Environmental Engineering and Management Journal

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PROPERTIES OF BIO-BASED CONSTRUCTION MATERIAL MADE WITH INDUSTRIAL WASTES

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Abstract

The civil engineering sector is shifting toward sustainable development, with environmental protection as an important objective. In order to reduce CO_2 emissions and aggregate extraction, as well as improve the mechanical performances and durability of concrete, this study looked at the feasibility of using industrial granite waste (GW) as a substitute for natural sand (NS) at 10, 20, 30, and 40 wt% combined with seashell powder waste (SSP) as a substitute for cement (OPC) at 5, 10, and 15 wt% to produce an ecological self-compacting sand-concrete (SCSC). The physical, mechanical, and durability performances of SCSC mixtures are evaluated using the setting time, mini-slump flow, V-funnel flow time, compressive and flexural strengths, abrasion resistance, and alkali-silica reaction (ASR) tests. The microstructure development of certain hardened SCSC mixtures was examined using SEM analyses. The obtained results indicate that the addition of up to 15% SSP to GW-based SCSC provides satisfactory flowability with a low superplasticizer (SP) dosage and extended setting time. Furthermore, it can fill the voids caused by the GW particles, thus improving the compressive and flexural strength and abrasion resistance, and can be prescribed within the 0.1% limit of the alkali-silica reaction (ASR). Moreover, the addition of SSP and GW enhanced the microstructure of SCSC mixtures by enriching the formation of additional C-S-H while meeting the durability requirements. Finally, the combination of up to 15% SSP and 40% GW may be used for producing eco-friendly concrete with all the properties required by the construction industry for various types of structural components, as well as reducing material costs and achieving sustainable development.

Key words: durability, eco-self-compacting sand-concrete, granite waste, physical-mechanical properties, seashells

Received: September, 2024; Revised final: June, 2025; Accepted: August, 2025

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