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Effect of elemental additions on hot-dipping galvanization behavior

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Abstract: Hot-dip galvanization is a common corrosion-prevention technique for steel structures. The steel is submerged in a molten zinc bath, which forms a zinc coating on the steel's surface. This provides a barrier against the corrosive elements. However, the galvanized covering can still deteriorate, especially in harsh environments. As a consequence, several studies have been conducted to improve the corrosion resistance of galvanized steel by adding metallic elements to the zinc coating. The aim of this study is to look at how metallic additions (Al addition up to 1%, Bi addition up to 1%, Pb addition up to 1%, Sb addition up to (1% and 2%), Sn addition up to 5%, Zn-Bi-Pb 1% addition, Zn-Sb-Sn 1% addition) affect the zinc coating by hot dipping galvanization. The microhardness, thickness, adherence, microstructure test, coating adhesion (Pull-Off test), and corrosion rate are studied.

Subjects: Coatings & Thin Films-Materials Science; Corrosion-Materials Science; Morphology

Keywords: Hot dipping galvanization; zinc coating; surface preparation; coating morphology; corrosion resistance; metallic additions

1. Introduction

Hot-dip galvanizing protects the steel from corrosion. Adding metallic components like aluminum, magnesium, and zinc to hot-dip galvanized coatings improves their effectiveness. By adding metal elements, galvanized coatings become corrosion-resistant and mechanically stronger, making them suitable for many applicatios. In hot-dip galvanization, metallic additions play an important role.

Several galvanized coatings were studied using EIS by Barranco et al. (2004). For pure zinc and Zn-5%Al coatings, electrochemical corrosion values were overestimated compared to gravimetric values, but not for Zn-10%Fe. As a result of corrosion products that layer barriers, immersion time was linearly related to attack time (Barranco et al., 2004).

Cabral et al. (2006) examined the anticorrosion performance of a novel pretreatment AA2024-T3 and hot-dip galvanized steel. EIS was used to assess corrosion resistance in NaCl solutions. Results demonstrated the pre-treatment provides excellent corrosion protection and improved corrosion protection due to improved barrier properties and cerium-based inhibitors in the silane matrix (Cabral et al., 2006).

The texture and corrosion resistance of hot-dip galvanized coatings were studied by Asgari et al. (2009) (00.2) texture coatings had lower corrosion current densities, and thicker coatings had