International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 02 | Feb 2020 www.irjet.net p-ISSN: 2395-0072

EXPERIMENTAL AND CASE STUDY ON PLASTIC STRIPS TO ENHANCE THE SHEAR SHRENGTH AND LOAD BEARING CAPACITY OF CLAY SOIL

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ABSTRACT:- *The quantity of waste plastic is increasing every year and the disposal of the same is a very big problem in cities like Erode. Recycling ratio of the plastic wastes is low and many types of plastics are not suitable for incineration process, It has become major concern attempts are being made to reuse the plastic wastes in each and every field effectively. This study gives a simple and easy way of using plastic waste in civil engineering field as a material for stabilization of soil. Stabilization of soil is an effective and reliable method for improvement of strength, stability and bearing capacity of soils. Feasibility studies on mixing plastic waste mixture with cohesive soil (Black Cotton soil) BC Soil at different mixing ratios (0, 0.4, 0.8, 1.2%) by weight of the soil. Maximum Dry Density (MDD), Optimum Moisture Content (OMC), California Bearing Ratio (CBR) and shear strength parameters (cohesion C and angle of internal friction Φ) of stabilized and un-stabilized soil were examined. Results conclude that, there is significant improvement in the strength of soil due to increase in angle of internal friction. However internal friction in the soil has improved but no large variation in cohesion. MDD of soil increases up to 0.8 % of plastic waste as stabilizer, beyond which there is no significant increase because of lesser specific gravity of plastic waste. Demand of water reduced as the plastic content increased since it does not absorb moisture. CBR value increased by 0.4% of plastic waste as stabilizer. This could be effective method of disposal of plastic waste with respect to environmental concern.*

