

Literature Review of Soil Stabilization using Different Materials

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Abstract- Soil is basic foundation for any Civil engineering structures and nowadays, considerable attention has been paid to the utilization of alternative materials, which bear higher engineering quality. While on the other hand the volume of wastes generated in the world has increased over the years. One of the most attractive options of managing such wastes is its re-use. Numerous methods are available in soil stabilization but in our project, we will be analysing soil strength by using different materials like rice husk ash, burnt brick dust and bagasse ash. From the past study it has been concluded that Surat is covered with black cotton soil. Soil stabilization has proved to be very economical as it provides cheap materials for the construction of low cost roads. Local materials can be used effectively. There are many techniques of soil stabilization. Cement stabilization is an important method of stabilization. It has proved very much effective in case of sandy soil due to ease of pulverization and mixing and the smaller quantity of cement required. Many researchers attempt to stabilize the black cotton soil with use of cementitious materials and agricultural waste as a combination; here we discuss some of works based on use of rice husk ash, burnt brick dust and bagasse ash which used in combination with cement or any other material.

Keywords- Soil stabilization, Rice husk ash, burnt brick dust, bagasse ash, CBR test

I. INTRODUCTION

Generally, as we know lands with Black Cotton soils are fertile and very good for horticulture, agriculture, sericulture and aquaculture. In India, Black Cotton Soils occupies an estimated area of 74 million hectare. The Black Cotton Soils are mostly found in Maharashtra, western parts of Madhya Pradesh, Gujarat and some parts of Andhra Pradesh, Tamil Nadu, etc. Black cotton soils are expansive clays which has potentials to shrinking or swelling under changing moisture condition. Black Cotton Clay has clay minerals known as “Montmorillonite” due to which this types of soils has some weak properties. These types of soils are formed under conditions of poor drainage from basic rocks or limestone under alternating wet or dry climatic conditions. Due to some typical behaviour of soil they results into failure of structure in form of settlements cracks etc.

In general, these expansive soils gets changes as per environment changes as they are too much sensitive. The environment includes the stress system, temperature variations, and the chemistry of pore water in the system, the seasonal variations in ground water table with consequent changes in natural moisture content, etc. These all above properties has made the soil unsuitable for civil engineering purposes either as foundation or embankment material. By stabilizing with lime, especially clays the engineering properties of clays can be made better up to much extent. Moreover, it has been founded that, by increasing pozzolanic action, the stabilization by lime is highly effective. A mostly country which produces rice such as India, rice-husk ash for stabilization appears to be a successful solution since rice-husk ash because its primarily being siliceous material, acts as a pozzolana. Hence, in this report or study, the compressibility behaviour of Black Cotton Soil treated with lime and rice-husk ash has been studied. For the purpose of comparison, similar studies have been carried out with admixtures such as lime and rice-husk ash separately. Also, we can use Fly ash, burnt brick dust and Bagasse Ash stabilizer.

What is Soil Stabilization?

Soil stabilization is a general term for any physical, chemical, biological, or combined method of changing a natural soil to meet an engineering purpose.

Improvements include increasing the weight bearing capabilities and performance of in-situ sub soils, sands, and other waste materials in order to strengthen foundation, soil stabilization can be accomplished by several methods.

