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Effect of Common Salt (NaCl) On Index Properties of Black Cotton Soil (BCS)

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Abstract: *In this research paper is to investigate the effect of Common salt (NaCl) on the index properties of Black cotton soil. This black cotton soil were mixed with various amount of Common Salt (0, 2, 4, 6, and 8) % to study the effect of Common Salt (NaCl) on consistency limits or index properties. In this study, the common salt (NaCl) is collected from shop Garha Market, Jabalpur M.P. and the Soil sample collected from NSCB Medical College, near Hostel campus Jabalpur MP. The soil falls under highly expansive category, based on consistency index and free swell. The modification of properties of soil such as physical nature, chemical composition and metallurgical properties and that soil on the nature of contaminant. These contaminant soil such organic solved or organic matter and inorganic. The laboratory test results showed the significant improvements upon the use of Common Salt (NaCl). The plasticity index reduced from 22.21 to 16.94. The liquid limit decrease from 46.30 to 33.47%. Plastic limit decrease from 22.26 to 17.87 %. Anlo increase the shrinkage limit from 12.98 to 15.98% and the free swell value reduced from 43 to 18 is observed.*

Keywords- *Black Cotton Soil (expansive soil), Common Salt (NaCl), Index Properties, Jabalpur*

I. INTRODUCTION

The black cotton soil as an agricultural origin. The black cotton soil is expansive soil with high plasticity and can retain the moisture throughout in the dry season which is why they are valuable for growing the crops. In India various type of soil available but black cotton soil is best for agriculture. All the black cotton soil are not expansive soil not in black colour. Black cotton soil is mostly expansive soil and they have the potential for shrinkage or swelling under the change of moisture. They are usually exhibit low bearing capacity, low permeability and also high volume change due to the presence of montmorillonite in its mineralogical content and these properties makes it unfit for the construction of embankment and any other engineering structures. When the black cotton soil is in dry condition, then the soil is very hard and it give the strength. In order to overcome this problem research has been carried out in the different parts of the world and to find out the economical and efficient that means the using of Common Salt. The Common Salt in the form of crystal and it in white colour. The common salt is deliquescent and hydroscopic and also the lower pressure of the water. Common Salt is prevent frost heave in soil by lowering freezing point of water and it is very effective as dust palliative. The Common Salt is easily available in the market so the transportation charges will reduced. In this study it is proposed to investigate the influence of the Common Salt on the Black Cotton Soil (expansive soil).

II. LITERATURE REVIEW

In order to overcome the problem in black soil, research has been carried out in the different parts of the world, to find out the economical and efficient means of using Common Salt. "Effect of Common Salt on index properties of Black Cotton Soil" by Prakhar Dubey on IJRST –International Journal for Innovative Research in Science & Technology| Volume 2 | Issue 02 | July 2015 ISSN (online): 2349-6010 & "Effect of sodium chloride on some geo-technical properties of expansive clay" studied by T Srikanth and K L A V Harnadh (2013). It has been reported that plasticity index, different free swell, and some other index properties (Liquid Limit and Plastic Limit decreases substantially due to addition of sodium chloride. The index properties were modified to a great extent. Ahmed T. M., Mohamed I. Wahdan, Geotechnical Institute Housing and National Building Research Center, (HBRC) Cairo, Egypt(2013) gave the detailed outcome of "Behavior of Expansive Soil Treated by using Different Electrolyte Substances" compared experimental programs on Common Salt from other additives, Literature review of Common Salt usage in Silty Clay soil stabilization by Tamadher T.Abood, , Anuar bin kasa, Zamri bin Chik (2007) gave the experimental results clearly that use of Common Salt decreases index properties.

III. METHODOLOGY

The methodology comprises of collection of Soil and Common Salt sample form the from the desired location. In this study, used

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the Black Cotton Soil mixed with Common Salt in Different proportion and a series of laboratory tests were conducted on samples containing a various percentages of Common Salt (0%, 2%, 4%, 6% & 8%) by dry weight of the Soil. The tested are conducted as per IS Code.

The experiments conducted are:-

- Grain-size distribution
- Liquid Limit
- Plastic Limit
- Plasticity Index
- Shrinkage Limit
- Differential Free Swell (DFS) Test

A. Black Cotton Soil

In this research, The Black Cotton Soil was brought from second gate of NSCB medical college, near Hostel campus, Jabalpur (M.P.). This soil is expansive soil ,is classified as the clay of intermediate compressibility (CI) ($G_s=2.32$ with 91% fines) with expansive behavior .

In Table 1, listed the physical characteristics of clay sample.

