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Abstract

Effect of Carbon Nanotubes (CNTs) on Chloride Penetration Resistance and Physical-Mechanical Properties of Cementitious Materials †

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Abstract: According to currently enforced Eurocode 2 for the design of reinforced concrete structures, it is essential to protect steel reinforcements from corrosion and concrete from degradation under aggressive environmental conditions such as marine, urban, industrial environments and soils, to which these are normally exposed. In this context, this experimental study investigates the enhancement of the physico-mechanical properties of common cement-based mortars and the electrochemical properties of reinforcing steel, through the addition of nanomaterials in the mix. For the experimental set-up, cylindrical, prismatic, and cubic specimens of different dimensions were cast and were partially immersed in sodium chloride solution for eight months. To evaluate the corrosion of steel rebars, cylindrical cement mortar specimens were used in order to induce a constant cover between exposure and the reinforcement; the physical and the mechanical tests were carried out on standardized shape cubes and prisms, respectively. Two groups were considered: cement-based mortar composites with 0.5 wt.% CNTs addition and plain (reference) specimens without any addition of nanomaterials, for comparison. The influence of adding CNTs on chloride penetration resistance was subsequently evaluated using standardized and non-standardized testing techniques: tests such as flexural strength and porosity, mass loss of steel, electrochemical measurements (corrosion current, HCP) and total chloride content calculation. The test results showed that using CNTs as an addition in mortar production led to the protection of steel rebars against pitting corrosion; moreover, an improvement (almost 9% at 120 days) in flexural strength and reduced porosity of mortars was also observed compared to the reference specimens without CNTs.

Keywords: carbon nanotubes; pitting corrosion; corrosion current; half-cell potential; porosity; flexural strength; cement-based mortar

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