International Journal of Education and Science Research
Review
E-ISSN 2348-6457
Volume-3, Issue-1 February- 2016 P-ISSN 2348-1817
www.ijesrr.org Email- editor@ijesrr.org

Cement Stabilized Soil as Subgrade Material for Road Construction

Nabakalpita Bora, Mridusmita Bora, Moushumi Deka
Tohsin Hussain, Himadri Baruah
Department of Civil Engineering
Royal School of Engineering and Technology
Assam

ABSTRACT:
Any constructional activity be it road projects or heavy civil engineering projects like dams, tunnels etc require a lot of earthworks and as such we need to enhance the engineering properties of the soil in order to strengthen it so that the soil has sufficient bearing capacity as well as density. Hence, in our project work an effort has been made to strengthen the soil as a subgrade by using soil stabilization using cement as a stabilizing material. The soil which has to be stabilized was taken from Zoo road area of Guwahati. At first the soil sample was experimented for sieve analysis, liquid limit, plastic limit, compaction test and CBR test under normal conditions without adding cement. After the results were calculated for normal soil, the soil was added with 2%, 3%, 4% and 5% cement and experimented for the liquid limit, plastic limit, compaction test and CBR test. From the experimental study it can be concluded that problematic red soil can be used for road projects or any other civil engineering constructions by stabilizing the soil.

KEYWORDS: Soil stabilization, Sub grade, Cement Stabilization, Sieve Analysis, Liquid Limit, Plastic Limit, Compaction, California Bearing Ratio.

I. INTRODUCTION:

Soil stabilization in a broadest sense is the alteration of ant property of soil to improve its engineering performance. Soil stabilization methods using the locally available cheaper materials have considerable scope in reducing the initial construction cost of the pavements. It is a technique for improvement of weaker soil and the engineering properties of the soil can be by soil stabilization. Engineers are often faced with the problem of constructing roadbeds on or with the soil, which do not possess sufficient strength to support wheel loads imposed upon them either in construction or during the service life of the pavement. It is, at times, necessary to treat these soils to provide a stable sub grade or a working platform for the construction of the pavement. This treatments result in less time and energy required for production, handling and placement of road and bridge fills and sub grades and therefore less time to complete the construction process thus reducing the disruption and delays to traffic.

The various method of soil stabilization includes:-

a) Mechanical Stabilization
b) Cement Stabilization
c) Lime Stabilization
d) Bitumen Stabilization
e) Stabilization by Geo-textiles

II. MATERIALS AND METHODS:

A. MATERIALS:

Soil – The soil sample used in the project work was selected from a local road in Sahab Tilla area, near Mother Teresa Road, Guwahati. The soil was purely cohesive and plastic. It had characteristic red colour. The soil was found to be well graded which comprised of varying proportion of gravel, sand, silt and clay. Basic soil tests such as specific gravity, Atterberg limits, sieve analysis, compaction test and C.B.R test were performed. Some of the physical properties of the soil are presented in Table 3.1.

Table I Physical properties of soil sample

Sieve Analysis	Type of gradation Well Graded soil	Type of gradation Well Graded soil
Atterberg Limits	Liquid Limit	57.44%
	Plastic Limit	30.24%
	Plasticity	27.2%
Standard Proctor Test	OMC and Max Dry Density	22% and 1.54 g/cc resp.
CBR	C.B.R value	2.86 %
Specific Gravity	Pure soil	2.51
	Pure soil + 2% cement	2.36
	Pure soil + 3% cement	2.31
	Pure soil + 4% cement	2.27
	Pure soil + 5% cement	2.21

As per studies, the soil is an organic soil.

