Corrosion behavior of chromate passivated Zn-Ni alloy coatings

G Savitha, V Ezhilselvi, Meenu Srivastava, J.N Balaraju*

Surface Engineering Division, CSIR - National Aerospace Laboratories, HAL Airport Road, Bangalore – 560 017.

Abstract:

Zinc-Nickel coatings are effective in providing corrosion protection to ferrous materials. Further, passivation with chromate conversion coating helps to enhance the corrosion resistance. These coatings are being considered as effective replacements for cadmium coating. In the present study an effort has been made to develop Zn-Ni coating under nearly neutral conditions to minimize the embrittlement effect. The deposition conditions were optimized to obtain Zn-Ni alloy coating with Ni content in the range of 10-15 wt.% so as to achieve improved corrosion protection. The coatings were deposited under optimized conditions on a suitably pre-treated stainless steel (SS) substrate so as to obtain a coating of ≈5μm thickness. The coatings were subjected to post baking to reduce hydrogen embrittlement. The adhesion of the coatings was tested in accordance with ASTM D3359 and the adhesion was found to be > 4 B. The Zn-Ni coatings were characterized using EDX for the Ni content and FESEM for surface morphology. The nanohardness of the as-deposited coating was observed to be 512 HVN for a load of 25 mN. The roughness of the coating was found to be around 70 nm. The electrochemical corrosion behavior of the coatings was evaluated in 3.5% NaCl medium using potentiodynamic polarization and electrochemical impedance spectroscopy (EIS) techniques. The polarization studies showed that the corrosion resistance of baked Zn-Ni coating ($i_{corr}$ 5.36 μA/cm²) was better than the as-deposited coating ($i_{corr}$ 23.8 μA/cm²). The baked Zn-Ni coating was passivated with chromate ($Cr^{6+}$) conversion coating. The passivated baked Zn-Ni coating showed about five times improved corrosion resistance as compared with unpassivated Zn-Ni coating. Similar observation was also made from electrochemical impedance studies. The long term corrosion behavior of the coatings was evaluated using salt spray test in accordance with ASTM B117 and the results will be discussed in detail.

*Corresponding author: jnbalraj@nal.res.in (J.N.Balaraju); Tel: 08025086239; Fax: 08025210113.