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Influence of aluminium alloy type on the corrosion behaviour of formed alumina films

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The influence of the type of aluminum alloy (99.5% Al, 8006 and 8011) on its corrosion characteristics has been investigated. This study was performed by means of linear sweep voltammetry (LSV) and electrochemical impedance spectroscopy (EIS).

All experiments were carried out in a conventional three electrode cell, where the Al alloy served as a working electrode, a Pt mesh as a counter electrode and for reference electrode (Ag/AgCl/3M KCl) was used. The samples were anodized in 15 wt% H₂SO₄ in isothermal (20 °C) and galvanostatic (15 mA cm⁻²) regime, for 45 min. The formed oxides were immediately sealed in distilled water for 60 min. Under these conditions the anodic films have a thickness of 20 μm. The electrochemical tests were conducted in an unstirred, neutral 3.5 wt% NaCl at 20 °C.

LSV measurements and EIS spectra were employed to monitor the corrosion behavior of the alumina films, using Autolab PGSTAT 30, driven by GPES and FRA software (Eco Chemie, The Netherlands).

The LSV curves of the aluminum alloys were obtained with a potential sweep rate of 10 mVs⁻¹, from -600 mV to +600 mV, in respect to the open circuit potential (OCP).

EIS spectra of the specimens were measured before and after anodization. The tests were performed applying a perturbation signal of 40 mV in the frequency range from 10 mHz to 10 kHz. The obtained impedance spectra have been fitted to equivalent circuits, which are based on different physical models. Equivalent circuit parameters for the porous layers formed on three types of aluminum alloys were calculated.

It has been found a noticeable influence of the type of aluminum alloy on the corrosion resistance of the formed oxide films. The importance of the sealing process of the porous film on their protecting properties is also discussed.