IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
PP 88-92

Soil Stabilisation Using Cement

Miss. Siyona M. Mudliar*[1], Mr. Shailesh S. Suryawanshi*[2],
Miss. Snehal S. Mankar*[3], Mr. Akshay M. Nandurkar*[4]
*[1]. *G.H.Raisoni University Amravati, India.*
*[2] *G.H.Raisoni University Amravati, India.*
*[3] *G.H.Raisoni University Amravati, India.*
*[4] *G.H.Raisoni University Amravati, India.*
Dept. Of Civil Engineering G.H.Raisoni University Amravati, Maharashtra.

Abstract: *Among the several modes of transportation, the roads have been the most ancient and widely used medium. Since the ancient time for transportation of goods or travelling purpose, we used roads. Heavy loaded trucks running on the roads need special care and attention during construction phase so that they can bear the maximum load. Stabilization is the improvement of a soil or pavement material usually through the addition of a binder or additive. Some of the soil having good and sufficient load bearing capacity but some of having poor. This research work mainly focuses on soil stabilization using cement to improve geotechnical properties such as plasticity, compaction, and Unconfined Compressive Strength of the studied soil. These properties were determined before as well as after the stabilization of soil. In this work it was found that higher the quantity of cement added to the soil, dry density of soil decreased and optimum moisture content increased. With the addition of cement to the soil, unconfined compressive strength increased, and it was also found higher at higher curing period.*

Cement stabilization of soil is done by mixing pulverized soil and Portland cement with water and compaction the mix to attain a strong material. The material obtained by mixing soil and cement is know as soil-cement. Since 1915 more then 1 lakh miles equivalent 7.5m wide pavement bases has been constructed from cement stabilized soil. Soil Stabilization is a process of treating a soil to improve its stability and bearing capacity for using the soil as Construction material. The most Important Purpose of Soil Stabilization is the increase the strength of pavement layers like sub-base, base course etc. and to increase the stability of earth work in embankment as a whole.

The soil to be stabilized is pulverized, water is added and is mixed. The bituminous material is then added and is remixed. The mixture is spread to the required grade and compacted. The compacted surface cured.

Key words: *Cement Stabilization, Unconfined Compressive Strength (UCS), Plasticity Index (PI), Compaction.*

I. Introduction

Road stabilization is the method of providing strength to the natural soil against the heavy load of modern day traffic and reduced the damage of road in a different climate. The methods employed include the used of admixtures, compaction and densification of soil. Admixture can be chemical binders, industrial wastes, cement, fly ash. Soil Stabilization is a technique used to change different soil properties and to enhance its performance for engineering purpose. Selection of stabiliser for a certain field depends mainly on the type of soil, type of construction to develop, and availability of materials to be used in construction.Cement base pavement has an advantage of great strength and durability. Also, it is widely available hence becomes the best material for stabilisation of soil. The hydrated product of cement binds with soil to form the cement-stabilized base or cement-treated aggregate base. The strength of stabilised soil will mainly depend on the quantity of cement used in the soil. The proportion of cement required in soil decides based on the type of soil. Portland cement widely used as a soil stabilisers, because of its easy handling and quality control properties. With the increase in cement quantity in the strength of the cement stabilised soil increases. Several researchers have found that stabilization using cement is more suitable for granular soil and clay soil having low PI. Based on UCS value, quality of soil used in subgrade classified as soft, medium, stiff, very stiff and hard. UCS value of stabilised soils on curing time increases with the higher quantity of cement added to the soil. The curing period effect the UCS test result of cement stabilisedsoil, and higher strength obtains for the soil sample cured for 14 days compared to 7 days curing.

For different types of soil, a guideline for stabilisation hasissued specifying the Plasticity

Index (PI) of sandy soil to be less than 30. For fine grain soil PI should not be more than 20 and to ensure proper mixing liquid limit (LL) should not be more than 40. For soil having a higher amount of clay two stage stabilisation may be adopted i.e. the clay is treated with lime in stage I to reduce the value of plasticity and

hence to provide a facility for pulverisation, whereas in stage II, the resulting soil stabilises with cement. Physical properties of soil like particle size distribution, clay content, liquid limit and plasticity index play a major deciding factor in any project. Also, the chemical nature of soil has a great impact on deciding the durability of roads. Hence to achieve a solid and stable foundation we need stabilization technique. Factors affecting soil cement stabilisation are soil, cement, pulverisation and mixing, compaction and curing. Material requirements for stabilisationare the well-graded soil of LL less than 45%, PI less than 20% and cement quantity based on UCS value.

