

Clayey Soil Improvement: Sustainable Solutions with Ladle Furnace Slag and Recycled Fibers from Wind Turbine Blades

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Abstract

This research delves into the utilization of industrial by-products as stabilizers to enhance soil bearing capacity, aiming to offer more sustainable alternatives to conventional lime or cement stabilization methods. In this study, the feasibility of using ladle furnace slag (LFS) as a binder for stabilizing clayey soils instead of lime is investigated, verifying compliance with the technical specifications of Spanish standards. Mainly, plasticity, unconfined compressive strength (UCS), and the CBR index, as well as its expansive behavior, were analyzed for this purpose. Additionally, the study examines the impact on UCS by incorporating fibers sourced from dismantled wind turbine blades, commonly referred to as Raw-Crushed Wind-Turbine Blade (RCWTB). The findings indicate that the addition of LFS to the soils leads to a slight decrease in the plasticity index. Moreover, the CBR of the soil experiences a significant improvement, rising from 5.3% to 74% immediately after mixing with 5% LFS. Furthermore, after 90 days of curing, a noteworthy 118% enhancement in UCS is observed compared to untreated soil, surpassing stabilization levels achieved with a 2% lime addition by 33%. The analysis includes monitoring pH levels in mixes during curing period, showing that the initially high pH in soils stabilized with LFS is sustained, promoting pozzolanic reactions and enhancing soil strength. Additionally, incorporating 1% RCWTB into the mix enhances UCS by 30% after 90 days of curing.