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A Review On Stabilization Of Black Cotton Soil Using Building Materials

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ABSTRACT :

This study explores the use of fly ash, glass powder, cement, lime, and eggshell powder to stabilize black cotton soil in order to enhance its geotechnical qualities. Black cotton soil presents major building issues due to its low bearing capacity and excessive shrink-swell behaviour. To improve soil performance, the study will add these stabilizers in different amounts (5% to 30% of soil weight). Various laboratory tests are used to assess changes in plasticity, density, and strength, including Atterberg limits, Proctor compaction, California Bearing Ratio (CBR), unconfined compressive strength (UCS), and permeability. While glass powder and fly ash increase density and decrease water absorption, lime and cement promote soil cohesiveness and decrease flexibility. Because it is high in calcium, eggshell powder aids in the pozzolanic process, which increases the stability of the soil. Findings indicate that maximum dry density (MDD), CBR, and UCS values significantly increased while optimal moisture content (OMC) and swelling decreased. The results show how these environmentally friendly materials can be used for sustainable soil stabilization and building.

Keywords: Black cotton soil, lime, cement, fly ash, glass powder, egg shell powder, consistency limits, UCS, CBR

INTRODUCTION :

Black cotton soil, which is found all over India, is a very expansive soil that presents difficulties for building because of its low bearing capacity, high shrink-swell potential, and poor shear strength. For this soil to become appropriate for construction and to increase its engineering qualities, stabilization is necessary. The chemical and physical characteristics of building materials including eggshell powder, fly ash, cement, lime, and glass powder make them popular stabilizers. By encouraging pozzolanic processes and increasing soil plasticity, lime increases strength and decreases swelling. Because cement has binding qualities, soil cohesiveness and load-bearing ability are increased. Coal burning produces fly ash, a byproduct that increases density and decreases water retention. For pozzolanic reactions, glass powder provides silica, and eggshell powder, which is high in calcium carbonate, improves soil stability by encouraging cementitious bonding. These materials were selected due to their affordability, accessibility, and capacity to handle characteristics such as strength, density, plasticity, and moisture content. They improve the soil's durability and construction suitability by altering its chemical and physical makeup.

LITERATURE REVIEW :

- The study investigates into stabilizing black cotton soil using lime to enhance its engineering qualities. Black cotton soil, which is common in India, presents difficulties because of its high rate of swelling and shrinking. Lime stabilization was evaluated with 3% and 5% lime concentration, which involves a pozzolanic interaction between hydrated lime and clay particles. Liquid limit, plastic limit, compaction, and California Bearing Ratio (CBR) tests were among the tests conducted. Results indicated that 3% and 5% lime increased Maximum Dry Density by 6.29% and 5.59%, respectively, while decreasing the liquid limit by 2.7% and 15.27%. The load-bearing capacity increased by 3.25 and 4.76 times as a result of the notable improvement in CBR values. With 3% and 5% lime, the swelling pressure dropped by 28% and 55%, respectively. The study came to the conclusion that lime successfully improves black cotton soil's workability, strength, and stability, making it appropriate for construction projects.
- The study examines into the use of glass powder (GP) and egg shell powder (ESP) as additions to stabilize black cotton soil. The significant swelling and shrinking of black cotton soil, which is plentiful in the Vidarbha region of Maharashtra, presents engineering issues. In order to evaluate soil samples for moisture content, grain size distribution, consistency limits, Standard Proctor, and unconfined compressive strength (UCS), ESP (5%, 10%, 15%) and GP (2%, 4%, 6%) were added. The findings demonstrated that both ESP and GP successfully increased soil strength, with 10% ESP and 4% GP producing the most benefit. These additions resulted in a large rise in UCS, but the percentage decline was greater. The maximum UCS, indicating synergistic effects, was obtained when 10% ESP and 4% GP were used together. ESP and GP are

cost-effective and environmentally friendly stabilizers for black cotton soil, according to the study's findings, which also improve soil performance for building applications.