II. Material And Methods

The soil used in this research work was local soil situated behind Kalinga University main building, Naya Raipur, Chhattisgarh. Physical properties of the soil determined and presented in Table 1. Test to be performed before soil stabilisation are a liquid limit (LL), shrinkage limit (SL), plastic limit (PL), PI, UCS, MDD, OMC and particle size distribution.

Primary methods of soil stabilisation used are mechanical stabilisation and chemical stabilisation. In any road construction, amechanical method conducted by compacting the soil through rollers, and chemical method includes utilisation of fly ash, lime, cement, etc. In chemical method two types of additives used at the time of stabilisation of soil. First one is mechanical additives and the second one is chemical additives. As a mechanical additives cement used and its main function is to alter the soil property mechanically by adding an optimum quantity, thereby to improve the soil bearing capacity. In laboratory stabilization using cement was conducted in 3 steps. In step one soil sample was prepared after that left it in the air to dry and then put it in the oven at 1000C for one day. Remove the soil from oven and crushed the sample using the crushing machine. In step second optimum quantity of cement required to the soil, stabilisationprocess determines with the help of pH-test [5]. In the third step,cement stabilised sample prepared by compacting it at a maximum dry density (MDD) and optimum moisture content (OMC).MDD and OMC of specimens were obtained
using modified Proctor test.

Table 1: Physical Properties of soil studied

Sr no	Properties	Local soil
1	Liquid Limit (%)	45
2	Plastic Limit (%)	27
3	Plasticity Index (%)	18
4	Shrinkage Limit (%)	20
5	Specific Gravity (%)	2.68
6	Gravel (%)	3
7	Sand (%)	52
8	Silt (%)	24
9	Clay (%)	21
10	Natural Moisture Content (%)	7
11	Maximum Dry Density(gm/cm3)	1.96
12	Optimum Moisture Content (%)	14

Various physical properties of soil like plasticity, compaction, and UCS were determined before as well as after the stabilisation. The pavement performance of a stabilised road largely governed by the gradation and the soil type or granular material used for the purpose of stabilisation. The strength of stabilised materials can measure by many ways, of which most popular is the UCS test. The quantity of cement added to the soil based on the type of soil. Soil Cement specimens prepared with various cement contents in constant volume mould. The compressive strength of these specimens tested after 1, 3, 7 and 14 days of curing. A graph plotted between cement content and compressive strength. Soils pulverized more easily when they contain proper moisture content. Pre-wetting helps in pulverisation of dry, hard soils. Other issues in soil cement are moisture content during compaction, rolling to be completed within 2 hours of mixing and minimum seven days curing.

III. Cement Stabilized Subgrade Construction Procedure

Construction of cement stabilised subgrade soil follow this procedure-

- Subgrade material was spread on the top of embankment layer (150mm + 25% loose) and lightly compacted.
- Total work area marked with grids of the area required for one bag of cement (2.5m X 2.5m) Figure 1(a).
- Cement spread at the rate of one bag per grid Figure 1(b).
- Soil and Cement mix by mechanical Harrow followed by tractor mounted rotovator Figure 1(c) and (d).
- Moisture added to the soil (+/-1% of OMC).
- Compaction isprocess completed done with 1(e).
- Quality Control tests conducted as per the frequency.

The methodology for cement stabilised subgrade can describe with the help of pictures taken at the site (fig. 1).
Soil Stabilization Using Cement

(a) (b)

(c) (d)

(e)

Figure 1: Showing cement stabilized subgrade at test site.

IV. Result And Discussion

Figure 2 shows the effect of quantity of cement added to the soil on consistency limit. From the figure, it was observed that there is an increase in consistency limit of soil with the increase in the quantity of cement added to the soil. However, the rate of increase is very less.

