Effect of Temperature on Properties of Intermediate Compressible Clay

Dr. D. Jyothi Swarup[1], A. Lavyana[2], P. Pooja Sri[3], M. Yamuna Sai[4], V. Madhuri[5], G. Sriya[6]
[1]*Associate Professor, Department of Civil Engineering, St. Ann's College of Engineering & Technology*
[2,3,4,5,6] *Student, Department of Civil Engineering, St. Ann's College of Engineering & Technology*

Abstract: **In general, clayey soils are residual deposits formed from the Basalt and trapped rocks. Block Cotton soils are having high plasticity. Different minerals are present in clay soils. Those are kaolinite, montmorillonite, Illite, hallosite. clay soil having high shrinkage and swelling characteristics. Shear strength of the soils is extremely lower. The soils have high compressible and have low bearing capacity. As a result of wetting and drying process the vertical movement takes place 1) failure pavement 2) settlement 3) heavy depression 4) cracking and unevenness. Instead of applying conventional methods of stabilization and improving the properties of clay soils by heating the clayey soils at higher temperature. The swelling and shrinkage properties are reduced due to decrease in water holding capacity, in this work we are going to study the index & engineering properties of intermediate compressible soil sample by heating at greater temperature (100°c,150°c,200°c,250°c).**

I. INTRODUCTION

Expansive soils, popularly known as black cotton soils in India, undergo swelling by absorbing water and shrinking by loss of moisture. Therefore, during summer when evaporation from the ground and transpiration due to vegetation exceeds the rainfall, the expansive soil dries up and moisture deficiency develops in the soil, giving rise to soil shrinkage. During the rains, the soil absorbs moisture and swells. Soils containing the clay mineral Montmorillonite generally exhibit these properties (Rao and Triphaty, 2003; Sivapullaiah et al. 1996; Wayne et al. 1984). Because of the alternate swelling and shrinkage, lightly loaded structures such as foundations, Embankments, Pavements, Canal linings and residential buildings founded on them are severely damaged. During the last five decades, damage due to swelling action has been observed clearly in the form of cracking and breakup of pavements, building foundations, embankments and irrigation systems. In the United States alone, the expansive soils inflict about $9 billion per year in damages to buildings, roads, airports, pipe lines and other structures – more than twice the combined damage from earthquakes, floods, tornados and hurricanes (Jones and Holtz, 1973; Jones and Jones, 1987).

2. LITERATURE REVIEW

Cui et al. (2000) described two phenomena produced during heating: (1) expansion of soil constituents (solid and water); (2) mechanical weakening of the contacts between soil aggregates. The expansion of the soil components explains the phenomenon of macroscopic thermal expansion under low stresses, as mentioned before; the mechanical weakening of contacts explains the thermal contraction under high stresses

Villar & Lloret (2004) studied the temperature effect on the hydro-mechanical behaviour of a compacted expansive clay (FEBEX bentonite, liquid limit 102% =Lw , plasticity index PI = 52%) in an oedometer. During wetting, it was observed that at higher temperatures, the swelling strain under constant pressure reduced, as did the swelling pressure under a constant volume condition.

Romero et al. (2005) observed that the stiffness upon loading at 14 MPa suction increased with temperature. On the contrary, with compacted Boom clay

Romero et al. (2003) noticed that the compression index is larger at higher temperatures, but the swelling index seemed to be temperature independent.

3. DETAILS OF THE STUDY

Laboratory investigations were conducted on the soil specimens in order to study the properties of

soil heated at varying temperatures. The tests were conducted according to Indian standards IS: 2720.
Tests were conducted to determine physical and engineering properties of expansive soil like grain size distribution, Atterberg limits, specific gravity, differential frees well index, IS heavy compaction test ,UCS,CBR test

Table 1 Properties of Soil

TEMPERATURE (°C) / PROPERTY	100°C	150°C	200°C	250°C
LIQUID LIMIT (%)	45	38	32.5	30.5
PLASTIC LIMIT (%)	20.34	23	26.66	20.73
PLASTICITY INDEX	24.66	15	5.84	9.77
SPECIFIC GRAVITY	2.10	2.3	2.43	2.48
SHRINKAGE LIMIT (%)	21.56	24.67	26.54	32.56

3.1 COMPACTION CHARACTERISTICS

IS heavy compaction tests were carried out on Soil samples heated at different temperatures in order to study variation in Optimum moisture content and Maximum dry density.

