cbecimat26
26° Congresso Brasileiro de Engenharia e Ciência dos Materiais
22 a 26 de novembro de 2026
Costão do Santinho
Florianópolis-SC

The influence of electrolyte chemical composition on copper corrosion

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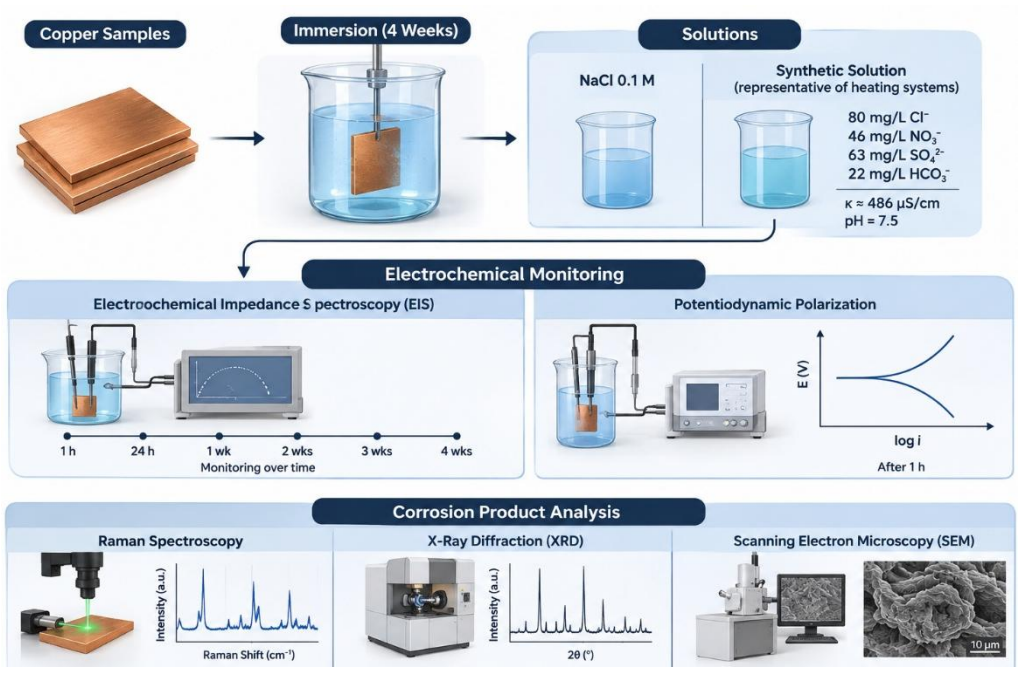
Introdution

In copper gas-water heaters, the composition of the water flowing through the equipment can have tremendous effects on the kinetics of copper corrosion, as well as on the rate of growth, chemical and structural composition of the corrosion product layer, leading to differences and unpredictability in equipment failure.

Objective

- Compare the effect of electrolyte composition on copper corrosion, using 0.1 M NaCl and a synthetic solution containing Cl^-, NO_3^-, SO_4^{2-} and HCO_3^-;
- Evaluate the evolution of electrochemical behaviour and corrosion products over the course of immersion.

Methodology



Results and Discussion

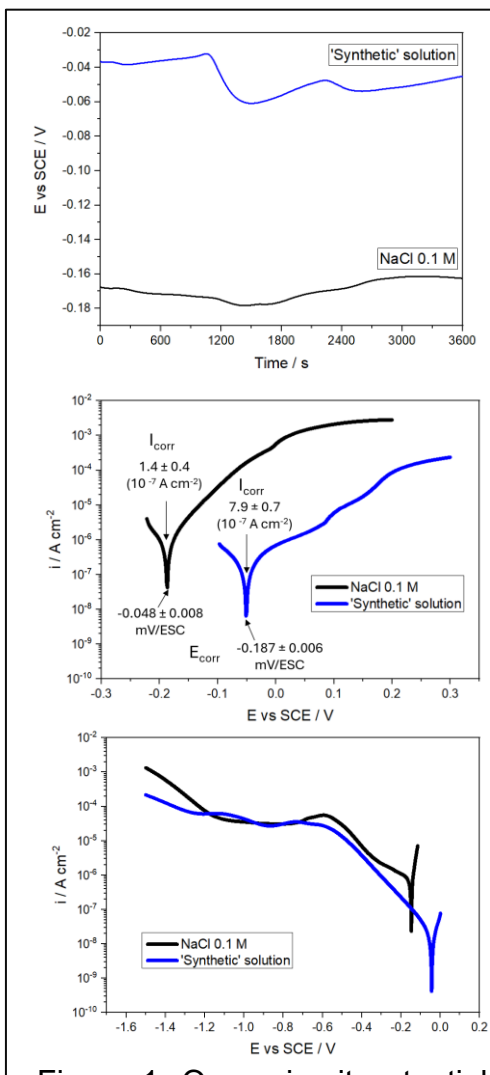


Figure 1. Open-circuit potential, and cathodic and anodic polarisation curves for copper after 1 hour in different electrolytes.

