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A Study on Properties of Sub Grade Soil added with Sugarcane Bagasse Ash and lime

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ABSTRACT

This study analyzes the use of lime and sugar cane bagasse ash (SCBA) as chemical stabilizers in compacted soil blocks. The blocks were tested for flexure and compression in a dry and a saturated state. The tests were performed at 7, 14 and 28 days of age in order to evaluate the effects of the addition of lime and SCBA on the mechanical properties of the compacted soil blocks. The results indicate that blocks manufactured with 10% of lime in combination with 10% of SCBA showed better performance than those containing only lime. It was also concluded that the combination of SCBA and lime as a replacement for cement in the stabilization of compacted soil blocks seems to be a promising alternative when considering issues of energy consumption and pollution. The results showed that sugarcane Bagasse ash improved the geotechnical properties of the soil samples. Sugarcane bagasse ash was therefore found as an effective stabilizer for sub grade soils. With increase percentage of bagasse ash, moisture content of soil samples decreases while dry density increases. Increasing percentage of bagasse ash increase the specific gravity of soil samples and decreases the water content. Liquid limit continuously decreases with increasing percentage of bagasse ash.

Keywords: Bagasse ash, lime, quarry dust, atterberg, CBR

I. INTRODUCTION

Soil stabilization means the improvement of the stability or bearing capacity of the soil by the use of controlled compaction, proportioning and the addition of suitable admixture or stabilizers. Due to lack of suitable soil at many places it need for soil stabilization. The common soil stabilized methods are lime stabilization and cement stabilization, which many be replaced by bagasse ash for economy. This reduces its disposal volume. Stabilization is being used for a variety of engineering works, the most common application being in the construction of road and air field pavements.

Methods of stabilization may be grouped under two main types.

a. Modification or improvement of a soil property of the existing soil without any admixture.

b. Modification of the properties with the help of admixtures. Compaction and drainage are the examples of first type, which improve the inherent shear strength of soil. Examples of second type are, mechanical stabilization, stabilization with cement, lime, bitumen and chemical.

Mostly the available soils do not have adequate engineering properties to bear the wheel loads. Several highways pavement fails due to lack of use of soil having adequate engineering strength. So the need for improvement of engineering properties of soil is always a major concern to Highway Engineers. To improve the engineering properties of soil continuous researches have been carried and still being carried out. The provision to make the soil better with enhanced soil properties lead to the concept ofsoil stabilization.

Keeping this view in mind the present study has been carried out to estimate utilization of sugarcane bagasse ash in enhancing the engineering properties of sub grade soil.

II GEOTECHNICAL ASPECTS OF PAVEMENT

Pavements generally are layered systems designed to meet the objectives to provide structural capacity, ride quality, safety, durability to pavements so that they does not deteriorate prematurely due to environmental

All pavements are constructed on earth and practically all components of pavements are constructed with earth materials. These earth materials are bound with asphalt or cement to form pavement surface layers as structural component. Mostly earth provides inferior foundation materials in their natural state, and replacement is quite impractical and uneconomical. The design engineer is often faced the challenge of using the construction materials available on or near the project site. Therefore construction of pavement systems requires a thorough understanding of the properties of available soils because that will constitute the components of the pavement system.

III. MATERIAL USED

3.1. BAGGASE ASH : - The burning of bagasse which a waste of sugarcane produces bagasse ash. Presently in sugar factories bagasse is burnt as a fuel so as to run their boilers. This bagasse ash is generally spread over farms and dump in ash pond which causes environmental problems also research states that Workplace exposure to dusts from the processing of bagasse can cause the chronic lung condition pulmonary fibrosis, more specifically referred to as bagassosis. So there is great need for its reuse, also it is found that bagasse ash is high in silica and is found to have pozollinic property so it can be used as substitute to construction material.

