Stabilization of Clayey Soil Using Chicken Bone Ash

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Abstract

The study focused on stabilizing potential of ash obtained from chicken bones collected from Jalandhar, Punjab. Dried it for 2 days in open area. Chicken bones obtained were burnt in an open air at uncontrolled temperature. The CBA allowed to cool, miled and sieved with sieve of aperture 425 micron to obtain CBA. The CBA was used to stabilized soil. The CBA was added in proportions of 0, 2, 4, 6 and 8% by weight of samples to the soils. The results obtained showed that on addition of CBA, **California bearing ratio** (CBR) **Increase in %age (**The CBA is having ability of conducting with the fine particle of soil to aid stabilization due to the calcium which present in CBA) and **Unconfined compressive strength** (UCS) (With the addition of CBA in clayey soil it makes the soil more capable to bear the shear strength of soil) Value showed an increase as percentage CBA increased up to 6%.

Keywords: Chicken Bone Ash, Stabilization Soil, Atterberg's Limit, California Bearing Ratio, Unconfined Compressive Strength.

1. INTRODUCTION

The desire soil properties for a suitable design for a subgrade or Sub structure of a project as desired are sometimes not met. Soil engineering has wide definitions in constructions of civil engineering works. The upper layer of the earth is called soil which is known as a surface. Soil has organic and inorganic qualities. The quality of organic matter is not right for construction or stabilization purpose. Soil stabilization is the procedure of increasing the engineering properties of soil and also reduced the permeability and compressibility of soil. With the help of soil stabilization, the bearing capacity and shear strength of the soil raised. The soil stabilization is done by other material that can be provide in the environment Hence, there is essential requirement to change the substance of such soil by using some wastage from poultry farm, agricultural, industrial waste like Chicken bone. Researchers today are developing and looking into efficiency and effect means of utilizing both agricultural and environmental waste products to combat soil instability problems. Poultry waste was used in this research. There are many types of poultry waste comes from poultry form like: feather, litter, hatchery and bones. U.S. Department of Agriculture's Agriculture research service has make it easy to use the poultry feathers into a valuable fiber product like Keratin, Litter used as bedding in poultry operations, Liquid waste comes from water used to wash down hatcher and chick handling areas. The solid waste used for landfill or composting, Chicken bones are waste product after using the skin of chicken. It is a primary and un-manufactured product. Chicken bones are cause of contaminant

for environment. Alternative means of disposing this waste is sourced in this study that would be environmental friendly as well as contributing to income of people. This would invariably contribute to human sustenance.

Chicken bone is a dynamic tissue that performs biological and chemical functions. The main composition of CBA is calcium (34.3), alumina (41.7), magnesium oxide (4.2), Iron Oxide (2.9), Silica (1.2). The CBA is a grey in colour left from burning of bones.

The California bearing ratio (CBR) test is a penetration test for evaluation of the strength of road subgrade developed by the California state department of transportation. The test is best done by measuring the force required to penetrate a soil sample with a plunger of standard area. The thickness of pavement used is a function of the strength of the road. The stronger the subgrade CBR the less will be thickness of the road element that gives a considerable cost saving. If CBR of the subgrade is small, the road elements would be thicker to spread the wheel load over a greater area of a weak subgrade in order that the weak subgrade material is not deformed resulting to road failure. Various research works have been embarked upon on influence of soil addictive on CBR of subgrade material.

Strength Characteristics

The unconfined compression test is a special case of the triaxial compression test in which axial compressive stress only is applied to the cylindrical specimen. In the case of unconfined compressive strength (UCS) tests, size of samples was 3.8 cm in diameter and 7.6 cm in height i.e. height to diameter ratio of 2 are normally used. The sample fails either by shearing on an inclined plane or by bulging. Now for determining the quantitative information about the strength properties of the mixed soil in terms of UCS, having different varying percentages of chicken bone ash from 0 to 8% were mixed with soil and UCS tests were conducted on various mixes. Further for knowing the performance of CBA mixed soil, the said tests were done on the mixed soil with addition of CBA.

