

EFFECT OF COIR HUSK FIBRE ON RICE HUSK ASH AND CEMENT BASED PEAT STABILISATION

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Peat soils, with their high organic content, excessive compressibility, and very low shear strength, pose critical challenges for construction in tropical regions such as Sri Lanka. Conventional stabilisation practices rely mainly on cement, which, although effective, contribute significantly to greenhouse gas emissions and raise project costs. In the context of sustainable construction, this study explores the potential of rice husk ash (RHA) and coconut coir fibre, two locally available agro-industrial by-products, as partial replacements for cement in peat stabilisation. By utilising these alternatives, the research aims to balance technical performance with environmental and economic sustainability.

This study aims to examine the effect of coir husk fibre on rice husk ash (RHA) and cement-based peat stabilisation. The first objective is to evaluate the improvement in strength properties of peat stabilised by partially replacing cement with coir husk fibre and RHA, and to determine the optimum mix proportions through experimental analysis. The second objective is to assess sustainability by conducting a life cycle assessment (LCA) and comparing the cost of conventional stabilisers with coir husk fibre, cement, and RHA-based peat stabilisation.

A laboratory program was designed with control samples containing 30% cement and 70% peat. Modified samples were prepared with reduced cement content (15–25%) supplemented by varying proportions of RHA (4.5–13.5%) and coir fibre (0.5–3%). Mechanical behaviour was assessed through unconfined compressive strength (UCS) tests at 10 and 28 days of curing. Fourier-Transform Infrared Spectroscopy (FTIR) analysis was conducted to confirm the pozzolanic reactivity of RHA. Sustainability performance was evaluated using LCA and cost analysis, comparing the modified mixes against the control.

The results showed that optimal stabilisation was achieved with 25% cement, 0.5% coir fibre, and 4.5% RHA, which reached a UCS of 512 kPa after 28 days, closely approaching the 570 kPa of the control mix. Increasing coir content beyond 0.5% led to reduced strength due to fibre agglomeration and voids. When cement content was reduced to 20%, strength decreased to 331 kPa, although sustainability benefits increased significantly. At 15% cement, UCS dropped to only 50.87 kPa, rendering it unsuitable for engineering applications despite over 50% reductions in cost and CO₂ emissions.

Overall, the study concludes that moderate cement replacement using RHA and limited amounts of coir fibre provides an effective and eco-friendly approach to peat stabilisation. The recommended range of 20–25% cement combined with 4.5–9% RHA and 0.5–1% coir fibre balances mechanical performance with sustainability, making it suitable for ground improvement in low to medium-load applications such as road subgrades and embankments. By valorising locally available waste materials, this approach supports sustainable construction practices, reduces environmental burdens, and offers cost savings, contributing to greener infrastructure development in peat-rich regions.

Keywords: Soft ground improvement, Pozzolanic reaction, Unconfined compressive strength, Cost analysis, Life cycle assessment

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