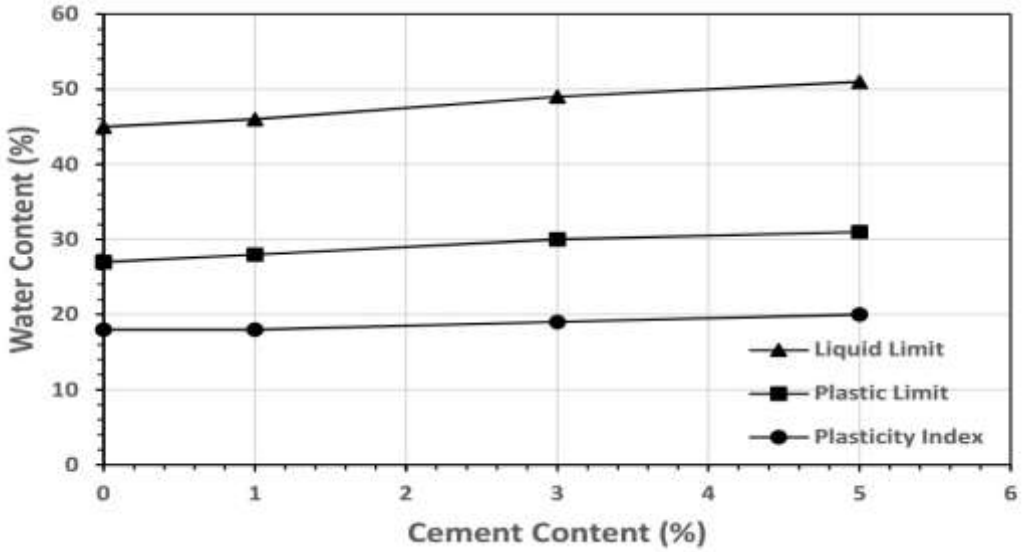

Figure 2: Effect of quantity of cement added to the soil on consistency limit of soil

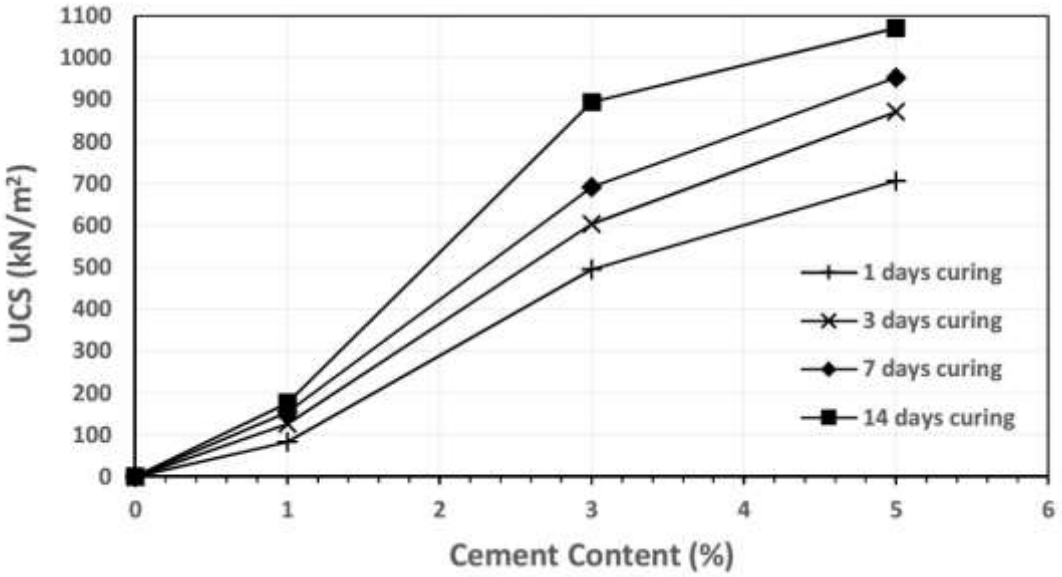

Figure 3: Effect of quantity of cement added to the soil on UCS of soil

Figure 3 shows the effect of quantity of cement added to the soil on unconfined compressive strength (UCS) of soil. The soil was kept for 1, 3, 7 and 14 days curing period. Several specimens were prepared in the laboratory for the compressive strength testing. The specimens were prepared by proportioning soil and cement according to selected ratios then adding the optimum percentage of water. The compression tests were carried out with standard cubes (7x7x7cm) and strength measured by ASTM D 422-63 which involve curing of the soil. With the increase in cement content, it was found that strength of soil increase. The strength of soil also depends on curing period. Figure 4 shows the effect of curing period on UCS of soil. From the figure, it was observed that with the increase in curing period strength of soil increases. So the strength of soil not only depends on cement content, but it also depends on the curing period of soil.

