International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 11 | Nov 2019 www.irjet.net p-ISSN: 2395-0072

Stabilization of Black Cotton Soil using different Stabilizers

H S Jayatheertha[1], Vinay Kumar K S[2], P Girish[3], Vinayak A Hosur[4]

[1,2,3,4]*Assistant Professor, Dept. of Civil Engineering, Dayanand Sagar Academy of Technology and Management, Bangalore, Karnataka, India.*

Abstract - *Black cotton soils are boon to agriculture but are proved to be serious threat to construction founded on it. These soils have the property of high swelling due to imbibing of water in monsoon and shrinkage due to evaporation of water in summer seasons. Over the past few decades, stabilization is found to be the best technique for reducing the swelling and shrinkage nature of black cotton soil. Soil stabilization is a process that improves physical soil characters such as increased shear resistance; load capacity etc… can be done by compacting or adding appropriate additives such as cement, lime, and waste materials etc. There are various materials in utilization for the stabilization of black cotton soils. Depending on the internal factor which describes the bonding between the soil and the stabilizer utilized. In this study, to find out the effect of addition of stabilizers such as bagasse, lime and crushed demolished concrete on the behavior of black cotton soil. The various stabilizers used were Lime, Bagasse ash and Demolished Waste Concrete. Lime was added as constant percentage of 5%. Bagasse ash and Demolished Waste Concrete was added in varying percentages of 10%, 20%, 30%.*

Key Words: **Stabilization, Black Cotton Soil, Lime, Bagasse Ash, Demolished Waste Concrete**

1. INTRODUCTION

Soil can be defined as the upper layer of the earth consisting of air, water and solid particles is generally produced by disintegration of rocks. The main requirement of soil stabilization is adequate strength and it depends on character of soil. In case of cohessionless soils the strength could be improved by providing confinement or by adding cohesion with a cementing or binding agent. In case of cohesive soil the strength could be increased by drying, making soil moisture resistant, altering the clay electrolyte concentration, increasing cohesion with a cementing agent and adding frictional properties. Black cotton soil swells during rainy season and shrinks during summer season. This alternate swelling and shrinkage creates cracks in the black cotton soil. These shrinkage cracks are 100 mm to 150 mm wide and 0.5 to 2 m deep. Swelling creates upward pressure on structure and shrinkage creates downward pull. It results into cracks or damage in the foundations.

2. OBJECTIVE

The high cost of traditional stabilizers and industrial waste disposal problem has led to intense global research towards economical utilization of industrial and agricultural waste for engineering purpose. The main objective of the study is:

- To investigate the potential of using agricultural waste and industrial waste in the field of geotechnical engineering.
- To monitor the effect of different combination of bagasse ash and demolition waste on the engineering properties of clayey soil including compaction and unconfined compressive strength study.
- To determine the change in geotechnical properties, upon addition of different percentages of stabilizers.
- To monitor the change in liquid limit, plastic limit, shrinkage limit, plasticity index, dry density resulting from various combination of stabilizers.
- To study the behavior of strength gain in Black cotton soil using Bagasse Ash, Lime and Demolished Concrete.
- To bring out the effect of Bagasse Ash on compaction characteristics and strength of treated soil.

3. MATERIALS USED

Black cotton soil is a highly clayey soil. The black colour in Black cotton soil is due to the presence of titanium oxide in small concentration. The Black cotton soil has a high percentage of clay, which is predominantly montmorillonite in structure and black or blackish grey in colour. Expansive soils are the soils which expand when the moisture content of the soils is increased. The clay mineral montmorillonite is mainly responsible for expansive characteristics of the soil. The expansive soils are also called swelling soils or black cotton soils. The structures on Black cotton soil bases develop undulations at the road surface due to loss of strength of the sub-grade through softening during monsoon. Black cotton soil for our project was collected from Dadanatti, Mudhol Taluk, Bagalkote District.

Bagasse is a residue obtained from the burning of bagasse in sugar producing factories. Bagasse is the cellular fibrous waste product after the extraction of the sugar juice from cane mills. It is currently used as a bio fuel and in the manufacture of pulp and paper products and building materials. For each 10 tons of sugarcane crushed, a sugar factory produces nearly 3 tons of wet bagasse which is a by-product of the sugar cane industry. When this bagasse is burnt the resultant ash is bagasse ash. Bagasse ash was collected from chamundeswari sugar cane industry, K M Doddi, Mandya District.

