International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 5, Issue 05, May-2019

EVOLUATION OF COMPACTION AND STABILIZATION OF BLACK COTTON SOIL BY USING ADMIXTURES AS CALCIUM CHLORIDE

Vijay Kumar[1], Rishi bhalavada[2], Prof. Ajay bindlish[3],
[1]*M.Tech. Student, Geotechnical Engineering,Rajasthan Technical University Kota,*
[2]*M.Tech. Student, Geotechnical Engineering,Rajasthan Technical University Kota,*
[3]*Prof., Deptt. Of Civil Engineering,Rajasthan Technical University Kota,*

Abstract*— Black cotton soils are widely circulated around the world, and are a wellspring of incredible harm to framework and structures. The issue with broad soils has been recorded everywhere throughout the world. These dirts can cause substantial financial misfortunes, just as being a wellspring of hazard to the populace. In storm they soak up water and swell and in summer they recoil on dissipation of water there from. The wetting and drying procedure of a sub grade layer made out of dark cotton soil result into disappointment of substructures in type of settlement and breaking. What's more, as a result of this elective swelling and shrinkage, daintily stacked structural designing structures like private structures, asphalts and channel linings are seriously harmed. It is, in this way, important to moderate the issues presented by broad soils and avoid breaking of structures. Numerous imaginative establishment systems have been concocted as an answer for the issue of sweeping soils. There are various soil adjustment methods for improving the quality of the in-situ soil, and one of the procedures is utilizing synthetic added substance. The common solutions on encountering such problems include excavation and replacement of soils. Present paper depicts the quality conduct of Black cotton soil treated with calcium chloride (CaCl2). From the quick compaction test as long as 1 day of relieving, Various measures of CaCl2 (2%, 4%, and 6%, 8%) were added to the dirt to think about the impact of CaCl2 on the compaction qualities, the principle discoveries of this investigation were that the expansion in the level of the calcium chloride compound expanded the most extreme dry thickness and lessening the ideal dampness content. As far as possible, plastic breaking point and pliancy record diminished with the expansion in calcium chloride.

Keywords*— Black cotton soil, soil stabilization, Standard Proctor Test, DFS test, Calcium Chloride.

I. INTRODUCTION

Black cotton soils are risky for Civil Engineers, in view of their eccentric conduct. These dirts show substantial volume changes concerning variety of occasional dampness content. These dirts when oppressed vehicular traffic, street asphalt gets hurled and split because of swelling and shrinkage. Henceforth, these dirts are to be balanced out before building the streets so as to have extremely powerful and productive and durable street. When the black cotton soil comes in the contact of water then over the top swelling is caused and when water content diminishes shrinkage happens in the dirt Extensive research has been occurred utilizing diverse balancing out materials, for example, lime, fly-powder, bond, mechanical waste and geo-synthetics and so on and turned out to be helpful in adjustment of black cotton soil.. On account of this development daintily stacked structures, for example, establishments, asphalts, channel beds, linings,and private structures established on them are seriously harmed (Chen, 1988). It has been assessed that the yearly harm to basic on sweeping soil are $1000 million in USA,£150million in UK and $1000 million pounds in around the world (Gourley et al., 1993). In India far reaching soils covers about 0.8 × 106 Km2 region roughly 20% of surface territory. The Black cotton soil contains high level of montmorillionite mineral which grants extensive conduct to it. Transfer of waste materials produced from various businesses causes numerous issues like condition contamination in the close-by region, shortage of land for transfer, and so forth. Mechanical waste like Blust furnace slag, fly-ash remains, silica-fume, rice husk powder and stone residue, and so on., are considered as elective materials for soil adjustment.

II. MATERIALS USED

2.1 Materials used

2.1.1 Soil

The black cotton soil collected from the neighborhood of collectorate office baran area Rajasthan at a profundity of 1.5m from ground level. Various tests have been performed to decide the file just as the designing properties of the parent soil by IS determinations.

