

Stabilization of Black Cotton Soil Using Bamboo Slag and Silica Fume

V.Ramya¹, S.Sowmiya², S.Karthickeyan³

UG Student, Department of Civil Engineering, DMI, Chennai, India¹²

Assistant Professor, Department of Civil Engineering, DMI, Chennai, India³

ABSTRACT: Due to rapid growth of urbanization and industrialization, minimization of industrial waste is serious problem in present days. To encounter this innovative and nontraditional research on waste utilization is gaining importances now a days. Soil improvement using the waste material like Slag, Rice husk ash, Silica fume etc., in geotechnical engineering has been recommended from environmental point of view. The main objective of this study is to evaluate the feasibility of using Silica fume and bamboo slag as soil stabilization material. In this paper the effect of bamboo slag and Silica fume on engineering characteristics of expansive clay like Black Cotton Soil has been presented. A series of laboratory experiment has been conducted on black cotton soil blended with Silica fume and bamboo slag content from 5% to 20% by weight of dry soil. The experimental results showed a significant increase in California bearing ratio and Unconfined compressive strength. The Differential free swell of the clay is reduced from 50% to 7% with increase in Silica fume and bamboo slag content from 0% to 20% respectively. The Proctor compaction results showed a small decrease in Maximum dry density and increase in Optimum moisture content. From this investigation it can be concluded that the Silica fume and bamboo slag as a potential to improve the characteristics of black cotton soil.

KEYWORDS: Bamboo Slag, Silica Fume, Liquid Limit, Plastic Limit, shrinkage Limit, Standard Proctor Test, California Bearing Ratio.

I.INTRODUCTION

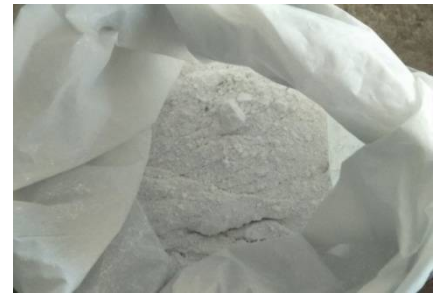
Black cotton soil (BC Soil) represents a well known category of problematic from civil engineering point of view. They exhibit large volumetric changes shrinkage and swelling behaviour if the moisture content changed. Due to this nature this type of soil is susceptible to damage to the structures and pavements founded on it. In India expansive soils cover about 0.8×10^6 km² area approximately 20% of surface area. Structure founded in areas with soft or weak soil have need for improvement of soil properties by using additives. Soil stabilization techniques are used to improve shear strength, CBR, reducing expansive characteristics, etc. Silica fume also referred as micro-silica is a product resulting reduction of high purity quartz with coal in an electric arc furnace in the manufacture of silicon or ferro-silicon alloy. Silica fume rises as an oxidized vapour. It cools, condenses and is collected. It is fine grey coloured powder sometime similar to Portland cement or some flyashes. Condensed silica fume is essentially silicon-dioxide (more than 90%) in non crystalline form. Since it is an air borne material like flyash it has spherical shape. It is extremely fine with a particle size less than 0.1 micron and specific surface area of about 20,000m²/kg. Silica fume is used as an artificial pozzolanic admixture in concrete. As far as the production of silica fume is concerned nearerly 100,000 tons of micro silica is produced each year world wide. Iron also has a large amount of micro silica production. Steel Authority of India has provided necessary facilities to produced more than 3000 tons of Silica fume annually. Many waste materials are used to modify the characteristics of soft soils. Traditionally the soils are stabilized by lime, cement, etc. In recent year the uses of waste materials like flyash, plastic, rice-husk ash, slag, etc. for soil stabilization is gaining importance. In this study attempts are made to find the influences of silica fume on engineering characteristics of black cotton soil. Bamboo is a naturally occurring composite material which grows abundantly in most of the tropical countries. Bamboo has a very long history with human kind. Bamboo is also one of the oldest building materials used by human kind. It has been used widely for household products and extended to industrial applications due to advances in processing technology.

II. MATERIALS USED

2.1.SILICA FUME:

Silica fume used was conforming to ASTM C 1240-2000 and was supplied by “ELKEM INDUSTRIES” was named ELKEM – micro silica 920 D. The Silica fume is used as a partial replacement of cement. The properties of silica fume are shown in table 1.