Lime production begins by extracting limestone from quarries and mines. Pure calcium oxide is fused with coke in order to render the highest yield in the manufacture of acetylene. The quality of the resultant carbide lime is a direct result of the excellent quality raw materials. Carbide lime is finer in particle size, and physically, having a very finely divided particle size makes carbide lime better. A finer particle size means faster and more reactivity.

Material engineers are persistently looking for suitable and cheaper stabilizers for use in clayey soil stabilization as alternatives to costly additives, like, cement, lime etc. Since **C&DW** contains aggregates of variable sizes including coarser and finer, coarser fraction had been used as recycled aggregates in pavement construction but finer fractions is being left out still as waste material. The material contains both cement and sand in sufficient quantity and which being fine enough to alter the soil gradation; on admixing of the same could improve the packing density of the soil mass and at the same time there would be chemical reaction to some extent due to presence of enormous remnant cement grains.

Hence, in the present study; efforts have been made to utilize these fines as a soil stabilizer for improving the properties of clayey soil.

In our project the waste concrete collected from our campus (DSATM CT laboratory) and crushed by using Los Angeles abrasion test machine.

4. RESULTS AND DISCUSSIONS

Table 1. Properties of Black cotton soil.

Sl.No.	Properties	Values obtained
1	Specific Gravity	1.98
2	Co-efficient of Curvature	1.09
3	Uniformity Co-efficient	11.79
4	Liquid Limit	55.7%
5	Plastic Limit	26.6%
6	CBR a) SOAKED b)UNSOAKED	 1.28% 2.38%
7	MDD	1.429g/cm^3
8	OMC	27.2%
9	Unconfined Compressive Strength (q_u)	1.618kg/cm^2

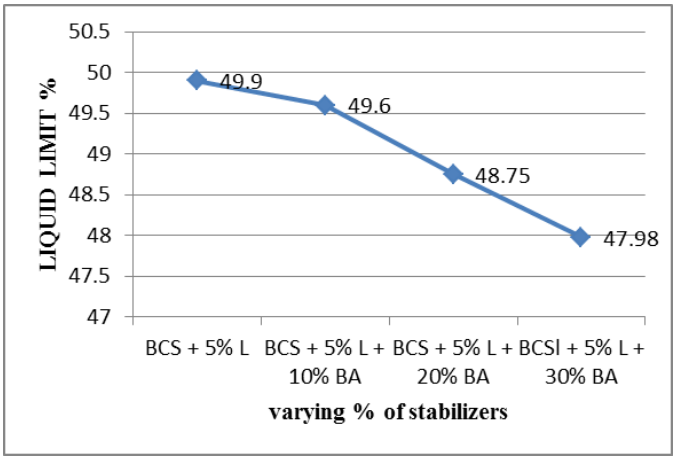

Chart -1: Variation in Liquid Limit with the addition of lime and bagasse ash

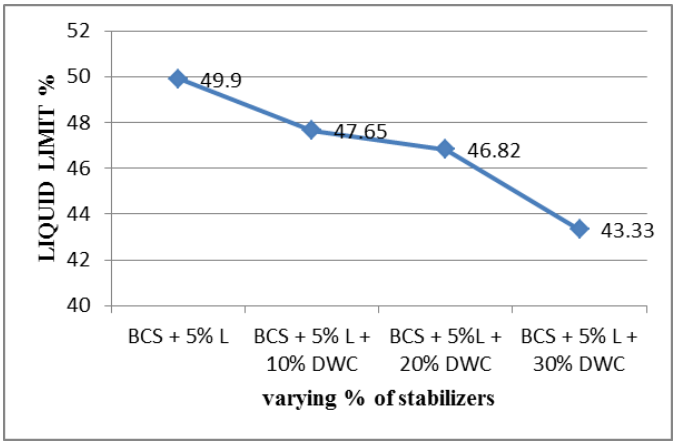

Chart -2: Variation in Liquid Limit with the addition of lime and demolished waste concrete

