Geopolymer Production From Waste Polyethylene Terephthalate and Glass For Clay Subgrade Stabilization

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In this study, the efficacy of Polyethylene Terephthalate (PET) and Waste Glass Powder (WGP) as soil stabilizers was investigated to address the research questions and objectives. It examines the enhancement of mechanical strength of clayey subgrade soils sourced from Ogun state, Nigeria across varying proportions (5% −20%) including the potential cost analysis. Providing experimental insights into soil stabilization using PET individually and in combination with WGP-based geopolymers. Optimal stabilization was achieved at 5% PET, accompanied by 5%-20% WGP, and activated with a 2M NaOH solution. Results demonstrated enhanced mechanical strength with both stabilizers, with the combination of PET and WGP proving the most effective. Specifically, stabilization with 5% PET (1.18mm) WGP geopolymer, activated with 2% NaOH, yielded optimal results, exhibiting UCS values ranging from 180kN/m^2 to 320kN/m^2, surpassing cement-based stabilization (UCS value: 380kN/m^2). Moreover, durability testing revealed significant improvements, with PET+WGP samples displaying a UCS mean of 259.4kN/m^2, a weight of 89.67g, and a percent change in mean and weight of −25.79% and −25.86%, respectively, compared to cement-stabilized soil (UCS mean: 408.66 kN/m^2, percent change: 2.15%, weight mean: 109.25g, percent change: -25.86%). Furthermore, PET+WGP exhibited a 125% increase in CBR compared to PET alone and a better cost reduction of $6,153,850,000.00 for 100km, highlighting its superior performance and cost reduction. The findings of this study hold significance for informed decision-making in material selection for road pavement works, offering an alternative method and contributing to Sustainable Development Goals and Circular Economy initiatives by advocating sustainable waste management and road infrastructure.

Keywords: CLAY SOIL STABILIZATION; COMPREHENSIVE STRENGTH (UCS); ENVIRONMENTAL SUSTAINABILITY; POLYTHENE TEREPHTHALATE (PET); SUSTAINABLE TECHNOLOGY; UNCONFINED; WASTE RECYCLED GLASS POWDER (RGP)

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