2. FRAMEWORK

Soil sample were collected from Ludhiana. Fetching of soil sample was done at depth of about 1 meter at sampling point. The soil sample were dried with the help of oven at 110^0C. In order to classify the soil using Indian Soil Classification System (ISC), soil sample grain sized were analyzed and Atterberg's limit. CBA used for the research were obtained from poultry forms. Chicken bones obtained were burnt in an open air at uncontrolled temperature. The CBA allowed to cool, miled and sieved with sieve of aperture 425 micron to obtain CBA. The filtrate bone ash was grey in colour. The ash was kept in well-sealed polytene bags to prevent ingration of moisture.

Collected the chicken bones from chicken shop at Jalandhar. Dried it for 2 days in open area.

Figure: 1 Chicken bones dried at sunlight

After 2 days all the moisture evaporated and chicken bones shrinked and dried. After dried chicken bones ready to burnt. Chicken bones burnt at uncontrolled temperature. Allowed to cool.

Figure: 2

Figure: 2 & 3 burning process of chicken bones

After burning then grind it in a mixer and it's became a form of powder ash. The color of ash is dark grey. Chicken bone ash is inorganic substance because the presence of calcium in its results of chemical composition.

Figure: 4 After burnt

Chicken bone ash Milled and sieved with sieved of aperture 425 micron to obtain CBA.

Figure: 5 Picture of chicken bone ash in powder form

Each soil sample was subdivided into 5 parts with each part receiving single dose of 0, 2, 4, 6 and 8%of CBA by weight. The soil samples moisture content and maximum dry density were determined. The value obtained were used to prepare sample for California bearing ratio (CBR) and Unconfined compression strength (UCS) determined.

- Details of mixing proportion of Rice husk ash (RHA) and lime with soil

Sample No.	CBA Content (%)	Test to be Perform	DESIGNATION (S: CBA)
1	0	S. G	100:0
2	100	S. G	0:100
3	0	LL	100:0
4	2	LL	98:2
5	4	LL	96:4
6	6	LL	94:6
7	8	LL	92:8
8	0	PL	100:0
9	2	PL	98:2
10	4	PL	96:4
11	6	PL	94:6
12	8	PL	92:8
13	0	& OMC	100:0
14	2	Modified Proctor test	98:2
15	4	Modified Proctor test	96:4
16	6	Modified Proctor test	94:6
17	8	Modified Proctor test	92:8
18	0	CBR Un-soaked	100:0
19	2	CBR Un-soaked	98:2
20	4	CBR Un-soaked	96:4
21	6	CBR Un-soaked	94:6
22	8	CBR Un-soaked	92:8
23	0	CBR Soaked	100:0
24	2	CBR Soaked	98:2
25	4	CBR Soaked	96:4
26	6	CBR Soaked	94:6
27	8	CBR Soaked	92:8
28	0	Unconfined Compressive Strength	100:0
29	2	Unconfined Compressive Strength	98:2
30	4	Unconfined Compressive Strength	96:4
31	6	Unconfined Compressive Strength	94:6
32	8	Unconfined Compressive Strength	92:8

3. RESULT AND DISCUSSION

The soil type is clayey soil with plastic limit of 23.2 and liquid limit 32.5 of and plasticity index of 9.3.

3.1 Atterberg's Limits of CBA Stabilized Soil

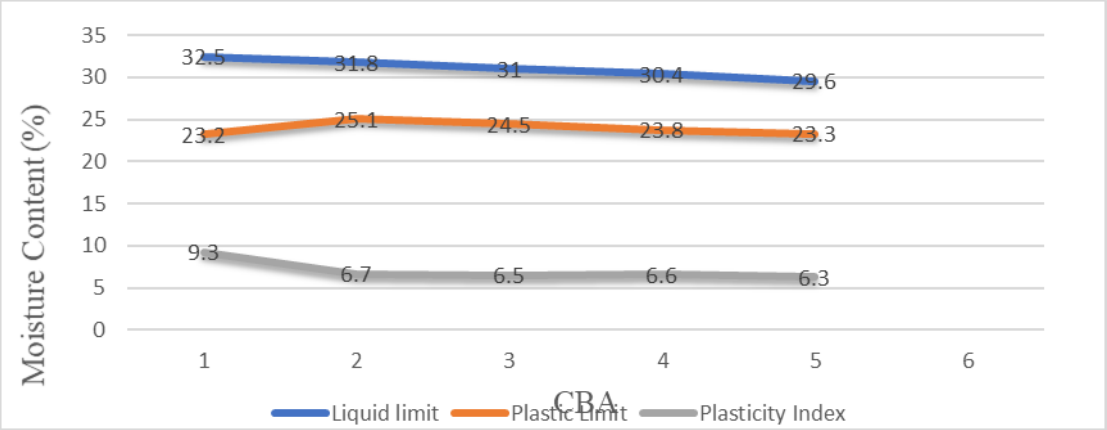

Fig: 3.1.1 showing effect of different proportions of CBA content on Liquid Limit, Plastic Limit and Plasticity Index