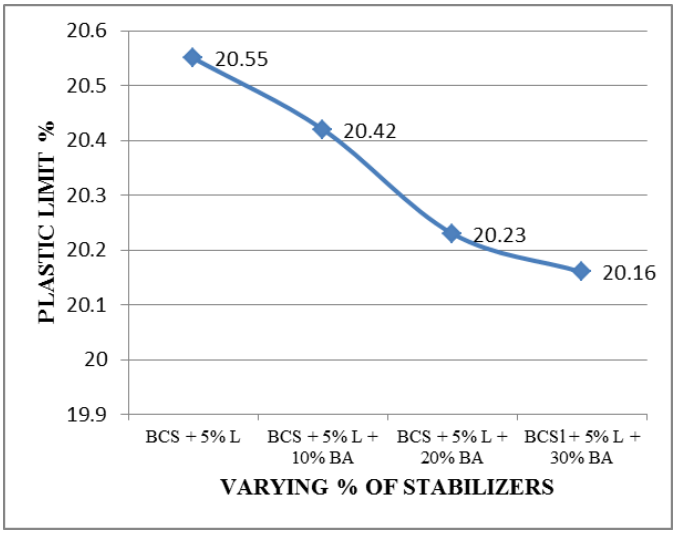

Chart -3: Variation in Plastic Limit with the addition of lime and bagasse ash

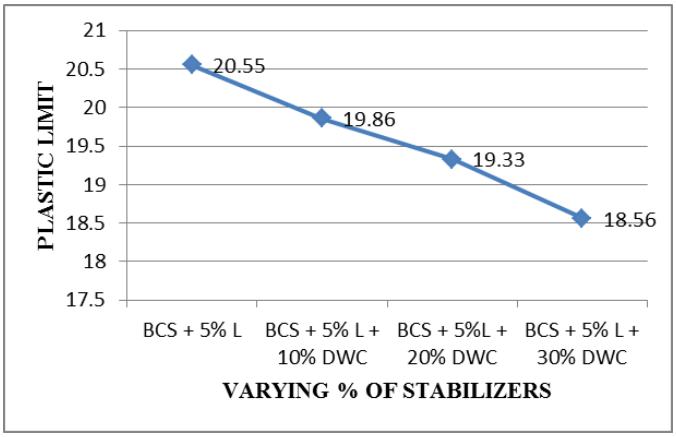

Chart -4: Variation in Plastic Limit with the addition of lime and demolished waste concrete

Table 2. Plastic limit and liquid limit variations

TYPE	PLASTIC LIMIT (%)	LIQUID LIMIT (%)
Black cotton soil	26.11	55.7
Black cotton soil + 5% Lime	20.55	49.9
Black cotton soil + 5% lime + 10% bagasse ash	20.42	49.6
Black cotton soil + 5% lime + 20% bagasse ash	20.23	48.75
Black cotton soil + 5% lime + 30% bagasse ash	20.16	47.98
Black cotton soil + 5% lime + 10% demolished waste concrete	20.3	53.33
Black cotton soil + 5% lime + 20% demolished waste concrete	19.33	46.82
Black cotton soil + 5% lime + 30% demolished waste concrete	18.56	43.33

