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Augmenting the Geotechnical Characteristics of Soil by Dry Bagasse and Fly Ash

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ABSTRACT

Increase in industrialization and urbanization has resulted in pollution of available land, and most of the agricultural land has turned into construction sites lately. Large proportion of the agricultural land is black cotton soil having high swelling and shrinkage property. Thus the soil should be treated or replaced with a suitable and effective material to enhance its mechanical properties for construction of buildings, referred as soil stabilization. Cost-effective and economically feasible solutions for waste management are the valorisation of waste from sugarcane industries using dry bagasse and fly ash from coal power plants in improving soil characteristics. This review provides comprehensive understanding on use of fly ash in combination with dry bagasse as an effective soil stabilizer.

Key words: *Dry Bagasse, Fly ash, Geotechnical properties, Soil stabilization, Waste management*

Introduction

Revolution and urbanization is a significant milestone in the history of civilization. Since the development of machines and technology, there is a rapid improvement in formation of industrial centres and commercial buildings. The structural and design parameters are greatly affected by the quality of soil used for construction. However, solid waste generated can be applied for modifying soil characteristics and sustainable management of solid wastes (Meena *et al.*, 2019).

Expansive Soil

The expansive or weak soils are recognized by the term 'Black Cotton Soils' in Maharashtra, possessing weak properties because of presence of 'Montmorillonite' (Adewuyi and Moatshe, 2019). Till date the most widely accepted method for eliminating the destruction caused by expansive or weak soils is stabilization of soil using different chemical agents. Over time, cement and lime have been used for stabilizing soils (James and Pandian, 2016); however, their prices have increased sharply. Agro-industrial waste utility, especially of sugarcane dry bagasse, is a principal source for stabilization of soils. Dry bagasse amended with soil stabilizes it for effective enhancements of geotechnical properties (Dang, 2019) and provide a sustainable source. Increase in energy demand has resulted in construction of coal-burning power plants that generate large amounts of fly ash. Appropriate management of fly ash disposal can be resolved by using fly ash in construction materials.

Dry Bagasse and Fly Ash for Soil Stabilization

Dry bagasse is a stringy material generated from sugarcane plant after extraction of sugarcane juice (Oliveira, 2018). Bagasse contains inorganic crystalline fractions and pyrolysed organic fractions (Chanaka Udayanga *et al.*, 2019), large amounts of silica, an important component of cement replacing materials. The presence of amorphous silica in ba-

gasse indicates pozolonic properties that hold soil grains together for better shear strength.

Fly ash is an efficient source for soil stabilization obtained as an industrial by-product from mining plants and coke combustion. Fly ash Class C is mostly employed as an unconnected material and Class F is blended with chemical additive to enhance soil attributes. Fly ash consists of aluminosilicates materials that undergo alkali activation to generate geopolymer that is effective for soil stabilization (Turan *et al*., 2019). Some examples showing dry bagasse and fly ash for soil stabilization are:

i. A study conducted through James *et al*., (2016) mixed Portland cement blocks by dry bagasse resulting in increased strength of blocks and enhancement in water absorption.
ii. Takhelmayum, (2013) demonstrated strength of black cotton soils by means of fine and coarse fly ash mixtures. Peak strength observed using fly ash was 25% more against coarse fly ash.
iii. Dry Bagasse in amalgamation with rice husk ash may perhaps be used for the development of stabilized blocks without any other binding agent (Madurwar *et al*., 2014).
iv. Use of bagasse in porcelain stoneware increased linear shrinkage and water absorption ability along with reduced flexural strength (Schettino and Holanda, 2015).
v. Rajkumar *et al.,* (2016) demonstrated use of bagasse in design of pavement that was cheaper than conventional flexible pavements.

Conclusion

This stabilization of soil using waste materials in combination with dry bagasse and fly ash provides better results. Hence, industrial waste materials produced from different industries can help in resolving the problem and overcoming the effect of swelling in expansive soils. Similarly, coal power plants emit huge amounts of fly ash that acts as an effective soil stabilizer. This helps to modify the characteristic properties of soil and makes it efficient to be used in long run without any detrimental effects on buildings or roads.

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