Study of the corrosion behavior of electrogalvanised steel/Cr(III) and Zr conversion layer/paint system by electrochemical and visual methods

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Finding environmentally friendly conversion layers with the same performance of those previously existing has been the great challenge for researchers of the surface treatment field. Successful examples are the Cr(III)-based pretreatments, which used to replace the Cr(VI) ones are, so far, the best alternative. In the last years, studies in nanotechnology are increasing and nanoparticulate systems based on silica, titanium and zirconium have been evaluated. In this work, the corrosion behavior of an electrogalvanised-zirconium conversion treatment-paint system was characterized by evaluating not only the open corrosion potential (OCP) and electrochemical impedance spectroscopy (EIS) evolution as a function of the exposure time but also the samples performance subjected to accelerated corrosion tests. All the electrogalvanised steel sheets were obtained by using an alkaline free-cyanide bath. After this, they were immersed in a nanoparticulate system containing Cr(III)-based salts and zirconium. Finally, part of these samples was covered with a solvent-based paint, and the remaining with a waterborne-paint. After curing, the samples were exposed to salt spray or humid chamber. Periodic inspections for measuring the treated samples' OCP and EIS were performed. Moreover, visual observations to detect and photographically record the eventual appearance of corrosion and/or blistering were also carried out. In order to compare the corrosion performance of the new system, samples pretreated with trivalent chromium or hexavalent chromium were also evaluated. The experimental results allowed to infer that the electrogalvanised-nanoparticulate conversion layer-paint system afforded a corrosion protection higher than that of the Cr(III) or Cr(VI) pretreated and painted samples, and therefore, that the new pretreatment is a promising alternative to the Cr(VI) one.