

Effect of Cr III passivation on the corrosion resistance of coated electrogalvanized steel

F. M. Queiroz¹, C. I. Elsner², A. R. Di Sarli², C. R. Tomachuk¹, I. Costa¹

¹ Instituto de Pesquisas Energéticas e Nucleares IPEN-CCTM, Av. Prof. Lineu Prestes, 2242, CEP 05508-000, São Paulo – SP, Brasil, mq_fernanda@yahoo.com.br, tomazuk@gmail.com, icosta@ipen.br, 055-11-3133-9226.

² Centro de Investigación y Desarrollo en Tecnología de Pinturas – CIDEPINT/CIC-CONICET, Av. 52, s/n, entre 121 y 122, CP B1900AYB, La Plata, Argentina, cielsner@ing.unlp.edu.ar, direccion@cidepint.gov.ar, 054-221-483-1141/44.

Electrogalvanized steel surfaces are usually passivated for corrosion protection. Many of the passivation processes involve the use of hexavalent chromium (yellow chromating) that is being increasingly banished due to its toxic and carcinogenic effects. The search of alternative treatments for replacement of the yellow chromating has been the aim of many research carried out in the last decades. Among the proposed surface treatments⁽¹⁾, those based on Cr III solutions have been related to the highest compatibility to the Cr VI based ones⁽²⁾. The present study evaluates the corrosion resistance of electrogalvanized steel passivated in Cr III or Cr VI based solutions and compares the effects of these two types of passivation treatments for samples with organic coating on top of the passivating surface film. Galvanizing of steel samples was carried out in an alkaline cyanide free zinc solution. Next, the electrogalvanized steel samples were passivated, either in a Cr III or a Cr VI based solutions, and then covered with an organic coating formulated specifically for this investigation. The electrochemical behavior of the prepared samples was monitored as a function of immersion time by electrochemical impedance spectroscopy (EIS) in a 0.05 mol L⁻¹ sodium chloride solution, as Figure 1 illustrates. The results show that although higher impedances were associated to the Cr VI based treatments along the test period (4 days), it largely decreased between the first hours and 1 day of immersion, and remained fairly stable for longer periods. For the Cr III passivated samples, however, the impedance continuously increased with time of immersion, due to sealing of the defects in the passive film with zinc products.

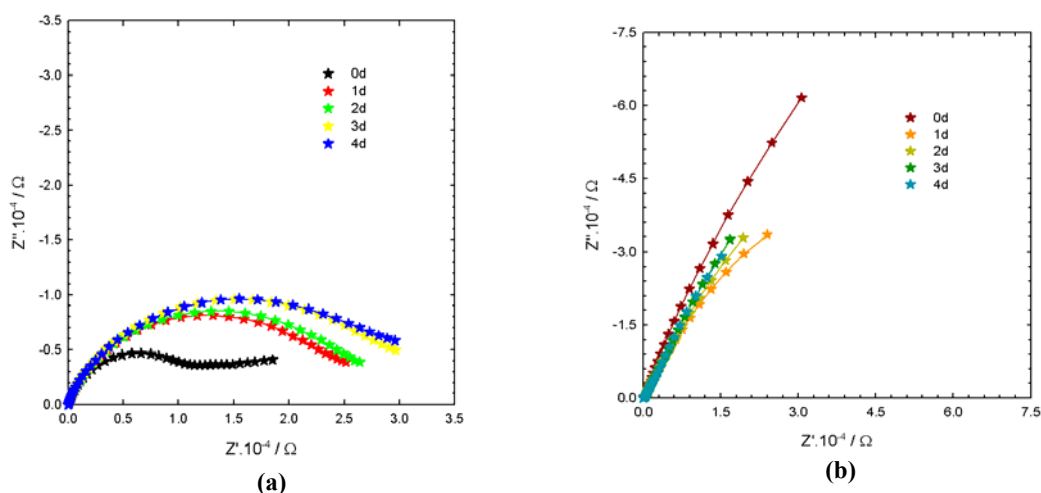


Figure 1: Nyquist diagrams of electrogalvanized steel passivated and organic coated samples for various periods of immersion in 0.05 mol L⁻¹ NaCl solution. Samples passivated (a) in Cr III solution, and (b) Cr VI solution.

References

- 1 C.R. Tomachuk, C.I. Elsner, A.R. Sarli, *Materials Chemistry and Physics*, 116 (2009) 339.
- 2 C.R. Tomachuk, C.I. Elsner, A.R. Sarli, *J. Coat. Technol Research*, 7 (2010) 493.