II. LITERATURE REVIEW

Sr. No.	Title	Author	Journal	Year
1.	Improvement of clayey soil characteristics using rice husk ash	Mohammed Y. Fattah et.al.	Journal of Civil Engineering and Urbanism	2013
2.	Analysis of swelling & shrinkage properties of expansive soil using brick dust as a stabilizer	Sachin N. Bhavsar, Ankit J. Patel	International Journal of Emerging Technology and Advanced Engineering	2014
3.	Laboratory study on soil stabilization using fly ash and rice husk ash	Anil Kumar Singhai et.al.	International Journal of Research in Engineering and Technology	2014
4.	Black cotton soil stabilization using Bagasse ash and lime	Amruta P. Kulkarni, Mithun. K. Sawant, Vaishnavi V. Battul, Mahesh S. Shindepatil, Aavani P.	International Journal of Civil Engineering and Technology	2016
5.	An Experimental Investigation on Stabilizing the Soil Using Rice Husk Ash with Lime as Admixture	R. Oviya R.Manikandan	International Journal of Informative & Futuristic Research	2016
6.	To study Soil Stabilization of Black Cotton Soil (BC) Using Fly Ash and Rice Husk Ash	Syed Sherroz Bukhari	International Research Journal of Engineering and Technology	2017
7.	Improvement of Pavement Soil Subgrade by using Burnt Brick Dust	Neha Pundir, M. K Trivedi	International Journal for Research in Applied Science & Engineering	2017

■ Discription:

1. Title- Improvement of clayey soil characteristics using rice husk ash

Author- Mohammed Y. Fattah et.al.

Journal- Journal of Civil Engineering and Urbanism

Volume- 3, Issue 1: 12-18 (2013)

Rice husk ash (RHA) is a pozzolanic material that could be potentially used in soil stabilization, though it is moderately produced and readily available. When rice husk is burnt under controlled temperature, ash is produced and about 17%-25% of rice husk's weight remains ash. This paper presents the results of experimental study carried out on three different soils improved with different percents of rice husk ash. Samples were brought from different sites of Iraq. The testing program conducted on the clayey soil samples mixed with different percentages of rice husk materials, included Atterberg limits, specific gravity, compressibility, unconfined compression test and consolidation test. It was found that the liquid limit of the three soils has been decreased by about (11 - 18) % with the addition of 9% RHA, while the plasticity index decreased by about (32 - 80) %. Treatment with rice husk showed a general reduction in the maximum dry unit weight with increase in the rice husk content to minimum values at 9% rice husk content. The optimum moisture content generally increased with increase in the RHA content. There is enormous increase in the unconfined compressive strength with increase in rice husk content for the soil to its maximum at RHA between (6 – 8) %.

2. Title- Analysis of swelling & shrinkage properties of expansive soil using brick dust as a stabilizer

Author- Sachin N. Bhavsar et. al.

Journal- International Journal of Emerging Technology and Advanced Engineering

Volume- 4, Issue 12, December 2014

Studied analysis of swelling & shrinkage properties of expansive soil using brick dust as a stabilizer. The expansive soil is also known as a black cotton soil or clayey soil. This has a unique swell-shrink behavior with various amounts of moisture and expansiveness. Due to this characteristics engineering properties and behavior of clayey soil or black cotton soil has been changed drastically. Based on many research we can conclude that the changes in properties and behavior are due to reaction with water that may reduce the strength and can damage the structure. Also the large amount of black cotton soil is available all around the world which leads us to a major investment over construction projects or a maintenance which gives an option to avoid the use of such land. So in this present paper we have performed stabilization on expansive type of soil with marble dust which is a waste material and also widely available in large quantity. To resolve the problem of swelling and shrinkage we have replaced the soil by stabilizing agent of its 50% dry weight. For the analysis of effect of stabilizer on soil the comparison has done of properties of 100% black cotton soil and the combination of 50% black cotton soil + 50% brick dust. The comparison includes total properties consideration by carried out compaction test, atterberg's limit test, linear shrinkage test, and swelling test on both normal & stabilized soil. From the above mentioned test. It has been observed great decrement in swelling and shrinkage of soil.

3. Title- Laboratory study on soil stabilization using fly ash and rice husk ash

Author- Anil Kumar Singhai et.al.

