International Journal of Research in Engineering, Science and Management
Volume-3, Issue-1, January-2020
www.ijresm.com | ISSN (Online): 2581-5792

Effect of Iron Dust on the Compaction Characteristics of Black Cotton Soil

A. M. Kadam[1], V. L. Patil[2], P. G. Chavan[3], Rushikesh Keshav Karate[4], Atharva Rahul Nadge[5], Bhushan Bhausaheb Sawant[6], Snehal Regji Vasave[7], Laxmi Sudhakar Jadhav[8]
[1,2]*Lecturer, Department of Civil Engineering, Guru Gobind Singh Polytechnic, Nashik, India*
[3]*Professor & HoD, Department of Civil Engineering, Guru Gobind Singh Polytechnic, Nashik, India*
[4,5,6,7,8]*Student, Department of Civil Engineering, Guru Gobind Singh Polytechnic, Nashik, India*

***Abstract*: Laboratory study on the stabilization of black cotton soil (BCS) with up to 8% lime admixed with up to 10% iron ore tailing (IOT) by dry weight of soil compacted with British Standard light, BSL energy (relative compaction – 100%) was carried out to establish the soil improving potential of the lime – IOT blend. Tests carried out include index, compaction, strength and durability. Unconfined compressive strength (UCS), CBR (soaked and unsoaked condition) and resistance to loss in strength of specimen yielded peak values at 8% lime / 8% IOT treatment. Microanalysis using scanning electron microscope (SEM) revealed that crystalline hydration products present in the optimally treated black cotton soil majorly contributed to the gain in strength. The batch equilibrium test results on the leaching potential of iron (Fe^{2+}) from the BCS – lime - IOT mixture into the environment show that the desorbed value 0.272 mg/l of Iron (Fe^{2+}) concentration for 8% lime / 8% IOT content falls within the permissible value of not more than 0.3mg/l Iron (Fe^{2+}) concentration for drinking water recommended by the World Health Organisation (WHO) and Nigerian Industrial Standard (NIS). Based on strength criterion, an optimal 8% lime / 8% IOT is recommended for treatment of black cotton soil for use as sub base material in the construction of low volume roads. The benefits of the application include reduction in the environmental impact of the disposal of iron ore tailings.**

***Keywords*: Iron dust, Black cotton soil.**

1. Introduction

The term 'soil' has various meanings, depending upon general professional field in which it is being considered. To an agriculturist, soil is the substance existing on the earth's surface, which grows and develops plant life. To the geologist also, soil is the material in the relatively thin surface zone within which roots occur, and all the rest of the crust is grouped under the term rock irrespective of its hardness. To an engineer, soil is the unaggregated or uncemented deposits of minerals and organic particles or fragments covering large portion of the earth's crust. It includes widely different materials like boulders, sands, gravels, clays and silts , and the range in the particle sizes in a soil may extend from grains only a fraction of micron (10 cm) in diameter up to large size boulders.

Soil is considered by the engineer as a complex material produced by the weathering of the solid rock. The formation of the soil is as a result of the geologic cycle continually taking place on the face of the earth. The cycle consist of weathering or denudation, transportation, deposition and upheaval, again followed by weathering, and so on. Weathering is caused by the physical agencies such as a periodical temperature changes, impact and splitting action off lowing water, ice and wind and splitting actions of ice, plants and animals. Cohesion less soils are formed due to physical disintegration of rocks.

Soils transported by gravitational forces are termed colluvial soils, such as talus. The accumulation of decaying and chemically deposited vegetable matter under conditions of excessive moisture results in the formation of cumulus soils, such as peat and muck. For any land- based structure, the foundation is very important and hence to be strong to support the entire structure. In order for the foundation to be strong, the soil around it plays a very critical role. So, to work with soils, we need to have a proper knowledge about their properties and factors which affect their behavior. The process of soil stabilization is to achieve the required properties in a soil needed for the construction work. From the beginning of construction work, the necessity of enhancing soil properties has come to the light. Ancient civilization of the Indians utilized various method to improve the soil strength etc., some of these methods were so effective that their building and roads still exists.

2. Methodology

1. *Moisture content determination:* The condition resulting from having been dried to essentially constant weight in an oven at a temperature that has been fixed, usually 221°F and 230°F (105°C and 115°C).
2. *Specific gravity:* The ratio of the density of a substance to the density of some substance (such as pure water) taken as a standard when both densities are obtained by weighing in air.
3. *Liquid limit:* The water content at which soil passes from the plastic to the liquid state under standard test conditions. The limit is expressed as a percentage of the dry weight of the soil. See also Atterberg limits.

4. *Plastic limit:* The water content at which a soil will just begin to crumble when rolled into a thread approximately 1/8" (3 mm) in diameter. Squeeze and roll a 0.3 oz. (8 g) test sample into an ellipsoidal shaped mass. Roll this mass between the fingers or palm of hand and the ground glass plate or satisfactory paper on a smooth horizontal surface with just sufficient pressure to roll the mass into a thread of uniform diameter throughout its length. The rate of rolling should be between 80 and 90 strokes/min, counting a stroke as one complete motion of the hand forward and back to the starting position again.
5. *Shrinkage limit:* The water content at which a reduction in water content will not cause a decrease in volume of the soil mass but an increase in water will increase the volume. See also Atterberg limits. Determines the volume of shrinkage dish which is evidently equal to volume of the wet soil as follows. Place the shrinkage dish in an evaporating dish and fill the dish with mercury till it overflows slightly. Press it with plain glass plate firmly on its top to remove excess mercury. Pour the mercury from the shrinkage dish into a measuring jar and find the shrinkage dish volume directly. 6. grain size. The average diameter or expressed dimension of the grains or crystals in a sample of metal or rock. Also particle size.
6. Compaction test 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.

3. Conclusion

As a result structures constructed on black cotton soil are subjected to serve deformations and frequent repair leads to high cost of maintenance. Useless land for construction can be converted to be useful land for construction by using land improvement technique. Soil stabilization is one of the techniques to improve soil properties. It increases the bearing capacity of soil, decrease swelling & permeability, and increase efficiency. There are various type of soil stabilization method they are divided into two categories chemical stabilization and mechanical (physical) stabilization.

References

[1] Chen F. H. Foundation on expansive soils. Elsevier Science Ltd, Second edition, New York, 1988.
[2] Barazesh, A., Saba, H., and Gharib, M. The Effect of Adding Iron Powder on Atterberg Limits of Clay Soils, International Research Journal of Applied and Basic Sciences, Vol. 3 (11): 2349-2354, 2012.
[3] Ahmed, B., Alim, A., and Sayeed, A. Improvement of soil strength using cement and lime Admixtures, Earth Science, Vol. 2(6): 139-144, 2013.
[4] Mukherjee, D. Selection & Application of Lime Stabilizer for Soil Subgrade Stabilization, IJISET.
[5] Gough I., Langford M., and Gough A. 1999. “The Hybrid Toilet System,” General Science, Engineering & Technology, Vol. 1 Issue 7, September, 2014.
[6] Gupta, Amit and Gupta B.L. ‘Road, Railway, Bridge and Tunnel Engineering’’, Standard Book House, 19(3): 18-28, 1990.
[7] Barazesh, A., Saba, H., Rad, M. Y., and Gharib, M, “Effect of Wood Ash Admixture on Clay Soils in Atterberg Test.”