Table1. Geotechnical properties of the untreated BC soil

S.No.	Property		Value
1	Specific gravity		2.61
2	Liquid limit %		61.32
3	Plastic Limit %		25.65
4	Soil Classification	Gravel %	4.0
		Sand %	13.0
		Sand %	22.0
		Clay %	61.0
5	D.F.S.%		63.22
6	O.M.C.%		19.80
7	M.D.D.%		1.71
8	CBR(Soaked)		1.78

2.1.2 Calcium chloride

Calcium chloride is the ionic compound of calcium and chloride. It is a salt that carries on as a regular ionic halide, being strong at room temperature and exceptionally dissolvable in water. As a result of its hygroscopic nature, anhydrous calcium chloride must be kept in firmly fixed, impenetrable compartments, it is utilized for various purposes at various focuses relying upon its utilization. This examination utilized its most noteworthy rate calcium chloride items.The properties chloride ($CaCl_2$) are given in Table-2

Table2. Chemical composition of Calcium chloride
(Refrence from Magdi M. E. Zumrawi, Khalid A. Eltayeb 2016)

Property	Value
Molar Mass	110.99 $g.mol^{-1}$
Appearance	White Powder
Minimum assay	95%
Minimum limit of impurities	
Iron (Fe)	0.002%
Heavy metal (as Pb)	0.002%
Sulfate (SO_4)	0.05%
Loss on drying	10%
Boiling point	1935^0C

Figure.1: Calcium chloride

III. SOAKING SOLUTIONS

Distilled Water: Distilled water was used in all tests.

Chlorides Solutions

The centralization of CaCl2 was gotten by dissolving in refined water to get the particular fixation for CaCl2 in by weight of soil, and after that blended with soil. The dirt examples were set up by Procter test methods as indicated by ASTM (American Society for testing and materials) (D 1557). Three distinct focuses for CaCl2 (2%, 4%, 6% and 8%) were readied.

IV.LABORATORY INVESTIGATION

Laboratory studies were carried out on the samples of Black cotton soil, Black cotton soil+ $CaCl_2$ mixes.

Liquid limit Liquid limit test was conducted on Black cotton soil, Black cotton soil with different % $CaCl_2$ mixes using Casagrande's liquid limit apparatus as per the procedures laid down in IS: 2720 part 4 (1970).

Plastic limit Plastic limit test was conducted on soil, Black cotton soil, Black cotton soil with different % $CaCl_2$ as per the specifications laid down in IS: 2720 part 4 (1970).

Differential Free Swell Test Differential Free Swell (DFS) is a parameter used for the identification of the Black cotton soil. For the determination of the differential free swell of a soil, 20g of dry soil passing through a 425µ size sieve is taken. One sample of 10g is poured into a 100c.c capacity graduated cylinder containing water, and the other sample of 10g is poured into a 100c.c capacity graduated cylinder containing kerosene oil. Both the cylinders are kept undisturbed in a laboratory. After 24 hours, the settled volumes of both the samples are measured

Standard Proctor Test In geotechnical engineering, soil compaction is the process in which a stress applied to a soil causes densification as air is displaced from the pores between the soil grains. It is an instantaneous process and always takes place in partially saturated soil. The Proctor compaction test is a laboratory method of experimentally determining the optimal moisture content at which a given soil type will become most dense and achieve its maximum dry density.

V.RESULTS AND DISCUSSION

The test results uncover that the free swelling index, liquid limit and plastic limit of the soil abatements with expansion of CaCl2, most extreme dry thickness of soil expanded from 1.71 g/cc to 2.1 g/cc by expansion of 8% of CaCl2 though, Optimum Moisture Content diminished from 19.7% to 13.35%. Likewise, the variety of liquid limit, plastic limit, OMC, MDD with CaCl2 are available in figure (2-6).