1.1 INTRODUCTION

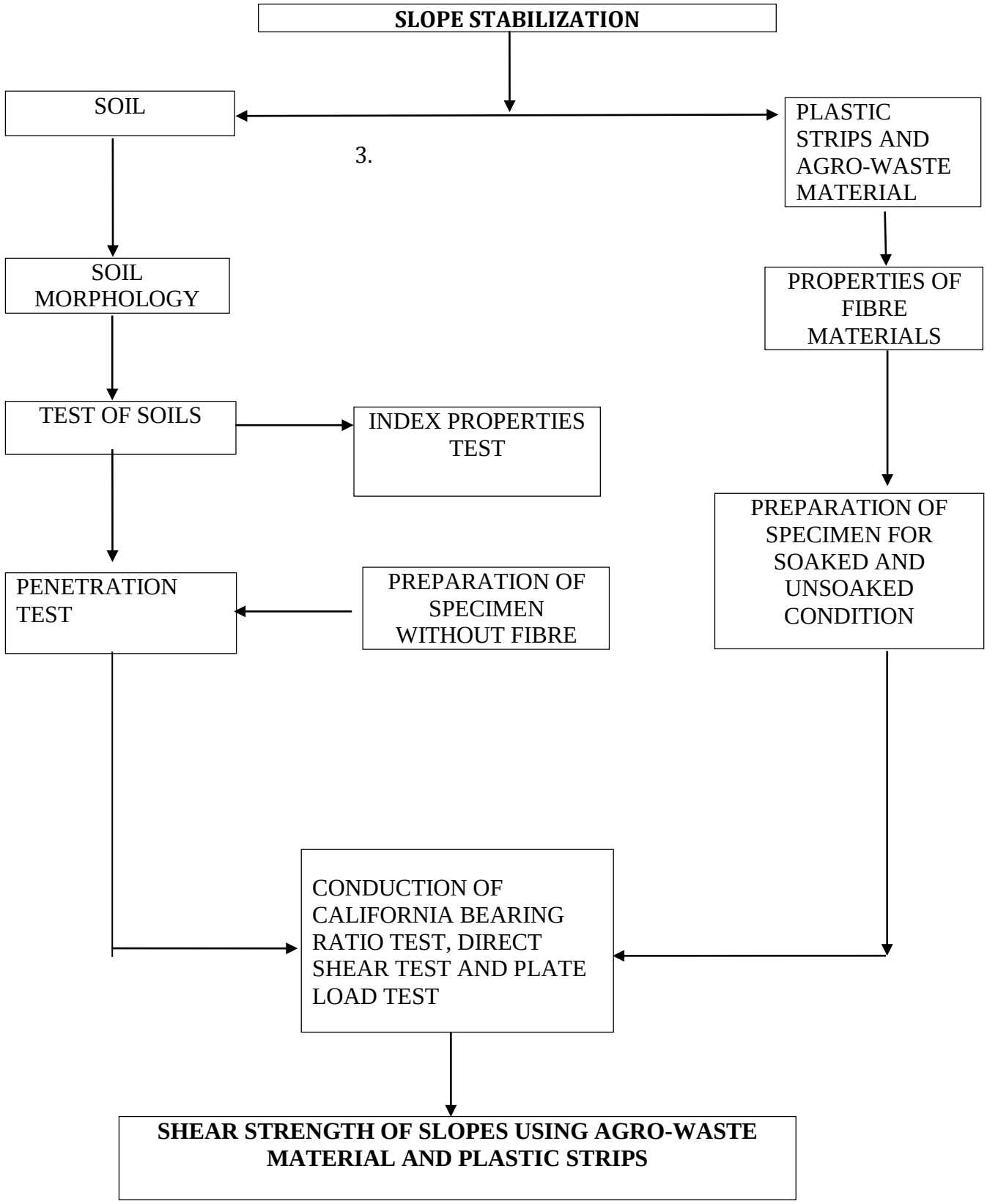
Dumping of plastic strips in open ground creates an unhealthy and unpleasant environment. In order to prevent environment, it is used in construction industry and also in ground improvement techniques. Avalanche is a picturesque wooded zone which is the home to the avalanche reservoir and the TNEB hydro-electric power generation unit while it is known to receive heavy rainfall on this year during the southwest monsoon period. The heavy rains triggered landslides on the western side of the hydro-power station. The debris and the wash off from the landslide almost blocked the outlet of the hydro-power station. Avalanche was virtually cut off due to landslides along the Emerald-avalanche road. Landslides occur when the slope undergoes some processes that changes its condition from stable to unstable. This is essentially due to a decrease in the shear strength of the slope material. Agro-waste material and plastic strips are used to increase the shear strength characteristic and load bearing capacity. The inclusions of plastic strips and agro- waste material have been successfully used in present times to enhance the shear strength parameters of the weak soil because of their immaculate behavior. To achieve this, the plastic strips and agro-waste materials are distributed over soil sample randomly with different proportions. Test experimental results show that the strength characteristics of reinforced clay soil improved over unreinforced clay soil. It is available in abundance at a very low cost and it can be easily used as a reinforcing material not only to improve poor or unsuitable construction sites for sustainable construction. The addition of plastic strips to the soil enhances the shear strength and bearing capacity of a clayey soil for sustainable development of infrastructure in a rapid urbanization. The test is to be conduct to get the strength properties of the soil which will be collected from avalanche in future.

1.2 PLASTIC WASTE

The exponential boom in use of 1 time usable plastic fabric in day to day life is producing huge volumes of plastic waste all over the world. Since they are used for shorter length, they quickly attain waste movement. Usually a few amount of those plastic wastes is recycled and the last waste is incinerated to get thermal energy. At final the last waste is disposed off in landfills and it calls for big regions of land.

The plastic waste is shredded into small portions with the aid of unique machine cutters. This plastic waste is a mixture of all forms of plastics like polythene luggage, cups, sheet plastics, sachets of shampoo, chocolate, biscuits, pan masala and many others. That reach municipal waste movement. The plastic waste accrued has a fusion factor of 1650 C as statistics provided through KK plastic Waste management. It was also determined to be good for soil stabilization via visible remark and additionally with regards to exhaustive survey of literature on plastic.

1.3 METHODOLOGY



1.4 EXPERIMENTAL STUDY

The experimental studies are required for you to understand the impact of addition of waste plastic on index and engineering properties of the soils. In the present observe investigations are made according to traditional process as consistent with IS- 2720. Waste plastic is delivered to the soil in dry situation, combined very well to get uniform mixture. Then the required water is brought and mixed properly, and then the samples are prepared and examined. Table 1 shows the checks conducted on soil samples before and after addition of plastic waste.

