International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 3 Issue 5, August 2019 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

An Experimental Study on Stabilization of Clayey Soil by using Granulated Blast Furnace Slag

B. Ramesh[1], P. Hima Bindu[2]

[2]Assistant Professor

[1,2]Sri Sun Flower Engineering College, Challapali, Lankapalli, Andhra Pradesh, India

How to cite this paper: B. Ramesh | P. Hima Bindu "An Experimental Study on Stabilization of Clayey Soil by Using Granulated Blast Furnace Slag" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-3 | Issue-5, August 2019, pp.655-658, **https://doi.org/10.31142/ijtsrd26440**

IJTSRD26440

ABSTRACT

Many of the areas in India contains clayey soil, for these soils Geotechnical properties are a week, which affects the stability of the soil. As Ground granulated blast furnace slag contains in this study, we received the Ground granulated blast furnace slag from steel plant waste mixing with clayey soil to enhance geotechnical properties and make it more suitable for use. In this effect of stabilized soil and change in geotechnical properties. Treatment of clayey soil using with GGBS is very simple, economical and pollution control. Ground granulated blast furnace slag (GGBS) and this material are obtained from the blast furnace of cement plant, which is the by-product of iron (from ACC plant, Sindri). It is generally obtained in three shaped one is air cooled, foamed shaped and another is in granulated shaped. The use of by-product materials for stabilization has environmental and economic benefits. Ground granulated blast furnace slag (GGBS) material is used in the current work to stabilize soil (clay). Ground granulated blast furnace slag which can be used as a stabilizer. GGBS were mixed in clayey soil in different proportions and various geotechnical characteristics are investigated through Unconfined Compression Test, Compaction Test, CBR test results show that addition of Ground Granulated blast furnace slag has a significant effect in geotechnical Characteristics of clayey soil.

INTRODUCTION

Expansive soils are a worldwide problem posing many challenges to civil engineers, construction firms and owners. Black cotton soils of India are well known for their expansive nature. In India, the black cotton soil covers 7 lakh square kilometers approximately 20-25 % land area and are found in the states of Maharashtra, Gujarat, Rajasthan, Madhya Pradesh, Uttar Pradesh, Karnataka, Andhra Pradesh and Tamil Nadu. These are derived from the weathering action of Basalts and traps of Deccan plateau. However, their occurrence on granite gneiss, shales, sandstones, slates and limestone is also recognized (Uppal, 1965; Mohan, 1973; Katti, 1979; Desai, 1985).

They are highly fertile for agricultural purposes but pose severe problems to the pavements, embankments and light to medium loaded residential buildings resting on them due to cyclic volumetric changes caused by moisture fluctuation. This volume change behavior is the reason for cracking to the overlying structures. The reason for this behavior is due to the presence of clay mineral such as montmorillonite that has an expanding lattice structure. During monsoon's, soils containing this mineral will imbibe water, swell, become soft and their capacity to bear water is reduced, while in drier seasons, these soils shrink and become harder due to evaporation of water. These types of soils are generally found in arid and semi-arid regions.

Here, in this project, our whole work revolves around the properties of soil and its stability. Basically, for any structure, the foundation has the priority importance not strong foundation means not safe structure and the foundation depends a lot on the soil nearby. Soil with higher stability has a more strong foundation and thus having a very strong and durable structure. So, in short, we can say that the whole structure on any construction-related things indirectly or directly depends on soil stability. Thus, for any construction work, we need to have proper knowledge about soil and its properties and the factor affecting the soil. The most commonly used stabilizers are

Lime	Slaked lime, Quicklime, Lime- fly ash, Lime- gypsum
Bitumen	Liquid bitumen, Bitumen, Emulsion
Resin	Epoxy resin, Polyacrylate Resin, Acrylic resin, Solvinated resin
Others	Chlorides, Phosphoric acid, Calcium Silicates, Calcium Aluminates, Sodium silicates, Sulphates, Hydroxy-aluminium, Aniline furfural.

Table.1

Major Soils Types in India:

Six Different Types of Soils Found in India are as follows: Soil is our prime natural and economic resource. Soils in India differ in composition and structure.

1. **Alluvial Soils:**

These are formed by the deposition of sediments by rivers. They are rich in humus and very fertile. They are found in Great Northern plain, lower valleys of Narmada and Tapti and Northern Gujarat. These soils are renewed every year.

