

Experimental Study on Utilization of Sand to Improve Properties of Clays

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Abstract— The locally available granular Material like sand may be mixed to the soil to obtain the desired characteristics. Liquid Limit, Plastic Limit is indicator of soil behavior. By mixing sand to two clays, the effect of sand content on Liquid Limit and Plastic Limit has been studied and Presented in this paper. It is shown that the utility of the Soil as a construction material has been increased greatly by simple mixing of the granular material.

Key words: Sand, Clays Liquid Limit and Plastic Limit

I. INTRODUCTION

Clays are quite impervious but they lack in weight and stability and tend to swell and slump when saturated with water and to shrink and crack when dry (Sundar Kumar and RatnakarNath Babu2010)

The present investigation deals with mechanical stabilization of clays with mixture of sand. This research work is to improve the behavior of clays by mixing of sand. The work Presented in this paper consist results of index properties of Liquid Limit and plastic limit reduces with the increasing percentages of sand content.

II. EXPERIMENTAL INVESTIGATIONS

A. Material used

Two samples of clayey soil, one black in colour and other yellow in colour were collected from S.A.T.I. campus Vidisha. The B.C. soil sample was collected from 50 cm below ground level and the yellow soil sample was collected from 1.8 m below the ground level.

Locally available sand (narmada) was used for mixing with clays.

S. No	soil Type	soil properties	values
1	Black soil	Grain	
		Gravel	3%
		Sand	8%
		silt and clay	89%
		Consistency limits	
		Liquid limit	48%
		Plastic limit	25 %
2	Yellow Soil	Plasticity Index	23%
		I.S. Classification	CI
		Grain size analysis	
		Gravel	2%
		Sand	5%
		silt and clay	93%
		Consistency limits	
		Liquid limits	58%
		Plastic limit	25%
		Plasticity Index	33%
		I.S. Classification	CH

Fig. 1: Properties of clayey soil

B. Details of the test variables

In the present work, the clays was stabilized by adding various percentages of sand

III. ANALYSIS OF TEST RESULTS

A. Effect of sand content on Index Properties of Black cotton soil

1) Sand Grade 1(size between 2 mm and 425 μ)

The liquid limit and the plastic limit of the black cotton soil mixed with various percentages of sand grade I are given in Table 1. The test results are also presented in fig 1&1 (a)

S. No	Percentage of sand Mixed	Description of Test		
		Liquid Limit by A. Casagrande	Liquid limit by come penetration Method	Plastic limit
1	0%	48%	48.0%	24.5 %
2.	2%	47.0%	47.5 %	24.2%
3	5%	46.%	46.7%	24.0%
4	8%	45.%	46.0%	23.0%
5	10%	43.0%	44.0%	22.5%
6	12%	42.0%	42.5%	20.0%
7.	15%	41%	41.0%	18.0%
8	20%	39.5%	40.0%	17.5%
9	25%	37.0%	38.1%	17.1%
10	30%	35.0%	36.5%	-
11	40%	30.0%	31.5%	-
12	50%	25.5%	26.2%	-
13	60%	-	23.0%	-

Table 1: The test results

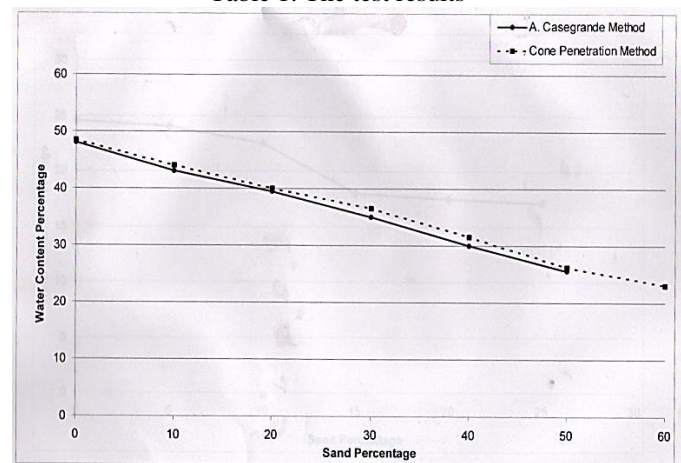


Fig. 1: Liquid Limit of Black cotton soil mixed with sand grade-I

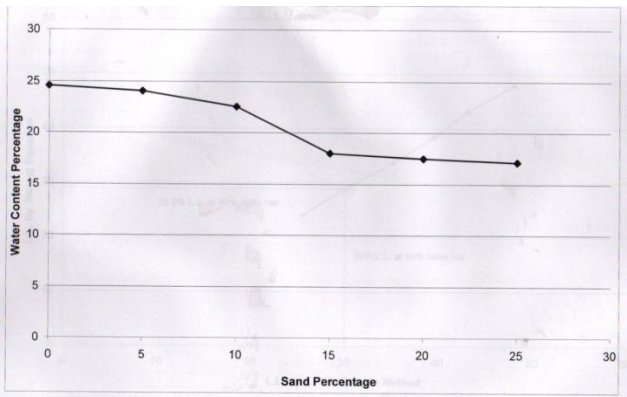


Fig. 1(a): Plastic Limit of Black cotton soil mixed with sand grade-I

From the Table 1 it can be noted that there is no appreciable difference between the values of liquid limit obtained by the two methods i.e. the Casagrande method and the Cone penetration method.

