12
1	4.4	5.5	13.90
1.5	5.1	6	14.5
2	6.6	6.5	14.9
2.5	10.45	7	15.43
3	10.8	7.5	16.0
3.5	11.3	8	16.2
4	11.7	8.5	16.53

CBR = (TEST LOAD/STANDARD LOAD)×100 = (10.45/1370)*100=0.76

Load Penetration Curve for Soil Without Strips is given in fig4.

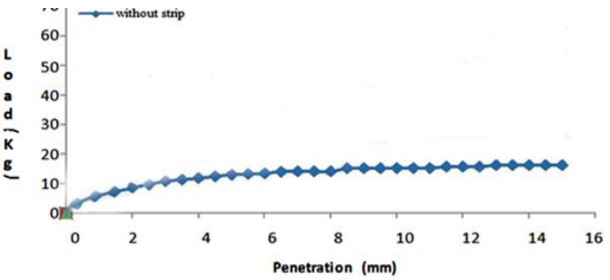

Figure 4: Load Penetration Curve For Soil Without Strips

3.2 CBR Test for Reinforced Soil of Varying Aspect Ratio

Load and Penetration for reinforced Soil of ASPECT RATIO ***(AR:1)***is given in Table4.

Table 4. Load and Penetration for Reinforced Soil of Aspect Ratio (AR:1)

Penetration(mm)	Load(kg)	Penetration(mm)	Load(kg)
0	0	4.5	16.8
0.5	3.0	5	20
1	7.3	5.5	20.67
1.5	8.0	6	22.08
2	9.06	6.5	22.79
2.5	15	7	23.0
3	15.4	7.5	23.65
3.5	15.9	8	24.0
4	16.34	8.5	24.73

CBR = (TEST LOAD/STANDARD LOAD)×100 = (15/1370)*100 =1.09

Load Penetration Curve for reinforced Soil of ASPECT RATIO*(*AR:1*)*is given in fig5.

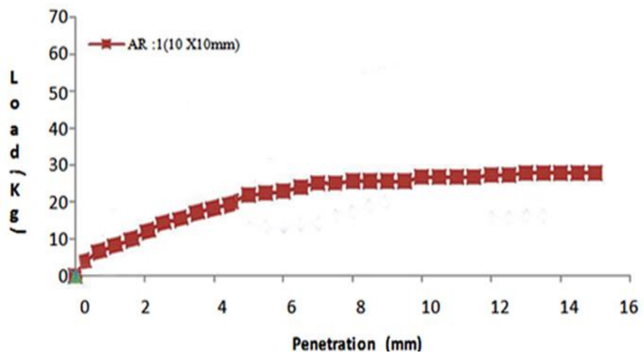

Figure 5: Load Penetration Curve of Strip Content 0.5% for AR:1 (10x10mm)

Load and Penetration for reinforced Soil of ASPECT RATIO*(*AR:2*)*is given in Table5.

Table 5. Load and Penetration for Reinforced Soil of Aspect Ratio (AR:2)

Penetration	Load	Penetration	Load
0	0	4.5	21.33
0.5	3.0	5	25.32
1	7.3	5.5	26.67
1.5	8.0	6	26.8
2	9.06	6.5	27.79
2.5	15	7	30.0
3	15.4	7.5	33.34
3.5	15.9	8	35.74
4	18.0	8.5	39.0

CBR = (TEST LOAD/STANDARD LOAD)×100 = (2532/2055)*100=1.232

Load Penetration Curve for reinforced Soil of ASPECT RATIO (AR:2) is given in fig6.

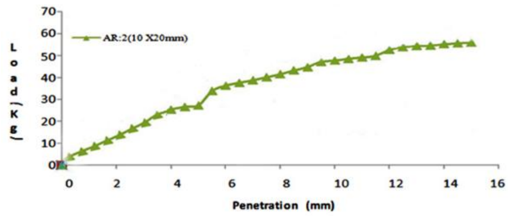

Figure 6: Load Penetration Curve of Strip Content 0.5% for AR:2 (10x20mm)

Load and Penetration for reinforced Soil of ASPECT RATIO ***(AR:3)***is given in Table 6

Table 6. Load and Penetration for Reinforced Soil of Aspect Ratio (AR:3)

Penetration	Load	Penetration	Load
0	0	4.5	35.00
0.5	4.0	5	59.32
1	10.12	5.5	60.11
1.5	15.0	6	60.32
2	19.31	6.5	60.52
2.5	25.87	7	60.73
3	29.0	7.5	61.05
3.5	30.43	8	61.3
4	31.33	8.5	62.45

CBR = (TEST LOAD/STANDARD LOAD)×100 = (59.32/2055)*100 =3.01

Load and Penetration for reinforced Soil of ASPECT RATIO ***(AR:3)***is given in fig7.

