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Stabilization of Black Cotton Soil using waste Material Bagasse Ash

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Abstract:- **In the present study the soil sample was taken on Jarimora Village, Mandavi Taluka, Surat District and the black cotton soil was classified as clay with high plasticity content as given in Indian Standard Classification System (ISCS). There is very serious problem for disposing waste nowadays. There is large amount of production of sugar in south Gujarat. The ash coming out from sugar factories after removal of sugarcane from machine, generally called as Bagasse Ash. We collected Bagasse Ash from Bardoli Sugar Factory. Different dosage of Bagasse Ash i.e. 5%, 10% and 15% were used with the black cotton soil as stabilizers and different test were carried out like; Atterberg's Limit, Compaction test, California Bearing Ratio Test and unconfined compressive strength Test. From the results, it was observed that by adding 5% of Bagasse ash, the satisfying results were obtained and beyond that results are not effective.**

Keywords: Soil Stabilization, Black Cotton Soil, Bagasse Ash

I. INTRODUCTION

The soil, which is lying at the base of the foundation, supports the structure and effectively distributes the load of the structure. If the soil is poor and its properties are weak, it may cause damage and depressions in pavements, cracks in the superstructure, damage in foundation, damage in retaining structures and even the unequal settlement of the structure. The black cotton soil is the type of expansive soil which is having the properties of shrinkage and swelling. This property of soil is due to the montmorillonite content. The property of expansiveness of the black cotton soil is more due to the higher content of the montmorillonite mineral. The structure constructed on the expansive soil may get failed due to poor soil properties below the foundation. In India, about 20% of soil mass is black cotton soil. So it is needful to remove or replace this soil or by improving soil properties to make the stable foundation of structure.

Generally, lime and cement are most commonly used stabilizers. The stabilizers are used for enhancing the poor soil properties. The solid waste materials such as Fly Ash, quarry dust can also be used as soil stabilizing materials. Rice husk ash is also used but it cannot be used alone for stabilization of black cotton soil because of it has lack of cementitious pproperties. So it is used with a binder like Lime, cement, lime sludge, Calcium chloride etc. In this paper, the properties of the black cotton soil stabilized with different proportions of bagasse ash are found.

II. LITERATURE REVIEW

- **M. Chittaranjan, M. Vijay, D. Keerthi** studied the 'Agricultural wastes as soil stabilizers'. In this study Agricultural wastes such as sugar cane bagasse ash, rice husk ash and groundnut shell ash are used to stabilize the weak sub grade soil. The weak sub grade soil is treated with the above three wastes separately at 0%, 3%, 6%, 9%, 12%and 15% and CBR test is carried out for each per cent .The results of these tests showed improvement in CBR value with the increase in percentage of waste.

- **Moses G., K. J. Osinubi studied the** 'Influence of Compactive Efforts on Cement-Bagasse Ash Treatment on Expansive Black Cotton Soil'The dark grey soil used in this study was obtained along Gombe-Biu road in YamatuDeba Local Government Area of Gombe State using the method of disturbed sampling. The index properties were determined on the natural and treated soils with Stepped percentages of cement (i.e., 0, 2, 4, 6 and 8%) were admixed with 0, 2, 4, 6 and 8% of bagasse ash by dry weight of soil. All the compactions involving moisture-density relationships, CBR and UCS tests were carried out by using energies derived from the standard Proctor (SP), West African Standard (WAS) and modified Proctor

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(MP) energies. Finally, an optimal blend of is 8% OPC/4% BA is recommended for treatment of expansive black cotton soil for use as a sub-base material.

III. MATERIALS USED

A. *Black Cotton Soil:*

The soil used in this project is a black cotton soil collected from Jarimora village,Mandavi Taluka,Surat district, Gujarat State of India. The black cotton soil was collected by method of disturbed sampling after removing the top soil at 150mm depth and transported to the laboratory. The soil was air dried and sieved with is sieve 425 as required for laboratory test. The index and engineering properties of the black cotton soil were determined as per IS codes and are presented in table- I.