Tests conducted	
Cohesive Soil	**Stabilized Soil**
1) Specific Gravity of soil 2) Natural Moisture Content 3) Grain size distribution 4) Atterberg limits 5) Standard Compaction test 6) Direct Shear test 7) CBR test 8) UCS test	1) Standard Compaction test 2) Direct shear test 3) CBR test 4) UCC test (with 0.4%,0.8%,1.2% waste plastic)

TABLE 1

1.4.1 PHYSICAL PROPERTY OF SOIL

Sl No	Property	Cohesive soil
1	Specific Gravity	2.43
2	Moisture content	13.60%
3	Particle size distribution Silt and Clay	91.7%
4	Liquid limit	47%
5	Plastic Limit	33.33%
6	Plasticity Index	13.7%

TABLE 2

After the physical properties we have calculated the stability of the soil by the Standard Proctor Test and by California Bearing Ratio.

1.4.2 STANDARD PROCTOR FOR COHESIVE SOIL

Variation of MDD and OMC with plastic waste attention for Black cotton soil which suggests that because the plastic waste awareness is multiplied MDD will increase first of all however later decreases due to low unique gravity of plastic cloth. Table 3 Variation of MDD and OMC with plastic attention for Black Cotton Soil at the side of void ratio and porosity.

Sl No	% Plastic waste	MD D g/cc	% Variation in MDD	OMC %	% Variation in OMC	Voi d ratioe	Porosit y %
1	0	1.46	-	28.2	-	0.65	39.4
2	0.4	1.50	2.52	20.5	-27.3	0.61	37.88
3	0.8	1.49	1.98	21.6	-23.4	0.62	38.27
4	1.2	1.48	0.88	24.4	-13.47	0.64	39.02

TABLE: 3 VARIATIONS OF MDD AND OMC

1.4.3 UNCONFINED COMPRESSIVE STRENGTH (UCS) TEST

UCS test is carried out on black cotton soil with increasing percentage of plastic waste. The variation of UCS strength of black cotton soil with increase in plastic waste content is shown in Table 4.

Sl No	Plastic concentration %	UCC strength N/ sq cm	% Increase in UCS
1	0	8.55	-
2	0.4	9	5.26
3	0.8	9.533	11.5
4	1.2	10.187	19.146

Table 4: UCS of soil after addition of plastic waste

1.4.4 CBR TEST:

CBR test is carried out on Black cotton soil with increasing percentage of plastic waste. Table 5 shows load values for increasing depth of penetration during CBR test for Black cotton soil with varying concentration of plastic waste.

Penetration mm	Load values (soil+0% plastic) kg	Load values (soil+0.4 % plastic) kg	Load values (soil+0.8 % plastic) kg	Load values (soil+1.2 % plastic) kg
0.5	5.28	7.92	5.28	5.28
1	7.92	13.2	7.92	10.56
1.5	10.56	15.84	13.2	13.2
2	13.2	18.48	15.84	15.84
2.5	15.84	21.12	21.12	21.12
5	29.04	34.32	34.32	42.24
7.5	39.6	42.24	44.88	55.44
10	50.16	47.52	52.8	66
12.5	58.08	52.8	58.08	73.92

Table: 5 Load values for Clayey soil with varying plastic concentration in CBR test

Table: 6 shows values of CBR for Black cotton soil for different plastic concentration which shows that there is an increase in CBR value for 0.4% plastic waste but there is no further significant increase in CBR value at 2.5mm penetration with increase in plastic waste. For 5mm penetration there is increase in CBR value up to 1.2% plastic waste.

Sl no	Plastic concentration %	CBR Value (At 2.5mm penetration) %	% Increase (2.5mm)	CBR Value (At 5mm penetration) %	% Increase (5mm)
1	0	1.16	-	1.41	-
2	0.4	1.54	32.76	1.67	18.44
3	0.8	1.54	32.76	1.67	18.44
4	1.2	1.54	32.76	2.055	45.74

Table: 6 Variation of CBR value of BC soil with plastic concentration

1.4.5 DIRECT SHEAR TEST:

Direct shear test is carried out on Black cotton soil with increasing percentage of plastic waste. Table 7 shows Maximum shear stress values for increasing normal stress during direct shear test for Black cotton soil with varying concentration of plastic waste.

Table 7 Maximum shear stress values for increasing normal stress for Black cotton soil with increasing concentration of plastic waste.