Journal- International Journal of Research in Engineering and Technology

Volume- 03 Issue: 11 | Nov-2014

Studied laboratory study on soil stabilization using fly ash and rice husk ash. The objective of this paper is to upgrade expansive soil as a construction material using rice husk ash (RHA) and fly ash, which are waste materials. Soil is a peculiar material. Some waste materials such Fly Ash, rice husk ash, pond ash may use to make the soil to be stable. Addition of such materials will increase the physical as well as chemical properties of the soil. Some expecting properties to be improved are CBR value, shear strength, liquidity index, plasticity index, unconfined compressive strength and bearing capacity etc. The objective of this study was to evaluate the effect of Fly Ash and Rice husk ash to improve the performance of black cotton soil. In this paper black cotton soil is treated with fly ash (5%,10%,15%,20%,25%) and rice husk ash (10%,15%,20%,25%,30%) and examine after 28 days of curing.

4. Title-Experimental study of Surat region expansive soil modified using bagasse ash and wood ash

Author- Khushbu S. Gandhi

Journal- International Journal in IT and Engineering.

Volume- 2 Issue-12, (December 2014)

Expansive soils are soils that expand when water is added, and shrink when they dry out. This continuous change in soil volume can damages the foundation causes cracks in superstructure. Surat city situated in South Gujarat region of India having expansive soil called black cotton soil as top layer. This soil being expansive required special attention for road construction as well as pavement design. To improve the engineering properties of such a soil, chemical stabilization is one of the most effective methods. The growing cost of traditional stabilizing agents and the need for the economical utilization of industrial and agricultural waste for beneficial engineering purposes has prompted. Investigation has been carried out to check the stabilizing potential of bagasse ash & wood ash in highly expansive clay soil (black cotton soil). In many situations, soils in natural state do not present adequate geotechnical properties to be used for foundation. In Order to adjust their geotechnical parameters to meet the requirements of technical specifications of construction industry, studying soil stabilization is more emphasized. Soil stabilization is the permanent physical and chemical alteration of soils to enhance their physical properties. Stabilization can increase the shear strength of a soil and control the shrink-swell properties of a soil, thus improving the load-bearing capacity of a sub-grade to support pavements and foundations. Stabilization can be used to treat a wide range of sub-grade materials from expansive clays to granular materials. Stabilization can be achieved with a variety of chemical additives including lime, fly ash, and Portland cement, as well as by-products such as lime-kiln dust (LKD) and cement-kiln dust (CKD). Proper design and testing is an important component of any stabilization project. This allows for the establishment of design criteria as well as the determination of the proper chemical additive and admixture rate to be used to achieve the desired engineering properties. Benefits of the stabilization process can include: Higher resistance (R) values, Reduction in plasticity, Lower permeability, Reduction of pavement thickness, Elimination of excavation - material hauling/handling - and base importation, Aids compaction, Provides "all-weather" access onto and within projects sites.

5. Title-Effect of burnt brick dust on engineering properties on expansive soil
Author- Sachin N. Bhavsar, Hiral B. Joshi, Priyanka k. Shrof, Ankit J. Patel
Journal- International Journal of Research in Engineering and Technology
Volume- 03 Issue: 04 | Apr-2014

The black cotton soil is known as expansive type of soil which expands suddenly and start swelling when it comes in contact with moisture. Due to this property of soil the strength and other properties of soil are very poor. To improve its properties it is necessary to stabilize he soil by different stabilizers. Expansive type of soil shows unpredictable behavior with different kind of stabilizers. Soil stabilization is a process to treat a soil to maintain, alter or improve the performance of soil. In this study, the potential of burnt brick dust as stabilizing additive to expansive soil is evaluated for the improving engineering properties of expansive soil. The evaluation involves the determination of the swelling potential, linear shrinkage, atterberg's limits, & compaction test of expansive soil in its natural state as well as when mixed with varying proportion of burnt brick dust (from 30 to 50%). The practices have been performed on three proportions 30%, 40%, and 50% with expansive soil. The research result shows considerable reduction in swelling of expansive soil .With increasing amount of stabilizer swelling decreases. Maximum decrement in swelling has been noted in 50% of replacement of soil by brick dust. Also by increasing stabilizing content linear shrinkage reduces. Maximum decrement in shrinkage has been noted in 50% replacement of soil by stabilizer. Maximum dry density of soil is improving and optimum moisture content is decreasing with increasing stabilizing content. For increasing content of stabilizing agent brick dust atterberg's limit values are also decreasing.

