

# Study on The Effect of Sandy Soil used as A Liner Material

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**Abstract** – Mixture of sandy soil and Sodium Bentonite are used as liner material at the waste disposal site. Sodium Bentonite is added to sandy soil to achieve low permeability. And the Free Swell Index also determined. Usually, sandy soil has high permeability but the addition of Sodium Bentonite reduces the permeability characteristics of soil. By the weight of soil 5 to 25% Sodium Bentonite is added. The result showed that 25% of Sodium Bentonite added to sandy soil gives the better result. Also determined the Ultimate Bearing Capacity and settlement of soil using plate load test.

**Keywords** – Sandy soil; Sodium Bentonite; Permeability; Plate load test

## I. INTRODUCTION

The first type of soil is sand. It consists of small particles of weathered rock. Sandy soils are one of the poorest type of soil for growing plants because it has a very low nutrients and poor water holding capacity. Sandy soils are often known as light soils due to their high proportion of sand little clay (clay weighs more than sand). These soils have quick water drainage and are easy to work with. The sandy soil has high permeability. The soil permeability decreases by the addition of Sodium Bentonite. The Sodium Bentonite are added in 5,10,15,20 & 25% by the weight of soil. And also determined the Free Swell Index of soil particle. Free Swell Index is the increase in volume of soil, without any external constraints on submergence in water. To conduct a plate load test determine the ultimate bearing capacity and settlement of sandy soil.

## II. OBJECTIVES OF STUDY

- A. To find the Physical properties of sandy soil
- B. To evaluate the performance of Sandy soil and Sodium Bentonite
- C. Mixture of sandy soil and sodium bentonite used as a liner material

## III. MATERIALS USED

- A. Sandy soil  
The sample is collected from Municipal waste dump site, Nedumangadu, Trivandrum district.



Fig: 3.1 Sandy soil

The physical properties of soil are identified by conducting various laboratory tests are per the code IS 2720 (1983) and the properties are shown in table 3.1.

## B. Sodium Bentonite

Sodium bentonite is a naturally occurring clay mineral derived from in situ chemical alteration of volcano ash, which has been deposited in sea water. It is highly plastic swelling clay of the smectite mineral group, and is mineralogically known as "Montmorillonite".



Fig.3.2 Sodium Bentonite

High quality sodium bentonite contains 65% - 95% montmorillonite by weight. It is a clay with extra ordinary properties such as very high expansion capability by absorbing water (swelling capacity). High iron exchange capacity and very low water permeability. Sodium bentonite is an excellent natural sealant mostly used for landfills, sealing recreational ponds and sewage lagoons.

C. TEST TANK

A test tank made up of steel having dimensions 40cm x 40cm x 40cm will be utilized for conducting load test and there by identify the ultimate load carrying capacity and settlement of soil.

IV. LABORATORY TESTING

A. Physical Properties

The physical properties of sandy soil are listed in Table 4.1.

Table 4.1 Physical Properties of Sandy Soil

Sl No	Properties of Soil	Values
1	Uniformity Coefficient, $C_u$	3.70
2	Coefficient of curvature, $C_c$	1.034
3	Specific gravity, $G$	2.13
4	Moisture content (%)	13
5	Dry density ( $kN/m^3$ )	8.924

B. Free Swell Index

Free Swell Index means increase in volume of a soil, without any external constraints on submergence in water.



Fig 4.1 Free Swell Index test

$$\text{Free Swell Index (FSI)} = \frac{v_d - v_k}{v_k} \times 100\%$$

Where,

$V_d$  = Volume of soil specimen read from the graduated cylinder containing distilled water

$V_k$  = Volume of soil specimen read from the graduated soil containing kerosene

Table 4.2: Determination of FSI

Material	$V_d$ (ml)	$V_k$ (ml)	FSI (%)
Sandy soil	19	16	19

In sandy soils, Free Swell Index should be less than 20%, so its degree of expansiveness is low.

