IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A REVIEW ON STABILIZATION OF BLACK COTTON SOIL BY USING LIME, FLY ASH AND BRICK POWDER

Name of Author- Dinesh Kumar Dangi

Designation of Author- Student (M.Tech.)

Name of Department of Author – Structural Engineering

Name of organization of Author - School of Engineering & Technology, Vikram University ,Ujjain (M.P.) India

Guided by - Prof. Sachin Sironiya

Abstract In our country, Black cotton soil covers more than one-fifth of the whole land territory. These are for the most part found in and around the Deccan level. The black cotton soil is a far-reaching soil which demonstrates hazardous for the designing work. Black cotton soil has low bearing limit, high compressibility and swelling and shrinkage properties. To defeat on these building issues soil stabilization is the best arrangement. In our exploration we utilized the idea of compound stabilization. We utilized fly fiery debris and rice husk straw slag in various extent with black cotton soil. The present paper quickly portrays the trial examination did by including fly fiery debris and rice husk straw powder to black cotton soil for enhancing its building properties. Nowadays the necessity of soil stabilization in black cotton soil has been expanded by including diverse material. It's an expected to extend the exploration and including conceivable material here has been talked about with this study. Stabilization utilizing strong squanders is one of the diverse strategies for treatment, to enhance the building properties and make it reasonable for development. The gainful impacts of some unmistakable strong squanders as got in research facility examines, in stabilization of extensive soil have been talked about in this study.

Index Terms- Black Cotton Soil (BC-Soil), fly ash, lime, brick powder, Engineering property, Stabilization

I. INTRODUCTION

There are three basic types of soil naturally occurring in this area: sand , silt and clay. Clay soils expand (increase in volume) as it absorbs water and it will shrink (lessen in volume) as water is frawn away . The effects can be dramatic if expansive soils supporting structures are allowed to became too wet or too dry. Building structures, foundations, driveways and walkways may crack and heave as the underlying expansive soils become wet and swell. Sometimes the cracking and heaving appear temporary as the soils dry and shrink back to their original position.

[...] be generally classified as "expansive." This means that a given amount of clay will tend

Map of soil deposits in Gujarat State shows that the majority of Gujarat area having black cottons Based on our visits to various industries we finally decided to take waste material (Fly ash) as soil stabilizers for chemical soil stabilization considering economic advantage and waste disposal problems.

Map of soil deposits in Gujarat State shows that the majority of Gujarat area having black cottons Based on our visits to various industries we finally decided to take waste material (Fly ash) as soil stabilizers for chemical soil stabilization considering economic advantage and waste disposal problems.

The term soil stabilization means the improvement of the stability or bearing power of the soil by the use of controlled compaction, proportioning, or the addition of suitable admixtures or stabilizers. Soil stabilization deals with physical, physicochemical, and chemical methods to make the stabilized soil serve its purpose as pavement materials. Chemical stabilization is one of the oldest methods of stabilization of problematic soil. In general, all lime-treated fine -grained soils exhibit decreased plasticity, improved workability, and reduced volume change characteristics. However, not all soils exhibit improved strength characteristics. It should be emphasized that the properties of soil lime mixtures are dependent on many variables. But Soil type, lime type, lime percentage, and curing conditions (time, temperature, and moisture) are the most. The misture of 15% brick powder, 15% of flyash and 70% lime stabilized black cotton soil under study resulted in increase in the CBR value by about 135% in comparion with lime- stabilized

black cotton soil . The basic objectives of the study of black cotton soil are as following:

1)Improvement of bearing capacity of Black Cotton Soil on the addition of lime.

2)Variation of Strength of soil at different water content.

3) Brick powder, a waste material available in abundance at brick kilns, is rich in silica and is available free of cost. Chemical analysis of brick powder showed rich composition of silica of about 55% along with minor compositions of iron oxide (8%), aluminum oxide (15%), calcium oxide (7%), magnesium oxide (2%), and sulfur trioxide (1%) . Brick powder is being successfully used in mortar and concrete making from the past few decades. It is reported that utilization of 25% brick powder in concrete making resulted in adequate strength and thermal resistance and also addressed cost effectiveness and environmental issues . Partial replacement of cement with brick powder in mortar has showed that with use of brick powder the recycled-aggregate mortar seemed to be superior in terms of mortar-brick bond strength mainly because of its rheological properties . Use of brick powder as a partial substitute for sand in concrete showed a reduction in unit weight of concrete and had improved the strength of concrete adequately. Also use of brick powder in cement mortar reduces the deterioration effect of alkali- silica reactions .