Specific Gravity	2.2
Bulk Density, (Kg/m ³)	576
Size, (Micron)	0.1
Surface Area, (m ² /kg)	20,000
SiO ₂	(90-96)%
Al ₂ O ₃	(1.2-0.8)%



SILICA FUME

2.2. BAMBOO SLAG:

Bamboo charcoal comes from pieces of bamboo plants, harvested after at least five years, and burned in ovens at temperatures ranging from 800 to 1200 degree celsius. It benefits environmental protection by reducing pollutant residue. It is an environmentally functional material featuring excellent absorption properties.



BAMBOO SLAG

III. EXPERIMENTAL WORK

In this project the project have conducted various experiments to find the stabilization of the soil base using the silic fume and bamboo slag the various test conducted to find the stabilization of the soil base.

3.1 LIQUID LIMIT

The liquid limit is the water content at which the soil changes from the liquid state to the plastic state. At the liquid limits, the clay is practically like a liquid, but possesses a small shearing strength. The shear strength at the stage is the smallest value that can be measured in the laboratory. The liquid limit of soil depends upon the clay mineral present. The stronger the surface charge and the thinner the particle the greater will be the amount of adsorbed water and, therefore, the higher will be the liquid limit.

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization

Volume 7, Special Issue 5, April 2018

1st International Conference on Recent Innovation in Civil Engineering and Management (ICRICEM '18)

22nd March 2018

Organized by

Department of Civil Engineering & MBA, Loyola Institute of Technology, Chennai, Tamilnadu, India



Liquid Limit

3.2 PLASTIC LIMIT

Plastic limit is the water content below which the soil stops behaving as a plastic material. It begins to crumble when rolled into a thread of soil of 3 mm diameter. At this water content, the soil loses its plasticity and passes to a semi-soil state,



Plastic Limit

3.3 SPECIFIC GRAVITY

Specific gravity is defined as the ratio of the unit weight of soil solids to the unit weight of water. The specific gravity is needed for various calculation purposes in soil mechanics, e.g. void ratio, density and unit weight.



Specific Gravity

3.4 STANDARD PROCTOR TEST

Take about 3 kg of air dried soil sample passing through 4.75 mm IS sieve. Add required water to it and mix thoroughly and keep it for soaking in an air tight container for about 16-20 hours. Find the mass of the empty and clean cylindrical mould along with the base plate fixed to it. Attach the collar and apply grease to the inside of mould and collar. Mix the matured soil thoroughly and fill the soil in 1000c.c mould. For light compaction, compact the moist soil in three equal layers, each layer being given 25 blows from the rammer weighing 2.6 kg with a drop of 310 mm for 1000c.c mould by distributing the blows evenly. Each layer of the compacted soil should be scratched with the spatula

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization

Volume 7, Special Issue 5, April 2018

1st International Conference on Recent Innovation in Civil Engineering and Management (ICRICEM '18)

22nd March 2018

Organized by

Department of Civil Engineering & MBA, Loyola Institute of Technology, Chennai, Tamilnadu, India

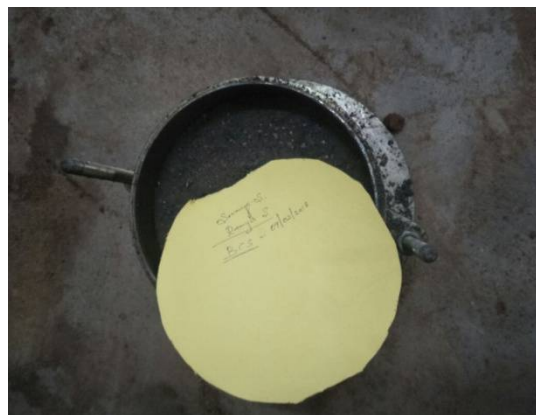
before putting the soil for next layer. The amount of soil should be just sufficient to fill the mould leaving about 5 mm to be struck off when the collar is removed. Remove the collar, trim the excess soil using a straight edge, clean the mould from outside and take the mass of the mould with base plate and compacted soil. Eject out the soil from the mould and take a representative sample for water content determination. Repeat the above procedure for 5 to 6 time with increasing water content.