3.2 Lime : Lime is a generic term, but by strict definition it only embraces manufactured forms of lime – quicklime (CaO) and hydrated lime ($Ca(OH)_2$). It is, however, sometimes used to describe limestone products, which can be confusing. The raw material for all lime-based products is a natural stone: limestone, which is composed almost exclusively of calcium carbonate ($CaCO_3$). When limestone contains a certain proportion of magnesium, it is called dolomite, or dolomitic limestone ($CaMg(CO_3)_2$). It is widely geographically available all over the world, (the Earth's crust contains more than 4% calcium carbonate,) and it is used for many different purposes.

IV . METHODOLOGY

All the laboratory tests conducted on native and stabilized soil. The California bearing ratio and unconfined compressive strength tests were conducted for different curing periods. Basic laboratory tests (Attenberg's limit,

compaction, CBR, UCC) were carried out on black cotton soil sample to determine the basic properties of soil sample in order to evaluate the improvement in strength characteristics of sub grade soil.

V. CHEMICAL COMPOSITIONOF BAGASSE ASH

Table 1: Chemical composition of Bagasse ash is as following:

Constituents	Abbreviation	Composition (%)
Silica	SiO_2	57.65
Alumina	Al_2O_3	8.23
Iron	Fe_2O_3	3.96
Calcium	CaO	4.52
Magnesium	MgO	1.17
Loss on Ignition	------	5.00

(Source: Ken C. Onyelowe, International Journal of Science and Engineering Investigations, 2012).

This composition is slightly same as that of chemical composition of the cement; hence it can be an initiative step to replace cement stabilization of soils by sugarcane bagasse ash stabilization of soils maintaining higher strength and economy for the construction.

VI.COST ANALYSIS

From the Literature survey, for a Pavement design in stabilized expansive or weak soil with sugarcane bagasse ash there will be:

- Saving of 15.4% in total cost per m^2 area if the transportation of the waste (SCBA**)** will be from a distance of 20 km.
- The saving in cost per m^2 area will be 13.9% if the transportation of the waste **(**SCBA) will be from a distance of 50 km.
- For soil covering Jaipur economic conditions can be achieved, as bearing capacity of the soil can be increased by adding SCBA, and an initiative can be stepped as shallow foundation can be designed instead of deep foundation.

VII. FUTURE SCOPE

For future construction works this research if further expand then following can be made possible:

- From Civil engineering point of view, sugarcane bagasse ash can be used for future constructions so that a high strength with very low cost stabilization can be achieved maintaining economical conditions.

- In future constructions if testing of subgrade soils with sugarcane bagasse ash are done then replacement of deep foundations with shallow foundations can be made possible with proper designing after adding SCBA to the soil.
- An overall economy in construction works can be achieved using sugarcane bagasse ash.
- As sugarcane bagasse ash is a solid non bio-degradable waste, therefore using it as soil stabilizer will reduce environmental pollution in its high production areas.

VIII. CONCLUSIONS

Different lime contents were selected by determining lime contents scientifically required for modifying and stabilizing soil based on established procedures. These lime contents were amended with four different BA contents to study the effect of amendment on lime stabilization.

Based on the summary of results of this research following conclusions were drawn:

- With increase in percentage of bagasse ash, moisture content of soil samples decreases while dry density increases.
- CBR values of soil samples of all sites were observed to be increasing with the increasing percentage of bagasse ash.
- Increasing percentage of bagasse ash increase the specific gravity of soil samples and decreases the water content.
- Liquid limit continuously decreases with increasing percentage of bagasse ash.
- As the properties were enhanced, it can be concluded that soil modification using bagasse ash can improve the existing poor and expansive sub soil by cementing the soil particles together.
- Bagasse ash is free of cost and available locally, hence soil modification will prove economical.
- It effectively dries wet soils and provides initial rapid strength gain, which is useful during construction in wet, unstable ground conditions.
- Environmental pollution can be efficiently reduced.
- It can be concluded that sugarcane bagasse ash is an effective stabilizer for enhancing the geotechnical properties of sub-grade soil samples.
- The agricultural waste bagasse ash can be utilized for strengthening existing subgrade soil in expansive soil areas with a significant amount of saving in cost of construction.
- Accurate geotechnical investigation and soil stabilization ensures the safety of a structure up to a great extent.

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