International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 02| Jan -2017 www.irjet.net p-ISSN: 2395-0072

A STUDY ON EFFECT OF BOTTOM ASH AND COCONUT SHELL POWDER ON THE PROPERTIES OF CLAY SOIL

A.T.Manikandan[1], Y.Ibrahim[2], M.P.Thiyaneswaran[3], B.Dheebikhaa[4], K.Raja[5]

[1]*Assistant Professor, Department of Civil Engineering, Kongu Engineering College, Erode, Tamil Nadu, India.*
[2] *Assistant Professor, Department of Civil Engineering, B.S.Abdur Rahman University, Vandalur, Chennai, Tamil Nadu, India*
[3]*Assistant Professor, Department of Civil Engineering, Kongu Engineering College, Erode, Tamil Nadu, India.*
[4] *Environmental Engineer, Tamil Nadu, India*
[5]*Assistant Professor, Department of Civil Engineering, Kongu Engineering College, Erode, Tamil Nadu, India.*

Abstract - *Stabilization of soil is essential for utilizing existing ground for construction purposes. Of all the soils, expansive soil causes major problems to civil engineering structures. Such soils swell when given an access to water and shrink when dry out. Due to depleting resources and high cost of construction, there is a need to expose the possibility of using alternate low cost materials. Thereby, stabilization of clay soil by using coconut shell powder (C.S.P) (agricultural and environment waste) and bottom ash (B.A) (by product of industrial waste) is an environmental friendly method. The study includes the evaluation of soil properties like optimum moisture content, dry density, and strength parameters. Different quantities of coconut shell powder and bottom ash (percentage by weight) are added to the expansive soil and the experiments were conducted on these soil mixes. The result shows that the use of coconut shell powder and bottom ash increases the strength of soil to a greater extent.*

Key Words: Soil stabilization, Bottom Ash, Coconut Shell Powder, Unconfined Compression strength, Atterberg limits, Plasticity index, swelling, shrinkage.

1. INTRODUCTION

Expansive soils are those whose volume change takes place while it comes in contact with water. It expands during the rainy season due to absorption of water and shrinks during summer season due to drying. Expansive soils cover nearly 20% of the landmass in India. The swelling soils are commonly known by the name of black cotton soils. General properties of the expansive soil are free swell index, swell potential and swelling pressure which directly affect the bearing capacity and strength of foundation lying on such a soil. Typical behavior of swelling and shrinkage of expansive soil develop problems like cracking in foundation. Hence, it is necessary to improve the properties of such a soil to avoid damages to the structure. Although mechanical compaction, dewatering and earth reinforcement have been found to improve strength of the soil, other methods like stabilization using admixtures are too advantageous. The different admixtures available are lime, cement, fly ash, blast furnace slag, coconut shell powder, bottom ash etc., In this study bottom ash & coconut shell powder have been chosen to stabilize the soil. The main aim of using these products is to bring economy in cost of construction and effective utilization of waste products. Bottom ash is a by-product of burning coal at thermal power plants. Bottom ash particles are coarser than the fly ash which exhibits high shear strength and low compressibility. Coconut shell powder is a residue and an environmental waste which has high stability with soil because of its hardness.

1.1 Scope of the study

In developing country like India rapid industrialization and large scale infrastructural development was left out with high cost of construction materials and tremendous increase in environmental pollution. Being a natural material, soil has complex properties varying from place to place from time to time. The cost of transportation of large quantities of good soil from distant areas for the construction of embankments, sub-grades for roads etc., is also high. So, soil stabilization has become the major issue in construction activity. Innovation methods of soil stabilization are in great demand all over the world.