Laboratory Test	Symbol	Results	Relevant IS Codes
Atterberg's limits			
Liquid Limit	WL	72.62	IS 2720 Part V
Plastic Limit	WP	26.54	IS 2720 Part V
Plasticity Index	PI	46.08	IS 2720 Part V
Specific Gravity	G	2.53	IS 2720 Part III
Compaction Parameters			
Optimum Moisture Content (%)	OMC	14.29	IS 2720 Part VIII
Maximum Dry Density (gm/cc)	MDD	1.67	IS 2720 Part VIII
CBR value (Unsoaked)	CBR	11.53	IS 2720 Part XVI
CBR value (Soaked)	CBR	2.00	IS 2720 Part XVI
Shear Strength Parameters			
Cohesion (kg/cm2)	C	0.17	IS: 2720 Part-13-1986
Unconfined Compressive Strength (kg/cm2)	UCS	0.34	IS 2720 Part X
Differential Free Swell	DFS	100	IS 2720 Part XI

B. *Bagasse Ash:*

Bagasse ash is a residue obtained from the burning of bagasse in sugar-producing factories. This material contains amorphous silica, which is an indication of cementing properties, which can develop good bonding between grains in the case of weak soil. To stabilize expansive soil, the waste product bagasse ash is collected from Sugar factory – Bardoli, Gujarat. Bagasse ash is used as a stabilizer to deal with environmental concerns through the reduction of sugar industry waste material.

Fig 1 bagasse ash

IV. METHODS ADOPTED

The bagasse ash which is passing through 4.75mm sieve was collected and mixed with the expansive soil from 0% to15% at an increment of 5%. Tests for finding the Atterberg's limits, Differential Free Swell Index, the compaction parameters (OMC&MDD), Unconfined Compressive strength, were conducted on the prepared samples as per the relevant Indian Standard (IS) Codes.

V. RESULT ANALYSIS

A. *The Atterberg's Limit*

The variations of Liquid Limit, Plastic Limit and Plasticity Index of expansive soil treated with different percentage of bagasse ash are shown in Figure 2.

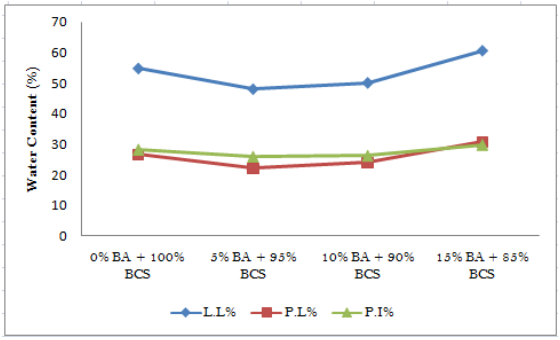

Fig 2 Variation of Atterberg's limit with bagasse ash percentage

From the above figure it can be observed that with increase in percentage of bagasse ash, the Liquid Limit, Plastic Limit and Plasticity Index of soil is
found to be decreasing and then increasing.. The values of LL,PL & PI at 05% BA + 95% BCS are 48.12%, 22.14% & 25.98% respectively.

B. *The compaction parameters*

The results of standard proctor test on the black cotton soil are shown in following figures. Fig 3 and fig 4 shows the variation in Max Dry Density and optimum moisture content with different percentage of quarry dust, respectively.

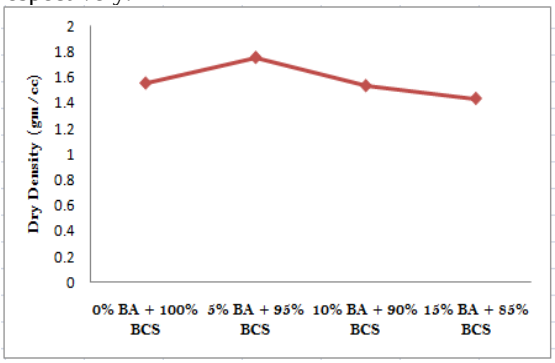

Fig 3 Variation of Dry Density with bagasse ash percentage

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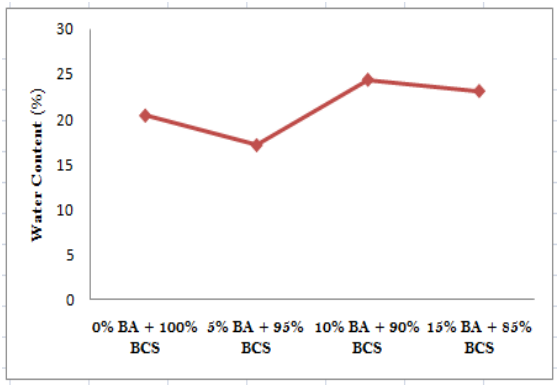