6. Title-Stabilization of expansive soil using bagasse ash & lime
Author- Meron Wubshet and Samuel Tadesse
Journal- Journal of EEA
Volume- 32, December 2014

The Expansive soil collected from Addis Ababa, Bole sub city, classified as an A-7-5 soil on the AASHTO classification was stabilized using 3% lime, 15% bagasse ash and 15% bagasse ash in combination with 3% lime by dry weight of the soil. The effect of the additives on the soil was investigated with respect to plasticity, compaction and California bearing ratio (CBR) tests.

The results obtained indicate an increase in optimum moisture content (OMC) and CBR value; and a decrease in maximum dry density (MDD) and plasticity of the soil for all additives. But there was also a tremendous improvement in the CBR value when the soil is stabilized with a combination of lime and bagasse ash. This shows a potential of using bagasse ash as admixture in lime stabilized expansive soil.

7. Title- Studies on soil stabilization by using bagasse ash
Author- Prakash Chavan and Dr.M.S.Nagakumar

Journal- International Journal of Scientific Research Engineering & Technology

Soil is the foundation material which supports loads from the overlying structure. Soil is the most widely used material in a highway system, either in its natural form or in a processed form. Also, all pavement structures eventually rest on soil foundation. The construction cost can be considerably decreased by selecting local materials including local soils for the construction of the lower layers of the pavement such as the sub-base course. The formation of undulations, corrugations, up heaving and rutting are generally attributed to the poor sub grade conditions. In the present study the soil sampling was done on Kavadimatti village Bagalkote district as per IRC recommendations. This soil was classified as CH as per Indian Standard Classification System (ISCS). Different dosages of blast furnace slag i.e. 3%, 6%, 9% and 12% were used to stabilize the expansive soil. The performance of Bagasse Ash stabilized soil was evaluated using physical and strength performance tests namely; plasticity index, specific gravity, compaction, California bearing ratio (CBR) and Unconfined compressive strength Test (UCS). These tests were conducted in order to evaluate the improvement in strength characteristics of the subgrade soil. Hence use of such advanced materials in road construction can prove efficient in increasing the strength of soil and in turn reduce the project cost. From the results, it was observed that the basic tests carried out proved significant after the addition of Bagasse Ash. Furthermore California bearing ratio (CBR) value improved from 1.16% to 6.8 %. And the unconfined compressive strength of specimens increased from 93KN/m² to 429 KN/m².

8. Title- Black cotton soil stabilization using Bagasse ash and lime

Author- Amruta P. Kulkarni, Mithun. K. Sawant, Vaishnavi V. Battul, Mahesh S. Shindepatil, Aavani P.

Journal-International Journal of Civil Engineering and Technology

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The construction on black cotton soil (expansive soil) has always been a difficult task for the engineers as the structure resting on black cotton soil cracks without any warning. Black cotton soil is found in M.P., Karnataka, Maharashtra and Andhra Pradesh in our country. Soil proportion changes depending upon their constituents, i.e. water content, density, bulk density, angle of friction, shear strength etc. The properties of black cotton soil can be modified by stabilizing the soil with the use of additives or by mechanical means. The scarcity and rising cost of traditional stabilizers like Lime and Cement has led to the research into clay soil stabilizing potential of bagasse ash that is cheaper, readily available and environmental friendly and has a serious disposal problem. In this paper attempt has been made to stabilize the black cotton soil by using mixture of bagasse ash and lime. Bagasse is a fibrous residue of sugarcane stalks that remains after extraction of sugar and when incinerated gives the ash. The chemical analysis on bagasse ash was found to contain mainly silica, and potassium, iron, calcium, aluminium, magnesium as minor components and exhibit pozzolanic properties. The research investigated the properties of expansive clay soil when stabilized by lime, ash and combination of lime and ash. The aim is to economically improve the engineering properties of the black cotton soil such that the structure built on this soil can efficiently withstand applied loads.