From Fig 1 and 1 (a) it can be observed that liquid limit and plastic limit decreases linearly with increase in sand content.

B. Effect of Sand Content on Index Properties of black Cotton soil

1) Sand Grade Ii (Size between 425 and 75 μ):

The liquid limit and the plastic limit of the plastic limit of the black cotton soil mixed with various percentages of sand grade Ii are given in Table 2. The test results are also presented in Fig. 2& 2(a).

Table No. 2 Index properties of Black cotton Soil Mixed with Sand Grade-II

S. No	Percentage of sand Mixed	Description of Test		
		Liquid Limit by A. Casagrande	Liquid limit by come penetration Method	Plastic limit
1	0%	48.0%	48.5%	24.5 %
2.	10%	44.0%	44.5%	23.0%
3	20%	39.0%	40.0%	10.0%
4	30%	35.0%	35.8%	16.7%
5	40%	30.5%	31.2%	-

Table 2: Index properties of Black cotton Soil Mixed with Sand Grade-II

Form the Table 2 it is noted that liquid limit values obtained by both the methods are almost identical and from Fig 2 & 2 (a), it is observed that liquid limit and plastic limit decreases with increase in sand content finer than 425 μ .

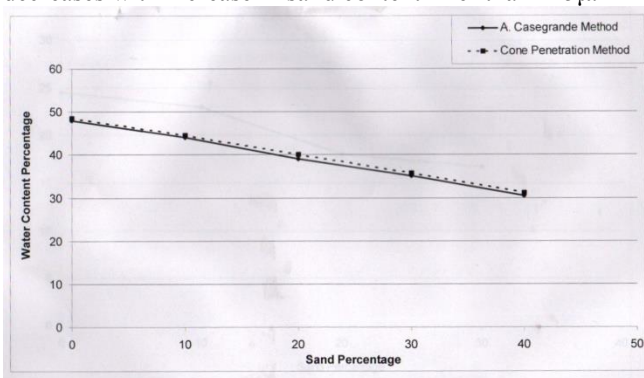


Fig. 2: Liquid Limit of Black cotton soil mixed with sand grade-II

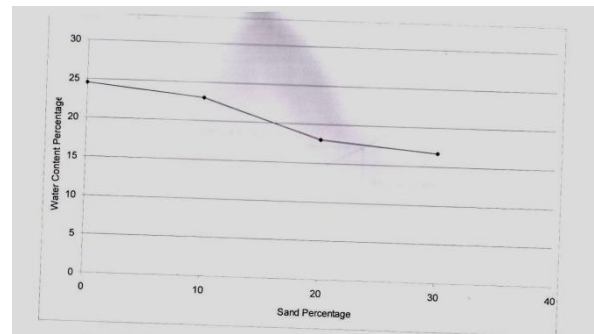


Fig. 2(a): Plastic Limit of Black cotton soil mixed with sand grade-II

C. Effect of Sand Content on Index Properties of Yellow Soil

1) Sand Grade 1 (Size between 2mm and 425 μ):

The liquid limit and plastic limit of yellow soil mixed the various percentage of coarser sand are given in next table 3. The test results are also given in fig. 3&3 (a)

Table No. 3 Index properties of Yellow Soil Mixed with Sand Grade-I

S. No	Percentage of sand Mixed	Description of Test		
		Liquid Limit by A. Casagrande Method	Liquid limit by come penetration Method	Plastic limit
1	0%	58.0%	59.0%	25.0 %
2.	2%	58.0%	58.5 %	24.5%
3	5%	54.0.%	56.0%	23.8%
4	8%	53.0.%	54.0%	23.4%
5	10%	52.0%	51.0%	22.8%
6	12%	50.0%	49.0%	21.9%
7.	15%	47.0%	47.5%	20.6%
8	20%	46.0%	47.0%	19.7%
9	25%	42.0%	43.5%	18.0%
10	30%	39.0%	40.0%	-
11	40%	34.0%	34.5%	-
12	50%	29.0%	29.6%	-
13	60%	-	24.3%	-

Table 3: Index properties of Yellow Soil Mixed with Sand Grade-I

From the Table 3 it is find out that the liquid limit values exits within1-2% difference obtained by both the method. From Fig 3 &3 (a) it is observed that as the percentage of coarser fraction of sand content increases the value of liquid limit and plastic limit decreases in yellow soil also. It is also observed that liquid limit and plastic limit follows a definite trend