4) Effect of lime on CBR value of the soil. To achieve the above objective, the black cotton soil has been arbitrarily mixed with lime. So the suitability of lime is considered to enhance the properties of black cotton soil. The figure of the black cotton soil is given below

5) Infrastructure projects such as highways, railways, water reservoirs; reclamation etc. requires earth material in very large quantity. In urban areas, borrow earth is not easily available which has to be hauled from a long distance. Quite often, large areas are covered with highly plastic and expansive soil, which is not suitable for such purpose. Extensive laboratory / field trials have been carried out by various researchers and have shown promising results for application of such expansive soil after stabilization with additives such as sand, silt, lime, fly ash, etc. As fly ash is freely available, for projects in the vicinity of a Thermal Power Plants, it can be used for stabilization of expansive soils for various uses. The present paper describes a study carried out to check the improvements in the properties of expansive soil with fly ash in varying percentages. Both laboratory trials and field tests have been carried out and results are reported in this paper. One of the major difficulties in field application is thorough mixing of the two materials (expansive soil and fly ash) in require proportion to form a homogeneous mass. The paper describes a method adopted for placing these materials in layers

Abbreviations and Acronyms

The term soil stabilization means the improvement of the stability or bearing power of the soil by the use of controlled compaction, proportioning, or the addition of suitable admixtures or stabilizers. Soil stabilization deals with physical, physicochemical, and chemical methods to make the stabilized soil serve its purpose as pavement materials. Chemical stabilization is one of the oldest methods of stabilization of problematic soil. In general, all lime-treated fine -grained soils exhibit decreased plasticity, improved workability, and reduced volume change characteristics. However, not all soils exhibit improved strength characteristics. It should be emphasized that the properties of soil lime mixtures are dependent on many variables. But Soil type, lime type, lime percentage, and curing conditions (time, temperature, and moisture) are the most. The misture of 15% brick powder, 15% of flyash and 70% lime stabilized black cotton soil under study resulted in increase in the CBR value by about 135% in comparion with lime- stabilized black cotton soil .

RESEARCH METHODOLOGY

1.1 Property of Black Cotton Soil

Table 1

The following property of the black cotton soil is given below in the form of the table:

S. NO.	PROPERTY OF SOIL	BLACK COTTON SOIL
1	Specific Gravity	27
2	Liquid Limit (%)	68
3	Plastic Limit (%)	27
4	Shrinkage Limit (%)	11
5	Maximum Dry Density of BCS (KN/m^3)	15.5
6	OMC (%)	25.21

7	Specific Surface Area (m^2/ gm)	63
8	Percentage of the Fine Sand	38

Black cotton soil used in the study is procured from Bhimavaram area of Andhra Pradesh, India. Extensive laboratory work is carried out to characterize the black cotton soil. The plasticity index is calculated by determining Atterberg's limits. Compaction characteristics are determined by conducting IS light compaction test and strength characteristics by conducting California bearing ratio (CBR) test. The results obtained are …..

1.2 Engineering Properties of Brick Powder

The engineering properties of the brick powder, procured from local brick kiln in Bhimavaram, are determined by carrying out extensive laboratory tests, namely, grain size analysis, Atterberg's limit tests, IS light compaction test, and soaked CBR test, and the results obtained are….

Table 2

Engineering properties of brick powder.

Engineering property	Value
Grain size analysis	
(a) Gravel size (%)	0
(b) Sand size (%)	86
(c) Fines (%)	14
Plasticity characteristics	
(a) Liquid limit (%)	NP
(b) Plastic limit (%)	NP
IS classification	SM
IS light compaction	
Maximum dry density (g/cc)	1.30
Optimum moisture content (%)	33
Soaked CBR (%)	21.17

1.3 Engineering Properties of Lime

Black cotton soil is mixed with lime in varying proportions of 2%, 4%, and 6%. The lime-mixed soil is then cured for a duration of 3 days. The mixture is then oven-dried for 24 hours. The results of various tests carried out on black cotton soil mixed with varying percentages of lime are…..

Table 3

Properties of black cotton soil stabilized with varying contents of lime.

