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Abstract

Throwing Power of Embedded Anodes for the Galvanic Cathodic Protection of Steel in Concrete †

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Abstract: The chloride-induced corrosion of steel reinforcement is one of the main causes of deterioration of reinforced concrete structures. Cathodic protection (CP) of steel in concrete is a widely accepted repair technique to reduce, or completely stop, reinforcement corrosion. One possible method of cathodic protection is through the use of embedded galvanic (sacrificial) anodes, consisting of a zinc metal core surrounded by a precast alkali-activated cementitious mortar. The design of a CP system based on embedded galvanic anodes is based on the required amount of zinc material and the throwing power of the anode (i.e., radius around the anode in which the steel achieves sufficient protection). In this research, the protection of steel reinforcement in concrete surrounding an embedded galvanic anode was evaluated through depolarisation measurements with internal and external reference electrodes. Based on these measurements, the throwing power of the galvanic anode was determined, taking into account the 100 mV depolarisation criterium (cf. EN ISO 12696:2016). Additionally, the influence of the degree of chloride contamination of the concrete and relative humidity and temperature of the environment on the throwing power was evaluated. The results show a strong influence of chloride contamination on the throwing power of the galvanic anodes, in the sense that a higher chloride concentration in the concrete matrix leads to a reduction in the throwing power. This reduction can be related to the more negative potential of corroding steel reinforcement compared to passive steel, thus leading to a lower driving potential for the galvanic reaction. Especially when the chloride concentration is higher than 1 m% vs. cement mass, the throwing power is greatly reduced. Additionally, it was found that a higher relative humidity (RH) of the environment (and consequently, a higher RH of the concrete) resulted in a higher throwing power.

Keywords: reinforcement corrosion; galvanic cathodic protection; embedded anodes; throwing power

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