Effects of Sodium Lauryl Sulfate (SLS) on Zinc-Nickel Alloy for Corrosion Resistance Improvement

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OBJECTIVES

This research was aimed to improve corrosion resistance of zinc-nickel (Zn-Ni) alloy coated on low carbon steel using sodium lauryl sulfate (SLS) as an additive, and to investigate structure-corrosion resistance relationships.

EXPERIMENTAL PROCEDURES

Zn-Ni alloy was electrodeposited on a 10x15 cm^2 low-carbon steel sheet in the chloride-plating bath. The bath electrolyte was composed of $NiCl_2 \cdot 6H_20$ 180 g/l, $ZnCl_2$ 200 g/l, H_3BO_4 40 g/l, and SLS 0-1.5 g/l was circulated under the conditions of current density of 2-5 A/dm^2, temperature of 38°C, and pH of 3.5. Coating surfaces were controlled to obtain a constant thickness of 9 µm.

Specimens were tested and characterized using Suga ISO-3-CY salt spray unit, 273A EG & G Princeton Applied Research potentiodynamic unit, and JEOL JSM-5800 scanning electron microscope equipped with energy dispersive spectroscope.

RESULTS AND DISCUSSION

Zn-Ni alloy coated surfaces from the bath without SLS yielded about 9 – 13 wt.% Ni with morphologies of whisker and nodular. The period of showing 5% red rust was after 521 - 663 hours. For the bath with SLS, the surfaces yielded about 5 – 10 wt.% Ni with morphologies of whisker, nodular, and massive cauliflower-like. The period of showing 5% red rust was after 144 – 781 hours. Figure 1 depicts no relationship between the Ni content and corrosion resistance.

The results did not significantly show that SLS improved corrosion resistance of Zn-Ni alloy coated on the low-carbon steel surface. However, with the same bath condition, SLS enhanced corrosion resistance only when the SLS amount was not less than 0.075 g/l. It was found that when SLS was lower than 0.075 g/l, precipitation of metal oxide and metal hydroxide occurred.

Apparently, the morphology may be used to indicate and determine the corrosion resistance of the Zn-Ni alloy coated surface. Despite the Ni contents, the corrosion resistance increased when nodular (Figure 2B) formed, and reduced to lesser when the massive cauliflower-like (Figure 2C) and whisker (Figure 2A) were formed.

CONCLUSION

Increasing Ni contents does not show direct relationship to corrosion resistance, but with the same bath condition SLS can enhance corrosion resistance only when the SLS amount is not less than 0.075 g/l. The morphology of the Zn-Ni alloy coated surfaces may be used to indicate and determine the corrosion resistance.

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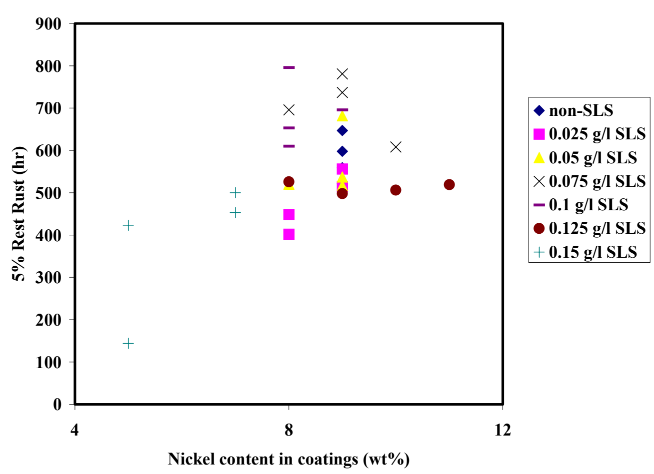
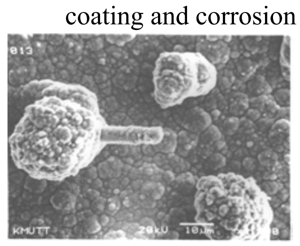
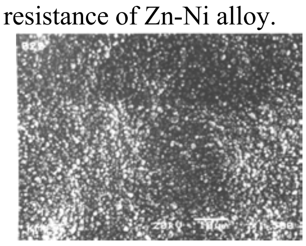


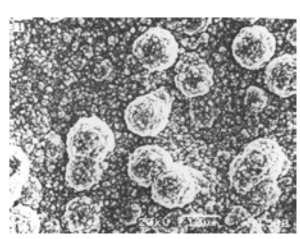
Figure1: Relationships between nickel content in coating and corrosion resistance of Zn-Ni alloy.



A: Ni= 8 %,
5% Red Rust = 559 hrs
whisker structure,
C.D. 3 A/dm^2.



B: Ni= 9 %,
5% Red Rust = 781 hrs
nodular structure,
0.075 g/l SLS, C.D. 3 A/dm^2.



C: Ni= 8 %,
5% Red Rust = 696 hrs
nodular structure,
0.075 g/l SLS, C.D. 5 A/dm^2.

Figure2: SEM Micrographs (1500x) of Zn-Ni alloy coated surface.

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