Grain size distribution curve of Black Cotton Soil as shown in fig.1

Test Result-

The Black Cotton Soil mixed with Common Salt, various tests were conducted in the different proportions as per IS Code of the practice.

In Table-2, shown the summarized result of the test.

Table-1
 Index Properties of Black Cotton Soil

S.No.	PROPERTIES	Test values
1	Soil Classification	CI
2	Specific gravity g/cc	2.32
3	Liquid Limit (L.L.) %	46.30
4	Plastic Limit (P.L.) %	22.26
5	Plasticity Index (P.I.) %	22.21
6	Shrinkage Limit (S.L.) %	12.98
7	Differential Free Swell Test %	43
8	Grain Size Distribution (%)	
	sand (%)	9
	silt + clay %	91

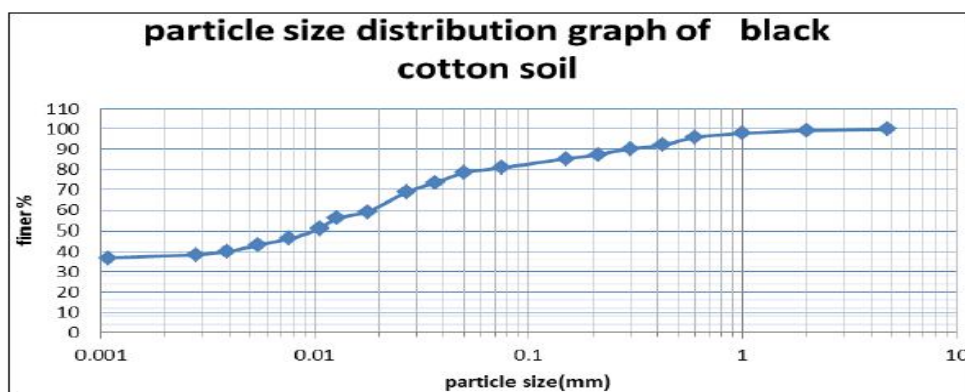


Fig. 1: Particle size distribution curve of black cotton soil

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B. Test Result

The Black Cotton Soil mixed with Common Salt, various tests were conducted in the different proportions as per IS Code of the practice.

In Table-2, shown the summarized result of the test.

Table-2
 Test Result of BCS-Common Salt

S.No.	Test	C0% Common Salt (NaCl)	C2% Common Salt (NaCl)	C4% Common Salt (NaCl)	C6% Common Salt (NaCl)	C8% Common Salt (NaCl)
1	Liquid Limit (LL) %	46.30	44.27	39.14	36.72	33.47
2	Plastic Limit (PL) %	22.26	21.30	21.89	18.01	17.87
3	Plasticity Index (PI) %	22.21	21.27	21.38	18.36	16.94
4	Shrinkage Limit (SL) %	12.98	13.37	14.87	15.27	15.98
5	Differential Free Swell (DFS) %	43	38	30	26	18

Where- sample1 = C0% Common Salt +BC Soil+ 0% Common Salt; sample2 = C2% Common Salt +BC Soil+ 2% Common Salt; sample3 = C4% Common Salt +BC Soil+ 4% Common Salt; sample4 = C6% Common Salt +BC Soil+ 6% Common Salt; sample5 = C8% Common Salt +BC Soil+ 8% Common Salt;

IV. RESULTS AND DISCUSSION

Figure 2 to 6 shown the Test Result variation in the term of Liquid Limit, Plastic Limit, Plasticity Index, Shrinkage Limit and Differential Free Swell. The Liquid Limit decrease from 46.30% to 33.47% as Common Salt content increased from 0% to 8% similarly, Plastic Limit decrease from 22.26% to 17.87% with increase of common salt in BC soil. Shrinkage limit increased from 12.98% to 19.98% and DFS decrease from 43% to 18% respectively. Here these test results indicate that swelling behavior of the soil is considerably reduced.

