DEPOSITION OF BRIGHT ELECTROCHEMICAL NICKEL COATINGS ON STEEL

Stanko Spasojević[1], Stana Stanišić[1], Danijela Jovičić[1], Zorica Ristić[1], Dubravka Banjac[1], Snježana Vučićević[2]*, Marija Mitrović[2], Milorad Tomić[2,3]

[1] ORAO, a.d. Šabačkih đaka bb, Bijeljina, Republic of Srpska, Bosnia and Herzegovina
*[2]University of East Sarajevo, Faculty of Technology Zvornik, Karakaj 34a, Zvornik, Republic of Srpska,Bosnia and Herzegovina, snjezanavucicevic66@gmail.com**
[3]Engineering Academy of Serbia, Kneza Miloša 9/IV, Belgrade, Serbia

Abstract

The characteristics of nickel coatings obtained by electrochemical deposition on steel samples of known chemical composition were investigated. The chemical composition of the steel was examined using the XRF method (X-ray fluorescence spectrometry) before and after the deposition of the coatings. The effect of current density and deposition time on the cathodic current efficiency, coating thickness, hardness, and adhesion of the electrochemically obtained nickel coatings was analyzed. The preparation of the steel samples was carried out in the same way using glass spherical beads. Nickel coatings were electrochemically deposited onto the prepared steel samples from three baths in an electrochemical reactor with a volume of 64 dm³. All three used baths were based on Vatov's electrolyte: (30-50 g/dm³ $NiCl_2 \cdot 6H_2O$, 15-30 g/dm³ H_3BO_3, 200-250 g/dm³ $NiSO_4 \cdot 7H_2O$). In bath 1, in addition to the standard Vatov electrolyte, the following were added: basic additive 302 (5 cm³/dm³), wetting additive 304 (8 cm³/dm³), and ductility additive 305 (12 cm³/dm³), (all additives from the company "Protekta" Belgrade). Compared to bath 1, baths 2 and 3 also had additives for brightness. In bath 2, a high-brightness additive 301 (0.5 cm³/dm³) from the company "Protekta" Belgrade was added, and in bath 3, sulfosalicylic acid (0.5 cm³/dm³) of p.a. purity. Electrochemical nickel coatings were deposited for 10, 15, and 20 minutes at current densities of 1, 1.5, and 2 A/dm², at a bath temperature of 42°C. Based on the mass increase of the samples due to electrochemical nickel deposition, the cathodic current efficiency and coating thickness were calculated. The roughness of the coatings was measured using a "Mitutoyo" device, and hardness was determined by the Vickers method. The adhesion of the nickel coatings was tested using the bending method. It was observed that with increasing current density and deposition time, the cathodic current efficiency increased, and thicker nickel coatings were obtained. Under the same deposition conditions, nickel coatings of approximately the same thickness were obtained from all three baths, leading to the conclusion that brightness additives do not significantly affect the thickness of electrochemical nickel coatings but do affect their compactness and brightness. Nickel coatings obtained under the given conditions from all three baths meet the requirements for good adhesion.

Keywords: *nickel coatings, electrochemical deposition, current density, roughness, current efficiency, hardness, adhesion, coating thickness*