ADHESION OF A LITHIUM BASED CONVERSION COATING ON THE 2024 ALUMINUM ALLOY

Castro, M.R.S.[a], Nogueira, J.C.[b], Thim, G.P.[a] and
Oliveira, M.A.S.*[, a]
[a]Chemistry Department, [b]Mechanical and Aeronautics
Department, Instituto Tecnológico de Aeronáutica (ITA),
Pça Mal Eduardo Gomes, 50 – CTA, São José dos
Campos, SP, Brazil, CEP 12228-900
*e-mail: dora@ief.ita.br

Non-chromate thin films have been prepared chemically on 2024-T3-aluminum alloy by immersion of coupons of this alloy in alkaline aqueous solution containing lithium, borate and aluminum ions.

The conversion-coated surfaces were painted with the 10P4-2-primer epoxy resin and wet tape adhesion tests were performed between the interfaces: alloy substrate/conversion coating and conversion coating/primer epoxy resin. The adhesion of films formed in the alkaline medium was compared with that of films formed in aqueous solution of 1200S Alodine; a chromate conversion coating that has been used successfully in the aerospace industry to protect aluminum alloys against corrosion.

As the chromium free film as the chromium containing film passed on the substrate/conversion coating wet tape adhesion test. Little, if none, film was removed from the substrate alloy surface. However, only the chromate conversion coating passed on the conversion coating/primer epoxy resin adhesion test. The surfaces covered with the non-chromate/prime epoxy films presented bubbles spots after the tape removal.

A Jeol scanning electron microscope (SEM), model JXA 840A, was utilized to analyze the surface morphologies and to measure the films thickness. Non-chromate conversion coated surfaces are very porous while the chromate conversion coated surfaces are more uniform. The porosity presented by the non-chromate conversion coated surfaces was ascribed to the gas evolution during the film formation. This porous structure is responsible for the poor adhesion of the films non-chromate conversion coating/prime epoxy. The thickness of the films formed on the aluminum alloy surfaces were: 1 μm for the chromate films, 6 μm for the non-chromate films and 20 μm for the prime epoxy films.

Electrochemical corrosion measurements were also performed for both, non-chromate and chromate conversion coated surfaces. A conventional three-electrode cell was utilized. In this cell, the conversion-coated surfaces were utilized as working electrodes, a saturated silver/silver chloride as reference electrode, and platinum wire as counter electrode. The exposed area of the working electrodes was 1.0 cm^2. The electrolyte solution was a 0.5 mol L^{-1} NaCl aqueous solution, pH 5.8. All potentials were measured at room temperature (≈ 25 ^{o}C) and were controlled with an MQPG-01 potentiostat. The working electrode potentials were varied from –2.0 to +2.0 V at a scanning rate of 5.0 mV s^{-1}.

Table 1 presents the corrosion parameters (corrosion current density (j_{corr}) and corrosion potential (E_{corr})) obtained from these electrochemical tests. The results presented in Table 1, show that the non-chromate films, despite of the high porosity, protect the 2024-T3 aluminum alloy. This is evident by the lower corrosion current density (lower corrosion rate) and higher corrosion potential presented by the non-chromate conversion coated surfaces in relation to the values of these same parameters measured for the chromate conversion coated surfaces, exposed to the chloride containing solution.

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Table 1. Corrosion parameters for the non-chromate and chromate conversion coated 2024-T3 aluminum alloy exposed to 0.5 mol L^{-1} NaCl aqueous solution, pH 5.8, at room temperature (≈ 25 ^{o}C).

Conversion coating	j_{corr} (A cm^{-2})	- E_{corr} (V Ag/AgCl sat)
Non-chromate	18.4×10^{-3}	1.38
Chromate	$12.9\ 10^{-3}$	1.26