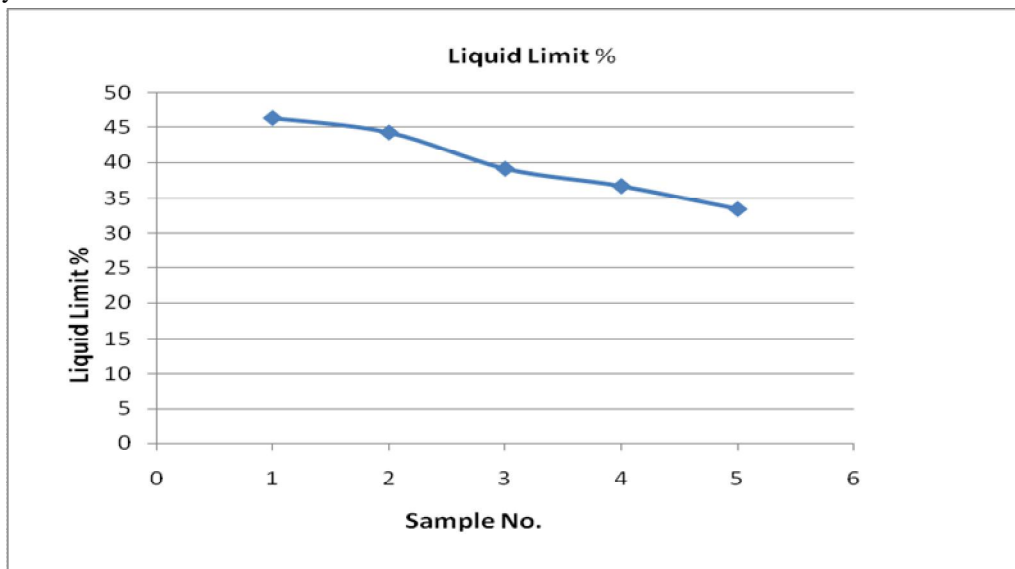


Fig-2 Variation of LL for BCS mixed with Common Salt

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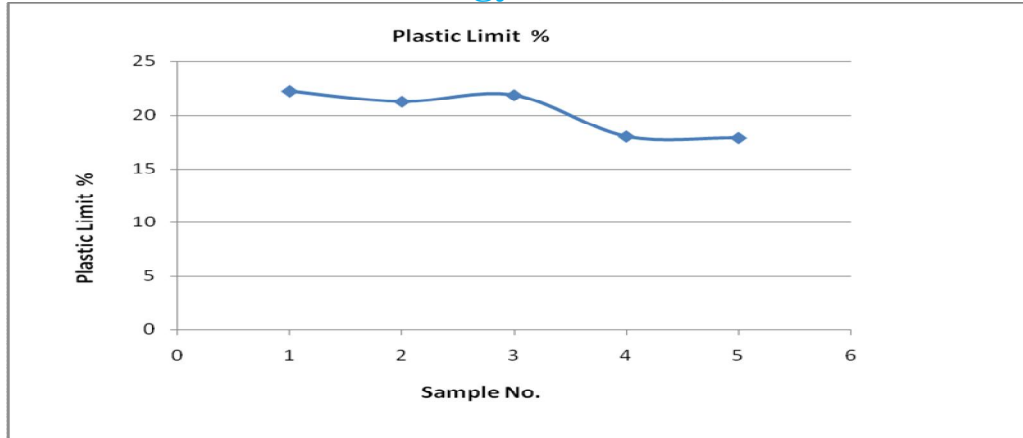


