CMDWC 2021

Article

Throwing power of embedded anodes for galvanic cathodic protection of steel in concrete

Bjorn Van Belleghem [1,*], Tim Soetens [1] and Mathias Maes [1]

[1] SANACON, Spin-off company Magnel-Vandepitte Laboratory for Structural Engineering and Building Materials, Tech Lane Ghent Science Park, Technologiepark Zwijnaarde 82, B-9052 Ghent, BELGIUM.
* Correspondence: bjorn.vanbelleghem@sanacon.be; Tel.: +32 478 511 876

Abstract: 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). Also, the influence of the amount of chloride contamination of the concrete and relative humidity and temperature of the environment on the throwing power was evaluated.
Results show a strong influence of the 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 of 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. Also, it was found that a higher relative humidity (RH) of the environment (and consequently a higher RH of the concrete) results in a higher throwing power.

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