

Influence of PET strips on CBR value of lime stabilized soil

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ABSTRACT: The constant and growing improvement rate of people in our nation is the purpose for creation of humongous measure of waste, the greater part of which is non-biodegradable just as non-recyclable. In this study, soil can be studied with different test Plastic Limit, Liquid Limit, Standard Proctor test and CBR test with the addition of waste Pet strips and lime in different percentages. In this experiment, various test carried out in college laboratory of different proportions of Pet strips and lime. The proportions of Pet strips are 0.5%, 1%, 1.5% and the variation in lime are 2%, 4%, 6%. The size of the Pet strips is 20mm length and 5mm width. The comparison of virgin soil and treated soil also conducted in this experiment. The value of CBR increases with the increasing proportion of Pet Strips and lime, in this mixing the value increases up to 1% of Pet strips after that the value start decreasing. The pavement is designed with the help of IRC 37:2012 which shows reduction in the thickness of pavement leads to cost effective approach.

Keywords: Lime; Pet Strips; Compaction; Compressive strength

1. Introduction

The need of increasing the Structure properties of soil has been seen for whatever the period of time that development has existed. Soil Stabilization is the way toward treating a soil in such a way as to keep up, and improve the presentation of the soil as a street development material and building. The adjustment in the soil properties are realized either by the joining of added substances or by mechanical mixing of various soil types. Soil Stabilization is utilized to improve the bearing limit of soil and lessen the settlement chance. Some similar results of Pet cup and soil were (Ali, et al., 2018) This test is utilized to conclude the liquid limit, plastic limit and CBR value of the treated soil. In this test the percentage of plastic content is 0.2%, 0.4%, 0.5%, 0.6%, 0.8% is used to determine the various test. (Naeini, et al., 2017) was conducted specimen mixed with waste plastic chips in triaxial tests with 0.25%, 0.50%, 0.75%, 1.0%, and 1.25% by weight of soil and the different length of the waste plastic chips are including 4, 8, and 12 mm. (Kumar, et al., 2017) studied the tri axial test, CBR test on Black cotton soil. This paper shows the different sizes of strips which are 2.5cm, 5cm, 7.5cm at different ratio of bottle strips. The percentage varying from 0, 0.25%, 0.50%, 0.75%, 1% of bottle strips is used. (Al-Neami, et al., 2016) In this paper, UCS, Direct shear test and vane shear test was performed to determine the shear strength of the soil with waste glass. (Subash, et al., 2016) was conducted UCS and CBR test on black cotton soil. The overall OMC increases after mixing with plastic glass and maximum OMC was obtained at 6% plastic is 22.6%. The percentage varying from adding of plastic glass show the results overall Dry density decreases and at 6% plastic the MDD is 1.53gm/cc is determined. (Sharma, et al., 2016) This test was conducted to conclude the shear parameters and CBR value of the treated soil. In this test the plastic glass is used in the ratio of 3%, 5%, 7% of the weight and the content of fly ash is the 10%, 15%, 20%, 25% by the weight of soil.

Tests conducted for fine grained soil mixed with lime and Pet strips are Plastic Limit, liquid Limit, Maximum Dry Density, and Optimum Moisture Content and California Bearing Ratio. A comparison between properties of fine-grained soil, fine grained soil mixed with lime, fine grained soil mixed with lime and pet strips is performed. It is found that the properties of fine-grained soil mixed with lime and Pet strips are suitably improved.

2. Methodology

2.1 Soil

As per Unified Soil Classification System, the soil used in this study was classified as clay of medium plastic

(CI). The maximum dry density of soil was found to be 17.7 kN/m³. The soil used in this collected from Kalsan village district Ludhiana.

Table 1 properties of virgin soil

S. No	Characteristics of soil	value
1.	Liquid Limit (%)	44
	Plastic Limit (%)	19
	Plasticity index (%)	25
2.	Soil classification	CI