1.2 Sampling & Testing

The study aimed to analyze the strength and behavior of bottom ash and coconut shell powder with clay. After collecting the soil sample from a site located at Kalipattur, Kelambakkam & OMR, Chennai, Tamilnadu. The soil sample was procured from an open excavation at a depth of 1m from the ground surface. The soil was air dried, pulverized and passed through IS 425-micron sieve and stored in airtight bags. Tests were conducted to determine the basic properties of the virgin soil such as Atterberg's limits, compaction characteristics, specific gravity, UCC strength etc. Bottom ash was collected from the Neyveli Lignite Corporation at Neyveli. Raw bottom ash is a granular material that consists of a mix of inert materials such as sand, stone, glass, porcelain metals and ash from burn materials. The coconut powder was collected from two places Kumbakonam and Periyakulam located in Tamilnadu. Different mix proportions have been identified for testing and the virgin sample properties were compared with the resulting highly stabilized soil.

2. RESULTS & DISCUSSIONS

The properties of virgin soil have been determined first in order to compare it with the results of soil mixed with bottom ash & coconut shell powder. The specific gravity, optimum moisture content, maximum dry density & UCC strength of soil were found to be 2.44, 15.5%, 1.94g/cc & 0.82kg/cm^2 respectively.

The unconfined compression test was carried out. Based on the individual strength behavior of the admixtures with virgin soil, we take the minimum percentage of mix proportion for the admixture bottom ash (10%, 15%, and 20%) and coconut shell powder (5%, 10%, 15%, 20%) to stabilize the clay soil. The test is carried out and the maximum unconfined compression strength is found for different proportions.

Table -1: Unconfined Compression Strength test results

For different proportions of Bottom Ash & Coconut Shell Powder				
S.No	**CONTENT MIX**	**0th DAY**	**3rd DAY**	**5th DAY**
1	B.A 10 + C.S.P 5	1.74	1.97	7.84
2	B.A 10 + C.S.P 10	2.58	2.84	8.18
3	B.A 10 + C.S.P 15	2.69	3.10	9.49
4	B.A 10 + C.S.P 20	2.20	2.78	8.16
5	B.A 15 + C.S.P 5	1.96	2.21	10.44
6	B.A 15 + C.S.P 10	2.69	3.06	11.31
7	B.A 15 + C.S.P 15	2.75	4.16	13.58
8	B.A 15 + C.S.P 20	2.04	4.03	12.34
9	B.A 20 + C.S.P 5	1.57	2.28	8.61
10	B.A 20 + C.S.P 10	2.48	3.41	10.56
11	B.A 20 + C.S.P 15	2.68	4.32	12.66
12	B.A 20 + C.S.P 20	2.32	4.18	11.21

In the chart-1, given below bottom ash 10% is mixed with different proportion of coconut shell powder (5%, 10%, 15%, and 20%) and clay.