C. CONSTANT HEAD PERMEABILITY TEST

The ability of soil to allow flow of water through it is called as permeability of soil. Sandy soils are known to have high permeability which results in high infiltration rates and good drainage. In sandy soils, permeability is determined by using constant head permeability test. The objective of constant head permeability test is to determine the coefficient of

permeability of soil. The coefficient of permeability ( $k$ ) is obtained from the relation,

$$k = \frac{qL}{Ah} = \frac{QL}{Aht}$$

Where,  $q$  = discharge

$Q$  = total volume of water

$t$  = time period

$h$  = head casting flow

$L$  = length of spectrum

$A$  = cross-sectional area



Fig 4.2 Permeability Test

Table 4.3 Permeability of Materials

SI No	Materials	Permeability (m/sec)
1.	Sandy soil + 0% Sodium Bentonite	$3.38 \times 10^{-6}$
2.	Sandy soil + 5% Sodium Bentonite	$2.034 \times 10^{-6}$
3.	Sandy soil + 10% Sodium Bentonite	$1.42 \times 10^{-6}$
4.	Sandy soil + 15% Sodium Bentonite	$1.22 \times 10^{-6}$
5.	Sandy soil + 20% Sodium Bentonite	$9.315 \times 10^{-7}$
6.	Sandy soil + 25% Sodium Bentonite	$6.79 \times 10^{-7}$

D. PLATE LOAD TEST

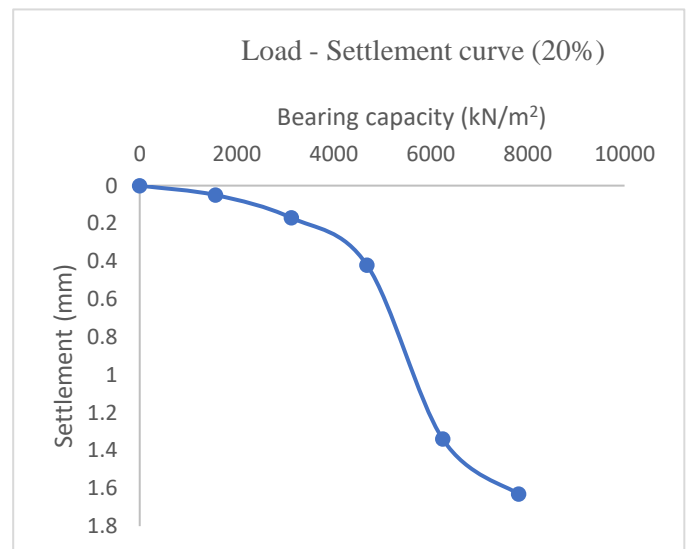
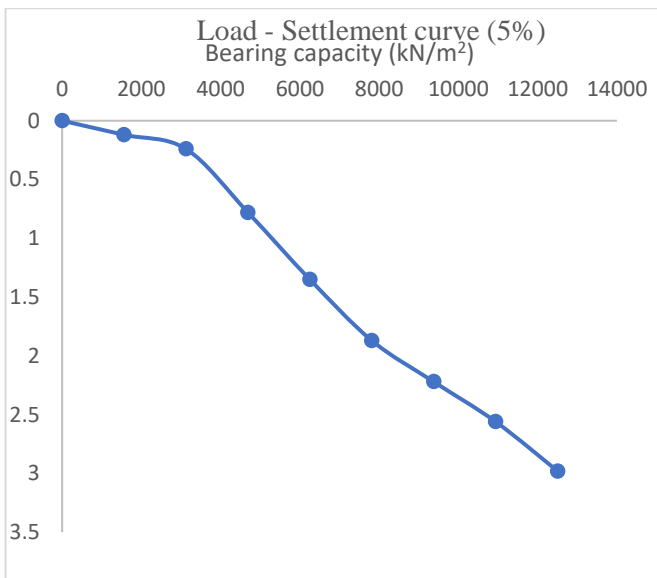
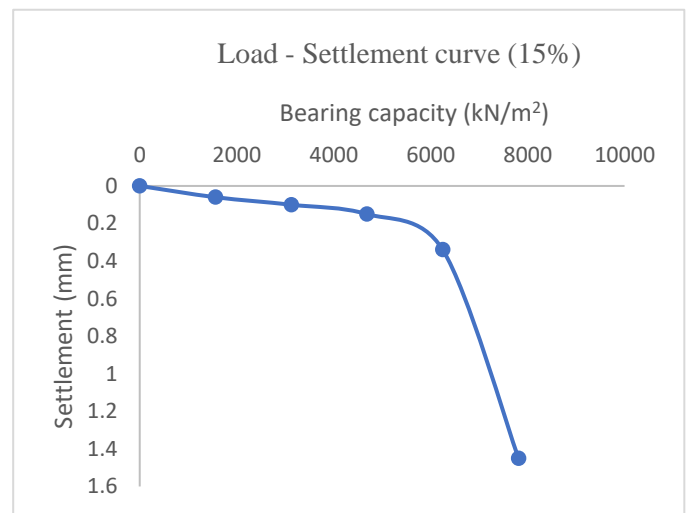
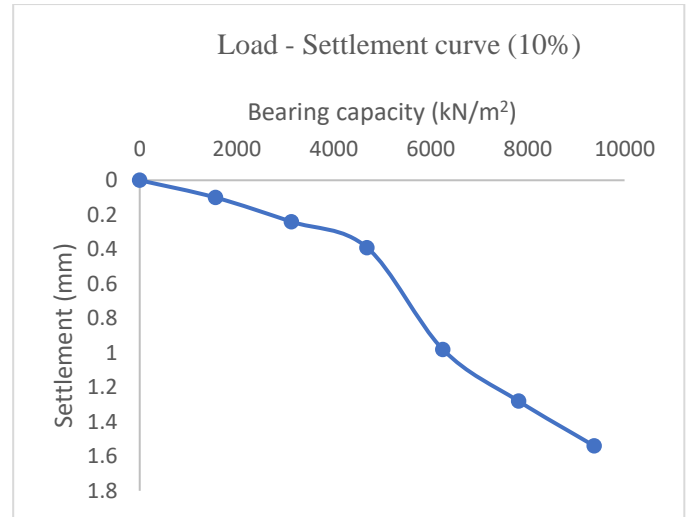
The ultimate plate load carrying capacity can be evaluated by analytically or field methods. One of the most convenient method for computing ultimate load carrying capacity is load test, which is depicts in figure 4.3. Also, the test is very popular for the selection and implementation of suitable foundation.