9. Title- An Experimental Investigation On Stabilizing The Soil Using Rice Husk Ash with Lime As Admixture

Author- R. Oviya, R.Manikandan

Journal- International Journal of Informative & Futuristic Research

Volume- 3 Issue 9 May 2016

In this experimental study, the effect of RHA on geotechnical properties of the expansive soil are investigated and analyzed. From the results obtained, it can be concluded there is little improvement in the usage of RHA stabilized soil. The conclusion to the study is summarized as follows: The specific gravity of the soil decreases with the addition of RHA to the soil. The liquid limit and plastic limit of the soil increases with the percentage increase of RHA. It was also observed that the maximum dry density (MDD) of the soil decreases with the addition of RHA due to lower specific gravity of RHA. The optimum moisture content (OMC) of the soil increases on stabilizing with RHA due to pozzolanic reaction between CaOH of the soil and RHA. The shrinkage limit of the soil decreases with the increase of RHA. The swelling nature of the soil decreases with the addition of RHA which reduces the formation of cracks on the pavement surface. The CBR and UCS value gets increased to high limit at an optimum value of 5% of RHA content and 2% of lime. It is also be concluded that for the improvement in strength using stabilization in practical purposes, these optimum percentage values of RHA and lime can be recommended for construction. But addition of lime and RHA beyond this limit to the soil is not beneficial and workable.

10. Title- Stabilization of Expansive Soil with Lime and Brick Dust

Author- Ajay kumar, Ashok kumar, Ved Prakash

Journal- International Journal of All Research Education and Scientific Methods
Volume- 4, Issue 9, September- 2016

Over the past few decades several factors have led to an increase in the number of people migrating to large cities. Consequently these large cities are getting over populated and quite expectedly necessity of business, residential construction has increased the civil engineering projects located in areas with unsuitable soil is one of the most common problems in many parts of the world. The unsuitable soil (Black cotton Soil) can be stabilized by performing soil stabilization. In India black soil is the most problematic soil when it comes to construction. In rainy season black cotton soil swells and become sticky. Whereas in summers the moisture present in the soil evaporates and soil shrinks resulting in the crack of approximate 10 to 15 cm wide and up to 1 meter deep. The percentage covered by black cotton soil in geotechnical areas of India is 16.6%, which says huge amount of soil in India needs stabilization. Mechanical, chemical, electrical, thermal and other methods are in practice to improve the engineering properties of soil. Chemical stabilization is the best method used for highways and air-field . The black cotton soil is known as expansive type of soil which expands suddenly and start swelling when it comes in contact with moisture. Due to this property of soil the strength and other properties of soil are very poor. To improve its properties it is necessary to stabilize the soil by different stabilizers. Expansive type of soil shows unpredictable behavior with different kind of stabilizers. Soil stabilization is a process to treat a soil to maintain, alter or improve the performance of soil. In The study the results are compared of potential of lime and burnt brick dust as stabilizing additive to expansive soil is evaluated for the improving engineering properties of expansive soil. The evaluation involves the determination of the swelling potential, atterberg's limits, & compaction test of expansive soil in its natural state as well as when mixed with varying proportion of burnt brick dust and lime .

III. CONCLUSION

- In the Surat city situated in South Gujarat region of India having black cotton soil.
- The majority of South Gujarat area having black cottons soil which is unstable and have to be stabilized for that we are using rice husk ash, burnt brick dust, bagasse ash.
- These materials are locally and cheaply available it becomes the first choice of stabilization when there comes the matter of economic solution. So instead of dumping it why not use in this way so the industrial problem is also solved.

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