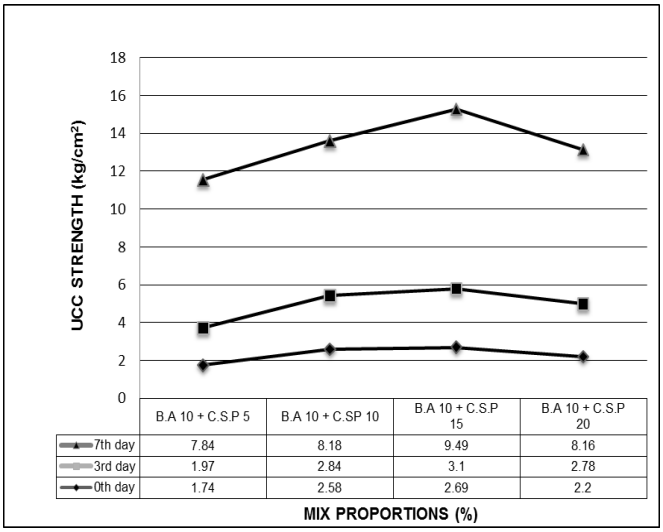

Chart -1: UCC values for 10% B.A

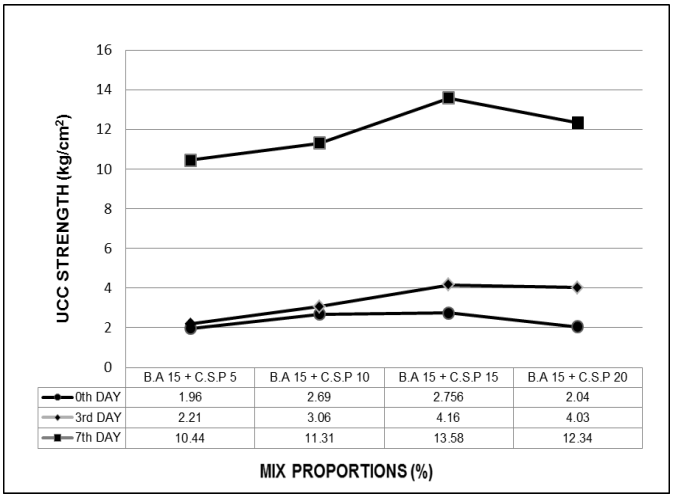

Chart -2: UCC values for 15% B.A

In the chart-2 given above the bottom ash 15% are mixed with different proportion of coconut shell powder (5%, 10%, 15%, and 20%) and clay. The test is carried out and the maximum unconfined compression strength is found for different proportions. Among these samples tested had a better value in proportion in the mix of bottom ash 15% + coconut shell powder 15%, and this proportion gives better stability to soil than the other samples in graph.

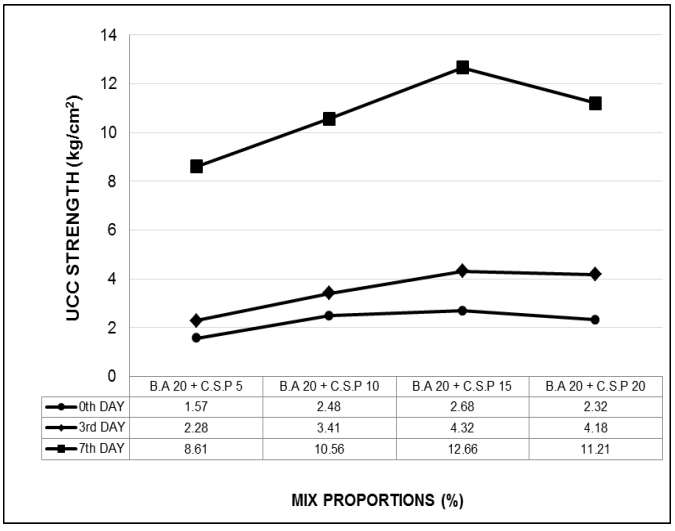

Chart -3: UCC values for 20% B.A

In this figure the bottom ash 20% are mixed with different proportion of coconut shell powder (5, 10, 15, and 20) and clay. The test is carried out and the maximum unconfined compression strength is found for different proportions. among these tested samples had a better value in proportion in the mix of bottom ash 20% + coconut shell powder 15%, and this proportion gives better stability to soil than the other samples in graph.

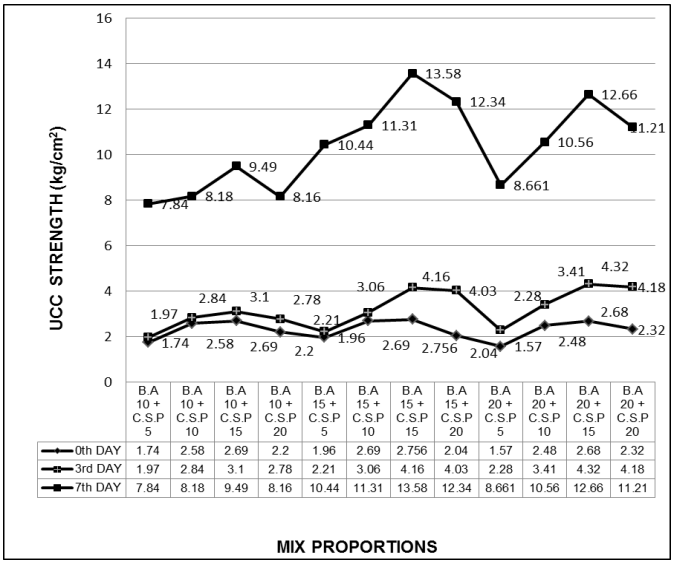

Chart -4: UCC values for all mix proportions

In chart-4, UCC values for all mix proportions are charted with their respective strength. In the chart, it clearly shows that the strength for samples with different proportions varies but in a uniform manner. There is a gradual increase from sample 1 and strength decreases in sample 4, so in sample 5 to sample 8, as well as from sample 9 to sample 12. The highest value in each set of samples are the best proportions and in those, the sample with maximum UCC value is the exact proportion mix which lowers the compressibility of clay soil to maximum extent and provides better stability to clay soil.