2. **Black Soils:**

These soils are made up of volcanic rocks and lava-flow. It is concentrated over Deccan Lava Tract which includes parts of Maharashtra, Chhattisgarh, Madhya Pradesh, Gujarat, Andhra Pradesh and Tamil Nadu. It consists of GGBS, Iron, Magnesium and also Potash but lacks in Phosphorus, Nitrogen and Organic matter

3. **Red Soils:**

These are derived from weathering of ancient metamorphic rocks of Deccan Plateau. Its redness is due to iron composition. When iron content is lower it is yellow or brown. They cover almost the whole of Tamil Nadu, Andhra Pradesh, Chhattisgarh, Karnataka, Maharashtra and parts of Orissa.

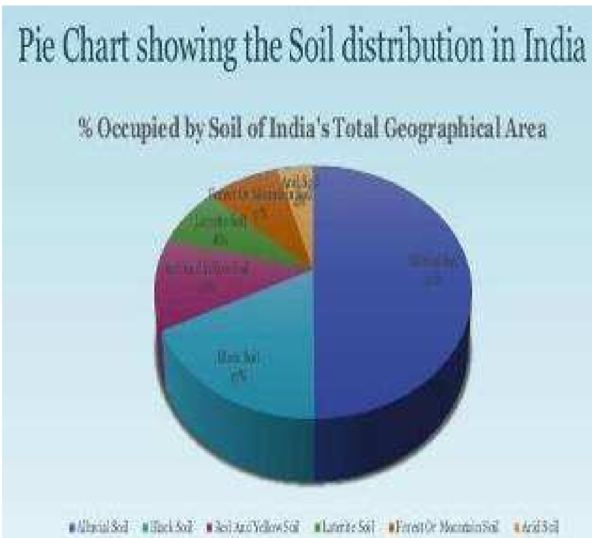


Fig-1 pie diagram showing various soil orders and their extent in India

GROUND GRANULATED BLAST FURNACE SLAG:

Ground-granulated blast-furnace slag (GGBS or GGBFS) is obtained by quenching molten iron slag (a by-product of iron and steel-making) from a blast furnace in water or steam, to produce a glassy, granular product that is then dried and ground into a fine powder. The blast furnace slag is considered as waste disposal which can be used in the construction material like pavement, road, landfills, railway ballast, etc. Different types of slag produce depending on the method used to cool the molten slag. The blast furnace slag (BFS) immerses the sulfur as of the charge comprises about 20% of iron product. There are different forms of slag produced depending on the methods used to cool the molten slag.

Fig2. GGBS

Table 2 Standard Specific gravity values:

S. No	Type of Soil	Specific Gravity
1	Sand	2.63 – 2.67
2	Silt	2.65 – 2.7
3	Clay and Silty Clay	2.67 – 2.9
4	Organic Clay	< 2.0

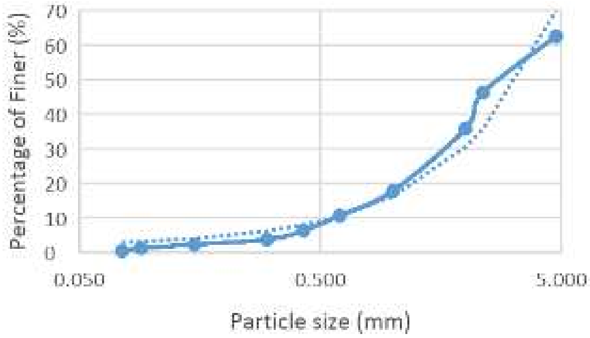
The specific gravity of Soil

Table 3: Relation between D.F.S and Degree of Expansion:

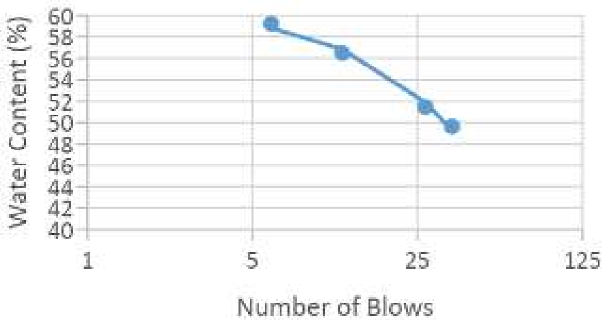
S. No	Degree of Expansion	D.F.S
1	Low	< 20%
2	Moderate	20 – 35 %
3	High	35 – 50%
4	Very High	>50%

Table 4: Sieve Analysis:

IS Sieve	Weight Retained (g)	Percentage Retained (%)	Cumulative Percentage (%)	Percentage of Finer (%)
4.750	375	37.5	37.50	62.5
2.360	163	16.3	53.80	46.2
2.000	104	10.4	64.20	35.8
1.000	180	18	82.20	17.8
0.600	72	7.2	89.40	10.6
0.425	43	4.3	93.70	6.3
0.300	26	2.6	96.30	3.7
0.150	14	1.4	97.70	2.3
0.090	11	1.1	98.80	1.2
0.075	8	0.8	99.60	0.4
PAN	4	0.4	100.00	0