Engineering property	2% lime	4% lime	6% lime
Plasticity characteristics			
(a) Liquid limit (%)	64.4	NP	NP
(b) Plastic limit (%)	34.0	NP	NP
(c) Plasticity index (%)	30.4	NP	NP
Differential free swell (DFS) index (%)	90	60	40
IS light compaction			
Maximum dry density (g/cc)	1.37	1.51	1.34
Optimum moisture content (%)	28	25	32
Soaked CBR (%)	7.59	8.52	0.62

IV. RESULTS AND DISCUSSION

Fly ash is a heterogeneous by-product material produced in the combustion process of coal used in power stations. It is a fine grey coloured powder having spherical glassy particles that rise with the flue gases. As fly ash contains pozzolanic materials components which reach with lime to form cementatious materials. Thus Fly ash is used in concrete, mines, landfills and dams.

Studied the effect of two types of fly ashes Raichur fly ash (Class F) and Fly ash by itself has little cementatious value but in the presence of moisture it reacts chemically and forms cementatious compounds and attributes to the improvement of strength and compressibility characteristics of soils. It has a long history of use as an engineering material and has been successfully employed in geotechnical applications.

Naively fly ash (Class C) on the CBR characteristics of the black cotton soil. The fly ash content was increased from 0 to 100%. Generally the CBR/strength is contributed by its cohesion and friction. The CBR of BC soil, which consists of predominantly of finer particles, is contributed by cohesion. The CBR of fly ash, which consists predominantly of coarser particles, is contributed by its frictional component. The low CBR of BC soil is attributed to the inherent low strength, which is due to the dominance of clay fraction. The addition of fly ash to BC soil increases the CBR of the mix up to the first optimum level due to the frictional resistance from fly ash in addition to the cohesion from BC soil. Further addition of fly ash beyond the optimum level causes a decrease up to 60% and then up to the second optimum level there is an increase. Thus the variation of CBR of

fly ash-BC soil mixes can be attributed to the relative contribution of frictional or cohesive resistance from fly ash or BC soil, respectively. In Naively fly ash also there is an increase of strength with the increase in the fly ash content, here there will be additional puzzolonic reaction forming cementitious compounds resulting in good binding between BC soil and fly ash particles.
Soil stabilisation is widely used in connection with road, pavement and foundation construction. It improves the engineering properties of the soil, e.g: ϖ Strength - to increase the strength and bearing capacity, ϖ Volume stability - to control the swell-shrink characteristics caused by moisture changes, ϖ Durability - to increase the resistance to erosion, weathering or traffic loading. To reduce the pavement thickness as well as cost. According to the selected sight the traffic type is guessed ass Pavement thickness according to the CBR values are estimated and compared to expose the economic impact of soil stabilization by using Fly Ash.

Component	Bituminous coal	Sub Bituminous coal	Lignite coal
Sio2(%)	20-60	40-60	15-45
Al2O3(%)	5-35	20-30	20-25
Fe2O3(%)	10-40	4-10	4-15
CaO(%)	1-12	5-30	15-40
LaI(%)	0-15	0-3	0-5

II. ACKNOWLEDGMENT

From the study carried out on brick powder and lime-stabilized black cotton soil mixture, the following conclusions can be drawn:
Based on the present tests, the following conclusions can be drawn:

1) As the locally available borrow soil has generally high plasticity (LL > 50) it was difficult to construction on it.

2) The inclusion of different percentage of fly ash in natural soil generally resulted in some increasing in unconfined compressive stress.

3) The unconfined compressive stress of natural soil without fly ash which was 114kN/m2, increased to 123 kN/m2 at 20% fly ash in natural soil showing 7.89 % improvement
.
4) A liquid limit was decreases with increases in percentage of fly ash up 30% in natural soil which was 74.4%, decreased to 72.5%, showing 2.56 % decreased.

5). Plastic limit was decreases with increases in percentage of fly ash up 30% in natural soil which was 38.4%, decreased to 32.93 %, showing 14.24 % decreased.

6) Maximum dry density was increase with increases in percentage of fly ash up 30% in natural soil which was 1.68gm/cc, increase to 1.71gm/cc at 14% OMC showing 1.78 %

increase.

7) As per grain size analysis the percentage of gravel 1.11%, percentage of sand 9.89% and percentage of fines 89%

8) Lime stabilization of black cotton soil under study improved the strength characteristics of the soil, but not to the extent of suitability as subbase material.

9) Mixing 15% brick powder, 15% Flyash and 70% lime-stabilized black cotton soil improved the maximum dry density and decreased the optimum moisture content in comparison to 4% lime stabilized soil.

