Threshold Level of Chloride Ions for Corrosion of SD345 Carbon Steel Reinforcement in Concrete

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Reinforced concrete is one of the most commonly used materials in the construction industry. The most and main causes of reinforcement corrosion in concrete structures are chloride attack and carbonation. Many studies have been carried out in this field so far, but due to the multitude of influencing factors and their complexity, different results have been obtained. In this study, reinforced concrete samples were prepared and investigated to monitor the threshold of chloride concentration for corrosion of SD345 carbon steel rebar using the electrochemical impedance spectroscopy (EIS) and half-cell potential (HCP) tests. A series of electrolyte solutions containing different NaCl contents, that is, 0, 1, 2 and 3 wt%, were used to simulate the chloride environment. Given that the HCP values are relatively low for carbon steel rebars, there are a high possibility for corrosion of all samples. By increasing the NaCl content in electrolyte solution, the current density values were increased from the early stages, indicating corrosion enhancement in the samples with increasing chloride ions in solution. The EIS results show that resistance of passive film gradually decreased by increasing the chloride concentration which shows that non-protective corrosion and porous products have been advanced on the surface of steel rebar. Furthermore, the EIS findings indicated an obviously increase of charge transfer resistance and a clearly reduction in the non-ideal interfacial capacitance after 16 weeks exposed to 2 wt% NaCl solution which can be attributed to the high degree of hydration and the efficiently refined the pore structure of the reinforced concretes. Scanning electron microscopy analysis confirmed the results obtained by electrochemical experiments.

Keywords: SD345 carbon steel rebar; Corrosion resistance; Electrochemical study; Threshold level of chloride ions; Half-cell potential

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