Influence of nano waste materials on the mechanical properties, microstructure, and corrosion resistance of self-compacted concrete

Recycling Nano wastes materials (NWM) including Nano waste glass (NWG) and Nano waste ceramic (NWC) as an eco-friendly alternative binder helps the reclamation of construction waste and reduces the demand for cement. Considering that self-compacted concrete (SCC) which needs high powder content has been largely used in building engineering due to its high flow ability, which allows it to self-compact and maintain homogeneity without separation, and thus, substituting NWM for partial cement in preparing SCC is more sustainable. This paper explores the effect of replacing cement in SCC with nanomaterials that were made in two ways. The first way is the milling technique, where glass and ceramic wastes are converted to NWM to overcome the problem of some wastes and the emission of CO2 during ordinary Portland cement manufacturing. The second way Also, to compare the behavior, a chemically prepared NS by precipitation technique was used. Several SCC mixes were made using nanomaterials as cement replacement materials with replacing percent up to 5% and analyzed. Fresh properties, mechanical characteristics, microstructure, and corrosion rate of SCC mixes were studied. The testing results revealed that SCC's flow ability, passing ability, and viscosity declined as the NS, NWG, and NWC increased while being within the EFNARC-2005 recommended limit. Waste milled nanomaterials are comparable to nano -silica, which is chemically prepared to improve SCC mechanical properties and purify the microstructure; replacing cement with 3% NWG increased compressive strength by 32.4%, while NWC and NS increased compressive strength by 17.3% and 26.4%, respectively. Replacing cement with nanomaterials decreases the anodic and cathodic over potentials and shifts the corrosion potential (Ecorr) of high-strength steel (HSS) embedded in SCC specimens cured in 3.5% NaCl solution to preferable values, in addition to reducing the current densities of corrosion (Icorr).