Fig 4 Variation of water content with bagasse ash percentage

With increase in percentage of bagasse ash, the Optimum Moisture Content (OMC) of soil and the MDD is obtained at 05% BA + 95% BCS. The OMC and MDD obtained at 05% BA + 95% BCS are 17.18% and 1.75gm/cc respectively.

C. The unconfined compressive strength

The figure below shows the variation in UCS with different proportions of BA and Black Cotton Soil.

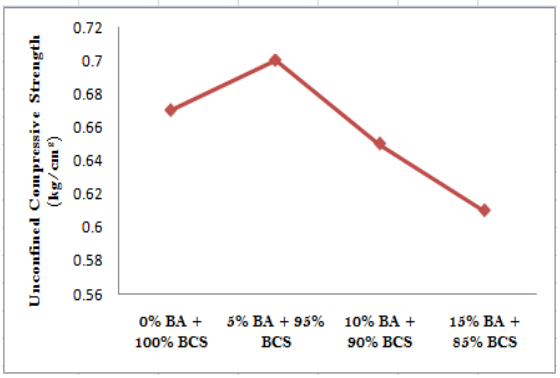

Fig 5 Variation of UCS with Bagasse Ash (%)

The maximum Unconfined Compressive Strength is obtained at 05% BA with 95% of black cotton soil is 0.70 kg/cm².

D. The California Bearing Ratio value

From the CBR test, the obtained results are shown in following fig.6

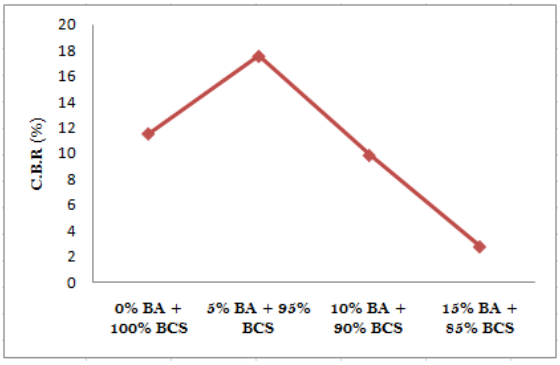

Fig 6 Variation of CBR value with Bagasse Ash (%)

The fig shows that at 05% BA + 95 % BCS, the results of CBR value are satisfactory. The CBR value obtained at 05% BA + 95% BCS is 17.55%.

VI. CONCLUSION

On the basis of experiments conducted on the black cotton soil mixed with bagasse ash in different proportions, the following conclusions can be made.

- The Shrinkage limit and swell index of soil observed as 20.18% and 90% respectively which indicates high swelling properties of soil.
- The LL decreased from 54.8% to 48.12%, the PL decreased from 26.54% to 22.14% and the PI also decreased from 28.26% to 25.98% at 05% BA + 95% BCS.
- The standard proctor test with addition of bagasse ash results 1.55gm/cc, 1.75gm/cc, 1.53gm/cc and 1.43gm/cc of MDD and correspondingly obtained the results of OMC are 20.44%, 17.18%, 24.39% and 23.15%. From the results, it can be concluded that there is up to 5% of BA, the value of MDD was increased and then it decreased. The maximum dry density obtained is 1.75 gm/cc from 1.55 gm/cc and the moisture content decreased from 20.44% to 17.18% at 05% BA + 95% BCS.
- After equal amount of addition of bagasse ash, it is concluded that up to 05% amount of bagasse ash, the CBR value is increased from 11.53% to 17.55%.
- The UCS value increased from 0.67 kg/cm² to 0.70 kg/cm².

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