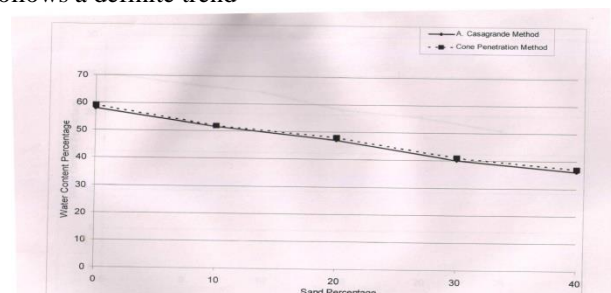


Fig. 3: Liquid limit of Yellow soil mixed with sand grade-I

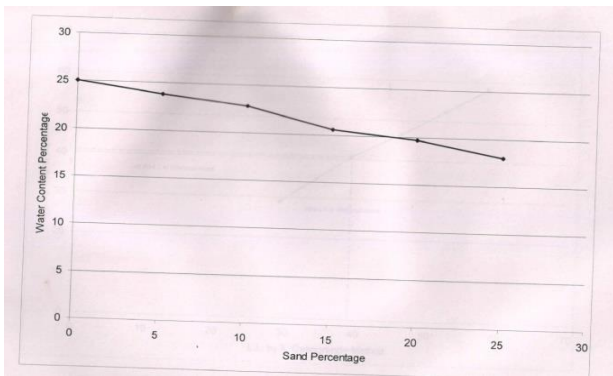


Fig. 3(a): Plastic Limit of Yellow soil mixed with sand grade-I

D. Effect of Sand Content on Index Properties of Yellow Soil

1) Sand Grade II (Size between 425 and 75 μ):

The liquid limit and the plastic limit of the plastic limit of the Yellow soil mixed with various percentages of sand grade II are given in Table 4. The test results are also presented in Fig. 4 & 4(a).

S. No	Percentage of sand Mixed	Description of Test		
		Liquid Limit by A. Casagrande	Liquid Limit by a Casagrande	Plastic limit
1	0%	58.0%	59.0%	25.0 %
2.	10%	51.5%	52.0%	23.2%
3	20%	47.0%	48.0%	19.5%
4	30%	40.0%	41.0%	17.0%
5	40%	36.1%	37.0%	-

Table 4: Index Properties of yellow soil Mixed with sand Grade II

Again it is observed from the Table 4 that liquid limit values obtained by both the methods give fairly same values. From Fig. 4 & 4 (a) it is observed that liquid limit and plastic limit decreases linearly.

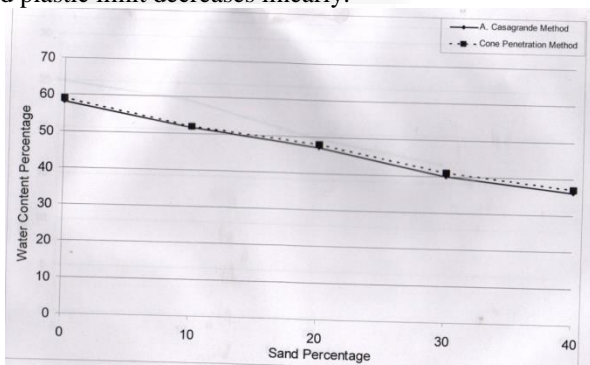


Fig. 4: Liquid limit of Yellow soil mixed with sand grade-II



Fig. 4(a): plastic limit of Yellow soil mixed with sand grade-II

IV. CONCLUSIONS

Based on the laboratory test results the following conclusions are drawn

- 1) The two methods of determining liquid limit namely the casagrande method and the cone penetration method gives nearly the same results. Being comparatively more convenient and fast. The Cone penetration method should be used wherever the equipment is available.
- 2) The liquid limit and the plastic limit of both the clays decreases linearly with mixing of sands. This irrespective of the grading of the sands.

REFERENCES

- [1] IS 2720(Part- Iv) 1985 "Indian standard for Grain size Analysis" BIS New Delhi
- [2] IS 2720(Part- Iv) 1987 " Indian Standard for Determination of Liquid limit and Plastic limit" BIS New Delhi
- [3] P. Purushothama Raj (1995). "Geo-technical Engineerinf" Tata McGraw Hill PUBLISHING Company Limited New Delhi.
- [4] Ranjan, Gpoal (1991) "Basic and Applied Soil, Mechanics", Willey Eastern Ltd. New Delhi.
- [5] Singh Alam (1991 "Modern Geo- technical Engineering"- Third Edition BS Publishers & Distributors, New Delhi.
- [6] T. Willian lamb and Robert, V., Whitman (1969) "Soil Mechanics" – SI version John willey & sons. Newyork.