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Effect of Adding Waste High-Density Polyethylene Flakes on the Subgrade Soil Behavior and Characterization for Pavement Applications

Arijit Kumar Banerji, Md. Hamjala Alam, Chanchal Das, and Shovan Roy

Abstract The widespread use of high-density polyethylene (HDPE) plastic products potentially leads to numerous environmental concerns. As a result, it is essential to identify techniques to recycle these wastes without posing environmental risks. The effect of adding waste HDPE flakes on the behavior and characterization of subgrade soil for pavement applications is investigated in this study. Geotechnical laboratory tests, including proctor compaction, California Bearing Ratio (CBR), and unconfined compressive strength (UCS) were carried out to assess the effectiveness of the stabilization with HDPE flakes (1, 3, and 5% by weight of soil). Laboratory investigations showed that the UCS and CBR values of subgrade soil were greatly improved by adding HDPE. The optimum replacement was found to be 5% by weight of soil, and the improvements in proctor compaction, CBR, UCS, and pavement thickness were estimated to be 18.46%, 51.21%, 24%, and 10.82%, respectively. Using the CBR values of the subgrade, the design of flexible pavement has been attempted using the IRC 37:2018 specifications and IITPAVE tool to determine the improvement in the structural behavior of the reinforced pavement section. For simplicity, the linear elastic behavior has been simulated for the bituminous layers, cemented base, granular sub-base, and subgrade layers. The results of the IITPAVE analysis demonstrated that HDPE could be an effective reinforcement for the subgrade layer in road construction. For an increase in HDPE content, the surface deflection and maximum vertical strain were reduced compared to the unreinforced subgrade layer.

Keywords High-density polyethylene · Subgrade · California bearing ratio · Flexible pavement · IITPAVE

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