Standard Proctor Test

3.5.CALIFORNIA BEARING RATIO

Take 5 kg of dry soil sample passing through 19 mm IS sieve. Add optimum amount of water to it and mix thoroughly. Apply grease to the inner surface of the CBR mould, place the spacer disc at the bottom of the mould and keep a filter paper over it and fill the soil sample into the mould in five layers with each layer being tamped for 55 blows using 4.89 kg rammer with a free fall of 450 mm, to obtain the required density. Keep the surcharge weight of 5 kg i.e., two discs weighing 2.5 kg each. Immerse this mould in clean water and allow it for soaking for minimum four days. Remove the assembly and test it for CBR using motorised loading machine.



California Bearing Ratio

IV.RESULT AND DISCUSSION

4.1 INDEX PROPERTIES

SINO	INDEX PROPERTIES	BLACK COTTON SOIL	BAMBOO SLAG	SILICA FUME
1	Liquid Limit (WL)%	60	70.2	53.8
2	Specific Gravity (G)g/cc	2.87	2.9	2.80
3	Plastic Limit (WS)%	38	48.4	34.6

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization

Volume 7, Special Issue 5, April 2018

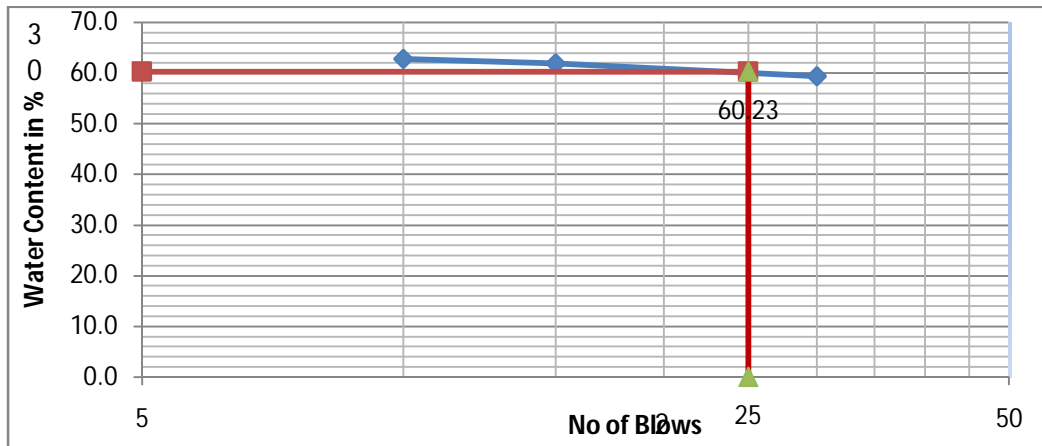
1st International Conference on Recent Innovation in Civil Engineering and Management (ICRICEM '18)

22nd March 2018

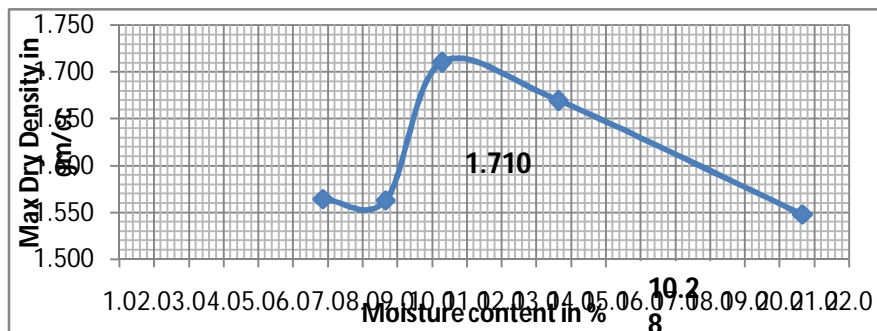
Organized by

Department of Civil Engineering & MBA, Loyola Institute of Technology, Chennai, Tamilnadu, India