The variation of liquid limit and plastic limit with mixes are done.

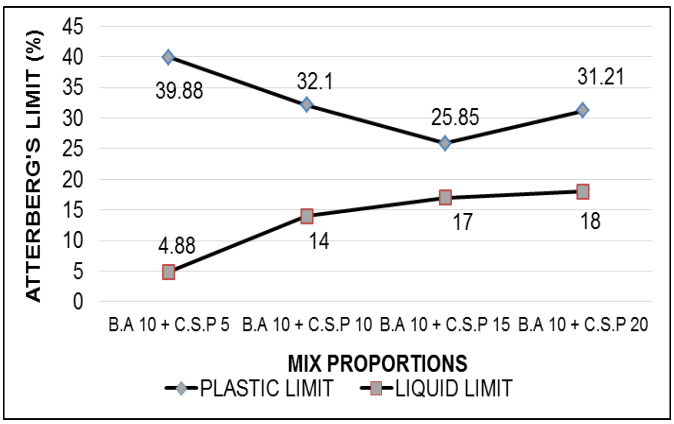

Chart -5: 10% Bottom ash with varying the Coconut Shell Powder by 5%, 10%, 15%, 20%

It is observed that as the coconut shell powder increases with 10%, 15% & 20% of bottom ash there is a marked reduction in liquid limit whereas plastic limit increases.

From chart-5, it can be deduced that the flow characteristics soil sample are gradually decreasing from 39.88% to lowest value of 31.21% with increase in coconut shell powder content with 10% bottom ash and plastic limit of these mixes increases from 4.88% to maximum of 18%.

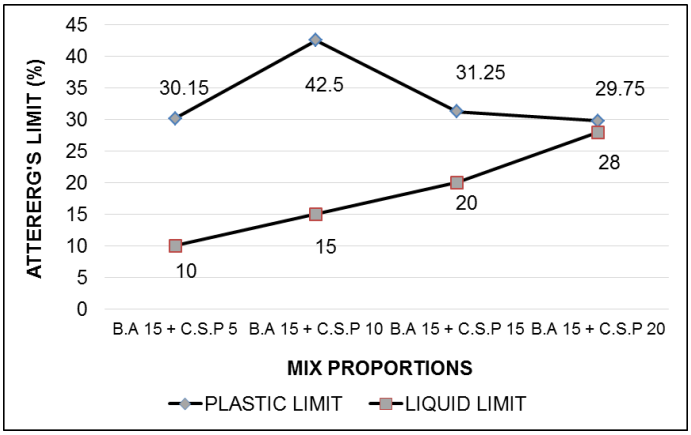

Chart -6: 15% Bottom ash with varying the Coconut Shell Powder by 5%, 10%, 15%, 20%

From chart-6, it can be deduced that the flow characteristics soil sample are gradually decreasing from 30.15% to lowest value 29.75% with increase in coconut shell powder content with 15% bottom ash and plastic limit of these mixes are increases from 10% to maximum of 28%.