- The study focuses on soil from Degirmenlik and Tuzla, Cyprus, to assess how well Class C fly ash stabilizes expansive soils. These montmorillonite-rich soils have significant swelling and shrinking, which can lead to structural problems. Tests such as Atterberg limits, swelling potential, and cation exchange capacity (CEC) were performed after adding 15% and 25% fly ash to these soils. Particularly in the highly plastic Degirmenlik soil, where swell potential dropped to 3.7% with 25% fly ash, the results demonstrated that fly ash affected both plasticity and swelling potential. Because of pozzolanic processes that created granular soil with a lesser capacity to absorb water, CEC values decreased. Additionally, fly ash changed the soil's categorization from clayey to silty, indicating better qualities. According to the study's findings, fly ash stabilizes expansive soils and solves fly ash disposal problems in an efficient and cost-effective manner.
- The study investigates into how to improve the geotechnical qualities of black cotton soil by stabilizing it with bone ash (BA) and ordinary Portland cement (OPC). Highlighting issues with expanding soils, the introduction suggests environmentally beneficial alternatives through the use of agricultural and industrial waste. California Bearing Ratio (CBR), compaction, unconfined compressive strength (UCS), Atterberg limits, and blending OPC and BA in varied ratios (0–8% OPC and 0–10% BA) were all tested under various compactive efforts. After 28 days, the UCS increased from 752 to 2667 kN/m², the soaking CBR reached 74%, and the plasticity index decreased, indicating that 6% OPC and 6% BA offered the best stability. By providing affordable and environmentally friendly stabilization techniques, this blend greatly increased the soil's workability, strength, and suitability as sub-base material. The study comes to the conclusion that in soil stabilization applications, it is possible to reduce costs and environmental impact by replacing 50% of the cement with BA.
- The study investigates how fly ash and lime can stabilize black cotton soil to enhance its engineering qualities for building applications. Changes in moisture cause black cotton soil to swell and contract, which compromises the soil's structural integrity. Lime (3%–12%) and fly ash (10%–40%) were mixed with the soil in the experiments, and characteristics like compaction, plastic limit, liquid limit, and California Bearing Ratio (CBR) were assessed. The results showed that while fly ash lowers the liquid and plastic limits while increasing CBR, lime raises the liquid and plastic limits and lowers the maximum dry density (MDD). The best results were obtained with 12% lime and 40% fly ash. The greatest CBR value of 7.99 was obtained with a blend of 20% fly ash and 12% lime, which qualified it for subgrade applications. The results validate the use of fly ash and other industrial wastes with lime to enhance soil stability, lower environmental risks, and promote environmentally friendly building methods.

CONCLUSION :

The literature analysis shows that the engineering qualities of troublesome soils, especially expansive and black cotton soils, are much improved by the use of construction materials as stabilizers. Stabilizers such as lime, fly ash, glass powder (GP), egg shell powder (ESP), bone ash (BA), and ordinary Portland cement (OPC) are useful for enhancing the workability, stability, and strength of soil. These substances make soils appropriate for construction uses including road subgrades, foundations, and embankments by reducing swelling, shrinkage, and deformation under stress. Lime stabilization improves the California Bearing Ratio (CBR) by 3.25-4.76 times, lowers the liquid limit by 2.7%-15.27 percent, increases the Maximum Dry Density (MDD) by 5.59%-6.29%, and lowers swelling pressure by 28%-55%. By converting clayey soil to silty soil, fly ash (10%–40%) reduces water absorption and swelling potential by up to 96%, decreases liquid and plastic limitations, and raises CBR up to 7.99. 10% ESP and 4% GP yield the greatest benefits. GP (2%–6%) and ESP (5%–15%) work in concert to maximize soil stability and increase Unconfined Compressive Strength (UCS). By substituting up to 50% of cement, BA (6%–10%) and OPC (6%–8%) improve soaking CBR to 74%, decrease the plasticity index, and raise UCS from 752 to 2667 kN/m², making the soil perfect for sub-base applications while reducing expenses and environmental effects. Soil qualities are assessed using tests like Atterberg limits, UCS, CBR, compaction, moisture content, and grain size distribution. By utilizing agricultural and industrial wastes, lowering environmental risks, and resolving material disposal issues, these stabilizers make sustainable construction possible. In order to create environmentally friendly and economically viable soil stabilization solutions, future research can examine the long-term performance of these stabilized soils, optimize material combinations for a variety of soil types, and create sophisticated techniques for large-scale applications in infrastructure projects.

REFERENCES :

1. Pallavi, P. T., & Poorey, P. D. (2016). Stabilization of black cotton soil using fly ash and nylon fibre. *Int Res J Eng Technol*, *3*(11), 1283-1288.
2. Muhammad, A., & Abdulfatah, A. Y. (2019). Geotechnical Study of the Properties of Black Cotton Soil Treated with Cement and Bone Ash as Admixture. *Journal of Construction and Building. Material Engineering*, *5*(2), 21-38.
3. Ramlakhan, B., Kumar, S. A., & Arora, T. R. (2013). Effect of lime and fly ash on engineering properties of black cotton soil. *International Journal of Emerging Technology and Advanced Engineering*, *3*(11), 535-541.
4. Mishra, B. (2015). A study on engineering behavior of black cotton soil and its stabilization by use of lime. *International Journal of Science and Research*, *4*(11), 290-294.
5. Paithane, M. (2022). STABILIZATION OF BLACK COTTON SOIL BY USING EGG SHELL POWDER AND GLASS POWDER. *Vidyabharati International Interdisciplinary Research Journa*, *14*, 39-48.
6. Nalbantoğlu, Z. (2004). Effectiveness of class C fly ash as an expansive soil stabilizer. *Construction and Building Materials*, *18*(6), 377-381.