Atmospheric corrosion behaviour and monitoring methods of mild steel under a thin autirust oil layer

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Abstract

Anti-rust oils (ARO) is a high efficiency-cost anti-corrosion technique to inhibit the atmospheric corrosion of metal parts and equipment. However, in contaminant or coastal environments, salt particles, aerosol, CO_2, SO_2, *etc*., may intrude into the oil layer, leading to the early failure of AROs. In this work, we first prepared a kind of ARO made of sodium petroleum sulfonate (SPS) inhibitor and white oil, then coated the ARO on a mild steel plate to investigate the deterioration process of AROs beneath saline water droplets by Quartz crystal microbalance (QCM) and electrochemical mapping techniques. It shows that the SPS concentration is crucial to the ARO inhibition property. When the SPS content is lower than its critical micelle concentration (CMC), saline droplets may permeate the barrier formed by the nonpolar paraffin groups of SPS and then adsorb on the steel surface, resulting in localised corrosion. However, once the SPS content exceeds its CMC, the saline droplets will be emulsified and captured in the oil phase by the reverse micelle effect, thus inhibiting the corrosion of steel substrates. The microstructure of the oil-water interface was characterised by micro-infrared spectroscopy techniques, showing that the surfactant molecules can transform water molecules from free to bonded water molecules through oriented adsorption, thus offering protection against the intrusion of saline droplets. In contrast, concentrated NaCl saline(>0.5 droplets may disrupt the bonded state of water molecules, decreasing the arresting ability of AROs on saline droplets. Moreover, wire beam electrodes (WBE) and thin electrical resistance (ER) techniques were employed to probe the atmospheric corrosion of mild steel under AROs, and it evidenced that the ER is better at evaluating the inhibition performance of AROs than traditional electrochemical methods.

Keywords: Atmospheric corrosion; Anti-rust oil; Oil-water emulsification; Corrosion monitoring.

Reference

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