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研究报告

电化学阻抗谱对比研究连续浸泡和干湿循环条件下有机涂层的劣化过程

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摘要： 用电化学阻抗谱（EIS）技术对比研究浸泡在3.5% NaCl溶液中的碳钢表面有机涂层在连续浸泡和干湿循环条件下的劣化过程。结果表明，连续浸泡和干湿循环条件下的涂层劣化过程均可分为三个主要阶段：涂层渗水阶段、基底金属腐蚀发生阶段和基底金属腐蚀发展与涂层失效阶段。和连续浸泡过程相比，干湿循环加速了整个涂层的劣化过程，使涂层进入快速失效阶段。但是干湿循环对涂层失效的三个子过程的加速效果又不完全相同。相对于涂层渗水阶段的加速效果，干湿循环对界面腐蚀发生阶段和腐蚀发展与涂层失效阶段的加速效果更为明显。

关键词： 有机涂层 干湿循环 EIS

EIS STUDY ON THE DETERIORATION PROCESS OF ORGANIC COATINGS UNDER IMMERSION AND CYCLIC WET-DRY CONDITIONS

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Abstract: Comparing between immersed and cyclic wet-dry conditions, the deterioration processes of the organic coatings on carbon steel surface have been comparatively studied by using electrochemical impedance spectroscopy (EIS). The wet-dry cycles were carried out in the alternating conditions by immersing in a 3.5% sodium chloride solution and drying at 25° and 50% RH for 4 h respectively. Coating resistance, R_f, coating capacitance, C_f, and double layer capacitance, C_d, were monitored continuously and separately under above two conditions. The percentages of the interface active area, A_w, were estimated from the obtained double layer capacitance, C_d. According to the EIS characteristics, the entire deterioration processes under two above-mentioned conditions can be divided into three main stages, consisting of the medium penetration into coatings, corrosion initiation and corrosion extension underlying coatings. In comparison with the immersed, the wet-dry cycles greatly accelerated the entire deterioration process; especially the corrosion initiation and the corrosion extension periods, leading the paint system lose its anti-corrosive performance in a short period. However, the underlying substrate corrosion of the cyclic coatings was far less serious than the immersed; even the delaminating area was seven times more than the immersed. The acceleration mechanism of the coatings and underlying metal corrosion under wet-dry cycles was discussed based on the above results.

Keywords: organic coatings wet-dry cycles electrochemical impedance spectroscopy

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