Ordinary Portland cement (OPC) - It is used for general construction purposes where special properties are not required. It is normally used for the reinforced concrete buildings, bridges, pavements, and where soil conditions are normal. It is also used for most of concrete masonry units and for all uses where the concrete is not subject to special sulfate hazard or where the heat generated by the hydration of cement is not objectionable. It has great resistance to cracking and shrinkage but has less resistance to chemical attacks. Any type of cement can be used for soil stabilization but OPC is most widely used. The two principal factors that determine the suitability of a soil for stabilization with OPC are, firstly whether the soil and the cement can be mixed satisfactorily and second whether after mixing and compacting the soil-cement will harden adequately. OPC is generally used in soil stabilization as it has comparatively less settling time and therefore hardens faster. The specific gravity of OPC is taken as 3.15. The density of OPC is measured by Le Chatelier Apparatus .The grade of OPC used is 53.

B. METHODOLOGY

The procedure used for this project is as follows:

- At first the soil sample obtained from the site is cleaned from any visible unwanted matter like leaves, plastic etc.
- Then the various index properties of the soil like sieve analysis, liquid limit, plastic limit and moisture content are found out using Cassagrande apparatus and oven drying method respectively.
- The maximum dry density and optimum moisture content is found out using the Standard proctor test.
- The CBR Test is carried out to evaluate the stability of the soil.

III. RESULTS AND DISCUSSION:

SIEVE ANALYSIS:

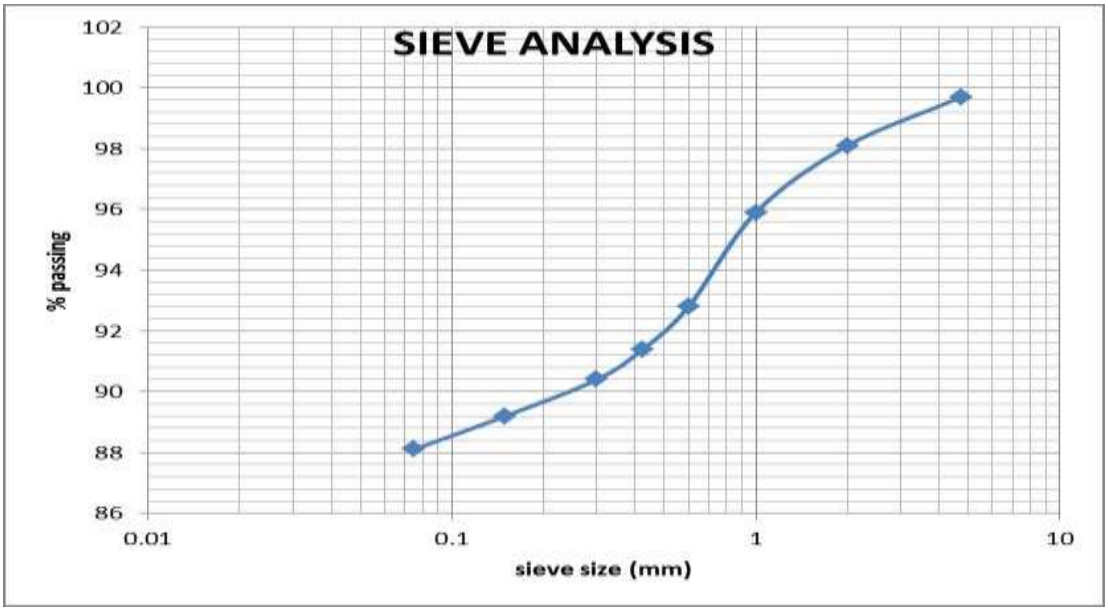

Figure 1 Sieve Analysis

The graph for the sieve analysis that was done for the soil sample is plotted in the figure 1. The abscissa represents the sieve size and the ordinate represents the % passing on each sieve.

PLASTICITY INDEX:

The plasticity index is calculated after the liquid limit and the plastic limit is calculated. We have to subtract the plastic limit from the liquid limit to find out the plasticity index. Hence, Plasticity index= Liquid Limit- Plastic Limit From table 2, it was observed that the liquid limit and plastic limit decreased with the increase in cement content but, the plasticity index seemed to decrease and then increase.