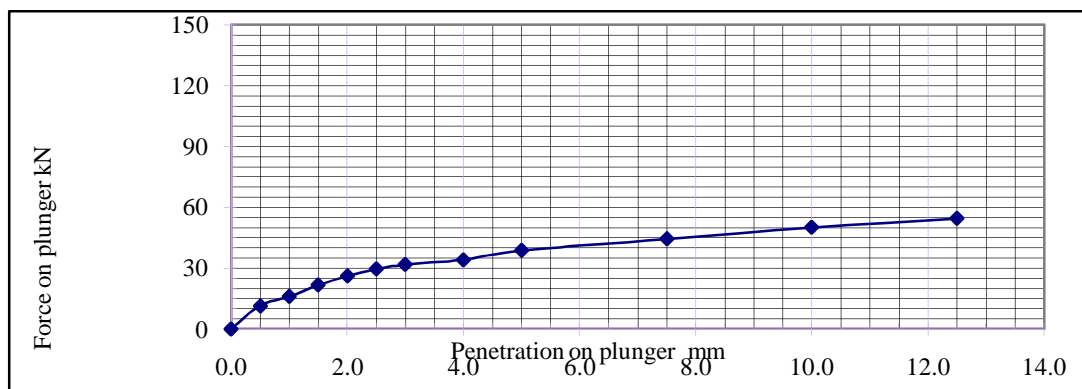
LIQUID LIMIT FOR BLACK COTTON SOIL



4.2 STANDARD PROCTOR TEST FOR BLACK COTTON SOIL



4.3 CALIFORNIA BEARING RATIO FOR BLACK COTTON SOIL



V.CONCLUSION:

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization

Volume 7, Special Issue 5, April 2018

1st International Conference on Recent Innovation in Civil Engineering and Management (ICRICEM '18)

22nd March 2018

Organized by

Department of Civil Engineering & MBA, Loyola Institute of Technology, Chennai, Tamilnadu, India

Thus from the above experimental studies we concluded that, Settlement in clay soil can be reducing by adding a silica fume. This will in turn improve the strength, reduce permeability, increase density and improve shear strength. Thus use of silica fume will be benefited to clay in improving their soil properties.

REFERENCES

- [1] Achmad Fauzi, Zuraidah Djauhari And Usama Juniansyah Fauzi "Soil Engineering Properties Improvement By Utilization Of Cut Waste Plastic And Crushed Waste Glass As Additive" *IACSIT International Journal Of Engineering And Technology*, Vol. 8, No. 1, January 2016
- [2] Akshaya Kumar Sabat, Associate Professor, Subasis Pati Research Scholar Department Of Civil Engineering Institute Of Technical Education And Research Siksha „O” anusandhan University Khandagiri Square, Bhubaneswar, Or, India, "A Review Of Literature On Stabilization Of Expansive Soil Using Solid Wastes"
- [3] M Anjan Kumar, Giet, Rajamundry & G V R Prasada Raju, Department Of Civil Engineering, Jntu College Of Engineering, " Use Of Lime Stabilized Pavement Construction " *Indian Journal Of Engineering & Material Science* Vol.16, August 2009.
- [4] M. Adams Joe, Maria Rajesh Associate Professor, Department of Civil Engineering, Middle East Engg College, Oman and ACEW, Tamilnadu, India "soil stabilization using industrial waste and lime"
- [5] Dallas N. Little, Texas A&M University, Eric H. Males, National Lime Association, Jan R. Prusinski, Portland Cement Association, Barry Stewart, " Cementitious Stabilization, Lime Stabilization, Coal Fly Ash Stabilization, Portland Cement Stabilization " *American Coal Ash Association* A2j01: Committee On Cementitious Stabilization Chairman: Roger K. Seals, Louisiana State University.
- [6] George Rowland Otoko Civil Engineering Department, Rivers State University Of Science And Technology, Port Harcourt, "A Review Of The Stabilization Of Problematic Soils " *International Journal Of Engineering And Technology Research* Vol. 2, No. 5, May 2014, Pp. 1 - 6, Issn: 2327 – 0349.
- [7] Mandeep Singh & Anupam Mittal, , Department Of Civil Engineering, Nit, Kurukshetra, "A Review On The Soil Stabilization With Waste Materials " *International Journal Of Engineering Research And Applications (Ijera)* Issn: 2248- 9622
- [8] Mukesh A. Patel, Dr. H. S. Patel " A Review On Effects Of Stabilizing Agents For Stabilization Of The projectak Soil " *Civil And Environmental Research* Issn 2222-1719 (Paper) Issn 22222863 Vol 2, No.6, 2012.