

INFLUENCE OF ADDITIVES ON THE  
ELECTRODEPOSITION OF ZINC-NICKEL-IRON  
ALLOYS

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INTRODUCTION:

Electroplated alloys of zinc with iron, cobalt or nickel are being used to improve the corrosion resistance of coatings, compared with normal zinc coatings. Out of the Zinc – Nickel alloy coatings have proved to be very effective because they are far superior to pure zinc deposits for both corrosion resistance and thermal stability. Electro deposition of Zn-Ni alloy has been investigated since 1980 in order to improve its chemical and physical properties [1-4]. It is well known that Zn-Ni alloys are a good substitute for cadmium, which is having two environmental hazards (cadmium & cyanide).

Many efforts have been made to develop brightly corrosion resistant steel sheets, especially for automotive body panels. Recently it has been shown that electrodeposited Zinc - Iron group metals alloys are suitable materials for this application.

In this paper, Zn-Ni-Fe alloys coatings are obtained on mild steel by electro deposition in chloride bath with and without additives and comparing it with Zn-Ni for composition corrosion, surface examinations by SEM and crystal orientation.

EXPERIMENTAL:

All plating baths are prepared from distilled water. The basic bath composition for the electro deposition of Zn–Ni-Fe is given in Table 1. Zinc-Ni was deposited from the same bath without adding Iron salt. By varying pH, current density and temperature several plating was carried out with and without additives keeping total molar ratio constant, and changing the ratio of Zn to Ni plating was done for 15 min.

Electrodeposits were electroplated on one side of a copper plate of 1mm thick (exposed area 6.45cm<sup>2</sup>). Before electro deposition the substrate were pretreated as given below. Degreasing by TCE following by cleaning cathodically in an alkaline solution for 2 min and activation in 5% HCl solution and finally rinsed with distilled water. Current was passed in the ratio of 86% for Zn to 14% for Ni. Zn and Ni anodes were connected through separate current regulators.

The composition of the plated alloys were determined using X-ray fluorescence for corrosion studies, XRD and SEM, the ternary alloy was plated on mild steel.

RESULTS AND DISCUSSION:

Fig.1 shows the composition of Zn and Ni at various current densities keeping the pH and temperature as a constant. It shows that at 30mA/cm<sup>2</sup> the iron content is about 1% when compared to the current densities at 20 and 40mA/ cm<sup>2</sup>.

Fig.2 shows the composition of Zn and Ni at a constant current density and various pH. By varying the pH of the bath there was no change in the composition. Fig.3 shows the composition of Zn and Ni with and without additives for constant current density and pH. The curve obtained shows that the Fe percentage decreases on adding additive. The surface morphology was analyzed by SEM.

Table 1  
Basic composition for the electro deposition of ternary Zn-Ni-Fe alloy.

| Bath ingredient                         | Concentration |
|-----------------------------------------|---------------|
| ZnCl <sub>2</sub>                       | 0.4 M         |
| NiCl <sub>6</sub> .6H <sub>2</sub> O    | 0.4 M         |
| FeCl <sub>2</sub> .4H <sub>2</sub> O    | 0.06 M        |
| NaCl                                    | 2.5 M         |
| CH <sub>3</sub> COONa.3H <sub>2</sub> O | 0.3 M         |
| H <sub>3</sub> BO <sub>3</sub>          | 0.5 M         |
| Additives                               |               |
| 1                                       | 1 gpl         |
| 2                                       | 0.1 gpl       |

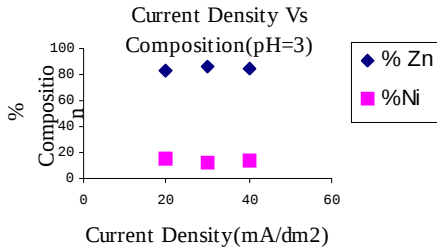


Figure 1

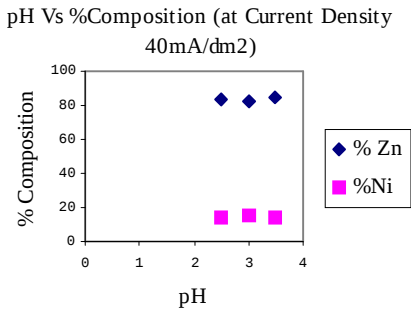


Figure 2

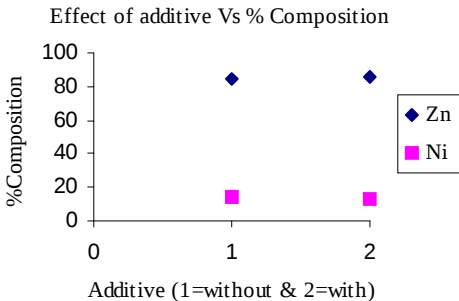


Figure 3

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