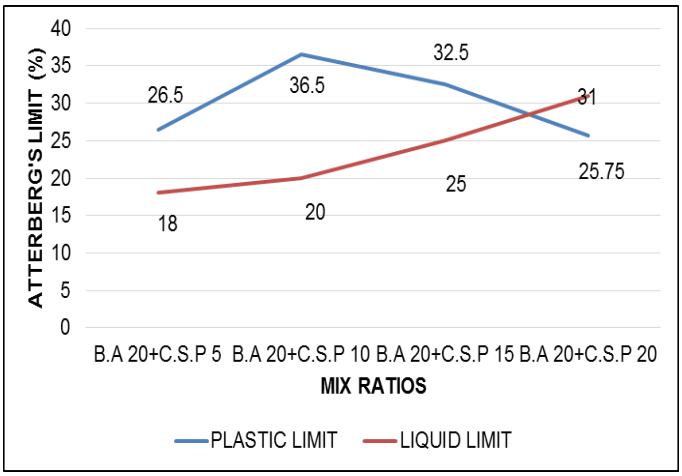

Chart -7: 20% Bottom ash with varying the Coconut Shell Powder by 5%, 10%, 15%, 20%

From chart-7, it can be deduced that the flow characteristics soil sample are gradually decreasing from 26.5% to lowest value of 25.75% with increase in coconut shell powder content with 20% bottom ash and plastic limit of these mixes are increases from 18% to maximum of 31%. From the change of Atterberg's limit is due to the cation exchange reaction and flocculation aggregation for presence of more amount of coconut shell powder and bottom ash content, which reduces plasticity index of soil. A reduction in

plasticity index causes a significant decrease in swell potential and removal of some water that can be absorbed by clay minerals. The increase of plastic limit implies that coconut shell powder and bottom ash treated soil required more water to change it plastic state to semisolid state. Initially the soil was clay with high plasticity. For the increasing amount bottom ash and coconut shell powder content, the soil class shifts to silt properties.

3. CONCLUSIONS

It can be concluded that there is an improvement of all the geotechnical properties of bottom ash and coconut shell powder treated soil. From the unconfined compression strength value, it is higher in all, but we get additional result in the mix of (B. A 15% + C. S. P 15%) whereas gradually decreasing after that. This is because of the absorption mechanism of coconut shell powder is more likely to bond to the clay content and the result is higher in shear strength of the resulting mixture. A series of liquid and plastic limit tests were performed on the untreated and bottom ash and coconut shell powder treated soil samples. It is observed that increase in bottom ash content with coconut shell powder, there is a marked reduction in liquid limit whereas plastic limit increases. This change of Atterberg's limit is due to the cation exchange reaction and flocculation aggregation for presence of more amount of bottom ash and coconut shell powder, which reduces plasticity index of soil. A reduction in plasticity index causes a significant decrease in swell potential. This results confirm that the mix (B. A 15% + C. S. P 15%) hardens, such that it possesses less damage to the building in site due to settlement, when the soil is mixed with these percentage as compare to that of virgin soil strata.

REFERENCES

[1] A.T.Manikandan, M.Moganraj (2014), "Consolidation and Rebound Characteristics of Expansive Soil by using Lime and Bagasse Ash", International Journal of Research in Engineering and Technology, Vol.03, Issue 04, April 2014, pp 403-411.

[2] K.V. Madurwar, P.P. Dahale, A.N. Burile (2013), 'Comparative Study of Black Cotton Soil Stabilization with RBI Grade 81 and Sodium Silicate ', International Journal of Innovative Research in Science, Engineering and Technology, Vol. 2, Issue 2, February 2013

[3] Misari, S.M., Busari, L.D. and Agboire, S. (1998), 'Current Status of Sugar Cane Research and Development in Nigeria', Proceedings of National Co-ordinated Research Programme on Sugar Cane, NCRI, Badeggi, pp. 2–12.

[4] Sharma, R.S., PhaniKumar, B.R., and Rao, B.V. (2008), 'Engineering behavior of a remolded expansive clay blended with lime, calcium chloride and rice –husk ash', Journal of Materials in Civil Engineering,Vol.20(8),pp 509-515.

[5] Ingles O. G., Metcalf J. A, "Soil Stabilization principles and Practice, Butter worths Sydney, 1972, p. 370 – 375.

[6] A.T.Manikandan, Animesh Sharma, G.Karthick, A.Abdul Jameel (2015), "Study on Effect of Molasses on Strength of Soil", International Journal of Advanced Research Trends in Engineering and Technology, Vol.02, Issue 02, February 2015, pp 57-61.