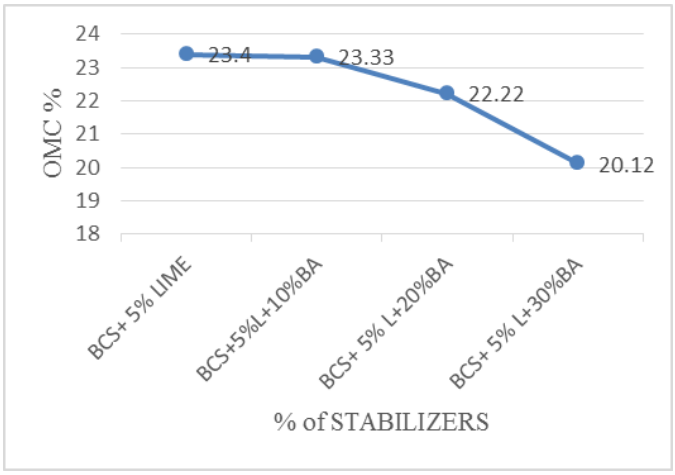

Chart -5: Variation in OMC with the addition of lime and bagasse ash

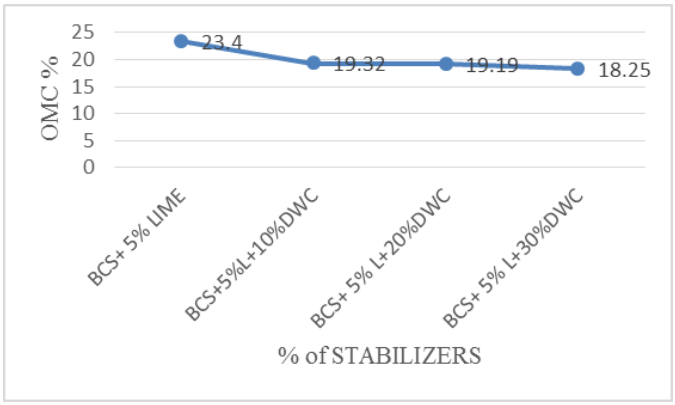

Chart -6: Variation in OMC with the addition of lime and demolished waste concrete

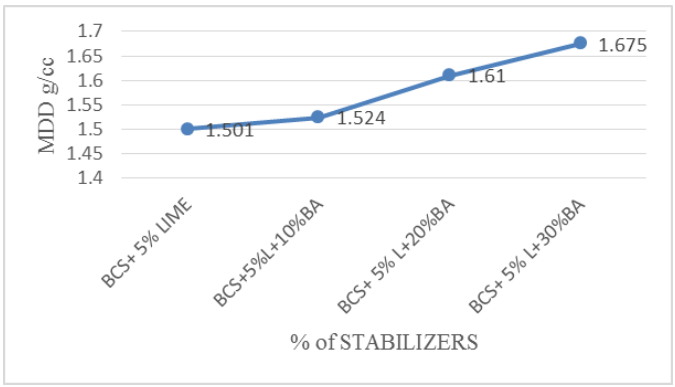

Chart -7: Variation in MDD with the addition of lime and bagasse ash

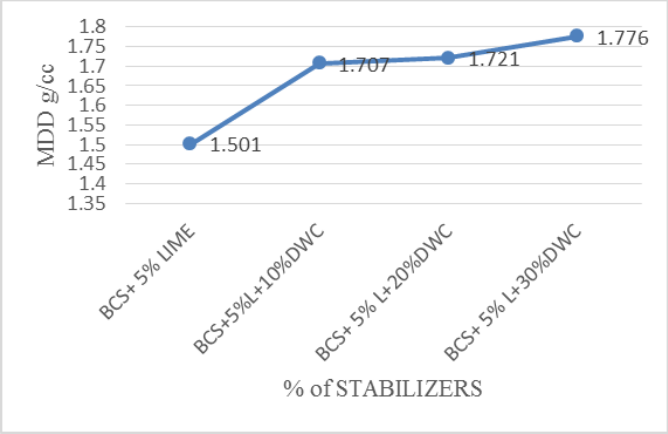

Chart -8: Variation in MDD with the addition of lime and demolished waste concrete

Table 3. Unconfined Compressive Strength Test Results.

TYPE	q_u (kg/cm^2)
Black cotton soil	1.618
BCS+ 5% Lime	1.719
Black cotton soil + 5% lime + 10% bagasse ash	1.786
Black cotton soil + 5% lime + 20% bagasse ash	1.826
Black cotton soil + 5% lime + 30% bagasse ash	1.862
Black cotton soil + 5% lime + 10% demolished waste concrete	1.912
Black cotton soil + 5% lime + 20% demolished waste concrete	1.938
Black cotton soil + 5% lime + 30% demolished waste concrete	1.942