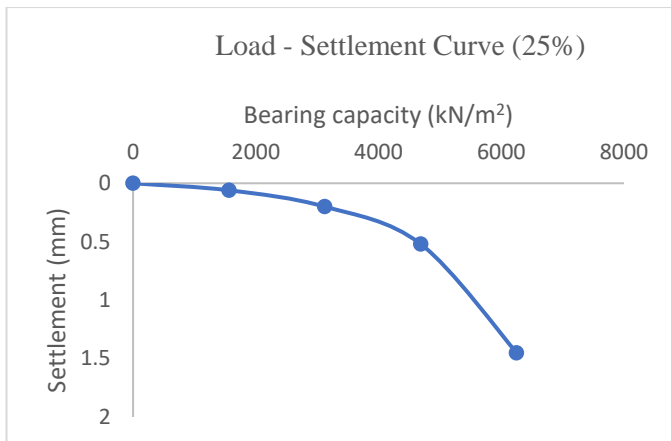


Fig 4.3 Plate Load Test

Table 4.4 Plate Load Test Result

PERCENTAGE (%)	ULTIMATE LOAD (kN/m <sup>2</sup> )	SETTLEMENT (mm)
5	3200	0.35
10	4500	0.4
15	6200	0.3
20	4800	0.42
25	4600	0.44





#### V. CONCLUSION

The Free Swell Index (FSI) of sandy soil found 19%. During the permeability test, the permeability of soil found reducing when adding 25% of Sodium Bentonite to it. Plate load test shows the ultimate bearing capacity of 6200 kN/m<sup>2</sup> and settlement of 0.3mm. As various study conducted, sandy soil with Sodium Bentonite is found as a good liner material.

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