Characterization of the corrosion behavior of Zn-Al-Mg coated steel under São Paulo acidic rain by Scanning Vibrate Electrode Technique

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Smart coatings tailored to enhance the corrosion protection of steel substrates are the target of the automotive industry, as they ensure the reliability and long-term performance of coated parts. In this field, galvanized steel progresses through the last decades entail the development of more durable, reliable, and sustainable anti-corrosive coatings, reducing the need for additional corrosion protection on coated components, while also lowering costs and fuel consumption in automobiles. The addition of aluminum and magnesium to the zinc bath leads to the formation of different metallurgical products in the galvanized layer, as well as more compact and stable corrosion products, increasing the service life of the steel. Also, the addition of those elements contributes to a self-repairing effect on scratches and at the cut edges, a crucial region under corrosive agents. In this study, electrochemical techniques were used to understand the corrosive process that occurs in Zn-3.5%Al-3%Mg alloy coated steel (ZM), when exposed to aggressive aqueous electrolytes, and the differences in its corrosion behavior with respect to conventional galvanized steels (GI). Besides the conventional polarization analysis, samples of ZM and GI were investigated by Scanning Vibrate Electrode Technique (SVET), a local probe technique outstanding in providing information about the corrosive process *in situ*, on the micrometer scale. Through SVET, it is possible to visualize the corrosion progress in terms of identifying anodic and cathodic regions with estimation of the respective currents and their evolution in space and time. The tests were performed synthetic acid rain, reproducing the conditions found in the city of São Paulo. The

study was complemented by Scanning Electron Microscope (SEM), Energy Dispersive X-Ray Analysis (EDX) and Glow-discharge optical emission spectroscopy (GDOES) analysis, for the identification corrosion products formed after exposure to the corrosive electrolyte. The superiority of ZM corrosion resistance over GI has been proven and attributed to the different corrosion products formed by the alloying elements added to the coating, therefore not observed in the conventional galvanized steel.

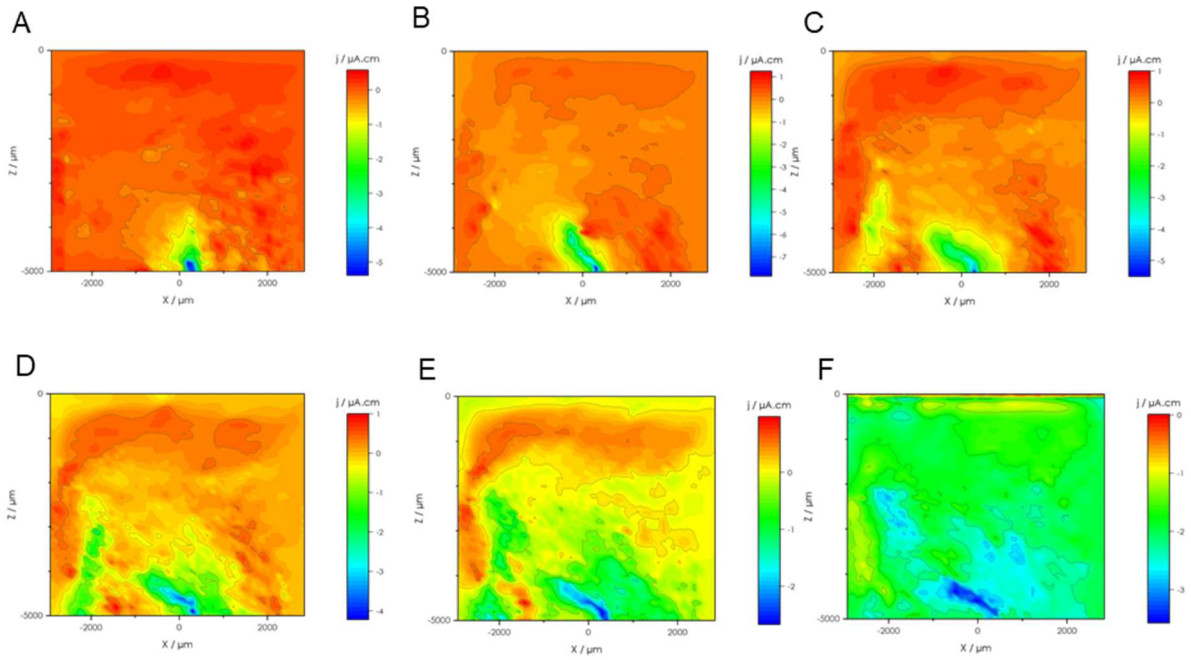

Figure 1 - SVET analysis of Zn-Al-Mg coated steel surface under synthetic São Paulo acid rain after 0h (A), 4h (B), 8h (C), 12h (D) 16h (E) and 20h (F) of exposition.