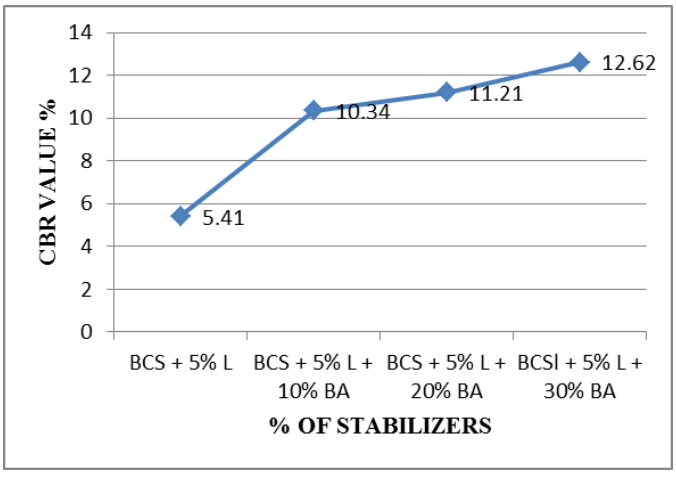

Chart -9: Variation in CBR with the addition of lime and bagasse ash in unsoaked condition

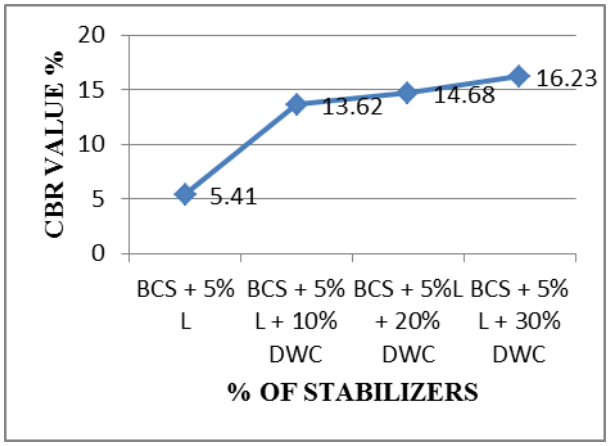

Chart -10: Variation in CBR with the addition of lime and demolished waste concrete in unsoaked condition

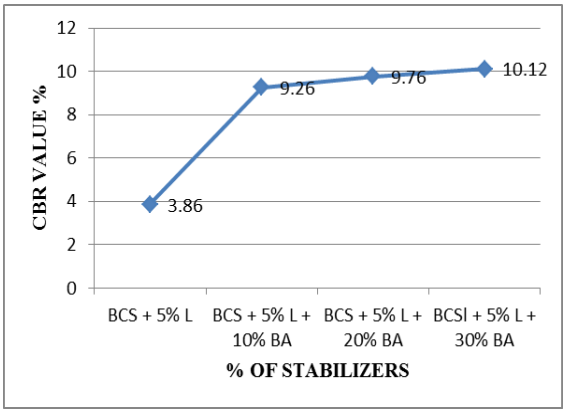

Chart-11: Variation in CBR with the addition of lime and bagasse ash in unsoaked condition

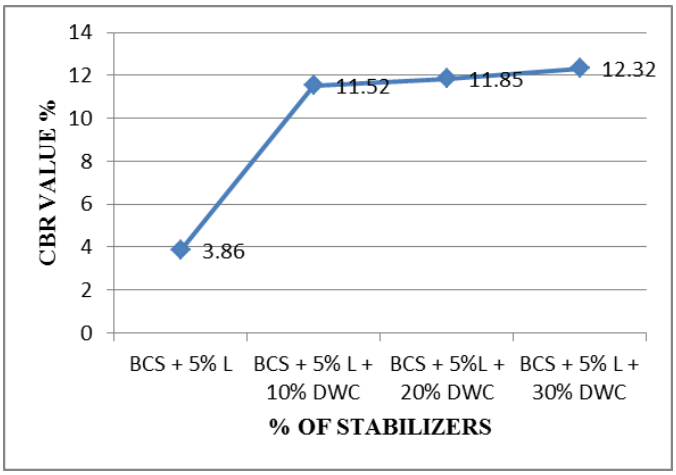

Chart -12: Variation in CBR with the addition of lime and demolished waste concrete in soaked condition

3. CONCLUSIONS

- Specific gravity increased from 1.98 to 2.34.