3.	OMC (%)	16.4
	MDD(kN/m ³)	17.7
4.	Soaked CBR (%)	2.5
5.	Specific gravity	2.54

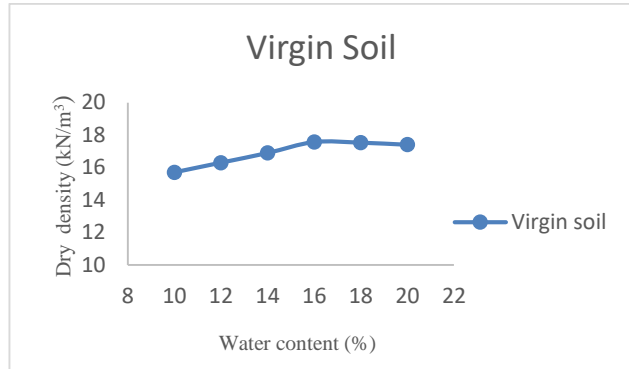


Figure:1 compaction curve of virgin soil

2.2 Pet Strips

Plastic Pet are transparent little plastic cup for generally useful utilize like gathering or any social or family assembling. The size of the Pet strips is length 20mm and width 5mm and thickness remains constant. Disposable cup is generally made from polystyrene sheets and polypropylene materials. Plastic cup is made with oil which isn't sustainable source. Disposable cup is made for only single time use. Plastic cup is dangerous for health as chemicals may drain into the drinks. This is more likely to happen with warm drinks than cold drinks.

The disposable cup is fast replacing the standard glass. For cold drink, drinking water and other dairy products like ice cream are disposable cup is used. Other than Ice cream cup, restaurants, canteens etc. have been using disposal cup as against regular

glass. Disposable cup is generally used drinking purpose and are made out of polystyrene sheets and polypropylene. The disposable cup is more popular now a day due to charming look, light weight for holder, simplicity of transportation, and low permeability. Presently a-days associations like airlines, railways are using disposable cup for serving water, tea and other drinking purpose etc.

It gives information about the effects on soil behavior like swelling and shrinkage characteristics or permeability of soil when water mixed with it. At that point we get into the compressibility of soil, which is very significant engineering structure constructed on soil masses. It is helpful to design the foundation, slopes and retaining walls.

Table 2 properties of Pet strips

No.	Properties	Value
1	Colour	Transparent
2	Tensile elongation (%)	1-5
3	Specific gravity	1.03-1.06
4	Tensile strength (MPa)	30-60

2.3 Lime

Lime(CaO) gives an efficient method for soil stabilization. Lime can be used in huge amounts in building material and structure for stabilization. Lime is better for improving of clayey soil. Lime material is less costly and good for improvement the soil structure. Lime material also help to maintain the correct pH level. The benefits of lime used in soil are:

- a) Increase the stability of soil
- b) Decrease the plasticity index
- c) Decrease the moisture holding capacity
- d) Decrease the swelling properties
- e) Ability to build up a solid working stage.

Lime stabilization is good for soil like clay, clayey gravel and silty clay etc. and not good for granular soil and sandy soil. There are five types of lime:

- i. Quick lime (CaO)
- ii. Hydrated lime [Ca(OH)₂]
- iii. Dolomitic Lime (CaO + MgO)
- iv. Normal Hydrated dolomitic lime [Ca (OH)₂ + MgO]
- v. Pressure Hydrated lime [Ca(OH)₂ + MgO₂].

3. Testing procedure

The proportion of lime used in this project is 2%, 4%, 6% and Pet strips were 0.5%, 1%, 1.5% is used.

Here S = Soil, PS = Pet strips and L = Lime.

Total sixteen laboratory tests were conducted by changing different proportions as shown in Table 4.

Table-4 Mix proportions of Soil, Pet strips and Lime

Sr.	Tittle (S-PS-L)
1	100-0-0
2	98-0-2
3	96-0-4
4	94-0-6
5	99.5-0.5-0
6	99-1-0
7	98.5-1.5-0
8	97.5-0.5-2
9	97-1-2
10	96.5-1.5-2
11	95.5-0.5-4
12	95-1-4
13	94.5-1.5-4
14	93.5-0.5-6
15	93-1-6
16	92.5-1.5-6

4. Results and discussion

4.1 Compaction Characteristics:

The maximum dry density of clayey soil used in this study was 17.7 kN/m³ with the optimum moisture content of 16.4%.

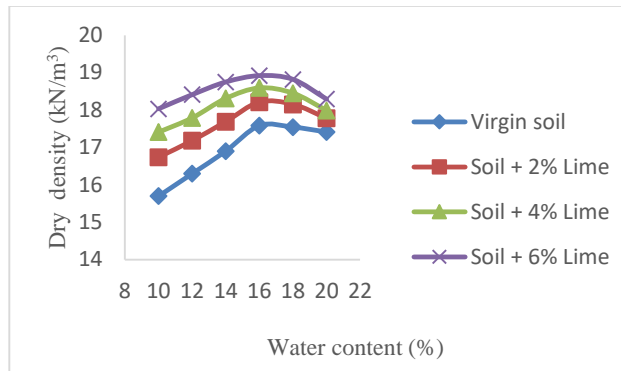


Figure: 2 compaction curve of virgin soil and lime

When percentages of lime 2%, 4%, 6% is used in soil OMC increases from 16.4% to 16.9% and MDD increases from 17.60 kN/m³ to 18.92 kN/m³. Reason for This increase in MDD was due to the hydration process between lime and water, and formed a gel which helped in binding the soil particles and therefore the strength increased.

