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Corrosion behavior of galvanized steel in aqueous solutions

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Title of M.Sc. Thesis

Corrosion behavior of galvanized steel in aqueous solutions

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Abstract

The most commonly used zinc coating deposition technology on carbon steel is by hot-dip galvanizing. Hot dip galvanized (HDG) coatings are widely used in industry for corrosion protection of steels. Silicate passivation coating on galvanized steel is considered as an alternative to Chromate passivation treatment to improve the corrosion resistance of hot-dip galvanized steel. In this study, silicate conversion coatings were prepared by immersing hot dip galvanized steel sheets immediately upon removing from the molten zinc in potassium silicate solution bath with chemical composition: 25% SiO_2, 12% K_2O and 63% water, at metal immersion temperatures in excess of about 150 ℃ or higher, the immersion time was constant about 30s. The surface modified by silicate conversion coating was characterized by X-rays diffraction (XRD), scanning electron microscopy (SEM), Energy dispersive X-ray-spectrometer (EDX), the corrosion behavior of the treated hot-dip galvanized steel was evaluated by means of electrochemical impedance spectroscopy measurements and Potentiodynamic polarization and Cyclic voltammogram (CV), The results showed that: the corrosion resistance increased with increasing silicate ions concentration up to 6%, also corrosion resistance increased as temperature of galvanized steel sheet increased up to 250°C. This can be related to the addition of the silicon ions in the zinc coating to form a zinc-silicate complex which is responsible for the highly corrosion resistant.

Keywords: corrosion; hot-dip galvanized steel; conversion coating; silicate; impedance; cyclic voltammogram; Tafel plots.

Aim of work

One of the main objectives of this work is to evaluate the viability of a simple and industrially easy-to-implement substitute to the widely employed chromate coatings to improve corrosion resistance of HDGS.

In the present study, a new method to form a dense silica layer onto galvanized steel was proposed, based on immersing of HDGS sheets immediately upon removing from the molten zinc in potassium silicate solution bath.

One of the main aims of this study is to match some important industrial requirements concerning the deposition procedure, like low cost, small number of treatment steps and friendly to environment. Therefore, in the process presented in this paper, the silicate bath concentration and temperature of HDGS sheets upon removing from the molten zinc bath were optimized.

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