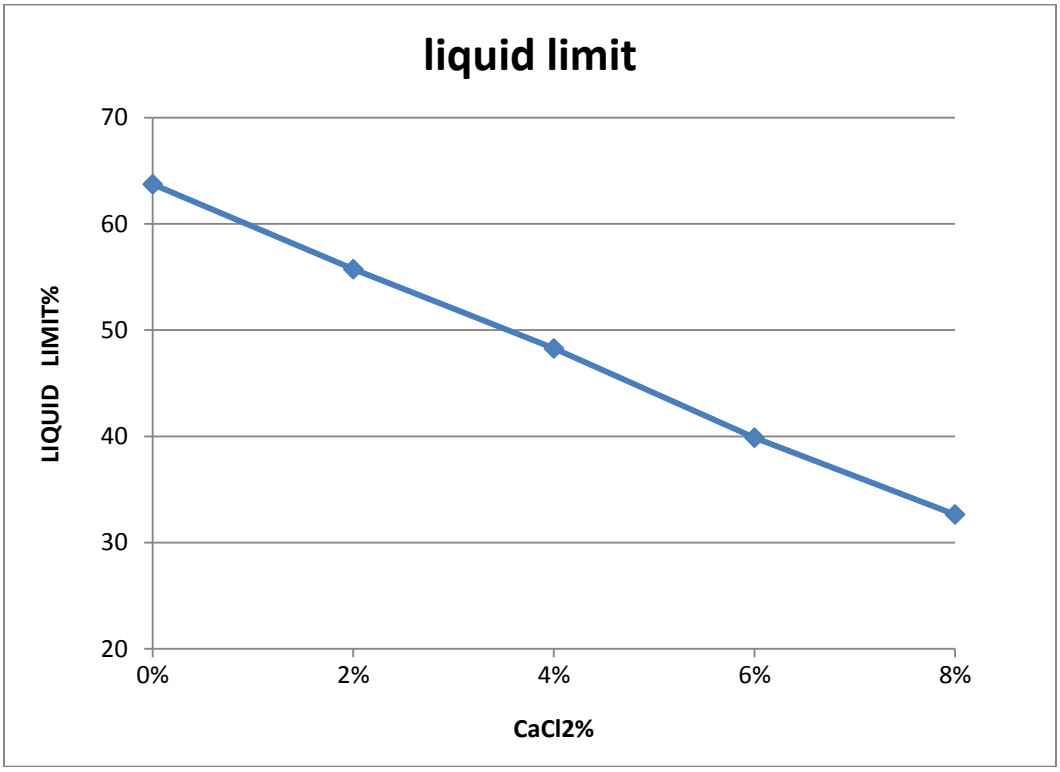

Figure. 2 Variation of Liquid limit with $CaCl_2$

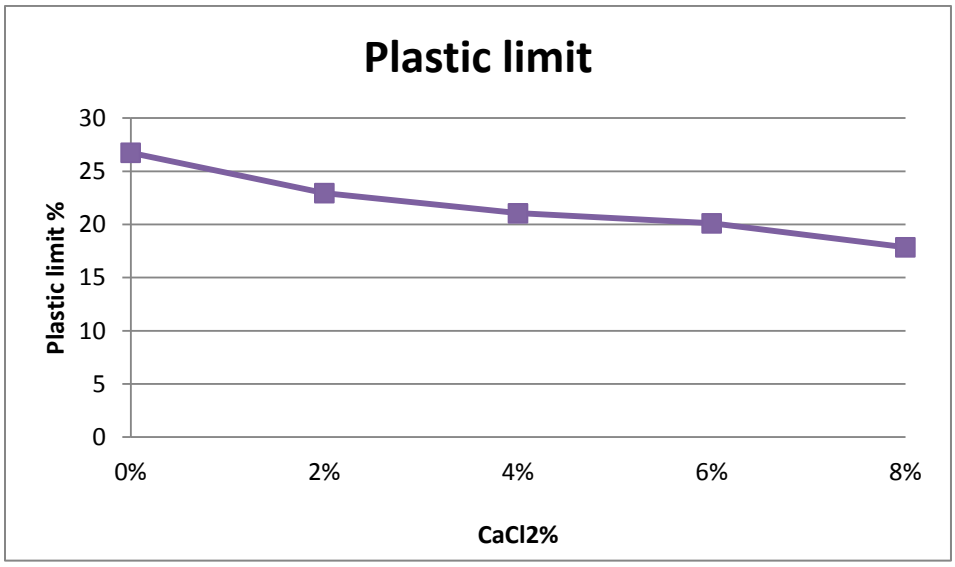

Figure.3 Variation of Plastic limit with $CaCl_2$

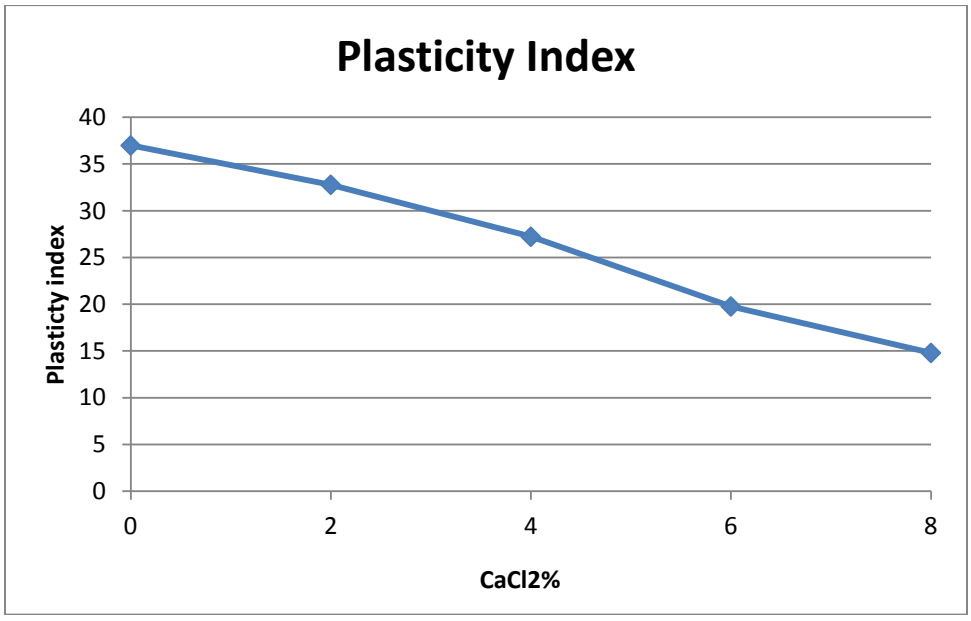

Figure.4 Variation of Plasticity Index with $CaCl_2$

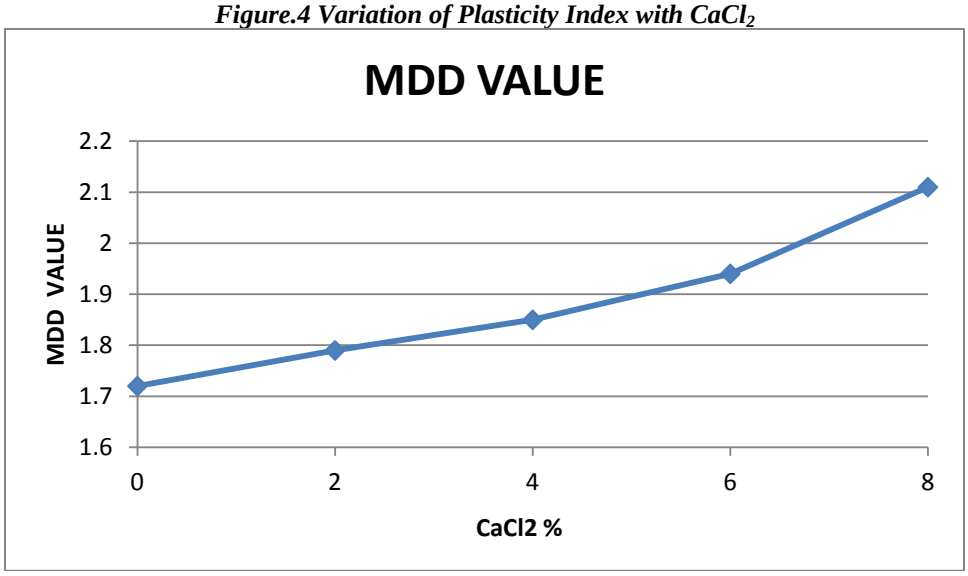

Figure.4 Variation of MDD with $CaCl_2$

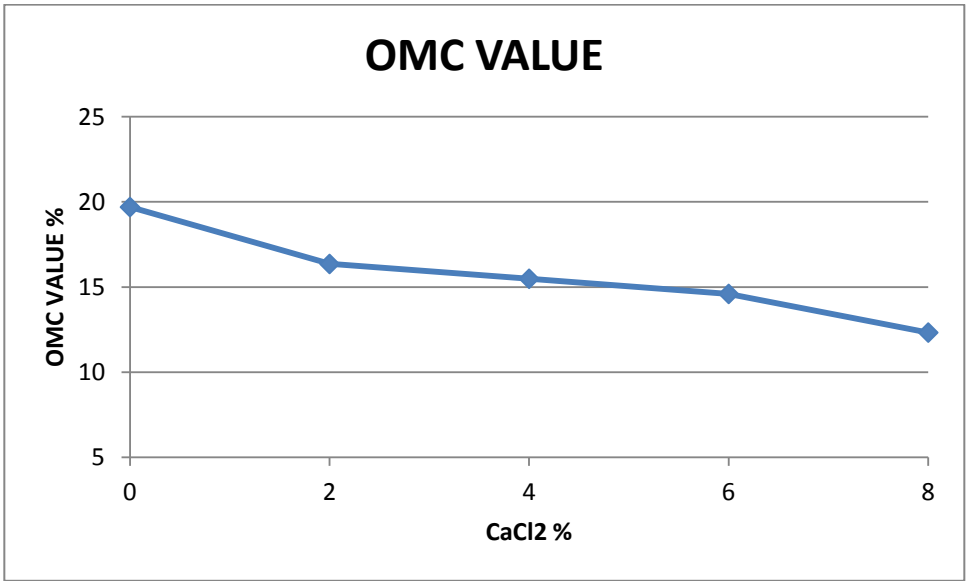

Figure.5 Variation of OMC with $CaCl_2$

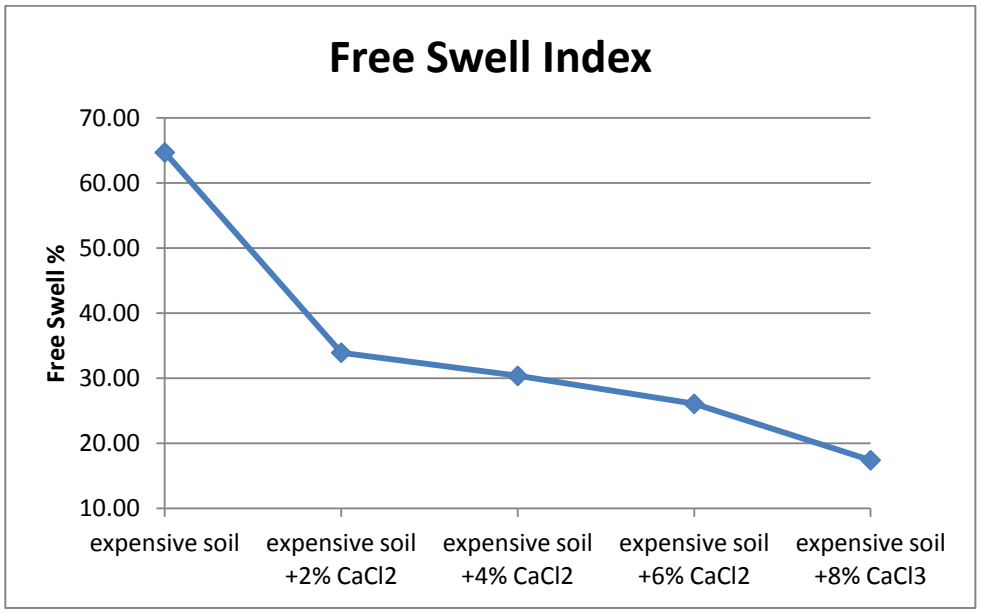

Figure.5 Variation of Free Swell Index with $CaCl_2$

III. CONCLUSIONS

Following conclusions are drawn from the study

- It is seen that by utilizing the synthetic stabilizer the property of soil is improved, the utilization of CaCl2 can be better alternative for the improvement of structures, street asphalt.