Sl no	Normal stress N/cm²	Max shear stress N/cm² (0% plastic)	Max shear stress N/cm² (0.4% plastic)	Max shear stress N/cm² (0.8% plastic)	Max shear stress N/cm² (1.2% plastic)
1	5	5.56	8.35	9.59	11.28
2	10	6.07	11.44	11.35	13.43
3	15	6.38	12.28	12.74	13.82

Table 7

Table 8 shows values of Angle of internal friction (Φ) and Cohesion (C) for Black cotton soil for different plastic concentration which shows that there is an increase in friction angle (Φ) value and Cohesion (C) value with increase in plastic waste. Maximum increase in friction angle (Φ) value is at 0.4% plastic content for Black cotton soil.

Sl no	Plastic concentration %	Angle of internal friction Φº	% Variation in Φ	Cohesion C In N/cm	% Variation in C
1	0	12	-	4.6	-
2	0.4	20	66.67	6.8	47.82
3	0.8	16	33.33	8.4	82.6
4	1.2	14	16.67	10.2	121.74

Table 8: Variation of Φ and C value for BC with plastic concentration

1.5 EFFECT OF PLASTIC WASTE ON STRENGTH PROPERTIES OF CLAYEY SOIL

1. The Standard Compaction check results on Black cotton soil stabilized with plastic waste (Table 3) it became found that the MDD expanded with increase in plastic waste (for zero.4%) because of increase in inner friction of soil due to presence of plastic waste. But for similarly increase in plastic waste (at zero.8% and 1.2%) MDD and OMC decreased because of decrease particular gravity of plastic waste which reduces the shear power of soil. Highest MDD of 1.504 g/cc at OMC of 20.Five% turned into acquired while the soil changed into blended with 0.8% plastic waste.

2. California bearing ratio test effects on Black cotton soil stabilized with plastic waste mixes were offered in Table 6 . It was determined that there was an growth in CBR value with 0.Four% plastic waste. But for similarly growth in plastic waste (at 0.8% and 1.2%) CBR value decreased because of decrease particular gravity of plastic waste which reduces the shear strength of soil. Highest CBR price of one.54% become received at0.Four%. CBR values at 5mm penetration showed nonlinear versions but there's huge growth (forty five). Seventy four% increase) in CBR at 5mm penetration for 1.2% plastic waste

3. Direct shear take a look at results on Black cotton soil stabilized with plastic waste have been provided in Table 7. It turned into located that the internal friction elevated with increase in plastic waste (for 0.4%) due to boom in friction with addition of plastic. Highest cost of attitude of inner friction of 20 turned into acquired while soil turned into blended with 0.4% plastic waste. But for further increase in plastic waste (at 0.8% and 1.2%) inner

friction perspective reduced because of increase in surface vicinity of plastic waste which reasons shear deformation of the soil without difficulty and decreases the shear strength of soil. Also it was located that as plastic waste is accelerated there was tremendous growth in brotherly love (C) fee of soil.

4. Unconfined compressive power test results of Black cotton soil stabilized with plastic waste mixes were provided in Table 4. UCS specimens were prepared for the above noted aggregate of stabilization. It changed into observed that there was linear increase in UCS of soil with increase in plastic waste awareness because of boom in inner friction with addition of plastic waste. Highest UCS value of 10.187 N/cm□becomes acquired w hilst the soil became combined with 1.2% plastic waste.

2. CONCLUSION

Addition of plastic waste with the aid of 0.Four% by means of weight of the soil improves MDD of soil by using 2.Fifty two%, on in addition increasing the percentage of plastic there's a discount in MDD of the soil. And hence it is able to be concluded that the premier percentage of plastic waste may be brought for stabilization of black cotton soil is 0.Four percentage. Addition of plastic waste increases the Friction attitude of the soil and a maximum cost of friction attitude of 20□became acquired at zero. Four% percentage plastic waste by means of weight of soil, on including similarly extra plastic there may be discount in friction angle due to reduction in MDD. There is simplest a small increase in California Bearing Ratio (CBR) fee of the black cotton soil because of addition of plastic waste to the soil and therefore it is able to be concluded that addition of plastic waste has no sizeable effect on CBR price of black cotton soil. There is increase in UCS strength of the soil while the plastic is delivered to the soil in growing percentage from 0 to 1.2 percent plastic by using weight of the soil so plastic waste may be correctly used for stabilization of black cotton soil. From the entire above take a look at outcomes, it can be concluded that plastic waste can be used to stabilize black cotton soil and surest plastic waste content material that may be delivered is 0.4% via weight of the soil.

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