Table 2 Compaction Characteristics of Soil

TEMPERATURE	100°C	150°C	200°C	250°C
OMC (%)	12.5	11.76	10	5
MDD (g/cc)	0.12	1.4	1.48	1.53

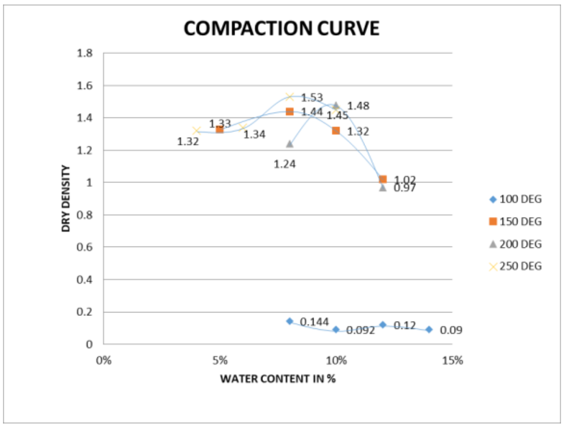

Fig1: Variation of compaction characteristics with temperatures

4. UNCONFINED COMPRESSIVE STRENGTH

The shear characteristics of soil heated at different temperatures are determined by conducting the UCC test

Table 3 Variation of C & ϕ with temperature

TEMPERATURE	C (kN/m^2)	Ø°
100°C	2.6	18
150°C	2.82	21
200°C	3.3	24
250°C	3.6	26

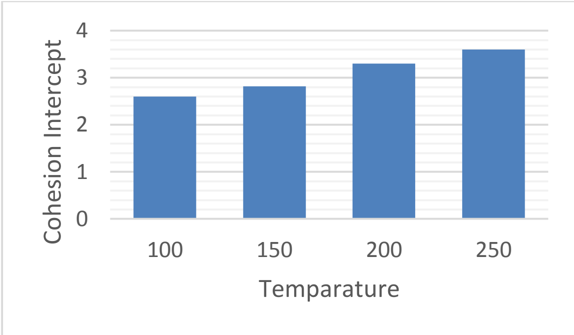

Fig 2 Variation of C with different temperatures

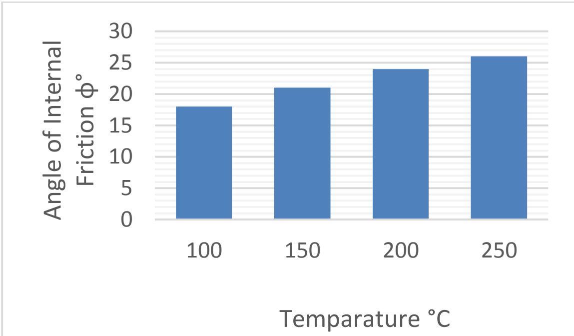

Fig 3 Variation of ϕ with different temperatures

5. CONCLUSIONS

By Conducting extensive laboratory investigations on soil heating at different temperatures, the following conclusions were drawn.

1. The swelling and shrinkage parameters of block cotton soil are reduced by heating at higher temperatures.
2. The compaction parameters optimum moisture content (OMC) was decreased & maximum dry density (MDD) was increased with increase in temperature.
3. The shear parameters cohesion intercept and angle of internal friction are increased with increase in temperature.
4. The CBR value of black cotton soil was increased with increase in temperature.

6.REFERENCES

[1] Effect of temperature on adhesion of clay soil to steel B. Azadegan1, j. Massah

[2] Laboratory Investigation of Thermal Effect on Compressive strength of Cement Admixed Clay Anuchit Uchaipichat, Department *of Civil Engineering, ongchavalitkul University, Nakhon Ratchasima, 30000, Thailand*

[3] Soil mechanics and foundation engineering: Dr. K. R. Arora

[4] Soil mechanics and foundation engineering Dr. B. C. Punmia

[5] Thermo-mechanical behaviour of a compacted swelling clay Anh-Minh Tang1, Yu-Jun Cui1, and Nathalie Barnel2

[6] Researcher and Professor respectively, École Nationale des Ponts et Chaussées, Paris CERMES – Institut Navier).