Mix proportions	Liquid Limit (LL)	Plastic Limit (Ip)	Plastic Index (PI)
Clay soil	32.5	23.2	9.3
Soil+2% BA	31.8	25.1	6.7
Soil+4% BA	31	24.5	6.5
Soil+6% BA	30.4	23.8	6.6
Soil+8% BA	29.6	23.3	6.3

Table no: 3.1.1 Shows variation of Wl, Wp and Ip with % of Chicken bone ash

3.2 MDD and OMC of CBA stabilized soil

The modified proctor test is used to simulate the field condition with the help of heavy roller. This test is representing the heavier compaction also known as modified AASHO-test.

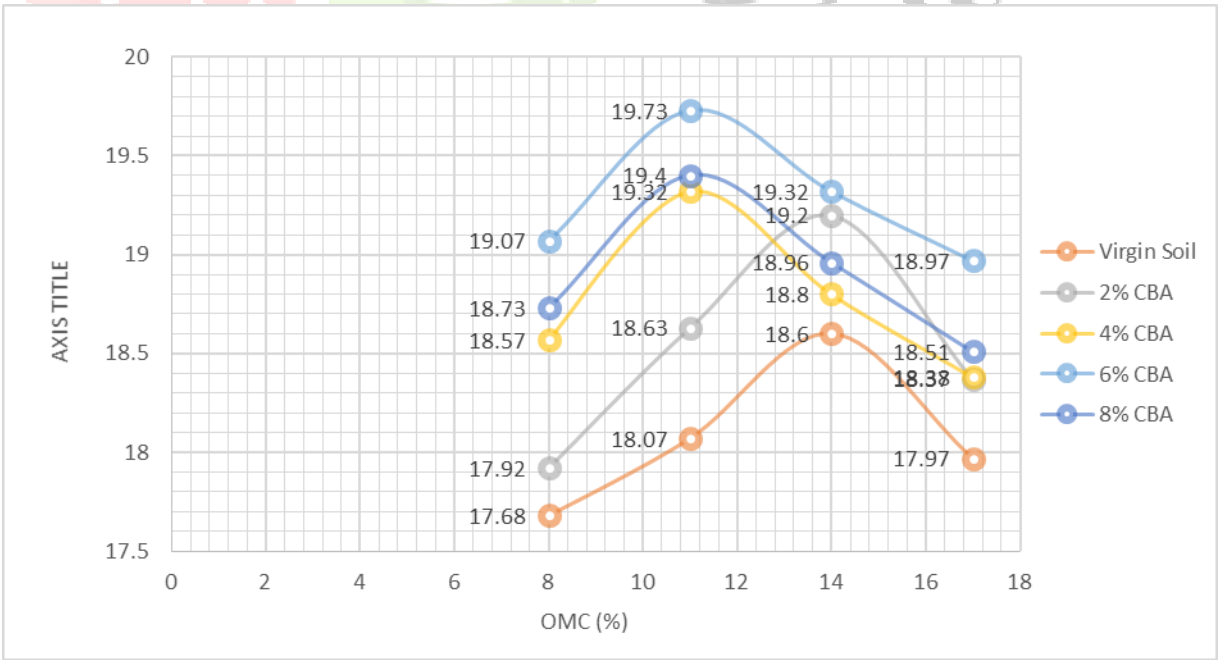

Fig: 3.2.1 MDD and OMC results with different proportion of chicken bone ash

Sample no.	Proportion Soil : Bone ash	MDD (kN/m^3)	OMC (%)
1.	100	18.60	14
2.	98:2	19.20	14
3.	96:4	19.32	11
4.	94:6	19.73	11
5.	92:8	19.40	11

Table no. 3.2.1 MDD and OMC for soil – CBA mixture

3.3 California Bearing Ratio (Un-Soaked)

The CBR test results show that Unsoaked California bearing ratio value of virgin soil is 4.67 with addition of CBA increased upto 6% at 8.39. The addition CBA of 2% more than in the soil then the value 8.02.

