Corrosion enhanced by bacteria and archaea differently enriched on copper and copper alloys

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The microbiological corrosion induced by methanogens is mainly studied on steel alloys, these being widely used in the Oil&Gas sector, where the most significant phenomena have been found. Most studies show that the effect of CO2-rich environments, pH and flow conditions could modify the interaction of methanogens with the substrate as for the use of hydrogenase and the catalyzation of protective corrosion products, such as Siderite or Vivianite [1]. In this work, the enrichment of a different pool of hydrogenotrophic methanogens and bacteria on the surface of two copper alloys (pure Cu and 60:40 brass) was documented, starting from the same microbial pool. The corrosion induced by methanogens enriched media, in comparison with sterilized media, were documented during replicated two-week tests. Electrochemical impedance spectroscopy (EIS) documented a different corrosion behaviour of the two materials, both affected by the biotic condition. This was confirmed by other electrochemical measurements and chemical characterizations of the corrosion products. Post-experiment observations performed by SEM and micro-Raman spectroscopy (μRS) underlined that microorganisms strongly affect the nature of corrosion products. Molecular analysis by next generation sequencing (NGS) of 16S RNA performed by swabbing the surface of the material and identifying the microorganisms constituting the microbial communities for each case evidenced a different enrichment of microorganisms depending on the material.

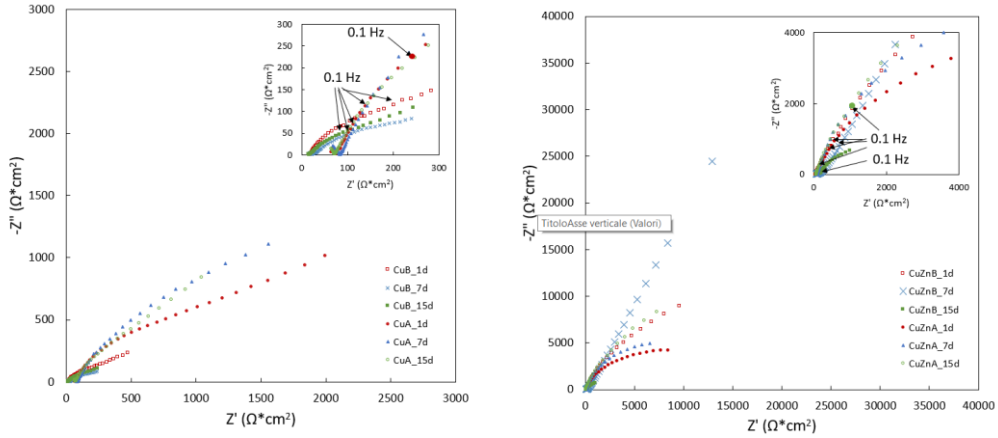

Figure 1: Nyquist plots for Cu (left) and CuZn (right) operated in biotic and abiotic conditions.

[1]Egger et al. *Geochim. et Cosmochim. Acta*, 2015, Volume 169, 217