STABILIZATION OF SAND WITH BENTONITE CLAY

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ABSTRACT

This paper explains experimental results on use of bentonite in stabilizing sand for the feasibility apply in geotechnical engineering. The addition of bentonite in the mix helps in making cohesive bond in the mix. The various mix proportions are prepared for tests were 5%,10%,15% and 20%. The laboratory tests such as compaction, California bearing ratio (CBR) in both soaked and un soaked condition, unconfined compression test (UCC), to measure the engineering characteristics of stabilized materials. The results showed substantial improvement in unconfined compression strength at 15% bentonite, and the small improvement by California. Thus, bentonite is used to improve the strength characteristics of sand.

KEY WORDS sand, bentonite, stabilization, unconfined compression test, California bearing ratio and permeability

1. INTRODUCTION

Sand is abundantly available at the sea shores and desert areas. It is too unattachable and cohesion less in its natural structure. Sand has low bearing capacity easy moment of vehicles is unbearable. To make work of sand as sub base and base course for roads it is must to be stabilized with some suitable admixtures. The construction further more protection of pavement for approach roads, temporary roads landing strips in desert region has been a difficulty of great concern, which imply stabilization of sand with some admixtures to upgrade its strength characteristics and lower settlements. The main aim of the present study was to develop a mix proportion that can be frugal used for stabilization of sand using cheap and locally (naturally) available materials like bentonite. The standard proctor test, unconfined compression test, California bearing ratio and permeability strengths were conducted for a the suitability of different proportions of mixtures of bentonite added to sand.

2. MATERIALS AND METHODS

The sand used for this paper is normal construction sand of 4.75mm to 75microns and the bentonite used is sodium bentonite which of size less than 75 microns.

2.1 SAND:

The grain size distribution by performing dry sieve analysis according to IS 2720 (part IV) -1965.the specific gravity of sand was determined by pycnometer under standard procedure as per IS 2720 (part II)-1980. The standard proctor test and the index properties of sand are listed below in Table No.1.

2.2 BENTONITE

The grain size distribution, Atterberg limits, standard proctor and specific gravity tests were conducted and the results are listed in Table No.1.

Table No.1. index properties

Property	Sand	bentonite
Specific gravity	2.57	2.20
Liquid limit	-	154.23
Plastic limit	-	55.32
Shrinkage limit	-	-
Grain size (4.75-0.075) mm	99	-
Silt	2.41	-
Maximum dry density	N1.78g/cc	1.44
Optimum moisture content	6%	66%
Is classification	Well graded sand	-

The test sample was prepared by mixing sand, bentonite, and water in various proportions. The various mix prepared were by using bentonite in 5%, 10%, 15% and 20% Proctor test was conducted to find out maximum dry density and optimum moisture content of the mix. The compaction test results of 5%,10%,15% are decreasing moderately in that the maximum dry density and water

content both are decreasing and the percentage of 20% the maximum dry density is decreased and water content is raised

Table 2 compaction data of present study

S.no	Sand and bentonite mixture	Sand %	Bentonite %	Maximum dry density (kg/cm)	Optimum moisture content
1	M1	95	5	1.77	19
2	M2	90	10	1.74	15
3	M3	85	15	1.73	11
4	M4	80	20	1.55	23

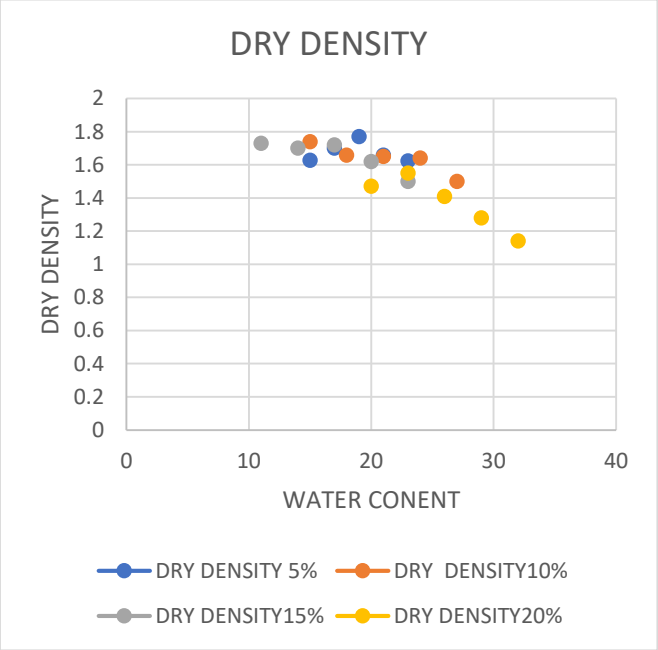

Fig.1 Dry Density

Table 3 unconfined compression test

S.no	Sand and bentonite mixture	Sand %	Bentonite%	Unconfined compression strength (kg/mm2) q u	Shearstrength q u / 2
1	M1	95	5	0.42	0.21
2	M2	90	10	1.65	0.825
3	M3	85	15	2.70	1.35
4	M4	80	20	1.42	0.71

2.3 Behaviour of addition of bentonite on unconfined compression strength of sand.

The unconfined compression tests were conducted for the mix proportions M1 to M4 as per IS 2720 (Part X) 1973.The specimen for the test was of the size (d) 38mm and (L) 76mm. The samples developed were of maximum dry density and optimum moisture content. the shear strength ranges from 0.21 to 1.35. The maximum shear strength at M3 of 1.35 kg/mm2. The graphical representation of % axial strain and unconfined compressive stress was done. The values are mentioned in Table No. 3

