

Trivalent chromium conversion layer: a way of enhancing the electrogalvanized steel corrosion protection

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ABSTRACT

Conversion coatings are used on galvanized steels to provide corrosion protection and for special applications are covered with an additional organic or inorganic topcoat. Hexavalent chromium-based passivation treatments have been successfully used as conversion coatings; however, as it is heavily toxic and carcinogenic, national and international environmental regulations impose its removal. From encouraging research works, less toxic alternative coatings have been recently proposed. Among promising alternatives, the environmentally friendly trivalent chromium-based conversion coating is one of the most studied. It decreases health hazards from airborne chromium and reduces the costs of waste treatment and final disposal, as the process needs low metal concentration and does not use hexavalent chromium or additives with strong oxidants. The present work aims to evaluate the corrosion behavior of electrogalvanized steel panels passivated with a trivalent chromium-based layer in 0.5 M NaCl solution. For this, electrochemical impedance spectroscopy (EIS) and morphological observations (SEM/EDAX and XPS) were carried out. The conversion treatments studied were based on: (i) Cr³⁺ (ZBLU); (ii) Cr³⁺ and Co ions (ZGREEN); and (iii) Cr³⁺, fluorozirconate ions and SiO₂ (ZCOAT). An hexavalent chromium passivation layer (ZHEX) obtained under the same conditions adopted for the other treatments was used as reference. The results suggest that the corrosion protection supplied by ZCOAT is similar to the ZHEX, and it was followed by ZGREEN and ZBLU, respectively. Therefore, ZCOAT is a promising alternative to the traditional chromated coating.

KEYWORDS: trivalent chromium, hexavalent chromium, electrogalvanized steel, conversion treatment.

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