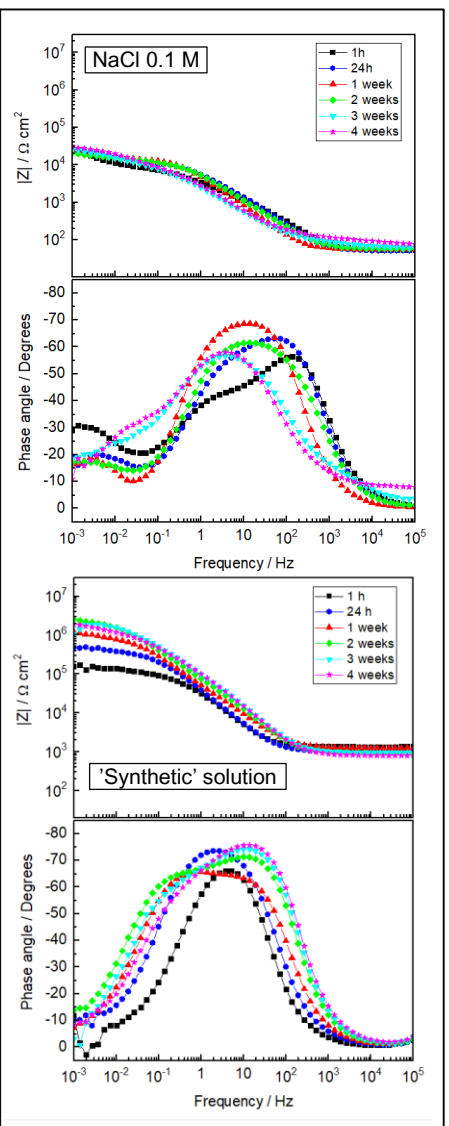


Figure 2. Bode plot of copper samples in different electrolytes.

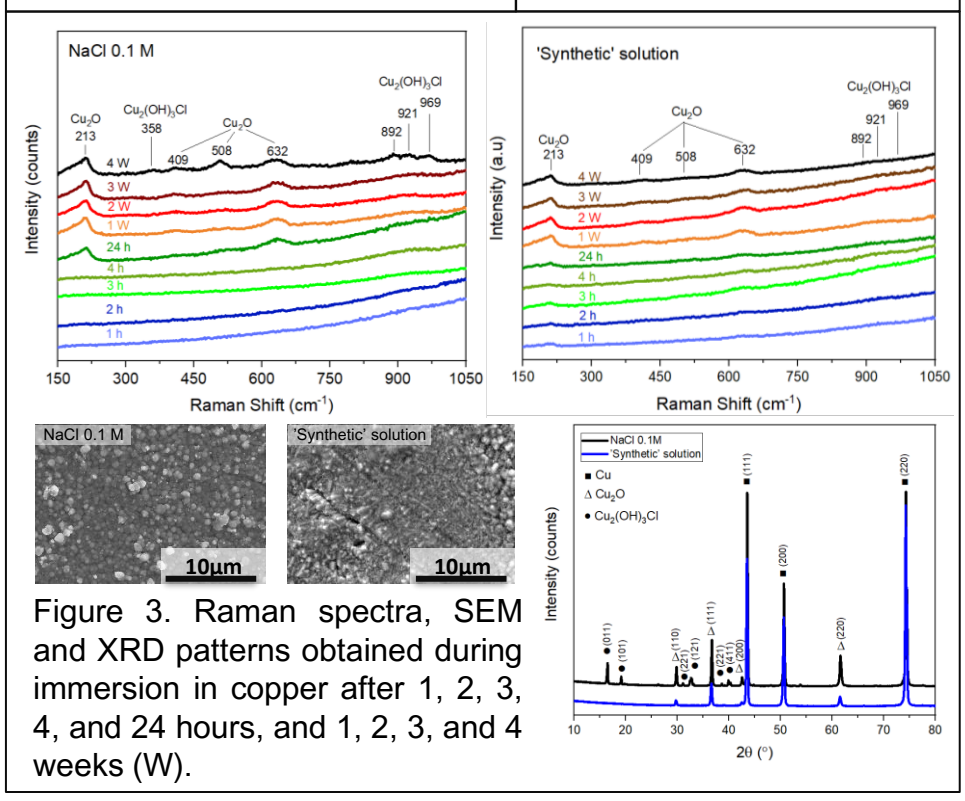


Figure 3. Raman spectra, SEM and XRD patterns obtained during immersion in copper after 1, 2, 3, 4, and 24 hours, and 1, 2, 3, and 4 weeks (W).

References

- FU, Zhongheng *et al.* Understanding atomic interaction between cuprous oxide film and aggressive chloride solution. **Corrosion Science**, v. 227, p. 111718, fev. 2024.
- LIU, Ming; LI, Jun. In-Situ Raman Characterization of Initial Corrosion Behavior of Copper in Neutral 3.5% (wt.) NaCl Solution. **Materials**, v. 12, n. 13, p. 2164, 5 jul. 2019.
- EDWARDS, Marc; MEYER, Travis; REHRING, John. Effect of selected anions on copper corrosion rates. **Journal AWWA**, v. 86, n. 12, p. 73–81, dez. 1994.

Acknowledgments

This work is being developed at CICECO-Instituto de Materiais de Aveiro, within the scope of the ILLIANCE Project with financial support from the Recovery and Resilience Plan and the European Funds NextGenerationEU.

Conclusions

- In the ‘synthetic’ solution exhibited a higher impedance modulus, a more positive OCP, and a lower corrosion rate than the 0.1 M NaCl solution;
- In the NaCl solution, Cu_2O and $Cu_2(OH)_3Cl$ formed, becoming more clearly defined over time. In the ‘synthetic’ solution, Cu_2O predominated, with only limited traces of $Cu_2(OH)_3Cl$.