

Study of Saline Water Effect on Geotechnical Properties of High Plastic Soil

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Abstract:- In this project work, we observed how the fine-grained soil properties affect by saline water. In the laboratory, several tests were conducted. The test was conducted with and without Sodium Chloride concentration. By adding Sodium chloride concentration to the soil, the liquid and plastic limit decreases with increases its concentration. As we know for the classification of soil, the liquid limit was an important factor. So in this project work, we study how salinity affects liquid limit and how it is carried out for future work purposes. Also, the plastic limit is affected by saline water, so plasticity index varies. Here we have discussed the result and the relative graphs such as Liquid limit vs NaCl concentration on High plastic soil, Plastic limit vs NaCl concentration on High plastic soil, OMC vs NaCl concentration on High plastic soil, MDD vs NaCl concentration on High plastic soil and also compared the results of distilled water.

Keywords:- Liquid Limit, Plastic Limit, Standard Proctor, Saline Water.

I. INTRODUCTION

The water from the ground or coming out from rock containing several minerals which enters into the soil. The saline water mixed with soil and the effect of saline water on the soil studied. The malleability indicator was the size of the range of water contents where the soil exhibits plastic parcels. The malleability indicator was defined as the difference between the liquid limit and the plastic limit. The soil with high malleability is known as complexion, whereas the lower malleability is known as ground.

➤ Atterberg Limits

The Atterberg limit basically known as liquid limit and plastic limit, which was used to measure the water content of soil. There are four stages of a material depending on the water content, such as solid, semi-solid, plastic and liquid. In each state, the engineering properties and behavior of soils were different. The boundary between each state can be defined by their behavior change. To distinguish between silt and clay the Atterberg limit can be used. When the soil submerged in the water, it expands its volume. The amount of expansion was the ability of soil to absorb the water into it and fill its void space. These tests were conducted on silt and clay due to their expand and shrink due to water content. Clay and silt were reacts with water and changes its

size as well as varying shear strength. Both liquid and plastic limits of soil can be found by measuring soil strength. The liquid limit and plastic limit was related to clay and silt respectively.

• Liquid Limit

The liquid limit is defined as the water content at which the soil changes from a plastic to a liquid state when the soil instance just fluid enough. The transition from plastic to the liquid state, the geste gradational over at a certain water content, and the shear strength of soil not actually zero at the liquid limit. The liquid limit was conducted by the Casagrande outfit. The liquid limit graph has colluded between a number of blows and water content. The liquid limit was found set up at 25 numbers of blows.

• Plastic Limit

The plastic limit defined as the water content at which the soil changes from semi-solid to plastic state. In plastic limit the thread breaks at a diameter of 3mm.

• Standard Proctor Test

To obtain the OMC and MDD we do this test. The zero void line was represented by the contraction of soil sample and moisture content. The peak point of the contraction curve was known as MDD. The water content respected to MDD was known as OMC. The proctor graph was colluded between water content and dry density.

II. RESULT AND DISCUSSION

➤ Results of High Plastic Soil of Laterite Zone (Cuttack)

The graph shows the results of different tests result of soil and saline water. The concentration mix with soil sample for plastic limit tests 20.3%, 19.2%, 17.6% and 16.5% for distilled water and different proportion of solution. Plastic limit wasn't veritably told by saltness i.e. effect wasn't veritably large. The salinity water decreases the liquid limit of the soil from 29.7% to 24.5%. The OMC increases and MDD decreases with increases the salinity proportion.

Table-1: Results of High plastic soil of Laterite zone (Cuttack) with NaCl

Proportion of Saline water	Liquid Limit (%)	Plastic Limit (%)	OMC(%)	MDD (gm/cc)
Distilled water	29.7	20.3	9.3	1.82
0.1M	27.6	19.2	9.6	1.82
0.5M	26.4	17.6	10.2	1.81
1.0M	24.5	16.5	10.6	1.81

