International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 01 | Jan-2018 www.irjet.net p-ISSN: 2395-0072

EFFECT OF BENTONITE ON COMPACTION CHARACTERISTICS OF SOIL

K.Padmavathamma[1], Dr. T. Kiran kumar[2]

[1]*M.Tech Scholar, Department of Civil Engineering, KSRM College of Engineering.*
Professor, Department of Civil Engineering, KSRM College of Engineering.

Abstract : There are several places in the world particularly middle East Asia and Africa has problem of bentonite contaminated soil known as bentonite soil. bentonite soils cover approximately 100 million hectors in the world. Bentonite not only dissolve in presence of water it also changes geotechnical properties of soil. In the current study effect of bentonite on Atterberg limits and compaction character tics of soil was studied. Different percentage of bentonite was added with a soil from Kadapa to simulate the conditions of bentonite soil. Laboratory test were conducted to determine effect of bentonite content on liquid limit, plastic limit and compaction characteristics of soil. It was noted that with increase in bentonite content liquid limit and plastic limit of soil decreased. The Maximum Dry Density (MDD) was noted to increase continuously on increasing bentonite content. Although, some deviation were noted, in general a trend of increasing Optimum Moisture Content (OMC) was noted with increase in bentonite content.

Keywords: Bentonite, soil, optimum moisture content, dry density etc.

I. INTRODUCTION:

There are several places in the world particularly middle East Asia and Africa has problem of Bentonite contaminated soil known as Bentonite soil. The origin of sulphate ions in the soil solution is in some circumstances due to the presence of sulphur-rich minerals such as pyrite in the parent material. By weathering and oxidation, the sulphur in these minerals is transformed into sulphuric acid which in calcareous soils reacts with $CaCO3$ to form Bentonite. On irrigated land, leaching of saline soils containing sulphate and calcium in the soil solution leads in some circumstances to the precipitation and accumulation of gypsum in the subsurface horizon. The formation of Bentonite may result from replacement of NaCl by $CaSO4$ when the irrigation water contains a substantial amount of calcium and sulphate. But it could be also a result of a partial leaching of salts from the soil because NaCl is much more soluble than $CaSO4$. It has been observed in the Euphrates Basin, that Bentonite is recrystallised and redistributed in the soil profile after leaching of other, more soluble, salts. Bentonite soils cover approximately 100 million hectors in the world (Verheye and Boyagiev, 1997). Bentonite not only dissolve in presence of water it also changes geotechnical properties of soil. Therefore detailed investigation is required to find out the change in geotechnical properties of Bentonite contaminated soil. In soils with a recent accumulation of Bentonite , the salt-affected horizon overlies the Bentonite horizon. In the case of old or residual Bentonite , the accumulation of soluble salts occurs either in the Bentonite horizon or at lower depths.

II. OBJECTIVE OF THE WORK:

The using soil from Middle East region. There is no work reported on Indian soil showing the effect of Bentonite content on geotechnical properties of soil. Therefore, main objective of the current study was to study effect of Bentonite content on Liquid limit, plastic limit and compaction characteristics of a low plastic soil from Kadapa.

III. MATERIAL AND METHODS:

Low plastic soil from kadapa was used to for this study. Liquid limit, plastic limit and specific gravity tests were carried out using distilled water following Indian Standard (IS) method.

Atterberg Limits –Liquid limit and Plastic limit tests

Atter berg limits are defined as the water content corresponding to different behaviour conditions of fine-grained soil (silts and clays). The four states of consistency in Atterberg limits are liquid, plastic, semisolid and solid. The dividing line between liquid and plastic states is the liquid limit; the dividing line between plastic and semisolid states is the shrinkage limit. If a soil in the liquid state is gradually dried out, it wills past through the liquid limit, plastic state, plastic limit, semisolid state and shrinkage limit and reach the solid stage. The liquid, plastic and shrinkage limits are therefore quantified in terms of the water content at which a soil changes from the liquid to the plastic state. The difference between the liquid limit and plastic limit is the plasticity index. Because the liquid limit and plastic limit are the two most commonly used Atterberg limits, the following discussion is limited to the test procedures and calculation for these two laboratory tests.

The liquid limit is that moisture content at which a soil changes from the liquid state to the plastic state. It along with the plastic limit provides a means of soil classification as well as being useful in determining other soil properties.