- It was seen from the research center test outcomes that as far as possible estimations of the examples are diminishing with the consideration of calcium chloride into the BC soils. It has been discovered that as far as possible diminished from 61.32% to 32.65% on adding of 0% to 8% calcium chloride into it.
- The properties of the black cotton soil are improved by the addition of calcium chloride at 8%.
- There is significant reduction in the plastic limit values from 25.65% to 17.86%.
- The MDD esteem expanded from 1.71g/cc to 2.11 g/cc when contrasted and the untreated BC soil. The OMC esteem continues diminishing from 19.8% to 12.33%.

REFERENCES

[1] G Radhakrishnan. Dr M Anjan Kumar and Dr GVR Prasada Raju "Swelling Properties of Expansive Soils Treated with Chemicals and Fly ash" American Journal of Engineering Research (AJER) e-ISSN: 2320-0847 p-ISSN: 2320-0936 Volume-03, Issue-04, pp-245-250.

[2] Durotoye T.O, Akinmusuru J.O., "Effects of Sodium Chloride on the Engineering Properties of Expansive Soils" IJRET: International Journal of Research in Engineering and Technology, eISSN: 2319-1163 pISSN: 2321-7308.
[3] Mallika, B. Ganesh, "Study on Effect of Chemical Stabilizing Agents on Strength and Swelling Properties of Soils" International Journal of Engineering Technology Science and Research IJETSR, ISSN 2394 – 3386 Volume 4, Issue 10 October 2017
[4] K.V. Manoj Krishna1and Dr. H.N.Ramesh," Strength and F O S Performance of Black Cotton Soil Treated with Calcium Chloride" IOSR Journal of Mechanical and Civil Engineering (IOSRJMCE) ISSN: 2278-1684 Volume 2, Issue 6 (Sep-Oct 2012)
[5] N.Gangadhara Reddy, Evaluating the influence of additives on Swelling characteristics of expansive soil