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Corrosion of copper in seawater and its aerosols in a tropical island

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Abstract

A complete characterization of copper corrosion behavior has been carried out under permanent immersion, water line, splash zone and at the atmosphere (near and far from the sea) at the tropical Cuban archipelago. No significant differences have been determined for corrosion of copper under complete immersion for test sites representative of Cuban archipelago. The maximum corrosion rate was observed on the line of water, related to the partial removing of the corrosion products layer due to water movement (waves) and a higher availability of oxygen. Patina composition was characterized using XRD, IR, EDS and SEM techniques. Paratacamite ($\text{Cu}_2(\text{OH})_3\text{Cl}$) was the main component of the patina formed under complete immersion, on the line of water and in the splash zone. In poorly polluted atmospheric marine environments also atacamite (another structural modification of $\text{Cu}_2(\text{OH})_3\text{Cl}$) was found. When environmental SO_2 reaches a competitive level with the chloride aerosol the patina formed is a complex mixture of basic cupric chlorides (paratacamite and atacamite) and basic cupric sulfates, antlerite ($\text{Cu}_3(\text{SO}_4)(\text{OH})_4$) and brochantite ($\text{Cu}_4(\text{SO}_4)(\text{OH})_6$). Brochantite and basic cupric chlorides are detected at inland rural sites. The patina morphology reveals details about the local environment in which it is formed and shed light on its more or less protective role for the metal. The relatively large corrosion rate under complete immersion and on the line of water is related to the formation of a patina with poor adherence to the metal surface and to a porous layer of cuprite formed by relatively large octahedral crystals.

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