Influence of inhibitive species on the corrosion resistance of Zn-Fe sacrificial coatings

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Sacrificial coatings, and particularly Zn-based ones, are commonly used to protect steel from corrosion. Zn-Ni (12-14 wt.% Ni) deposits have proven to be one of the most efficient Zn-based sacrificial coatings. Due to the toxicity of nickel salts, Zn-Fe electrodeposits have been investigated as a replacement for Zn-Ni ones.

ZnFe (14 wt.% Fe) was produced on steel using pulsed current. The influence on the corrosion resistance of ZnFe of two inhibitive species (cerium chloride and sodium molybdate) was assessed. Two types of experiments were carried out. Electrochemical measurements (Electrochemical Impedance Spectroscopy and potentiodynamic polarization curves) were performed on the top surface of Zn and ZnFe deposits in 0.1 M NaCl + 0.005 M inhibitor. Then, a local electrochemical technique (Scanning Vibrating Electrode Technique) was used on the cut-edge of ZnFe coated steel in 0.015 M NaCl + 0.005 M inhibitor. Precipitation products formed on the cut-edge after 24 h of immersion were analyzed by Scanning Electron Microscopy coupled with Energy Dispersive X-Ray Spectroscopy.

EIS results revealed sodium molybdate as a promising inhibitor for ZnFe coatings. A model coupling established from the polarization curves indicated an accelerating effect of cerium for the Zn/steel couple. Regarding the cut-edge configuration, both inhibitive species decreased the anodic activity of ZnFe and influenced the composition and localization of precipitation products.