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Stabilization Of Black Cotton Soil Using Sugarcane Bagasse Ash

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ABSTRACT

The stabilization of black cotton soil, known for its expansive and problematic nature, is crucial for improving its engineering properties for construction purposes. This study explores the use of sugarcane baggase ash (SBA), an agricultural byproduct, as a stabilizing agent for black cotton soil. Sugarcane bgasse ash, being rich in silica, is utilized to enhance the soil's strength, reduce its plasticity, and control its swelling and shrinkage characteristics. Experimental tests, including Atterberg limits, compaction, unconfined compressive strength (UCS) were conducted to evaluate the effectiveness of SBA in improving the soil's geotechnical properties. Results indicated that the addition of SBA led to a significant improvement in soil strength, a reduction in plasticity index making the soil more suitable for construction purposes. The study concludes that sugarcane ash can be an effective and eco-friendly stabilizing agent for black cotton soil, offering a sustainable solution for soil improvement in regions where black cotton soil poses challenges for infrastructure development.

1 INTRODUCTION

Black cotton soil, also known as Vertisol, is characterized by its expansive nature, which makes it highly susceptible to volume changes due to variations in moisture content. This shrinkage and swelling behavior leads to significant challenges in the construction industry, particularly in the development of stable foundations and road structures. The geotechnical properties of black cotton soil, such as low shear strength, high plasticity, and poor compaction, make it unsuitable for direct use in engineering applications without modification.

Soil stabilization techniques are widely employed to mitigate the adverse effects of such expansive soils. Traditional stabilization methods include the addition of lime, cement, or other chemical agents, but these solutions can be expensive and environmentally harmful. In recent years, there has been increasing interest in sustainable, cost-effective alternatives that utilize agricultural by-products. One such material is sugarcane ash (SCA), a waste product derived from the combustion of sugarcane bagasse in sugar mills.

Sugarcane ash, rich in silica, lime, and other mineral constituents, offers several advantages when used as a stabilizing agent for black cotton soil. The pozzolanic properties of sugarcane ash enable it to react with the clay minerals in the soil, forming cementitious compounds that enhance the soil's strength, reduce its plasticity index, and mitigate its swelling potential. The use of sugarcane ash not only improves the engineering properties of the soil but also provides an environmentally friendly approach by repurposing industrial waste, which would otherwise contribute to environmental pollution.

This paper investigates the effects of sugarcane ash on the stabilization of black cotton soil, examining its impact on various soil properties, including compaction characteristics, plasticity index and UCS. The objective is to explore the potential of sugarcane ash as an effective and sustainable stabilizing agent, offering an alternative solution to traditional methods. Additionally, the study seeks to optimize the proportion of sugarcane ash for achieving the best performance in terms of soil improvement, while also considering the environmental and economic benefits associated with its use.

2 Materials And Methadology

2.1 Black cotton soil

Is a clay or soil that is prone to large volume changes (swelling and shrinking) that are directly related tochanges in water content. Soils with a high content of expansive minerals can form deep cracks in drier seasons or years; such soils are called vertisols. Soils with smectite clay minerals, including montmorillonite and bentonite, have the most dramatic shrink-swell capacity.

2.2 Sugarcane bagasse Ash

Is a fibrous material obtained from sugar cane plant after the extraction of sugar cane juice. Sugar factorywaste bagasse is used as bio fuel and in manufacturing of paper. Sugar industry produces 30% bagasse foreach lot of crushed sugar cane, when this bagasse is burnt the resultant ash is known as Bagasse Ash‟. Bagasse shows the presence of amorphous silica, which is an indication of pozolonic properties. The use of bagasse ash as stabilizing material for black cotton soil can be checked under various tests.

2.3 Metodology

The methodology involves series of steps.

1. Procurement of materials

2. Preparation of soil sample

3. To conduct test on the prepared soil sample to calculate soil sample.

4. To treat the soil sample with proportions of bagasse ash.

5. To conduct test on bagasse ash treated sample.

A) Procurement of materials

1) Black cotton soil The soil procured from Khadarwadi Belgaum is used as sample. The soil was collected at depth of 1m below ground level.

2) Sugarcane Bagasse Ash the sugarcane bagasse is collected from sugarcane juice sellers in Belgaum City.The bagasse was dried in sunlight for 24 hours and burnt to get ash. Ash formed was collected and sieved using 475 micron sieve to get fine powdered ash.

3) Preparation of Soil Sample The black cotton soil is spread and is beaten to remove lumps.The soil is sieved through 425 micron sieve is stored in container.

4) Tests Conducted on Soil Sample

1)Atterbergs limits □

2) Compaction Test□

3)Unconfined compression test

4) Treating the Soil Sample with Different Proportions of Bagasse Ash Bagasse ash is added to soil in proportions of 4%, 8%,12% tests are conducted Stabilising agent: bagasse ash.

5) Standard proctor Compaction test

Compaction is the procedure of minimizing air voids in soil. Dry thickness establishes the compaction level. Dry thickness and the ideal water content are obtained from the wet soil sample blend.

