International Journal of Multidisciplinary Research and Technology
ISSN 2582-7359, Peer Reviewed Journal, Impact Factor 6.325
www.ijmrtjournal.com
https://doi.org/10.5281/zenodo.12207355

OPTIMIZATION OF BAGASSE ASH CONTENT IN CEMENT STABILIZED LATERITIC SOIL

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Introduction

I worked on 6 lane Greenfield Ambala Ring Road project which starts from junction with shamli Ambala section of NH-344 (Design KM 18+226) and terminating at Ambala Ismailabad section of NH-152 (Design KM 40+750) where i witnessed with geotechnical properties with the help of baggase ash we can improve the quality of soil which results to strengthen the highway structure. Cement stabilisation is a common technique used by geotechnical engineers to improve the suitability of soils for construction. In many developing countries, lateral soil can be obtained readily and used for a variety of infrastructural projects. However, due of its high flexibility and low strength, employing lateritic soil may be challenging. Bagasse ash, a by-product of the sugar processing industry with a high silica content, has shown promise as an additive for soil stabilisation.Tropical climates are home to a large number of lateralitic soils, which present considerable construction issues because of their poor engineering qualities (high plasticity and low strength). As a result, methods for stabilizing soil, especially cement stabilization, have become popular as efficient ways to improve these soils' suitability for building. However, the addition of other ingredients, including bagasse ash, has drawn interest as a way to increase the effectiveness and sustainability of such stabilization techniques. A by-product of sugarcane processing called bagasse ash has been found to have pozzolanic qualities and may be added to lateritic soil that has been cement-stabilized. Its application provides the twin advantages of improving soil qualities and resolving environmental issues related to waste disposal. Enhancing the amount of bagasse ash added to cement-stabilized lateritic soil offers a way to increase engineering performance, construction techniques' cost-effectiveness, and sustainability. The purpose of this study is to investigate the effectiveness of this strategy, with an emphasis on the stabilized soil mixtures' mechanical characteristics, longevity, and environmental effects. By means of methodical inquiry and examination, this study aims to enhance soil stabilization methods for tropical areas, providing valuable perspectives on ideal material mixes and clearing the path for ecologically responsible building methods. Because of its high silica content, bagasse ash, a remnant left behind from burning sugarcane bagasse, has pozzolanic qualities in the sugar business. In the presence of moisture, this material demonstrates the potential to react with calcium hydroxide to produce additional cementitious compounds that aid in the densification and hardening of soil matrices. In addition, using bagasse ash for soil stabilization has the potential to alleviate environmental issues related to waste disposal, which is consistent with the ideas of sustainable development and the circular economy. Research efforts in the past few years have been focused on maximizing the use of bagasse ash and cement to stabilize lateritic soils. Through meticulous manipulation of the ratios and combinations of these components, scientists aim to produce synergistic effects that improve stabilized soil mixture performance and sustainability. The optimization method comprises a thorough assessment of mechanical qualities, including modulus of elasticity, flexural strength, and compressive strength, as well as durability factors, such as resistance to chemical assault, moisture infiltration, and environmental deterioration. The goal of this study is to add to the increasing amount of information on bagasse ash optimization in lateritic soil stabilized with cement. It attempts to clarify the impact of different material compositions on the engineering qualities of stabilized soils by methodical testing and analysis, offering insights into ideal mix designs for real-world applications in construction. In order to create more robust and resource-efficient infrastructure in tropical areas, this research aims to integrate the concepts of sustainability, environmental stewardship, and technical innovation.