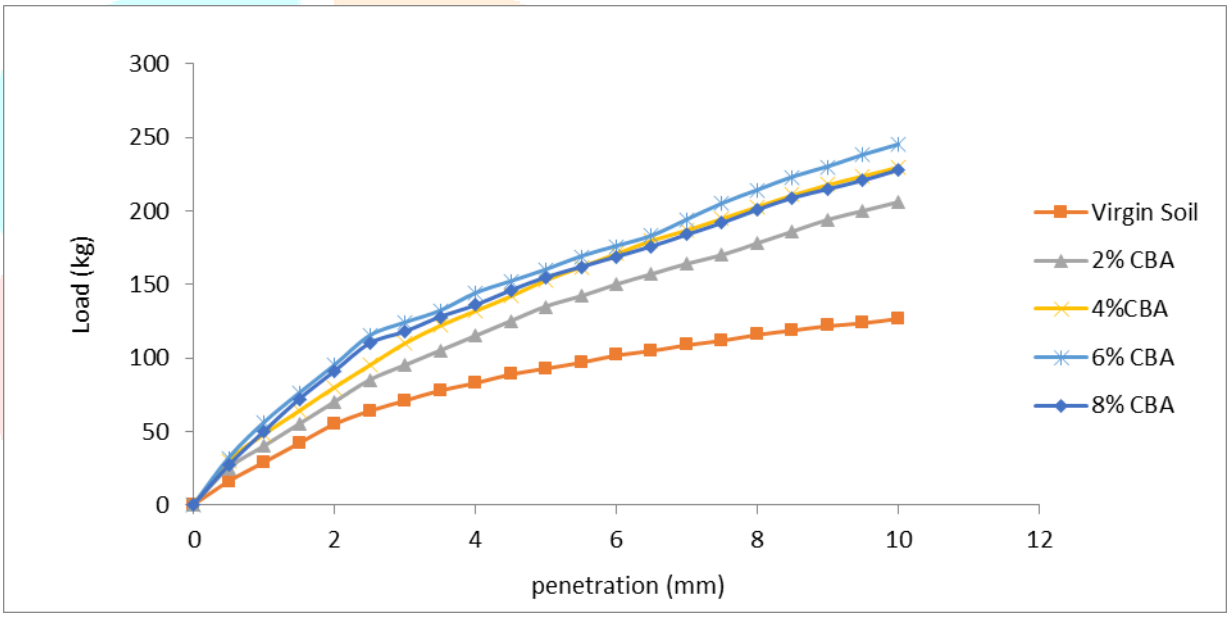

Fig: 3.3.1 Load v/s Penetration curve of soil stabilized with different proportion of CBA under un-soaked conditions

Sample no.	Proportion Soil : Bone ash	Unsoaked CBR (%)
1.	100:0	4.67
2.	98:2	6.20
3.	96:4	6.93
4.	94:6	8.39
5.	92:8	8.02

Table no. 3.3.1 CBR (Un-soaked) test results for soil: CBA mix

3.4 California Bearing Ratio (Soaked):

For soaked conditions, filter paper were placed on base plate. Surcharge plate of the weight is 5 kg were placed over plate, whole mould were placed in water tank for soaking of sample for 168 hours. After 168 hours mould was taken out of water tank. Test on CBR procedure was same as an Un-soaked test.

