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COMBINED EFFECTS OF CERAMIC AND GRANITE INDUSTRIAL WASTES ON ENGINEERING PROPERTIES OF SELF-COMPACTING SAND CONCRETE

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Abstract

The concrete industry consumes a significant amount of natural resources, which has an impact on global warming and climate change. Therefore, many attempts have been made to develop green and eco-friendly concrete from various waste materials. Granite and ceramic wastes industrial byproducts that are generated in huge quantities from the granite polishing and ceramic tile industry, respectively, cause serious environmental problems. Therefore, using these non-biodegradable wastes for making building materials presents an effective and sustainable endeavor to environmental problems through the reduction of natural non-renewable resources extraction and solid wastes disposal problems, with a low cost as well. This study experimentally investigates the feasibility of using combined ceramic waste (CW) and granite waste (GW) as an alternative to natural sand (NS) in self-compacting sand concrete (SCSC) manufacturing. The CW and GW were simultaneously partially replaced sand in 5, 10, 15, 20, 25, and 30% and 10, 20, 30, 40, 50, and 60%, respectively. A total of seven mixes were cast, including the control mix (CSCSC) and six mixes with the combined addition of CW and GW. Several tests were performed on fresh and hardened mixes to assess the flowability, mechanical, durability, and microstructure performances of the produced SCSCs. The obtained results show a negative effect on the fresh properties of all SCSC mixes as the amount of CW and GW increases. However, all the flow diameter and V-funnel flow time values were discovered to be within an acceptable range according to the EFNARC recommendations. The results also show that adding up to 30% CW and 60% GW presents the best substitution rate for fine aggregate in SCSC. Whereas, the SCSC mix prepared with the combined use of 30% CW and 60% GW (i.e., the C30G60 mix) exhibited the highest compressive strength, flexural strength, ultrasonic pulse velocity, apparent density, and lower permeable voids. The better acid attack resistance and lower water absorption were found for mix with 20% CW and 40% GW. Scanning electron microscopy (SEM) images revealed a denser microstructure and a stronger transition zone (ITZ) between the aggregate and cement paste for the C30G60 mix.

Key words: acid attack resistance, ceramic waste, granite waste, physical-mechanical properties, self-compacting sand concrete

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