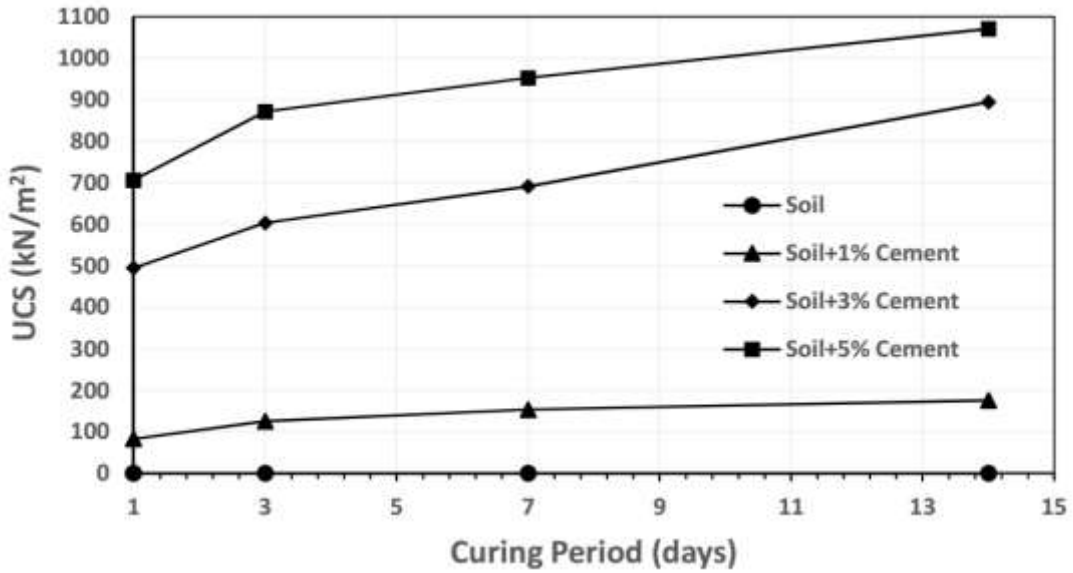

Figure 3: Effect of curing period on unconfined compressive strength (UCS) of soil

V. Conclusions

The conclusions obtained from the research work can be summarised as follows:

- Soil cement provided strength and durability which is outstanding value as a base/sub-base material. Also, it is best alternative material for low-cost structure.
- Soil cement benefits the pavement by distributing the load uniformly, eliminate base rutting and reduces deflection as well as moisture problem.
- The OMC of mixture (soil-cement) increase with increasing of cement content.
- The UCS of stabilised soil increases with increasing the quantity of cement in a mixture.
- The UCS of stabilised soil increases with increasing the curing period.

References

[1]. Broms, B.B., 1986. Stabilisation of Soft Clay with Lime and Cement Columns in Southeast Asia. Applied Research Project, Nanyang Technical Institute, Singapore.
[2]. Curr in, D.D., Allen, J.J., Little, D.N., 1976. Validation of soil stabilisation index system with manual development. Frank J. Seisler Research Laboratory, United States Air Force Academy, Colorado.
[3]. Das, B., 1994. Principle of Geotechnical Engineering. 3rd Edition, PWS-Kent Publishing Company, Boston.
[4]. Derucher, K.N., Korfitatis, G.P., Ezeldin, A.S., Materials for Civil and Highway Engineers. Prentice-Hall.
[5]. Eades, J.L., Grim, R.E., 1996. A Quick Test to Determine Lime Requirements for Lime Stabilization. Highway Research Board, National Research Council, Washington DC, No. 139, pp. 61-72.
[6]. Imran, M.S., Gary, K.F., Michael, P.E., 2007. Innovation in cement stabilisation of airfield subgrades. Proceedings of FAA worldwide airport technology transfer conference, Atlantic City, New Jersey, USA, pp 6-8.
[7]. Sadek, D., Roslan, H., Abubakar, D.A., 2008. Engineering Properties of Stabilized Tropical Peat Soils. Bund, EJGE13, pp 7-8.
[8]. Saitoh, S.Y., Suzuki, Shirai, K., 1985. Hardening of Soil Improvement by Deep Mixing Method. Proc. of the 11th ISCMFE, San Francisco, Vol. 3, pp. 1745-1748.
[9]. Winterkorn, H.F., 1975. Soil Stabilisation. Foundation Engineering Handbook". Chapter 8, Winterkorn and Fang, eds., Van Nostrand Reinhold, New York, pp. 312-336.
[10]. Sree Kumar. V. Babu and Mary Rebekah Sharmila. S, Soil Stabilisation Using Marble Dust. International Journal of Civil Engineering and Technology, 8(4), 2017, pp. 1705- 1712
[11]. Sai Kumar V B Y and Hanumantharao Ch, Behavior of Building Frames On Soils of Varying Plasticity Index. International Journal of Civil Engineering and Technology, 8(1), 2017, pp. 623–627.
[12]. Amruta P. Kulkarni, Mithun. K. Sawant, Vaishnavi V. Battul, Mahesh S. Shindepatil and Aavani P., Black Cotton Soil Stabil ization Using Bagasse Ash and Lime. International Journal of Civil Engineering and Technology, 7(6), 2016, pp.460–471