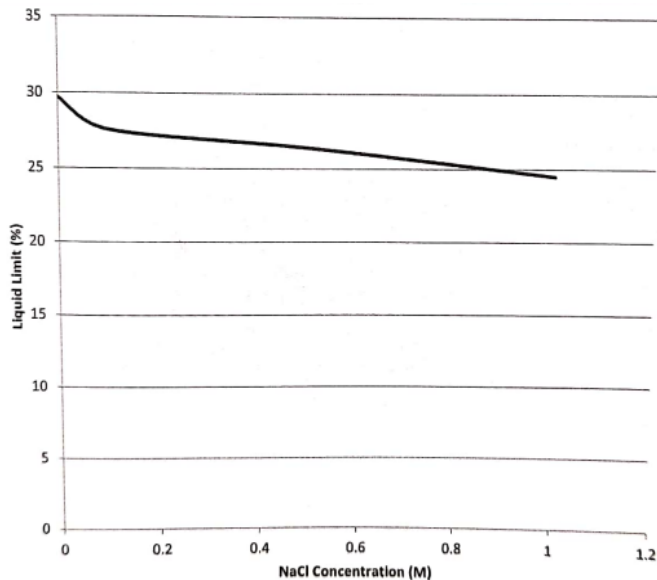


Fig 1: Change in NaCl concentration with different values of liquid limit

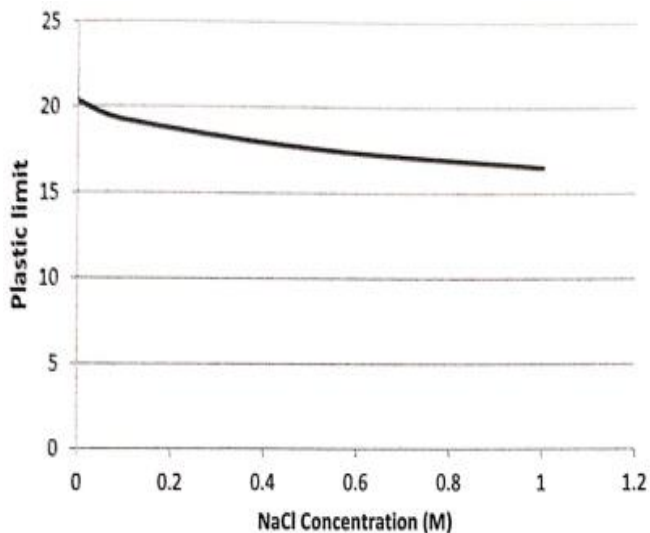


Fig 2: Change in NaCl concentration with different values of plastic limit

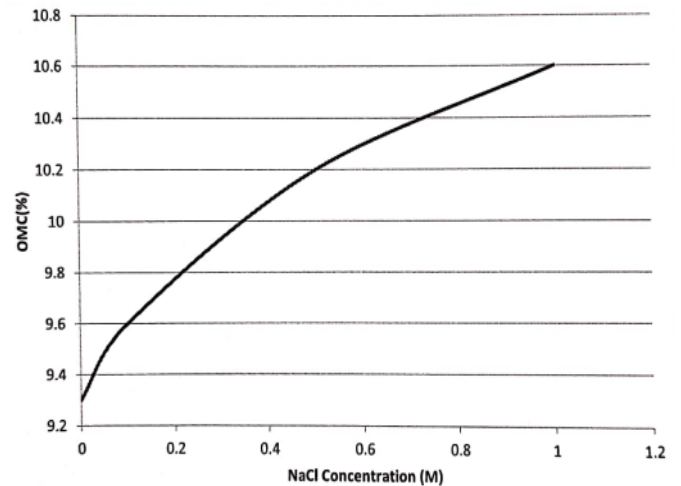


Fig 3: Change in NaCl concentration with different values of OMC

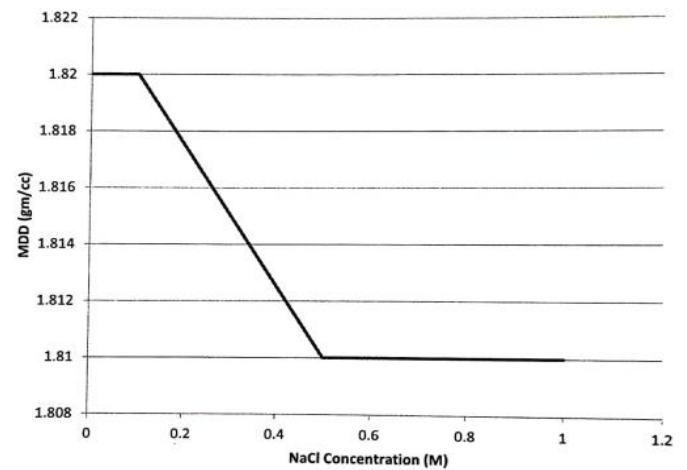


Fig 4 Change in NaCl concentration with different values of MDD

III. CONCLUSION

From the experimental work we attained that the liquid and plastic limit was decreases by increases the proportion of saline water. The OMC increases and MDD decreases with increase the saline water proportion. After adding 0.5M saline water with soil sample, the MDD value remain constant and the result between distilled water and 0.1M saline water also remain constant. The important of the liquid limit test was to be classifying the soil but it decreases while using saline water. Therefore using saline water won't give proper bracket of soil.

REFERENCES

- [1]. Kashyap, R., 2015. Effect of Saline Water on Geotechnical Properties of Low Plastic Soil and High Plastic Soil (Doctoral dissertation).
- [2]. Alainachi, I. H., and G.A. Alobaidy (2010) "The Effects of Basra Gulf Salt Water on The Proctor Compaction and CBR Test Results of Soil Samples at Baniyas City, Abu Dhabi, UAE," Electronic Journal of Geotechnical Engineering, 15.

- [3]. Harries-kees KJ, Minerals in waste and effluent treatment. *Industrial Minerals*, (308):29-39,1993.
- [4]. Alamdar, S. S. (1999) “Long time Effect of Saline Water on Clay,” M.Sc Thesis, Faculty of Engineering, Tarbiat Modares University. (In Persian).
- [5]. Arasan, S., and T. Yetimoglu (2008) “Effect of Inorganic Salt Solutions on the Consistency Limits of Two Clays,” *Turkish J. Eng. Env. Sci*, 32, 107-115.
- [6]. Pusch Roland, Swelling pressure of highly compacted clay, skb technical report.
- [7]. Bag Ramakrishna, Coupled thermo-hydro-mechanical-chemical behavior of MX80 clay in geotechnical applications. PhD thesis, Cardiff University, 2011.
- [8]. Mitchell JK, 1993, fundamentals of soil behavior, Wiley John and sons, inc., New York.
- [9]. Murthy VNS. Soil mechanics and foundation engineering, Nai Sarak, Delhi, 1984.
- [10]. IS: 2720 (Part 5-1985) methods of test for soils for determination of liquid and plastic limit, Indian standards institution, Manak Bhavan, 9 Bahadur Shah Zafar Marg New Delhi 110002.
- [11]. IS 9259: Liquid limit apparatus for soil, Publication on 1979.
- [12]. IS: 2720 (Part 7-1980) methods of test for soils for determination of water content-dry density relation using light compaction, Bureau of Indian Standards, Manak Bhavan, 9 Bahadur Shah Zafar Marg New Delhi 110002.