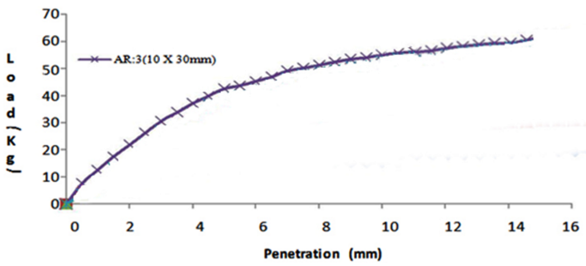

Figure 7: Load Penetration Curve of Strip Content 0.5% for AR:3 (10x30mm)

Load and Penetration for reinforced Soil of ASPECT RATIO ***(AR:4)***is given in Table7.

Table 7. Load and Penetration for Reinforced Soil of Aspect Ratio (AR:4)

Penetration(mm)	Load(kg)	Penetration(mm)	Load(kg)
0	0	4.5	34.30
0.5	3.89	5	45.46
1	10.12	5.5	47.23
1.5	14.06	6	49.86
2	16.77	6.5	50.12
2.5	24.31	7	50.20
3	28.0	7.5	51.30
3.5	29.43	8	51.66
4	30.33	8.5	52.07

CBR = (TEST LOAD/STANDARD LOAD)×100 = (45.46/2055)*100 =2.21

Load and Penetration curve for reinforced Soil of ASPECT RATIO*(*AR:4)is given in fig8.

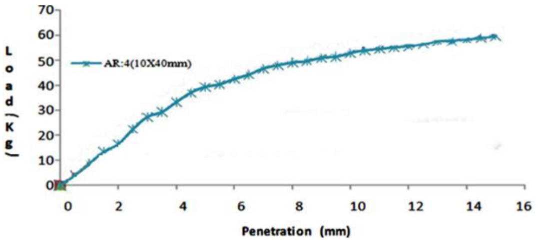

Figure 8: Load Penetration Curve of Strip Content 0.5% for AR:4 (10x40mm)

3.3 CBR TEST for Reinforced Soil for Aspect Ratio(AR: 3) With Varying Strip Content

Load and Penetration for Reinforced Soil of Aspect Ratio (AR:3) with strip content 0.25% is given in Table8.

Table 8. Load and Penetration for Reinforced Soil of Aspect Ratio (AR:3) with strip content 0.25%

Penetration(mm)	Load(kg)	Penetration(mm)	Load(kg)
0	0	4.5	17.32
0.5	6.37	5	17.77
1	6.37	5.5	18.03
1.5	6.7	6	18.65
2	13.0	6.5	18.93
2.5	15.43	7	19.23
3	16.05	7.5	19.64
3.5	16.23	8	20.17
4	16.90	8.5	22.00

CBR = (TEST LOAD/STANDARD LOAD)×100 = (15.43/1370)*100 =1.12

Load Penetration Curve for Aspect Ratio (AR: 3) with varying Strip Content (0.25%) is given in fig9.

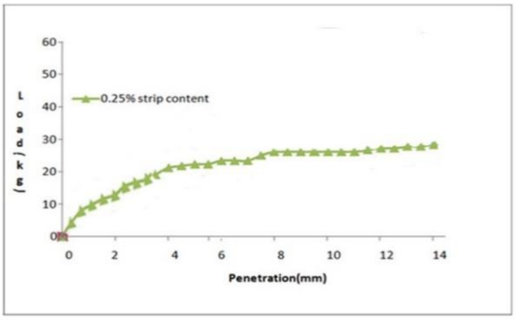

Figure 9: Load Penetration Curve for Aspect Ratio (AR: 3) with varying strip content (0.25%)

Load and Penetration for Reinforced Soil of Aspect Ratio (AR:3) with strip content 0.5% is given in Table9.