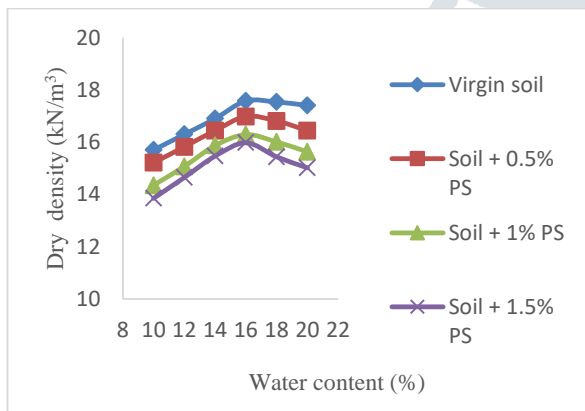


Figure: 3 compaction curve of virgin soil and Pet strips

When the Pet strips is utilized as 0.5 %,1 %,1.5 % thusly, as needs be an imperative decrement was shown in OMC and MDD reduces. The expansion in OMC ranges from 16.4 to 16% and the MDD was in scope of 17.7% to 15.98 %. Reason for MDD decreases due to lower specific gravity of Pet cup as compared to soil. These plastic also don't let the soil particles to come near each other and hence the density decreases. The reason for decrease in OMC is the water absorbing capacity of Pet cup which is less as compared to soil particles.

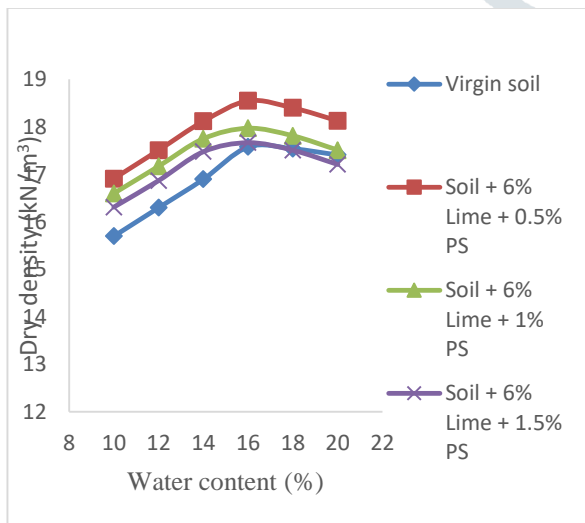


Figure: 4 compaction curve of virgin soil, Pet strips And lime

A decrease in OMC from 16.4% to 15.6% when the percentages of lime and Pet strips used were 2, 4, 6% and 0.5, 1 and 1.5% respectively and also a decrease in MDD from 18.92 kN/m³ to 17.67 kN/m³ was observed when the percentages of lime and Pet strips used were 2, 4, 6% and 0.5, 1 and 1.5% respectively.

4.2 C.B.R Test

Inclusion of Pet strips in soil also resulted in the observation of rise in CBR value. The optimization occurs at the inclusion of 1 % Pet strips. This increase in CBR value may be due to the enhancement in isotropic and homogenous properties of soil with the addition of plastic. This increase was found up to 1% plastic content, beyond which the CBR value decreased as it became difficult to mix the plastic. Initial Value of CBR in virgin soil was detected as 2.5% but with the inclusion of 1 % Pet strips and 6% lime to it. It rises from 2.5% to 8.4%.

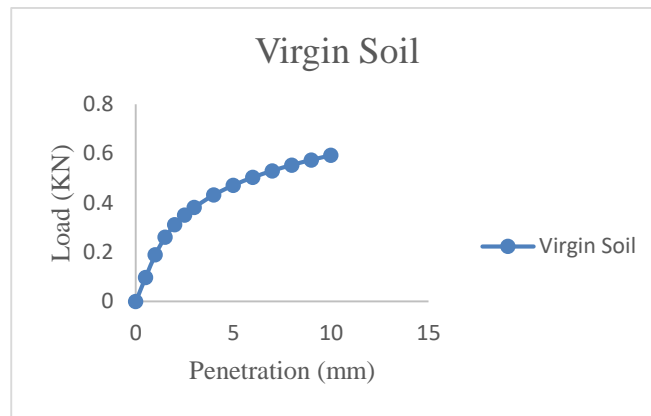


Figure: 5 CBR curve of virgin soil

When the lime used in soil as 2%, 4%, 6% the CBR value increases from 2.5% to 6.6%. Pet strips were also effect on CBR value of soil, the CBR value increases from 2.5% to 4.1% but the effect of pet strips is less as compare to lime.

