

Reactivation of Hydrated Cement and Recycled Concrete Powder by Thermal Treatment for Partial Replacement of Virgin Cement

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Abstract : The generation of Construction and Demolition Waste (CDW) has globally increased enormously due to the enhanced need in construction, renovation, and demolition of construction structures. Several studies investigated the use of CDW materials in the production of new concrete and indicated the lower mechanical properties of the resulting concrete. Many other researchers considered the possibility of using the Hydrated Cement Powder (HCP) to replace a part of Ordinary Portland Cement (OPC), but only very few investigated the use of Recycled Concrete Powder (RCP) from CDW. The partial replacement of OPC for making new concrete intends to decrease the CO₂ emissions associated with OPC production. However, the RCP and HCP need treatment to produce the new concrete of required mechanical properties. The thermal treatment method has proven to improve HCP properties before their use. Previous research has stated that for using HCP in concrete, the optimum results are achievable by heating HCP between 400°C and 800°C. The optimum heating temperature depends on the type of cement used to make the Hydrated Cement Specimens (HCS), the crushing and heating method of HCP, and the curing method of the Rehydrated Cement Specimens (RCS). This research assessed the quality of recycled materials by using different techniques such as X-ray Diffraction (XRD), Differential Scanning Calorimetry (DSC) and thermogravimetry (TG), Scanning electron Microscopy (SEM), and X-ray Fluorescence (XRF). These recycled materials were thermally pretreated at different temperatures from 200°C to 1000°C. Additionally, the research investigated to what extent the thermally treated recycled cement could partially replace the OPC and if the new concrete produced would achieve the required mechanical properties. The mechanical properties were evaluated on the RCS, obtained by mixing the Dehydrated Cement Powder and Recycled Powder (DCP and DRP) with water ($w/c = 0.6$ and $w/c = 0.45$). The research used the compressive testing machine for compressive strength testing, and the three-point bending test was used to assess the flexural strength.

Keywords : hydrated cement powder, dehydrated cement powder, recycled concrete powder, thermal treatment, reactivation, mechanical performance

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