Table 9. Load and Penetration for Reinforced Soil of Aspect Ratio (AR:3) with strip content 0.5%

Penetration(mm)	Load(kg)	Penetration(mm)	Load(kg)
0	0	4.5	35.00
0.5	4.0	5	59.32
1	10.12	5.5	60.11
1.5	15.0	6	60.32
2	19.31	6.5	60.52
2.5	25.87	7	60.73
3	29.0	7.5	61.05
3.5	30.43	8	61.3
4	31.33	8.5	62.45

CBR = (TEST LOAD/STANDARD LOAD)×100 = (59.32/2055)*100 =3.01

Load Penetration Curve for Aspect Ratio (AR: 3) with varying Strip Content (0. 5%) is given in fig10.

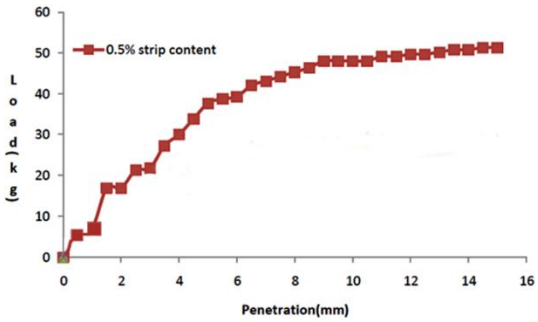

Figure10: Load Penetration Curve for Aspect Ratio (AR: 3) With Varying Strip Content (0.5%)

Load and Penetration for Reinforced Soil of Aspect Ratio (AR:3) with strip content 1% is given in Table10.

Table 10 . Load and Penetration for Reinforced Soil of Aspect Ratio (Ar:3) With Strip Content 1 %

Penetration(mm)	Load(kg)	Penetration(mm)	Load(kg)
0	**0**	**4.5**	**21.33**
0.5	**3.0**	**5**	**25.32**
1	**7.3**	**5.5**	**26.67**
1.5	**8.0**	**6**	**26.8**
2	**9.06**	**6.5**	**27.79**
2.5	**15**	**7**	**28.0**
3	**15.4**	**7.5**	**29.34**
3.5	**15.9**	**8**	**30.04**
4	**18.0**	**8.5**	**30.10**

CBR = (TEST LOAD/STANDARD LOAD)×100 = (2532/2055)*100 =1.232

Load Penetration Curve for Aspect Ratio (AR: 3) with varying Strip Content (1%) is given in fig11.

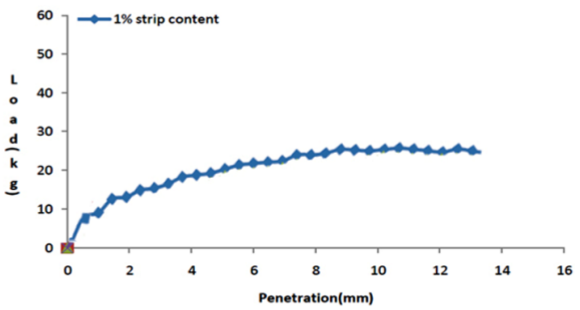

Figure 11: Load Penetration Curve for Aspect Ratio (AR: 3) With Varying Strip Content (1%)

3.4 Comparison of the Results

Load Penetration Curve of Strip Content 0.5% for Varying Aspect Ratios are given in fig12.

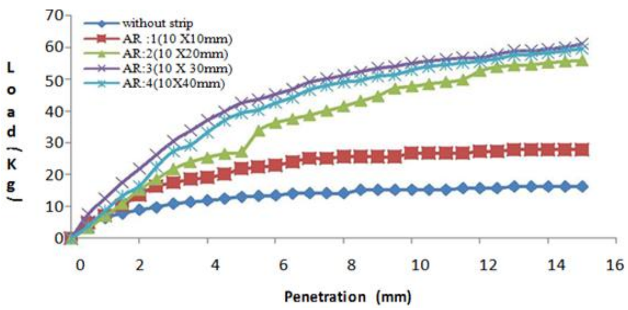

Figure 12: Load Penetration Curve of Strip Content 0.5% for Varying Aspect Ratios.

