

Influence of pH on the corrosion protection of epoxy-silica-zirconia sol-gel coatings applied on EN AW-6063 aluminium alloy

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Aluminium alloys of 6000 series can suffer severe corrosion in polluted (acidic) and/or marine environments and in contact with alkaline media like fresh cementitious materials. Therefore, architectural aluminium components are often coated, what requires its surface pre-treatment. Organic-inorganic hybrid (OIH) sol-gel coatings have been proposed as an effective, environmental compliant new pre-treatment for aluminium coating. In this work, an epoxy-silica-zirconia sol-gel coating was synthesized and applied on EN AW-6063 alloy. Cerium nitrate was incorporated as corrosion inhibitor. Cerium doped and undoped OIH coatings were exposed to neutral, acidic (pH~3) and alkaline (pH~10) chloride solutions. Electrochemical impedance spectroscopy (EIS) and SEM/EDS characterization of coated samples revealed that the best performance is achieved in the neutral and the worst in the acidic solution. In the alkaline solution, the cerium doped coatings exhibited much better anticorrosive performance than the undoped ones, clearly evidencing the beneficial role of the corrosion inhibitor in this media.

Introduction

Aluminium alloys properties such as light weight, corrosion resistance, with inherent high durability, in combination with the good strength-to-weight ratio, justify the extensive use of these alloys in a broad range of industrial applications. Transport, building, packaging and energy industries are the main end-use markets of aluminium alloys, each one requiring specific aluminium alloys properties and products tailored to their needs. The aluminium alloys of 6000 series, for instance, are particularly suited for the building industry due to their good corrosion resistance, which derives from the presence of a thin oxide layer that naturally forms on its surface when exposed to oxygen. However, the protective efficacy of this natural oxide layer is highly reduced in polluted (acidic) and/or marine environments, in which these alloys can suffer severe corrosion (1). Therefore, architectural aluminium components are often surface treated to increase their durability and aesthetical appearance, reducing maintenance needs. Coating, namely, with thermoset powder paints, one of the most common surface treatments applied to architectural aluminium components.

Coating an aluminium alloy requires its surface pre-treatment so as to promote adherence of the organic coating. Chromate based chemical conversion layers (CCC)