10) 70% lime-stabilized black cotton soil 15% flyash and 15% brick powder mixture resulted in increase in the soaked CBR value by about 135%, when compared to 4% lime-stabilized soil, making it satisfactory for use as subbase material.

11) Use of brick powder reduces the content of lime which in turn reduces the cost of project as brick powder is freely available. Also, use of brick powder reduces the problem of waste disposal.

Hence brick powder, flyash and lime-stabilized black cotton soil mixture can be effectively used as subbase material in flexible pavements of rural areas where brick powder is available in good amounts and also in areas with less availability of good quality materials.

References

1. B. Mishra, "A study on engineering behavior of black cotton soil and its stabilization by use of lime," *International Journal of Science and Research*, vol. 4, no. 11, pp. 290–294, 2015.
   View at: Publisher Site | Google Scholar
2. S. Bhuvaneshwari, G. Robinson, and S. Gandhi, "Stabilization of expansive soils using flyash," in *Proceedings of the Fly Ash India 2005*, vol. 8, pp. 5.1–5.6, New Delhi, India, December 2005.
   View at: Google Scholar
3. J. Oja and P. Gundaliya, "Study of black cotton soil characteristics with cement waste dust and lime," in *Proceedings of the Nirma University International Conference on Engineering (NUiCONE 2012)*, pp. 110–118, Gujarat, India, December 2013.
   View at: Google Scholar
4. R. Rathan Raj, S. Banupriya, and R. Dharani, "Stabilization of soil using rice husk ash," *International Journal of Computational Engineering Research*, vol. 6, no. 2, pp. 43–50, 2016.
   View at: Google Scholar
5. M. K. Mohanty, *Stabilization of Expansive Soil Using Fly Ash*, Department of Civil Engineering, National Institute of Technology, Rourkela, Odisha, India, 2015.
6. A. Ali Aliabdo, M. Abd-Elmoaty, and H. Hani Hassan, "Utilization of crushed clay brick in cellular concrete production," *Alexandria Engineering Journal*, vol. 53, no. 1, pp. 119–130, 2014.
   View at: Publisher Site | Google Scholar
7. G. Moriconi, V. Corinaldesi, and R. Antonucci, "Environmentally friendly mortars: a way to improve bond between mortar and brick," *Materials and Structures*, vol. 36, no. 10, pp. 702–708, 2003.
   View at: Publisher Site | Google Scholar
8. D. Tavakoli, A. Heidari, and S. H. Pilehrood, "Properties of concrete made with waste clay brick as sand incorporating SiO_2," *Indian Journal of Science and Technology*, vol. 7, no. 12, pp. 1899–1905, 2014.

View at: Google Scholar

9. L. Turanli, F. Bektas, and P. Monterio, "Use of ground clay brick as a pozzolanic material to reduce the alkali silica reaction," *Cement and Concrete Research*, vol. 33, no. 10, pp. 1539–1542, 2003.
View at: Publisher Site | Google Scholar
10. M.-Z. Chen, J.-T. Lin, S.-P. Wu, and C.-H. Liu, "Utilization of recycled brick powder as alternative filler in asphalt mixture," *Construction and Building Materials*, vol. 25, no. 4, pp. 1532–1536, 2011.
View at: Publisher Site | Google Scholar
11. S. Wu, J. Zhu, J. Zhong, and D. Wang, "Experimental investigation on related properties of asphalt mastic containing recycled red brick powder," *Construction and Building Materials*, vol. 25, no. 6, pp. 2883–2887, 2011.
View at: Publisher Site | Google Scholar
12. S. N. Bhavsar, H. B. Joshi, P. K. Shrof, and A. J. Patel, "Effect of burnt brick dust on engineering properties of expansive soil," *International Journal of Research in Engineering and Technology*, vol. 3, no. 4, pp. 433–441, 2014.
View at: Publisher Site | Google Scholar
13. B. R. Malhotra and K. A. John, "Use of lime–fly ash-soil-aggregate mix as a base course," *Indian Highways*, vol. 14, no. 5, pp. 23–32, 1986.
View at: Google Scholar
14. K. Sudharani, S. K. Abhishek, N. Adarsh, and Manjunath, "Stabilization of black cotton soil using brick dust and bagasse ash," *International Journal for Scientific Research and Development*, vol. 5, no. 5, pp. 140–144, 2017.
View at: Google Scholar