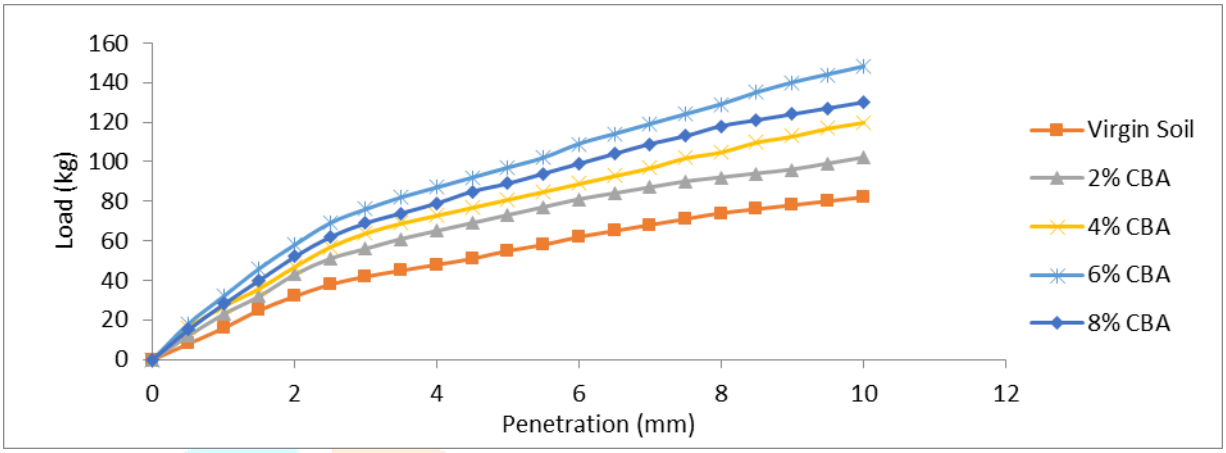

Fig: 3.4.1 Load v/s Penetration curve of soil stabilized with different proportions of CBA under soaked

Sample no.	Proportion Soil : Bone ash	Soaked CBR (%)
1.	100:0	2.84
2.	98:2	3.78
3.	96:4	4.16
4.	94:6	5.03
5.	92:8	4.52

Table no. 3.4.1 CBR (Soaked) test results for soil – CBA mixture

3.5 Unconfined Compressive Strength Test

The UCS test result shows that the UCS value of virgin soil is 36 kN/m^2 and with addition of 2% upto 4% of CBA its increased 55 kN/m^2 then decreased with the addition of 6% CBA. UCS test is performed with curing period of 3 days.

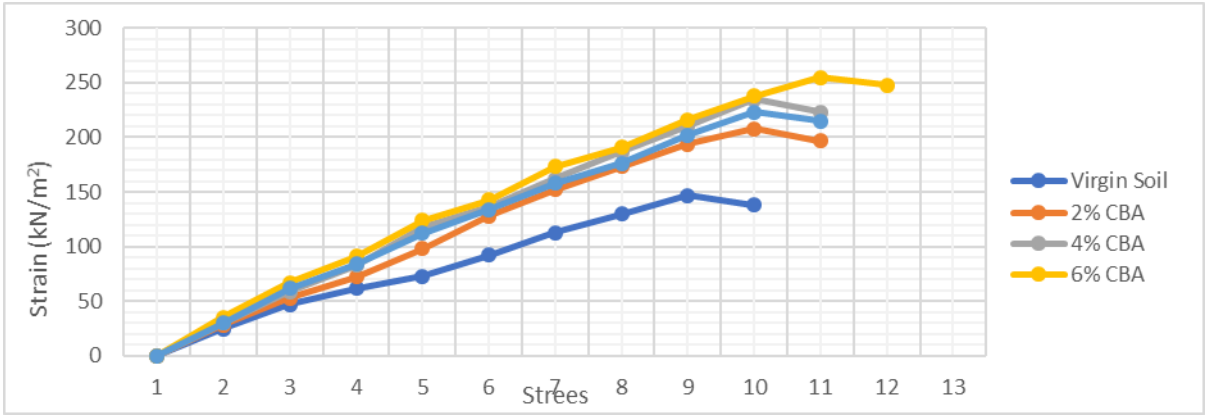

Fig. no. 3.5.1 Stress v/s strain relationship curve of soil stabilized with different quantity of CBA

S. No	Mix proportion (Soil : CBA)	Curing period (Days)	Unconfined compressive strength (kN/m^2)
1.	100	3	147
2.	98:2	3	208
3.	96:4	3	235
4.	94:6	3	255
5.	92:8	3	223

Table. 3.5.1 Unconfined compressive strength test results with increase in quantity of CBA

CONCLUSION

The investigation of the geotechnical properties the soil used in this research has enabled us to establish the effect of CBA on the soil California bearing ratio. The maximum amount of CBA that would allow for an increase for CBR value is 6%.

According to this research to achieve the maximum shear strength of soil with the help of 6% of CBA mixed into soil by using the Unconfined compressive strength test. After the test we found the shear strength was increased.

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