Marine Microorganisms and Metal interaction: The Start Point of a New Bio solution for Corrosion Protection

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To be able to drive the evaluation and exploration of ocean and sea potential resources, well-orchestrated research and industrial efforts at small and large scale are necessary to improve the durability of the materials. In the last decades, new emerging microbial-based technologies have been proposed following the development of more environmental friendly anti-corrosion solutions to increase longevity of structural metals. The fact that microorganisms can influence corrosion behavior in an advantageous way, the so-called MICI (microbiologically influenced corrosion inhibition) have opened different lines of research. So far, different MICI mechanisms, including formation of a barrier film on metal surface, oxygen depletion, secreting inhibitory enzyme, and corrosion inhibition via biomineralization have been proposed.

The evidence that the result of the interactions between microorganisms and the metallic surface can result in an efficient protective layer increasing the corrosion resistance of the metal established the new approach of our MICOATEC project to develop a Nature Inspired Anticorrosion Solution [1-5]. The main goal is to translate the natural biotic process into an abiotic technological process for corrosion protection, without replicating the biofilm itself or incorporating active biocompounds into a coating matrix.

To reach the above-mentioned main objective, the growth process and the chemical-physical properties of the protective layer naturally formed as consequence of microorganisms/metal interactions must be better understood.

In this context, several samples of AA 5083, commonly used in marine industry due to their corrosion resistance, have been immersed at Genoa Outdoor Experimental Marine Station (GEMS) for different periods of time. The goal was to assess the impact of the microbial diversity (bacteria, algae, etc.) present in the complex marine environment which affects the corrosion process in a variety of ways. After 15 days, 1 and 2 months of exposure, the surface and interface of AA 5083 was characterized by advanced analysis techniques as ToF-SIMS, XPS and SEM/EDX for a more comprehensive insight into the chemical composition and mechanism of formation of the protective layer in biotic condition and consequently its influence in the aluminum alloy corrosion resistance.

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