Effect of Salinity on the Biomineralization Process of Biocalcifying Bacteria Under Cathodic Protection

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Résumé

When a metallic structure is immersed in seawater, colonization by micro- and macro-organisms occur, a phenomenon known as biofouling. Corrosion could be strongly reduced by cathodic polarization, which induces the formation of calcareous deposit on the metal surface. This deposit, composed of CaCO3 and Mg(OH)2, results from the alkalinization of the metal/seawater interface leading to Ca2+ and Mg2+ cations precipitations. In this complex mineral/organic dual structure, biocalcifying bacteria that promote calcium carbonate (CaCO) precipitation may actively contribute to mineral layer formation. The increase in the calcareous layer thickness can reduce oxygen diffusion and decrease anode consumption, benefiting cathodic protection1. Nevertheless, it can also be harmful to the materials, increasing fouling on materials, which can damage structures2. Salinity may further impact biocalcifying bacteria. Studies suggest that low-salinity environments activate genes involved in bacterial biocalcification, such as carbonic anhydrase or urease3. This occurs for exemple in brackish waters, as seen in Lorient (Atlantic coast, France), where Naval Group is located at the mouth of the Scorff River. Although the effect of salinity on biocalcifying bacteria is relatively well known, they remain unstudied under cathodic protection conditions. To address this gap, we designed a setup to mimic and perform bacterial liquid cultures under cathodic polarization, and with varying salt concentrations. Solid cultures were also conducted. Our results indicate that bacteria are unaffected by cathodic protection, while lower salt concentrations appear to enhance CaCO production. Biocalcifying bacteria combined with fluctuating salinity conditions therefore influence the formation of mineral deposits on corrosion-protected metal structures.

Mots-Clés: Biofouling, Biocalcifying bacteria, Cathodic polarization, Calcareous deposit, Calcium carbonate (CaCO), Salinity impact

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