Background of the Study

Ordinary stabilisers, such limestone and cement, might be pricey since lateritic soil is frequently utilised in underdeveloped nations. As a by-product of manufacturing, bagasse ash is frequently less expensive. By adding additional bagasse ash to the cement-stabilized lateritic soil, it may be possible to make lateritic soil stabilisation more feasible for infrastructure projects in areas with limited resources. Due to its high degree of flexibility, low level of strength, and propensity for erosion, lateral soil presents difficulties. To enhance the engineering qualities of lateritic soil, bagasse ash can be applied. Increased engineering merit for use in building is the aim of soil stabilisation procedures. Traditional stabilisers like cement and lime are now often used. Previous researchers actively explored towards substitute stabilisers due to the high cost and environmental problems connected with these substances. The investigation on the alteration of bagasse ash content in cement-stabilized lateritic soil is a result of the research for efficient and affordable soil stabilisation methods . Benefits of using bagasse ash as a partial substitute for cement include increased strength, less plasticity, increased durability, and a decreased dependency on conventional stabilisers. By converting industrial waste into a useful resource, the previous researches compiled with the concepts of waste management and circular economy. The stabilised soil's durability, permeability, strength, and consolidation may all be improved by increasing the ash content, making it appropriate for a variety of building applications.

Objectives

The primary goal of this research is to maximise the bagasse ash concentration in cement-stabilized lateritic soil in order to obtain optimum strength and durability. The precise goals are as follows:

- The main goal of this study is to increase the geotechnical performance of cement-stabilized lateritic soil by optimising the bagasse ash concentration.
- To analyse the plasticity, consolidation, and strength variables of the native lateritic soil's geotechnical properties.
- To evaluate the influence of bagasse ash on the engineering qualities of the stabilised soil by employing SEM (scanning electron microscopy)
- To provide empirical models or recommendations for the best use of bagasse ash on lateritic soil stabilised with cement.

LITERATURE REVIEW

According to Okonkwo (2015), Bagasse ash usage as more than just pozzolanic materials throughout soil stabilisation has gotten a considerable amount of attention in the literature. Zainab *et al.* (2018) examined the impact of varied bagasse ash quantities on the durability and strength of cement-stabilized laterite. Previous studies have used varied quantities of bagasse ash, spanning around 5% to 25% by the cement's weight (Ekperusi *et al.* 2019). In accordance with these studies, adding bagasse ash to soil enhances its strength properties, longevity, and practicability (Ogundipe *et al.* 2021). In the presence of moisture, the hydration reaction combining bagasse ash as well as Ca(oh)2 generates the hydrate of calcium silicate fluid, which enhances soil resilience and longevity (Gnanamoorthy *et al.* 2019).

Ofuyatan *et al.* (2021) investigated the viability of replacing some cement with bagasse ash to support lateritic soil. According to Seco *et al.* (2022), adding bagasse ash to the stabilised soil made it stronger and more resilient. On the other hand, Vinayagamoorthy (2020) asserted that cement-stabilized lateritic soil was adversely affected by bagasse ash. The study's findings were that bagasse ash increased the soil's stability properties and lowered its permeability (Moghal *et al.* 2018). However, the study did not focus on increasing the bagasse ash content.

Raghuram *et al.* (2020) looked at the possibility of using bagasse ash in place of some cement to maintain lateritic soil. Another study discovered by Pangaluru *et al.* (2019) that the addition of bagasse ash increased the stability and strength of the stabilised soil. The proper ash content, however, was not identified. But Nagaraj *et al.* (2021) examined how bagasse ash impacts the lateritic soil's engineering characteristics. The outcomes showed that the soil's strength and plasticity were both improved by the addition of bagasse ash.

Ogunbayo *et al.* (2021) carried out an experimental examination into the use of bagasse ash in cement stabilisation of lateritic soil. According to Andavan and Pagadala (2020), adding bagasse ash increased the stability soil's strength, compaction, and durability. However, the bagasse ash content was not especially optimised by the study.

Ekperusi *et al.* (2019) assessed how bagasse ash affected the lateritic soil's engineering characteristics. The findings demonstrated that bagasse ash enhanced the soil's strength and lowered its flexibility. The best performance, according to Vinayagamoorthy (2021), was attained at 15% of the ideal ash concentration. Ofuyatan *et al.* (2021) researched ways to increase the quantity of bagasse ash in cement-stabilized lateritic soil. To determine the right ash concentration for producing the desired strength properties, the researchers used a response surface technique (Alazigha *et al.* 2018). According to the investigation done by (Ikeagwuani and Nwonu, 2019), the bagasse with the highest compressive strength included 13.6% ash.