Table 2 Plasticity Index

Cement %	Liquid limit	Plastic limit	Plasticity index
Pure soil	57.44	30.24	27.2
2	49	27.68	21.32
3	42	25.17	16.83
4	40	22	18
5	39.5	20.91	18.59

Optimum Moisture Content and Maximum Dry Density

The OMC and the Maximum Dry density of pure soil, +% cement, +3%cement, +4% cement and +5% cement is given. It is seen that both OMC and MDD increases with the increase in cement content with the pure soil.

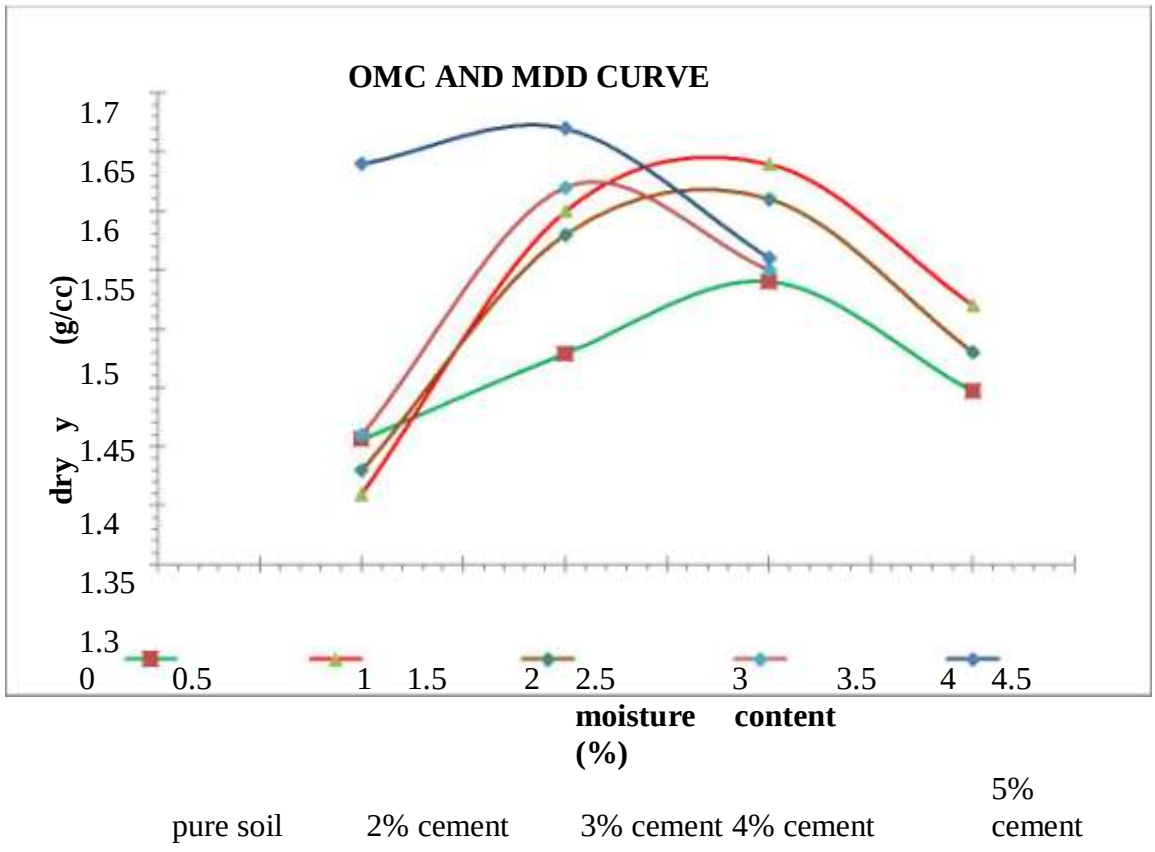

Figure 2 OMC and MDD Curve

CALIFORNIA BEARING RATIO:

From the graph of California Bearing Ratio (C.B.R) test, we can infer that the C.B.R value increases to a significant extend on addition of cement to pure soil .As per the results of C.B.R test, on addition of 2% cement the C.B.R value increases by 14.28% .For addition of 3%, 4%, 5% cement the C.B.R value increases by 0.90%, 0.80% and 1% respectively which is fairly uniform.

