Effect of Water Hardness and pH Value on the Corrosion Behaviour of Copper in an Emulsion

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Hard tap water and soft water were used to prepare oil-in-water (O/W) emulsions separately. The effects of water hardness and emulsion pH (2.5, 4.8, 8.3, and 12.1) on the corrosion behaviour of copper in an emulsion were investigated using potentiodynamic (PD) polarization curves, electrochemical impedance spectroscopy (EIS) and open circuit potential (OCP). The surface morphology of the Cu electrodes and the attachment of corrosive products were analysed by scanning electron microscopy (SEM) and energy dispersive spectrometry (EDS), respectively. The results showed that without an inhibitor, the corrosion current density of hard tap water increased by $1.6 \times 10^{-3} \text{ A/cm}^2$, and the electrochemical resistances were significantly reduced compared with those in soft water, resulting in the disruption of the passive layer and accelerating corrosion. The corrosivity order of the four emulsions with different pH values was found to be strong acid (pH=2.5) > strong alkali (pH=12.1) > weak acid (pH=4.8) > weak alkali (pH=8.3). For strong acid/alkali emulsion systems, copper is more likely to react with chloride ions and oxygen ions to generate pitting corrosion.

Keywords: Corrosion, Soft water, Electrochemical impedance spectroscopy, Alkali, Acid

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