Plastic limit is the dividing line between the plastic and semisolid states. From a physical standpoint, it is the water content at which the soil will begin to crumble when rolled in small threads. In the current study liquid limit of soil was determined by Casargrande apparatus.

SPECIFIC GRAVITY TEST:

Specific gravity of soil solids was determined using a pycnometer. Specific gravity is the ratio of the mass of unit volume of soil at a stated temperature to the mass of the same volume of gas-free distilled water at a stated temperature. Indian Standard (IS) test procedure was followed to determine the Specific Gravity of Soil Solids by Water Pycnometer. The specific gravity of a soil is used in the phase relationship of air, water, and solids in a given volume of the soil.

The results obtained by conducting above tests on low plastic soil from Kadapa are presented in Table 3.1

Table 3.1: Properties of soil used in this study

Properties	value
Liquid limit (%)	22
Plastic limit (%)	14.2
Specific gravity	2.78

STANDARD PROCTOR COMPACTION TEST:

For construction of highways, airports, and other structures, it is often necessary to compact soil to improve its strength. Proctor (1933) developed a laboratory compaction test procedure to determine the maximum dry unit weight of compaction of soils, which can be used for specification of field compaction. This test is referred to as the Standard Proctor Compaction Test. In the current study standard Proctor compaction test was carried out for various % of gypsum content. The proctor mould diameter is 10 cm and height 11.7 cm. The inner volume is 945 cm^3. Weight of hammer is 2.5 kg and the height of fall of the hammer is 30 cm.

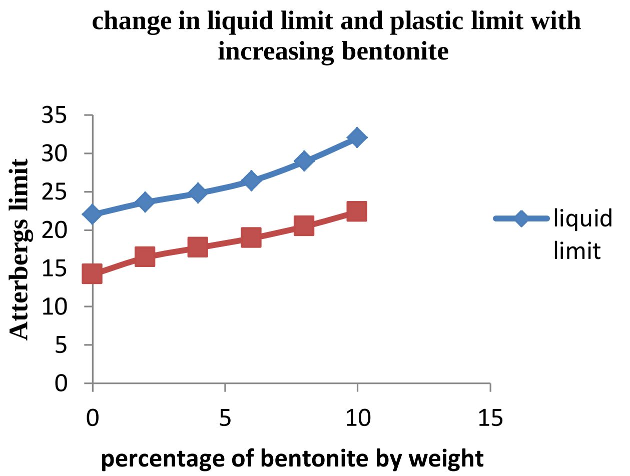
IV .RESULTS AND ANALYSIS:

Variation of Liquid Limit & Plastic Limit :

Bentonite content(%) by weight	Liquid Limit (%)	Plastic Limit (%)
0	22.0	14.2
2	23.6	16.4
4	24.8	17.7
6	26.4	18.9
8	28.9	20.5
10	32.0	22.4

Liquid Limit and Plastic Limit tests are performed on Kadapa soil by successive increment of percentage of Bentonite by weight. Bentonite was added to the soil by 2,4,6,8 and 10% by weight. The change in liquid limit and plastic limit due to increase in Bentonite content is presented. It was noted that with increase in Bentonite content both liquid limit and plastic limit of soil increased.

Variation of liquid limit and plastic limit due to increase in Bentonite content

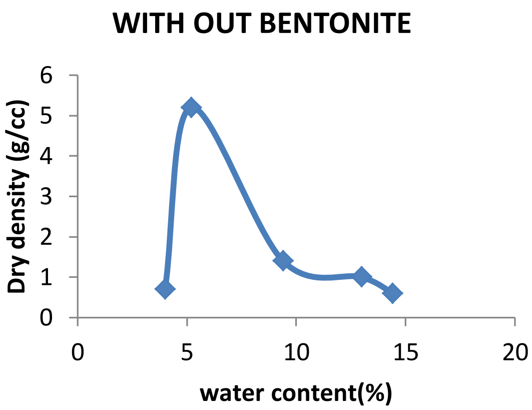


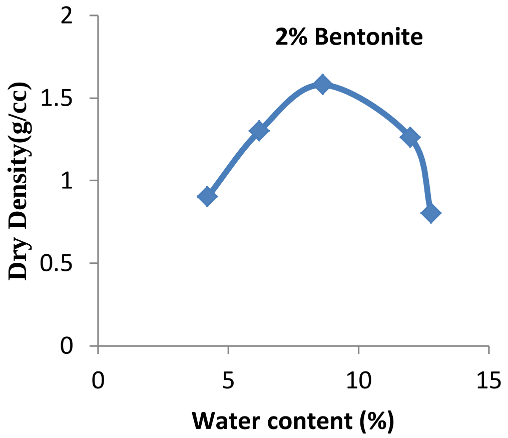
Variation of Optimum Moisture Content and Maximum Dry Density:

Standard proctor Test is performed on Kadapa soil by successive increment of percentage of Bentonite by weight. The test results were presented in below table . The compaction curve with 0%,2% ,4%, 6%, 8% and 10% addition of Bentonite with soil Maximum Dry Density (MDD) was found to be increased 1.4gm/cc to 1.98gm/cc. Optimum Moisture Content was found to be varying from 9.4 %to 12.4%.

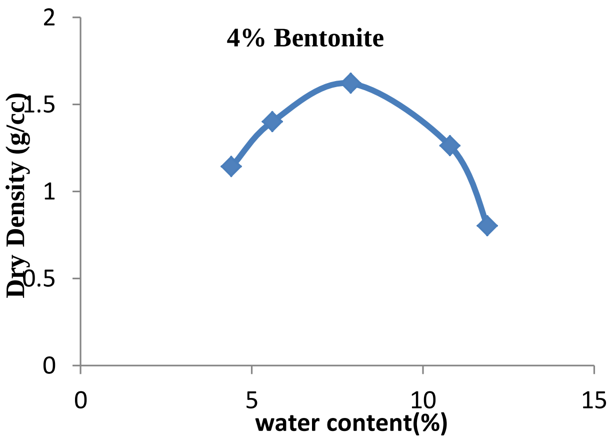
Variation of OMC and MDD with various percentages of Bentonite content

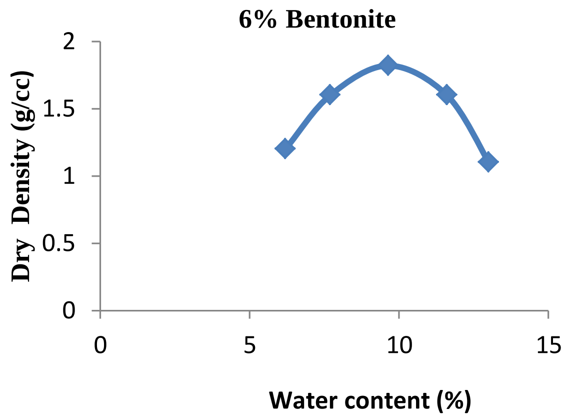
Bentonite content(%) by weight	OMC (%)	MDD (%)
0	**9.4**	**1.40**
2	**8.6**	**1.58**
4	**7.9**	**1.62**
6	**9.6**	**1.82**
8	**10.7**	**1.90**
10	**12.4**	**1.98**



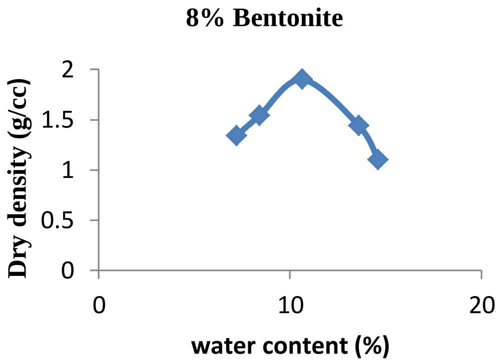


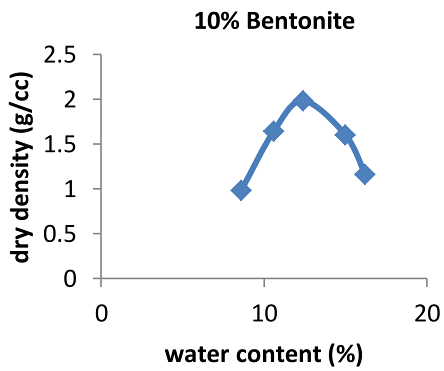
Without adding Bentonite optimum moisture content 9.4 and maximum dry density 1.4 and then laterally decreased % of Bentonite adding@ 2% optimum moisture content is 8.64 and maximum Dry density increasing 1.58 and then gradually decreasing.