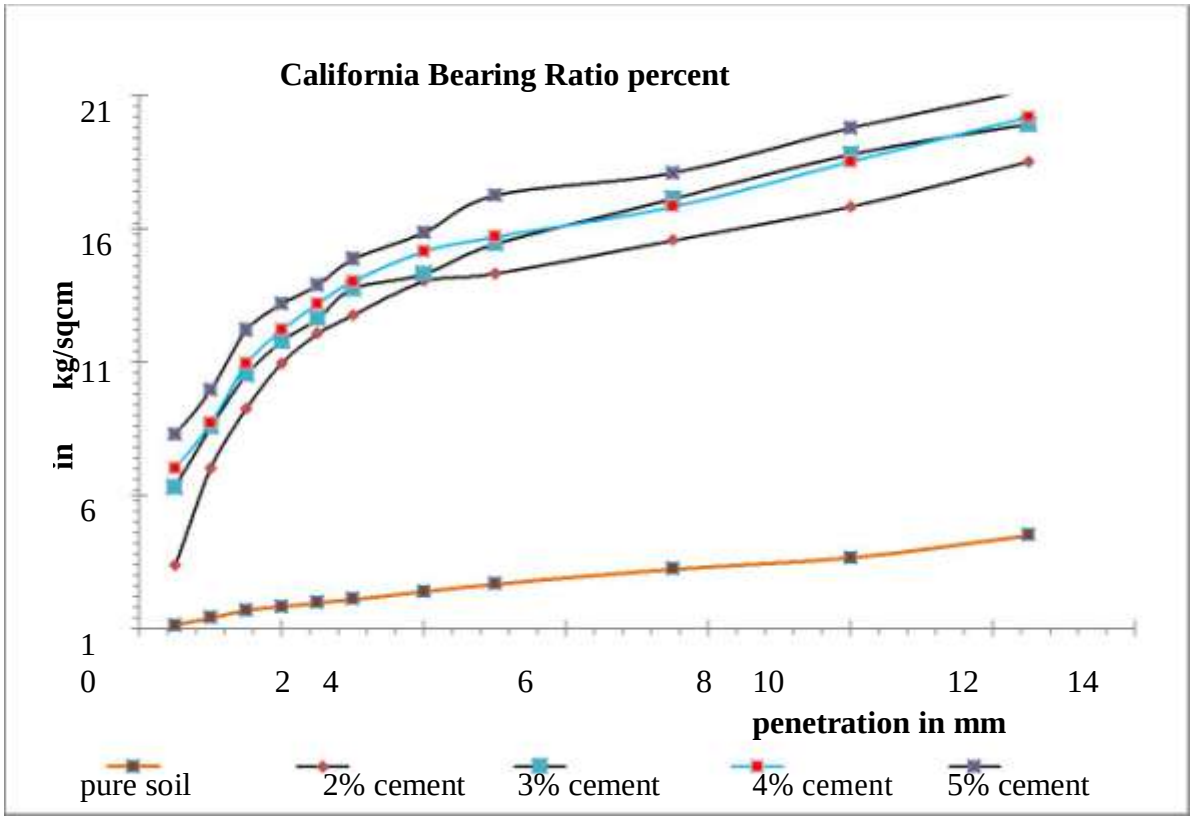

Figure 3 California Bearing Ratios

IV CONCLUSIONS:

