

Corrosion behaviour of electrodeposited Zn and Zn-Fe coatings in saline environments

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Electrodeposited cadmium coatings have been widely used for many years as a protection against corrosion of steel substrates. The toxicity of cadmium combined with European regulations have led to replace them by other sacrificial coatings, such as electrodeposited zinc coatings. However, many studies have shown that the addition of an element nobler than zinc like Ni, Fe or Co can reduce the galvanic coupling between the coating and the steel substrate. Consequently, the lifetime of the sacrificial protection is increased. Among zinc alloys, Zn-Ni was one of the most used, due to its efficient corrosion resistance, but the toxicity of nickel salts leads to replace Ni by more eco-friendly elements, such as Fe without degrading anticorrosion properties. Nevertheless, only few information on corrosion mechanisms of electrodeposited Zn-Fe coatings and on the influence of corrosion inhibitors is reported in the literature. This study aims at understanding the influence of iron incorporation in the corrosion behaviour of electrodeposited Zn-Fe coatings with and without corrosion inhibitors, in relation with the metallurgical features of the coatings.

Zn-Fe alloys with different iron contents (max 14 wt.%) have been deposited on a low alloy steel substrate by electrodeposition from an additive-free bath composed of zinc oxide, ferrous gluconate and potassium hydroxide [1] using direct and pulsed currents. These coatings have been characterized in terms of composition, morphology and microstructure. Electrochemical tests such as polarization curves and Electrochemical Impedance Spectroscopy (EIS) have been performed in two electrolytes (0.1 and 0.6 M NaCl) to assess corrosion potentials and corrosion rates. Corrosion inhibitors have been added to improve the performance of the coating. Moreover, Scanning Vibrating Electrode Technique (SVET) has been used on the cross-section to evaluate the evolution of the sacrificial behaviour of the coatings. Corrosion products have been analysed by X-Ray Diffraction (XRD) and metallic species have been dosed in solutions by Atomic Absorption in order to understand corrosion mechanisms and to relate them to the formation of corrosion products.

[1] C. J. Lan, W.Y. Liu, T.S. Chin. Journal of The Electrochemical Society, 154 (1) D30-D33 (2007)