Fig-3 Variation of PL for BCS mixed with Common Salt

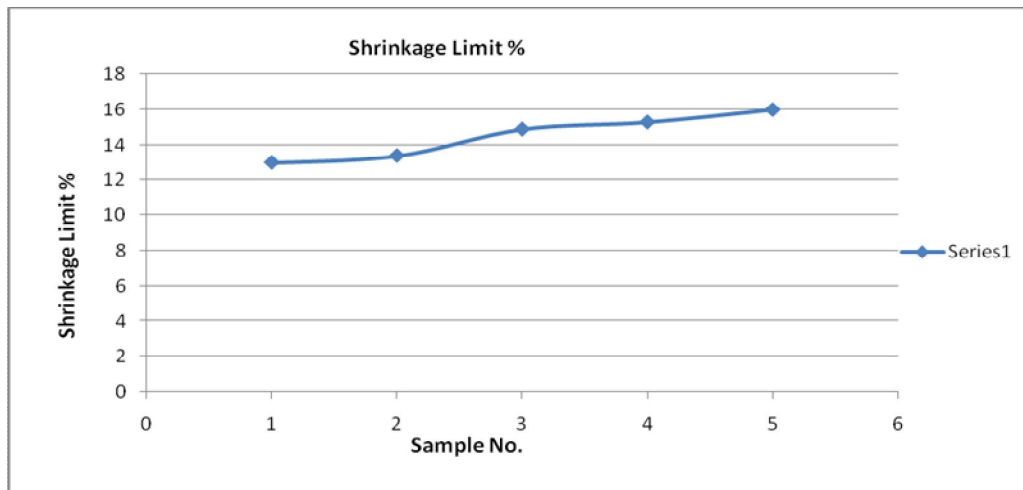


Fig-4 Variation of SL for BCS mixed with Common Salt

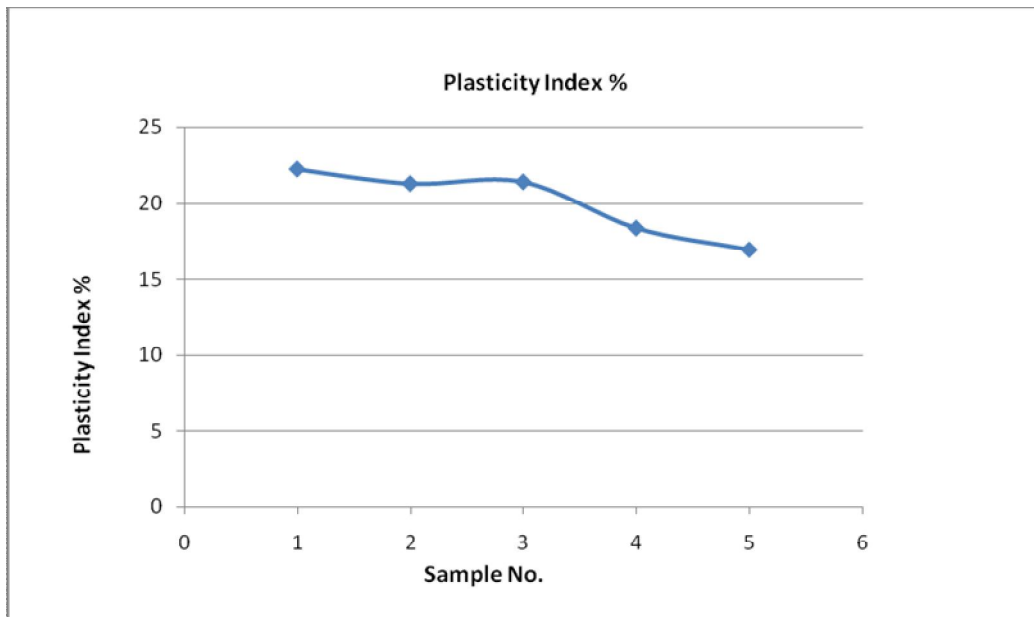


Fig-5 Variation of PI for BCS mixed with Common Salt

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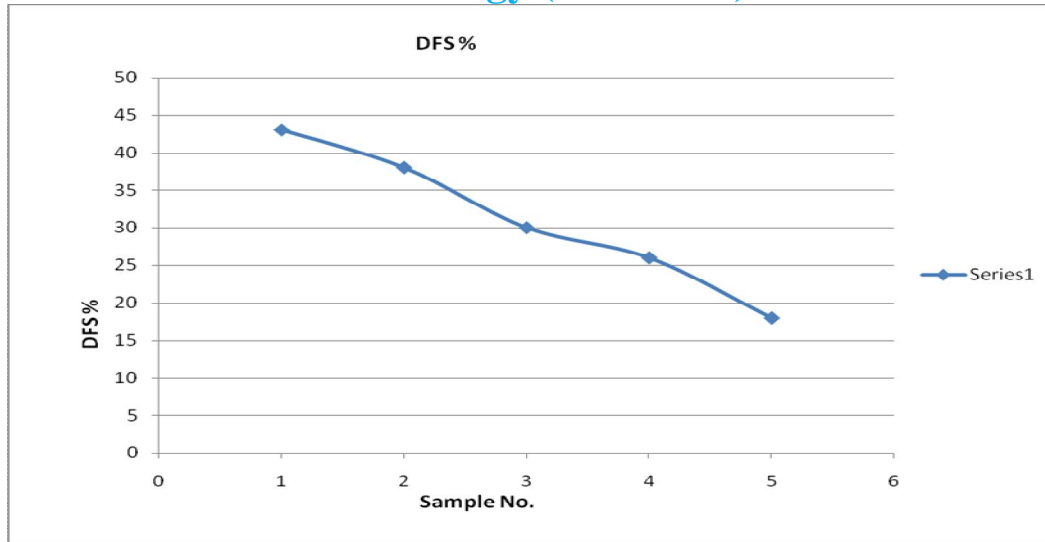


Fig-6 Variation of DFS for BCS mixed with Common Salt

V. CONCLUSION

On the laboratory research conducted on Black Cotton Soil mixed with the Common Salt from 0% to 8% by dry weight of the soil. The following conclusion can be drawn as-

- A. The samples of Liquid Limit are decreasing with the inclusion of Common Salt into the Black Cotton Soil. It has been found that the liquid limit decrease from 46.30% to 33.47%.
- B. Plastic limit decrease from 22.26% to 17.87%.
- C. Plasticity index decrease from 22.21% to 16.94%.
- D. Shrinkage limit decreased from 12.98% to 15.98%.
- E. Differential Free Swell index has reduced from 43% to 18%.

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