According to Adetayo *et al.* (2019), the appropriate quantity of bagasse ash needed for maximum strength and durability, on the other hand, varies depending on various parameters, including curing time, water-cement ratio, and soil properties such as clay content and particle size distribution. Some research has shown that the best quantity of bagasse ash by weight of cement is between 10% and 15%, while others have stated that the optimal amount might be as high as 25% for particular applications (Hartley *et al.* 2021). Overall, the research shows that adding bagasse ash to cement-stabilized lateritic soil may greatly increase its performance. Nevertheless, the ideal quantity of bagasse ash for each given application must be established via further study, taking into consideration soil conditions and intended application features (Kraemer *et al.* 2019).

PROBLEM STATEMENT

Despite tremendous advances, the ideal quantity of bagasse ash needed to produce maximal strength and durability in cement-stabilized lateritic soil remains unknown (Salahudeen and Ochepo, 2015). The uncertainty about the correct quantity of bagasse ash is a serious issue since it impacts the economic viability and environmental sustainability of employing bagasse ash in soil stabilisation (Adetayo *et al*. 2019). Too little bagasse ash may lead to poor soil performance, while too much bagasse ash can lead to greater expenses and potentially detrimental environmental effects.

Need for the research

The application of bagasse ash to cement-stabilized lateritic soil is a viable strategy for long-term soil stabilisation. However, a detailed understanding of the optimum concentration of bagasse ash required to achieve the required engineering properties of the stabilised soils is inadequate (Alazigha *et al.* 2018). The goal of this work is to close this knowledge gap and provide practical guidance for increasing the quantity of ash from bagasse in cement-stabilized lateritic soil. Bagasse ash is a pozzolanic substance that has the ability to improve the characteristics of cement-stabilized lateritic soil. As a consequence, the purpose of this study is to optimise the bagasse ash concentration in stabilized cement lateritic soil in order to obtain maximum strength and durability.

METHODOLOGY

The first step will involve the collection of lateritic soil and bagasse ash samples. Next, this research will follow a laboratory-based experimental approach to achieve the research objectives (Adetayo *et al.* 2019). The chemical, as well as physical properties of the soil and ash, will be determined using standard procedures.

Data Source

This study will make use of both primary and secondary data. The basic data will be gathered through laboratory experiments (Adetayo *et al.* 2019). For the secondary data collection process, supplemental information on the engineering qualities of cement-stabilized lateritic rock including the bagasse ash, including test results, case studies, and suggestions, may also be included in these articles (Kraemer *et al.* 2019). Researchers may find important information by having access to these reports.

Sampling

Field surveys can be used to identify the best areas to sample native lateritic soil. To track changes in soil properties, representative soil samples can be taken at different depths using a hand auger or a soil probe. ***Samples of bagasse*** ash can be obtained from companies that produce trash from sugarcane, such as sugar refineries (Hartley *et al.* 2021). The ash may be collected from the industrial process itself or from the ash disposal regions. Then, the ***laboratory experiments*** might be considered a supplementary sample collecting method after initial sample collection. Representative soil and ash samples must be used in investigations employing ***standardised laboratory techniques (Test)*** to accomplish it (Ikeagwuani and Nwonu, 2019). For the secondary research, a thorough investigation of pertinent information might be employed as a secondary sample collection approach, similar to what was done in the literature review phase.

Expected Outcome

The study's goal is to find the best quantity of bagasse ash to add to cement-stabilized lateritic soil to increase its durability as well as strength. The research's intended conclusion is crucial because it will give vital information that the building industry can use to encourage sustainable construction practices. The study's results will assist construction professionals in making informed decisions about employing bagasse ash in cement-stabilized laterite. Moreover, the study will contribute to existing knowledge concerning the use of agricultural waste materials, including bagasse ash, throughout the construction industry (Adetayo *et al.* 2019). The outcomes of this study will also provide light on the possible environmental advantages of using bagasse ash as a sustainable building material. Moreover, this research will contribute to the body of information on the usage of local resources, which may lower the cost and environmental effect of getting materials from far distances. Academic papers, presentations at conferences and seminars, and other appropriate venues will be used to disseminate the study results. This research is intended to contribute to the development of environmentally friendly and economically feasible sustainable building strategies.

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