- It is observed that by the addition of 5%lime and 30% of demolished concrete Liquid limit decreased from 55.7% to 43.33%. And Plastic limit decreased from 26.11% to 18.56%.
- It is seen that by the addition 5% lime and bagasse ash (30%) liquid limit decreased to 47.98 % and plastic limit decreased to 20.16%
- An Addition of 5% lime and 30% demolished waste MDD increased from 1.429g/cc to 1.776g/cc.
- An Addition of 5% lime and 30% demolished waste OMC decreased from 27.2% to 18.25%.
- Unconfined compressive strength increased from 1.618 kg/cm^2 to 1.9422 kg/cm^2.
- CBR value increased from 1.28 % to 12.34% for soaked condition. And for unsoaked condition CBR value increased from 2.38% to 16.23%
- From the above study it is shown that the Bagasse ash waste is used to improving geotechnical properties like CBR value of the soil while demolished waste concrete is more effective than bagasse ash in the improvement of index properties (liquid limit, plastic limit of the black cotton soil).

REFERENCES

[1] Harish G R, 2017, "Studies on Stabilization of Black Cotton Soil Using Lime", International Research Journal of Engineering and Technology (IRJET) Volume: 04, Issue: 06, June -2017.

[2] Shailendra Singh, Hemant B and Vasaikar 2013, "Stabilization of Black Cotton Soil using Lime", International Journal of Science and Research (IJSR) Volume 4, Issue 5, May 2015.

[3] Nadgouda, K.A and Hegde, R.A 2010, "The Effect of Lime Stabilization on Properties of Black Cotton Soil", Indian Geotechnical Conference – Dec 2010, GEOtrendz

[4] Mr Archit Jain and Mr Arpit Chawda 2016, "Apraisal of Demolished Concrete Coarse and Fines for Stabilization of Clayey Soil", International Journal of Engineering Sciences & Research Technology Sep 2016.

[5] Vivek S, et all.., 2018, "Stabilization Of Expansive Soils Using Construction And Demolition Waste", Volume: 05, Issue: 06 | June-2018.

[6] Varun Neekhara, and Prof. A. K. Saxena 2017, "Improvement in Engineering Properties of Locally Available Expansive Soil using Construction &Demolition Waste and Marble Waste Powder", International Journal for Research in Applied Science & Engineering Technology (IJRASET) Volume 5, Issue VIII, August 2017.

[7] Vipul Kerni, Vinod Kumar Sonthwal, and Umar Jan 2015, "Review on Stabilization of Clayey Soil Using Fines Obtained From Demolished Concrete Structures", International Journal of Innovative Research in Science, Engineering and Technology Vol. 4, Issue 5, May 2015.

[8] C.Subhacini, et all.., 2015, "Expansive Soil Stabilization Using Waste from Sugarcane Industry", Journal for Studies in Management and Planning Volume 01, Issue 03, April 2015.

[9] Lokesh Gurjar, Prof. Kausik Majumdar, and Prof. Mayank Gupta 2018, "Experimental Analysis on Stabilization of Black Cotton Soil Using Bagasse Ash, Lime & Quarry Dust", International Research Journal of Engineering and Technology (IRJET) Volume: 05 Issue: 02 | Feb-2018.

[10] Amit S. Kharade, et all.., 2014, "Waste Product 'Bagasse Ash' From Sugar Industry Can Be Used As Stabilizing Material For Expansive Soils", IJRET: International Journal of Research in Engineering and Technology Volume: 03 Issue: 03 | Mar-2014.

[11] Amruta P. Kulkarni, et all.., 2016 "Black Cotton Soil Stabilization Using Bagasse Ash And Lime", International Journal of Civil Engineering and Technology (IJCIET) Volume 7, Issue 6, November-December 2016.

[12] Prakash Chavan and Dr.M.S.Nagakumar 2014, "Studies On Soil Stabilization By Using Bagasse Ash", International Journal of Scientific Research Engineering & Technology (IJSRET) ISSN: 2278–0882 ICRTIET-2014

BIOGRAPHIES

Mr. H S Jayatheertha
Asst. Professor.
Civil Engineering Department
DSATM, Bangalore

Mr. VINAY KUMAR K S
Asst. Professor.
Civil Engineering Department
DSATM, Bangalore

Mr. P Girish
Asst. Professor.
Civil Engineering Department
DSATM, Bangalore

Vinayak A Hosur
Asst. Professor.
Civil Engineering Department
DSATM, Bangalore