1. From the graph of sieve analysis we can infer that the soil is a well graded soil and has a good representation of grain sizes over a wide range with particles ranging from gravel to silt and clay.
2. The plasticity index decreases first and then increases. The soil is medium plastic.
3. From the results and graphs of Standard Proctor test we can infer that the maximum dry density and Optimum moisture content (OMC) increases with increase in cement content. The OMC increased by 0.68 %, 1.02 %, 0.50 % and 0.70 % for addition of 2%, 3%, 4% and 5% cement respectively. So, the increment of OMC can be considered to be almost uniform for each cement percentage content increment. Whereas for the dry density which increased by 0.1 g/cc, 0.040 g/cc , 0.040 g/cc , 0.02 g/cc with each increasing cement percentage respectively.
4. From the results and graphs of California Bearing Ratio (C.B.R) test, we can infer that the

C.B.R value increases to a significant extend on addition of cement to pure soil .As per the results of C.B.R test, on addition of 2% cement the C.B.R value increases by 14.28% .For addition of 3%, 4%, 5% cement the C.B.R value increases by 0.90%, 0.80% and 1% respectively which is fairly uniform. Research has shown that if a subgrade has a CBR value in between 5% and 15% the sub-grade material is good and will not deflect under traffic loadings and will not cause pavement deterioration. Generally a C.B.R value of 10 is considered adequate for sub-grade material used for road construction. The soil sample on which the laboratory tests were conducted had an initial C.B.R value of 2.86 %, which is a material with poor strength and hence cannot be utilized as a subgrade material. On adding 2% OPC to it the value increased significantly to 17.14 %. Therefore, on account of various tests conducted for the work entitled " CEMEMT STABILIZED SOIL TO BE USED AS A MATERIAL FOR ROAD CONSTRUCTION " we can

conclude that soil sub-grade can be stabilized by Ordinary Portland Cement by adding cement in percentage less than 2% so that it attains a C.B.R value in between 5-

ACKNOWLEDGEMENTS:
This research was carried out in Royal School of Engineering and Technology, Assam and the author would like to express her gratitude to the Civil Department and the Road Research Laboratory, Assam for helping in the work.

REFERENCES:

1. Aiban, S.A, Al-Ahmadi H.M., Asi I.M., Siddique Z.U. and Al-Amoudi O.S. B. (2005), "Effect of geotextile and cement on the performance of sabkha subgrade".
2. Al-Hamoud A.S., Khedaywi T. and Al. Ajlouni .A.M. (1999), "Comparison of effectiveness and economic feasibility of bitumen , lime and cement as stabilizing agents for reduction of swell potential of a clayey soil", Indian Highways, January 1999, pp. 51-58
3. Arumugam A. and Muralidharan K. (1997), "Optimization of pavement of construction cost on stabilized soil subgrade", Indian Highways, March 1997, pp. 33-42
4. Basha E.A., Hashmi R and Muntohar S. (1999), "Effect of the cement-Rice husk ash on the plasticity and Compaction of soil".
5. Horpibulsuk S. et al. (2006), "Strength development in cement Stabilized low plasticity and coarse grained soils".
6. IS 2720, Part III, 1980, "Methods of Test for Soils: Determination of Specific Gravity", Indian Standards Institute, New Delhi, India
7. IS 2720, Part V, 1985, "Methods of Test for soils: Determination of liquid limit and plastic limit", Indian Standard Institute, New Delhi, India
8. Kumar V. (2002), "Compaction and permeability study of soil stabilized with Fly ash, Lime and sodium tri carbonate".
9. Lopez- Lara, T., Zepeda- Garrido J.A. and Castario V.M. (1999), "A comparative study of the effectiveness of different additives on the expansion behavior of clays".
10. Mandal M. and Mazumdar M. (1995), "A study on the effect of sodium carbonate as an additive to stabilized soil", Indian Highways, December 1995, pp. 31-36
11. Ranjan G., Rao.A S R. Basic And Applied Soil Applied Mechanics (Second Edition), New Age International (P) Limited, Publishers, New Delhi-1100