After completion of each test, the specimen was dissected and the strips were examined. Many of the strips showed elongation, thinning and clear impression of silt particles. Apparently, as the soil sheared during penetration, strip fixed in the soil by friction, elongated and together provided strength against the deformation. Deformation of the soil specimen being predominantly shear in nature, the CBR value can be regarded as an indirect measure of strength . The Load Penetration Curve for Aspect Ratio (AR: 3) with varying strip content is given below fig 13.

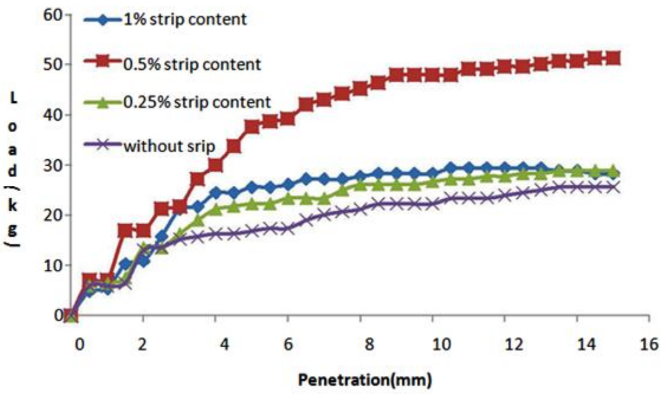

Figure 13: Load Penetration Curve for Aspect Ratio (AR: 3) With Varying Strip Content

The result is as shown in figure under. It is able to be discovered from these figures that mixing of uniformly allotted plastic strips in soil multiplied the piston load at a given penetration substantially. It's also evident from these figures that inclusion of waste plastic multiplied the CBR value appreciably.The CBR value of the unreinforced soil corresponding to 2.5mm and 5.0mm penetration were found to be 0.71 percentage and 0.64 percentage respectively. Which have been accelerated to at least 1.20 percentage and 1.06 percentage respectively when soil become bolstered with 0.5 percentage waste plastic strips having aspect ratio equal to one.

Further increase in aspect ratio from 2 to 4 without changing the strip content again enhanced the CBR value to 1.40% and 1.33% for (AR: 2) and CBR values of 1.90% and 2.07% for (AR: 3) and finally CBR values of 1.63% and 1.91% for (AR:4) respectively. The maximum value of CBR at 2.5mm & 5mm penetration is 1.90% & 2.07% respectively when 0.5% waste plastic strip content having aspect ratio equal to 3 was mixed with the soil, that the CBR value kept increasing up till (AR: 3) (10 X 30mm), and then a decrease in CBR is noticed at (AR: 4). This reveals that at (AR: 3) for 0.5% strip content give us the maximum bearing strength. Now, based on the maximum CBR value at (AR: 3), similar tests have been performed with varying percentage of strip content, the results of which can be observed from figure 3.The CBR value kept increasing till 0.5% strip content and at 1% strip content decrease in CBR is noticed. The CBR values at 2.5mm and 5mm penetration are 1.55% and 1.67%. At (AR: 3) increase in

CBR value of a reinforced system was found approximately 1.70 times as high as that of an unreinforced system.

4 CONCLUSION

The examine after several experiments, determined following significances in using plastic strips as stabilizing agent.

- The addition of reclaimed plastic waste fibre to the local soil increases the CBR value.
- At the same time the maximum improvement in CBR is obtained as using 0.5percentage plastics strips having aspect ratio 3.
- For (AR: 4) and 0.5percentage plastic strip, corresponding the CBR value seems to be decreased.
- The reinforcement benefit increases with an increase in AR and percent of strip content as much as manifest restriction, and further increases, that it reduces its strength.
- The most CBR value of a reinforced system is about 1.70 times that of an unreinforced system.

We will therefore finish that base course thickness can be considerably reduced if waste plastic strip is used as soil stabilizing agent for sub-grade material. This shows that the strips of suitable length reduce from reclaimed plastic wastes may also show useful as soil reinforcement in highway sub-base if mixed with locally to be had granular soils in appropriate quantity.

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