Special Issue on Corrosion of Reinforced Concrete Structures (in Memoriam of Prof. Jose Antonio Gonzalez), Part II

David M. Bastidas (University of Akron) and Nick Birbilis (Deakin University)

This second Special Issue in memoriam of esteemed Prof. Jose Antonio Gonzalez includes a collection of articles presented during the Research in Progress symposium organized by AMPP in 2022.[1] This collection is a tribute to the work of Jose Antonio, and recognition of his outstanding contribution to the application of electrochemical techniques for monitoring corrosion processes in reinforced concrete structures.

An ever-contemporary topic that mirrors our present societal needs for sustainable infrastructure, prolonged durability of reinforced concrete structures can lead to both a contribution in extended service lifetime and in the mitigation of structural end-of-life.

The work by Rincon Troconis, et al.,[2] presents a comprehensive study regarding the use of duplex 2205 stainless steel (SS) strands for prestressed bridge piles in marine environments. It was revealed that outstanding corrosion resistance was achieved by 2205 SS under applied stress (970 MPa) using laboratory test conditions, where no pitting developed even after more than 340 h in a high-chloride environment (5.4 M $MgCl_2$) during exposure at 38% relative humidity.

The outcomes of the DURACON international project were presented by Millano-González, et al.,[3] comprising the electrochemical corrosion monitoring of reinforced concrete in natural marine exposure obtained after 10-year exposure. It was found that empirical models for predicting corrosion current density obtained by multiple linear regressions from experimental data from tropical and non-tropical marine stations can reveal an inherent relationship with meteorological variables (relative humidity, temperature, and rainfall) and capillary absorption of the concrete.

A study by Lu, et al.,[4] presents the chloride threshold (CT) values for steel reinforcement with different alloyed chromium content, studied by AC and DC electrochemical techniques. Theoretical calculations were correlated using the mixed potential model (MPM) coupled with the point defect model (PDM). It was concluded that for an accurate CT determination, long-term exposure tests are required to evaluate the corrosion performance of steel reinforcements. The CT for UNS S32304 as determined by electrochemical impedance spectroscopy and cyclic polarization was ~3.5 wt% and was >23.8% (for $[Cl^-]/[OH^-]$) by the MPM/PDM calculation given for 4% Cr steel, an approximately 10 times higher CT value than that of Alloy 615 due to the formation of a defective Cr_2O_3 layer, although the chromium content is barely sufficient to sustain this phase on the surface as the barrier layer.

The need for new sustainable (alternative) cementitious binders was explored in a study by Achenbach and Raupach,[5] who aimed to minimize carbon footprint and greenhouse gas emissions. A key parameter for describing the concrete pore structure was the formation factor (FF), which was used to evaluate concrete durability. The so-called FF is based on the ratio of the electrical resistivity of the concrete and of the pore solution. It was determined that correlation between mortar resistivities and chloride migration coefficients is also valid for the investigated binder types. The FF successfully correlates with the chloride migration coefficient of the investigated alternative binders, which is directly related to the corrosion susceptibility.

A study regarding durability obtained in design of light rail transit (LRT) reinforced concrete structures in North America was presented by Nash.[6] That study valuated standards and guidelines for improving practices to extend LTR lifetime in service, with particular emphasis on the mitigation of corrosion by avoiding the use of stray current collectors and diode grounded traction negatives—the latter of which have been demonstrated to raise the extent of stray current and thus negatively impact corrosion. Additionally, it was recommended to sectionalize reinforcing steel to increase the resistance of the parallel path.

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In summary, we are delighted to present Part II of this collection regarding corrosion of steel in concrete, and we hope you enjoy it as much as we enjoyed the curation of the works. It is with gratitude that we acknowledge all contributing authors for their valuable work that has been included in the special issue collections. This collection, as a whole, we hope makes some contribution in representing and memorializing the legacy of Prof. Jose Antonio Gonzalez. The work of Jose Antonio was not only outstanding as landmark research, but equally paralleled in his passion to teach and help in the development of the next generations of researchers and young scientists.

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