

Influence of the initial surface roughness of aluminum alloy 5083 on surface modifications in presence of marine microorganisms

J. JAUME¹, MJM MARQUES^{1,2}, M.L. DÉLIA¹, R. BASSÉGUY¹

¹*Laboratoire de Génie Chimique, Université de Toulouse, CNRS, INPT, UPS, Toulouse, France*

²*Laboratório de Materiais e Revestimentos, LNEG – Laboratório Nacional de Energia e Geologia, Lisboa, Portugal.*

Aluminum alloys are commonly used in the marine industry for its major assets such as easy workability, lightness of the material. The Al-Mg alloy 5000 series are especially used for their better corrosion resistance.

Although this alloy has a very good corrosion resistance, it can show significant corrosion in seawater due to chlorides destroying the passivation layer naturally formed on its surface. Marine environment contains also a wide microbial population that influences the corrosion phenomenon. They are able to enhance corrosion, named microbiologically influenced corrosion (MIC) [1] but also to inhibit it by microbiologically influenced corrosion inhibition (MICI) [2].

In our recent works (in publication process), a MICI phenomenon was observed on aluminum alloy 5083 in the presence of salt marshes. After immersion of Al alloy samples in seawater and salt marshes for two months, a homogeneous black layer was observed on the surface, preventing the corrosion of the sample. When the salt marsh (source of the microorganisms) was sterilized, this black layer was not present, and the aluminum plate showed significant corrosion.

The work presented here shows the influence of the initial surface roughness on the formation of the black layer and its characteristics, especially its thickness. It is known that surface roughness influences the colonisation of the surface by microorganisms or the development of the biofilm. Generally, a too low roughness will prevent microorganisms from adhering to the electrode surface [3], that in our case could hinder MICI. Moreover, it is known that a too high roughness can promote corrosion, which can create defects in the developed layer in presence of microorganisms.

Silicon carbide grinding papers with several grain sizes: 80, 240, 400, and 800 were used to prepare the different surface roughness on aluminum alloy samples. The roughness was measured before and after immersion using the technique of interferometry. During immersion, the evolution of the open circuit potential (OCP) was measured and the corrosion current was estimated using voltammetry. After

immersion, plates were observed at the scanning electron microscopy (SEM) and characterized by energy dispersive X-ray spectrometry (EDS), both in surface and cross-section.

The aim of this study is to find the optimal roughness to enhance MICI and promote the development of the protective layer as homogeneous as possible.

[1] T. Liengen, D. Féron, R. Basséguy, I. Beech, *Understanding Biocorrosion: Fundamentals and Applications - European Federation of Corrosion (EFC) Series 66 (Hardback)*, Woodhead Publishing Ltd, 2014.

[2] N. Kip, J.A. van Veen, *The dual role of microbes in corrosion*, ISME J. 9 (2015) 542–551.

[3] P. Champigneux, M.-L. Delia, A. Bergel, *Impact of electrode micro- and nano-scale topography on the formation and performance of microbial electrodes*, *Biosensors and Bioelectronics*. 118 (2018) 231– 246.