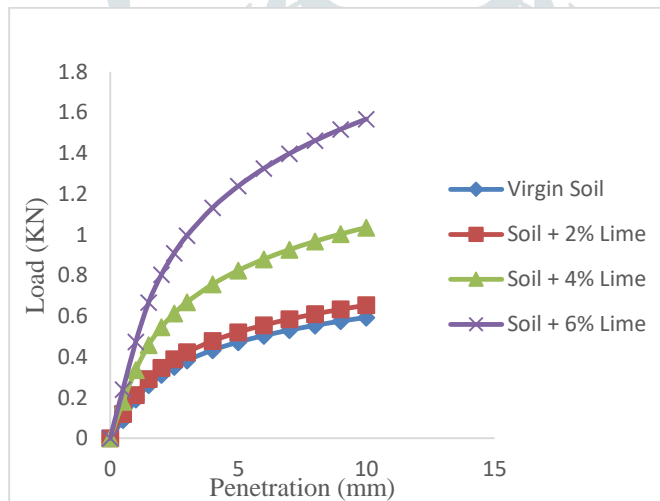


Figure: 6 CBR curve of virgin soil and lime

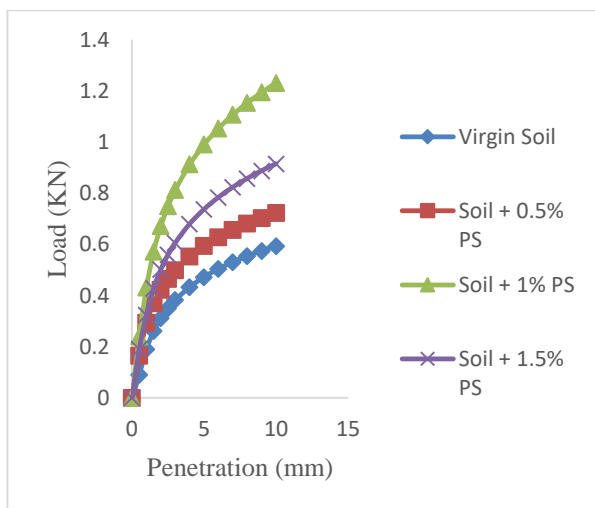


Figure: 7 CBR curve of virgin soil and pet strips

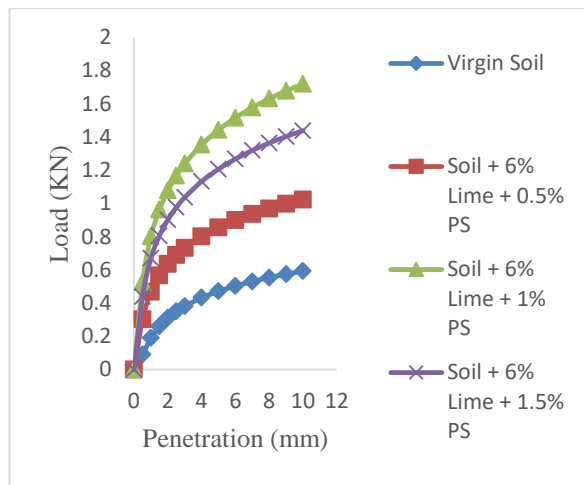


Figure: 8 CBR curve of virgin soil, lime and pet strips

When both pet strips and lime is used in untreated soil, the CBR value increases from 2.5% to 8.4%. Reason for increase in CBR value are When lime and Pet both are used at a same time, they form strong interconnection with soil and act as a hard mass which increases the CBR value.

5. Conclusion:

From this learning it is found out that by utilizing Pet strips, street material of good quality can be built.

When the addition of Pet strips 0.5%, 1%, 1.5% the MDD decreases and also OMC decreases. When lime is added in soil 2%, 4%, 6% the OMC increases and MDD increases from untreated soil.

•The CBR value increases from 2.55% to 8.47% when addition of lime and Pet strips (93:1:6). This CBR value decrease the thickness of pavement layer.

This analysis gives the another technique to arrange the waste Pet.

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