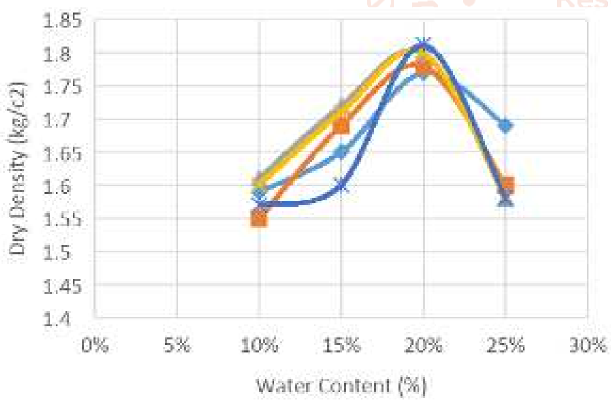
Graph1: Sieve Analysis Graph



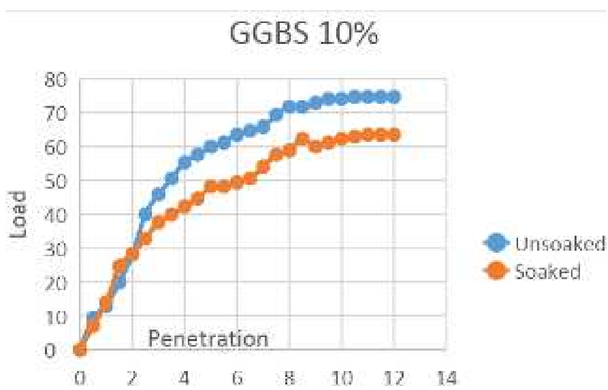
Graph 5.2: Liquid limit determination Graph

Table 4: Observation table to determine the compaction characteristics:

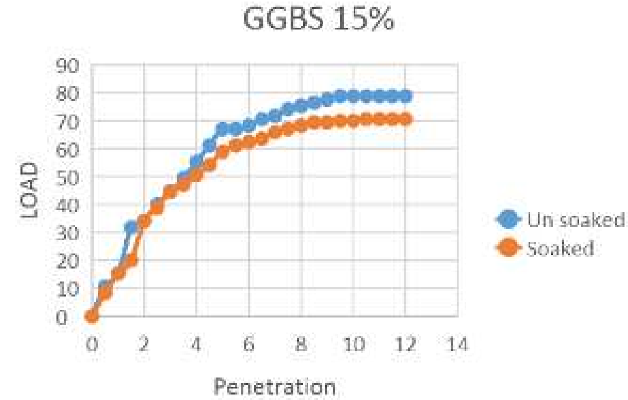
Height of the Mould	12.73	mm
The diameter of the Mould	15.00	mm
The volume of the Mould	2250	cc
Weight of the Empty Mould	4980	gms



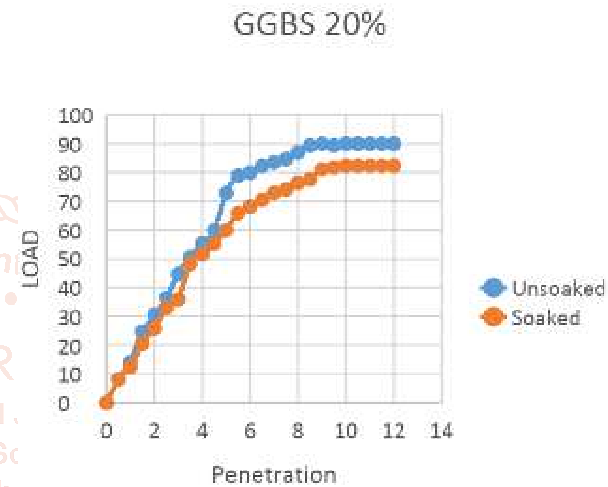
Graph2: Compaction curves for soil samples with 0%, 5%, 10%, 15%, 20% & 25% of GGBS



Graph3: Load Vs Penetration graph for BC+10%GGBS (Unsoaked & Soaked)



Graph 4: Load Vs Penetration graph for BC +15% GGBS (Unsoaked & Soaked)



Graph 5: Load Vs Penetration graph for BC +20%GGBS (Unsoaked & Soaked)

CONCLUSION

The following conclusions are drawn based on the laboratory studies carried out.

The cost-effectiveness of using GGBS mixes for stabilization is an economic analysis**.**

From the results obtained from Atterberg Limits, the collected soil sample in this study is classified as Clay of Low Compressibility (CH) from A-Line chart.