2.4 Behaviour of addition of bentonite on California bearing ratio strength of sand.

The California bearing ratio (CBR) tests were conducted for the samples M1 to M4 as per IS 2720 (Part 16) 1979. The tests are conducted in both the soaked and un soaked conditions. The samples prepared were of maximum dry density and optimum moisture content. The soaked conditions values range from 0.68 to 0.257 at 2.5mm and 1.25 to 0.286 at 5mm. The strength of the mixtures decreases from M1 to M4 as the bentonite increased and the 2.5 mm value is less than the 5mm value. Three trials are done on it and the cross check with graph is also done. The graph representation of penetration and load was done the values are mentioned in the TABLE NO.4 the California bearing ratio values of various soaked mixtures are as represented in the Figure. (2)

Table 4 soaked (CBR)

S.no	Sand and bentonite mixture	Sand%	Bentonite%	CBR value at 2.5mm	CBR value at 5mm
1	M1	95	5	0.025	0.515
2	M2	90	10	0.025	0.045
3	M3	85	15	0.025	0.034
4	M4	80	20	0.025	0.028

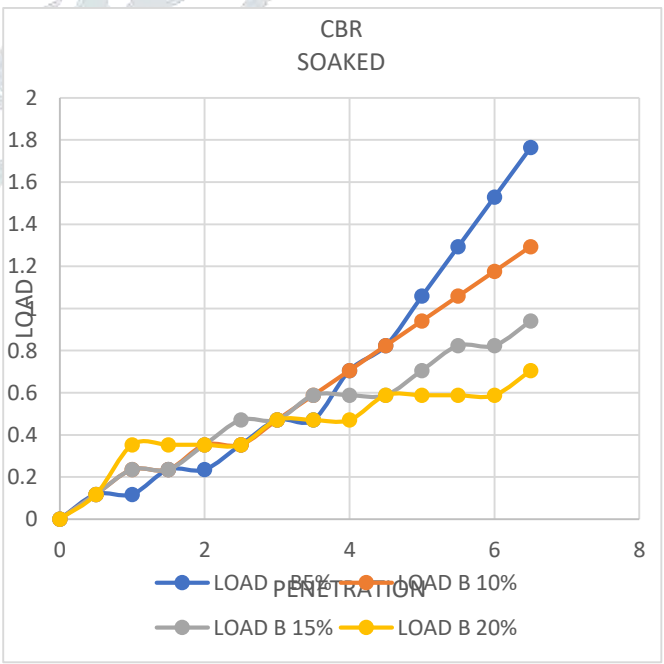

Fig.2 CBR Soaked

The un soaked conditions values range from0.68 to 0.257 at 2.5mm and 0.515 to 0.028 at 5mm. The strength of the mixtures decreases from M1 to M4 as the bentonite increased and the 2.5 mm value is less than the 5mm value. Three trials are done on it and the cross check with graph is also done. The strength of the mixtures lowers fromM1 to M4 as the bentonite increases. The graph representation of penetration vs load was done the values are mentioned in the TABLE NO.5 The California bearing ratio values of various soaked mixtures are as represented in the Figure (3)

Table 5 un soaked (CBR)

S.no	Sand and bentonite mixture	Sand%	Bentonite%	CBR value at 2.5mm	CBR value at 5mm
1	M1	95	5	0.68	0.125
2	M2	90	10	0.51	0.068
3	M3	85	15	0.42	0.051
4	M4	80	20	0.257	0.0286

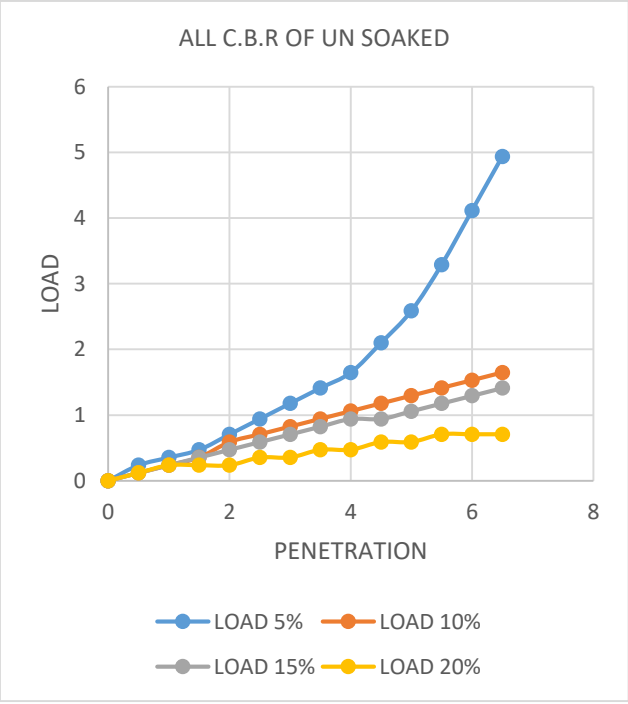

Fig.3 All CBR of unsoaked

3. CONCLUSION

After performing the laboratory test on Sand with varying percentages of Bentonite. Comparing the test results, we found that there is a small increase in strength parameter of sand. From the standard proctor test, it is inferred that the optimum moisture content is decreasing, and moisture dry density is decreasing and at the 20% of the bentonite addition there is a rise in the both water content and maximum dry density of the sample. We can conclude that,

- The dry density is increased to 1.77 g/cm^3 at Optimum moisture content of 19 % with addition of 5% of bentonite.
- The CBR value at un soaked 5 mm penetration has increased to 0.125 with addition of 5% of bentonite.
- The CBR value at soaked 5mm penetration has increased to 0.515 with addition of 5% of bentonite.
- From UCS Test, the Shear strength has increased to 1.35 kg/cm^2 with addition of 15% of bentonite.

Finally, by comparing the results, we can conclude that the improvement of strength parameter of sand on an average is being obtained at 5 % of bentonite

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