B) Unconfined Compression Test

The unconfined pressure test is by a wide margin the most well known technique for soil shear testing since it is one of the quickest and least expensive strategies for estimating shear quality. The strategy is utilized essentially for immersed, firm soils recouped from thin-walled testing tubes. The reason for this test is to decide the unconfined compressive quality of the dirt.

3 RESULTS AND DISCUSSIONS

As the black cotton soil is collected from the foundation, the original water content was high. The soil was tested for liquid limit, plastic limit, compaction test and unconfined compression test. The following are the results of the original and sugar cane bagasse added soil are as below.

1)Liquid limit

Liquid Limit	%
Liquid limit of original soil sample	47.98
Liquid Limit of soil with 4% of bgasse ash	36.29
Liquid Limit of soil with 8% of bgasse ash	29.61
Liquid Limit of soil with 12% of bgasse ash	20.63
Liquid Limit of soil with 16% of bgasse ash	40.12
Liquid Limit of soil with 20% of bgasse ash	55.21

Table .1 Liquid limit Results

2)Plastic Limit

Plastic limit result

Plastic Limit	%
Plastic limit of original soil sample	25
Plastic Limit of soil with 4% of bgasse ash	66
Plastic Limit of soil with 8% of bgasse ash	56
Plastic Limit of soil with 12% of bgasse ash	38
Plastic Limit of soil with 16% of bgasse ash	56
Plastic Limit of soil with 20% of bgasse ash	38

Table .2 Plastic Limit

3) Plasticity Index

Plasticity Index	%
Plasticity index of original soil sample	22.98
Plasticity index of soil with 4% of bgasse ash	29.71
Plasticity index of soil with 8% of bgasse ash	26.39
Plasticity index of soil with 12% of bgasse ash	17.37
Plasticity index of soil with 16% of bgasse ash	15.88
plasticity index of soil with 20% of bgasse ash	17.21

Table .3 Plasticity Index

By the above values of the plasticity index, we can conclude that the optimum dosage of add admixture (bagasse ash) is 16% to the weight of soil. As clayey soil has high plasticity and that can be a problem in the field of construction. So stabilizing it with bagasse ash of 16% of its weight can give the desired strength to the soil.

C) Compaction Test Original soil sample

The optimum moisture content is 25%

The maximum dry density obtained is 1.45gm/cu.c

Results with bagasse ash

% of baggase ash	Optimum moisture content	Maximum dry density
4%	23.34	1.41
8%	22.4	1.39
12%	19.46	1.33
16%	12.34	1.43
20%	17.34	1.31

Table.3 Compaction test results with bagasse ash

By the above values of the compaction test, It is concluded that the optimum dosage of add admixture is 16% to the weight of soil. As clayey soil has high water content and that creates problem in the field of construction. So stabilizing it with bagasse ash of 16% of its weight can give the desired strength to the soil.

D) Unconfined Compression Test

Results Original soil The unconfined compressive strength is 0. 298N/mm2

The shear strength for this soil is 0.149 N/ mm2

% of baggase ash	Unconfined compressive strengh	Shear strengh
4%	0.37	0.185
8%	0.475	0.2375
12%	2.74	1.37
16%	4.53	2.265
20%	3.25	1.625

Table.5 Unconfined compression test

By the above values of the unconfined compression test, we can conclude that the optimum dosage of add admixtureis 16% to the weight of soil. As clayey soil is weak and causes problem in the field of construction. So stabilizing it with bagasse ash of 16% of its weight can give the desired shear strength to the soil.

6)Conclusion

Soil stabilization method can increase the strength of black cotton soil. In our project the following results are obtained: □

At 16% dosage of bagasse ash the plasticity index reduced from 22.98% to 15.88% which is desirable for construction site .□

The maximum dry density improved from 1.41 gm/cc to 1.43 gm/cc at 16% dosage of bagasse ash .□

The unconfined compressive strength increased from 0.298 N/ cm2 to 4.53 N/cm2 at 16% dosage of bagasse ash .□

The shear strength improved from 0.149 N/cm2 to 2.265 N/cm2 at 16% of bagasse ash.

References

1. Chittaranjan, M., Vijay, M., Keerthi, D. (2011). Agricultural wastes as soil stabilizers. Int. Journal of Earth Sci. and Eng. 4(6), pp. 50-51.

2. Gandhi, K.S. (2012) “Expansive Soil Stabilization using Bagasse Ash,” International Journal of Engineering Research and Technology, 1(5), 1-3.

3. Manikandan, A. & Moganraj, M. 2014, 'Consolidation and Rebound Characteristics of Expansive Soil by Using Lime and Bagasse Ash', International Journal of Research in Engineering and Technology, vol. 03, no. 04, pp. 403-11.

4. Osinubi, K. J. (2000). “Influence of compaction energy levels and delays on cement treated Soil.” Nigerian Society of Engineers Technical Transactions, Vol. 36, No. 4, pp 13

5.International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-2S December, 2018