% of Bentonite increasing @4% optimum moisture content is 7.89 and maximum density is 1.62 and then gradually decreasing and % of Bentonite incrasing 6% optimum moisture content is 9.64 and maximum dry density is 1.82 and then gradually decreasing.

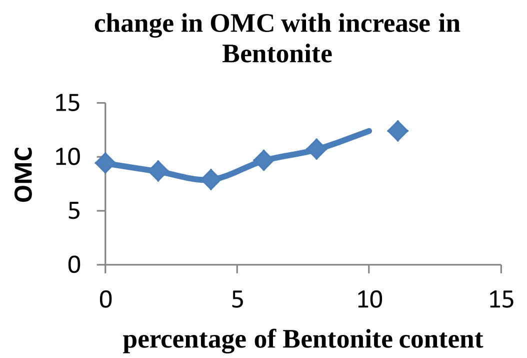


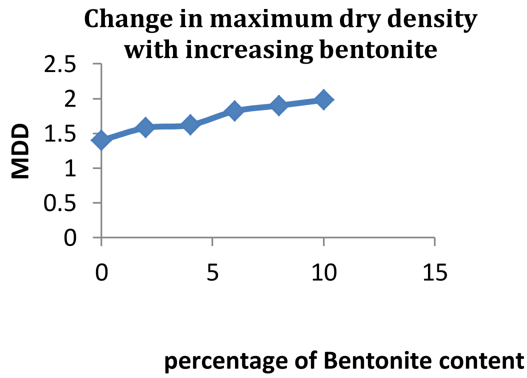


% of Bentonite incrasing 8% optimum moisture content is 10.68 and maximum dry density is 1.90 and then gradually decreasing % of Bentonite incrasing 10% optimum moisture content is 12.4 and maximum dry density is 1.98 and then gradually decreasing.

Comparison of OMC and MDD with percentage of bentonite content:

Below graphs represents change in optimum moisture content (OMC) and maximum Dry density (MDD) due to increase in Bentonite content in soil. It was noted that increase in Bentonite content MDD increase continuously. For optimum moisture content (OMC), although some deviation were noted.





By adding varying percentage of Bentonite the OMC is Gradually decreased and then increased whereas MDD is gradually increased.

V . CONCLUSION:

Based on the laboratory tests carried out on a low plastic soil from Kadapa, the following conclusions can be drawn.

- The Liquid limit and plastic limit of soil was found to decrease with increase in the percentage of Bentonite content.
- The Maximum Dry Density (MDD) was increase continuously i.e. 1.4 to 1.98 on increasing Bentonite content at 2% to 10%
- Although, some deviation were noted, in general a trend of increasing Optimum Moisture Content (OMC) was noted with increase in Bentonite content.
- The percentage of Bentonite increasing at 10% the optimum moisture content is 12.4%

VI. REFERENCES:

[1] Ahmed, K.I., (2013), Effect of gypsum on the hydro-mechanical characteristics of partially saturated sandy soil, PhD thesis, Cardiff University.

[2] Bjerrum, L., (1997), Engineering Geology of Norwegian Normally Consolidated Marine Clay as Related to Settlement of Building, Geotechnique, 17, 81–118.

[3] IS 2720 (Part- 5), (1985), Method of test for soil, determination of liquid limit and plastic limit, Indian Standards Institution, New Delhi.

[4] Murthy, V.N.S., (1993), Principles of soil mechanics and foundation engineering, 5th Edition, UBS publishes distributors Pvt Ltd., New Delhi.

[5] Petrukhin, V.P. and Arakelyan, E.A (1984), Strength of gypsum clay soils and its variation, Journal of soils and sediment, 21(6), 264-268.

[6] Razouki, S.S., Kuttah, D.K., Al-Damluji, O.A. and Nashat, I. H., (2007), Strength erosion of a fine-grained gypsiferous soil during soaking, The Arabian journal for Science and Engineering, 32, 147-152.

[7] Torrance, J. K., (1974), Laboratory Investigation of the Effect of Leaching on the Compressibility and Shear Strength of Norwegian Marine Clay, Geotechnique, 24, 155–173.

[8] Verheye, W.H and BoyadgievT.G. (1997), Evaluating the land use potential of gypsiferous soils, Journal of soils and sediment, 13(2), 97–103.