The Specific Gravity of normal soil sample obtained is 2.69 From CompactioTest, Max. Dry density and OMC for normal soil are found to be 1.8 gm/cc and 20% respectively.

CBR (Unsoaked) value for normal soil at 2.5 mm penetration is found to be 3.54 %.GGBS with those results the following conclusions are drawn

From the results obtained from Compaction Test, we have observed that there is a gradual increase in the Optimum Moisture Content from 5 % to 20 %

As we increase the addition of GGBS increase in maximum dry density and increasing the moisture content up to 20% GGBS had been observed.

The CBR value had increased with increasing of POFA content & jute fiber, the maximum value has occurred when treating with GGBS 20% and with further increasing of GGBS the CBR value had been reduced.

REFERENCES:

[1] "Study on the Effects of Marine Clay Stabilized with Banana Fibre" by Teresa Sunny, Annie Joy, International Journal of Scientific Engineering and Research - IJSER, ISSN: 2347-3878, Volume 4 Issue 3, March 2016, pg: 96-98.

[2] "Effect of Jute Fibre on Engineering Characteristics of Black Cotton Soil" by Harshita Bairagi, R.K. Yadav, R. Jain, International Journal of Engineering Sciences & Research Technology – IJESRT, ISSN: 2277 – 9655, Volume 2, February 2014, pg:705–707.

[3] "Experimental Study on Stabilization of Black Cotton Soil by Fly Ash, Coconut Coir Fiber & Crushed Glass" by Amit Taiwan, H.K. Mahiyar, International Journal of Emerging Technology and Advanced Engineering – IJETAE, ISSN 2250-2459, Volume 4, Issue 11, November 2014, pg.330-333.

[4] "Effect on Strength Characteristics of Expansive Soil Using Sisal Fibre and Waste Materials" by Amrutha Mathew, Dr. Raneesh. K. Y, International Journal of Science and Research – IJSR, ISSN: 2319-7064, Volume 5, Issue 9, September 2016, pg.1702-1707.

[5] "Effect of Sisal Fiber and GGBS on Strength Properties of Black Cotton Soil" by Abhijith S, Aruna T, International Journal of Innovative Research in Science, Engineering and Technology – IJIRSET, ISSN (o): 2319-8753, Volume 4, Issue 7, July 2015, pg.5409-5417.

[6] "Effect of Random Inclusion of Jute Fibers on Strength Characteristics of Lime Treated Expansive Clay" by Sabreena Mohammad, Deeba Qadir, Sarmistha R. Paul, International Journal of Innovative Research in Science and Engineering – IJIRSE, ISSN(o) 2454 – 9665, Volume 3, Issue 04, April 2017, pg.865 – 870.

[7] "Effect of Jute Fibers on Engineering Properties of Lime Treated Black Cotton Soil" by Harshita Bairagi, R.K. Yadav, R. Jain, International Journal of Engineering Research & Technology –IJERT, ISSN: 2278 – 0181, Volume 3, Issue 2, February 2014, pg.1550 – 1552.

[8] "Effect of Random Inclusion of Sisal Fiber on Strength Behavior of Black Cotton Soil" by Manjunath K. R, Venugopal G, Rudresh A. N, International Journal of Engineering Research & Technology – IJERT, ISSN: 2278 – 0181, Volume 2, Issue 7, July 2013, pg.2227 – 2232.

[9] "Compressibility Behavior of Black Cotton Soil Admixed with Lime and Rice Husk Ash" by Dr. A. V. Narasimha Rao, B. Penchalaiah, Dr. M. Chittranajan, Dr. P. Ramesh, International Journal of Innovative Research in Science, Engineering and Technology – IJIRSET, ISSN: 2319 – 8753, Volume 3, Issue 4, April 2014, pg. 11473 – 11480

[10] "Consolidation Characteristics of Fly Ash and Lime Treated Black Cotton Soil" by Vijayakumar Sureban, Proc. Of International Conference on Recent Trends in Transportation, Environmental and Civil Engineering - TECE, 201, pg. 49 – 52.

[11] "Experimental study on stabilization of clay soil using coir fiber" by T. Subramani, D. Udayakumar, International Journal of Application or Innovation in Engineering and management – IJAIEM, ISSN: 2319-4847, Volume 5, Issue 5, May 2016, pg.192-203.

[12] "Stabilization of Black Cotton Soil using Lime" by Shailendra Singh, Hemant B. Vasaikar, International Journal of Science and Research – IJSR, ISSN: 2310-7064, Volume 4, Issue 5, May 2015, pg.2090-2094.

[13] "Quality Assessment for Stabilization of Black Cotton Soil by Using Lime" by Amruta A. Badge, Lobhesh N. Muley, Kunal R. Raul, International