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论文

电解法处理压载水对316L不锈钢腐蚀行为的影响

刘光洲,王建明,张鉴清,曹楚南

浙江大学化学系, 杭州 310027

摘要： 通过监测处理前后海水环境参数的变化, 利用开路电位-时间曲线、电化学阻抗谱及极化曲线等电化学方法, 研究了316L不锈钢在电解处理前后的压载水中的腐蚀行为. 结果表明, 在处理海水中,316L不锈钢的耐点蚀性能优于天然海水, 腐蚀倾向减小.处理海水中316L不锈钢的开路电位正移约0.4 V, 电化学反应电阻明显增大,钝化膜的击穿电位正移0.37 V以上, 316L不锈钢的耐蚀性增强.这可能与电解处理后海水中含有ClO^{-}, Cl$_{2}$和HClO等强氧化性物质,导致316L不锈钢的钝化膜增厚、变得更加致密有关.

关键词： 压载水 电解处理 316L不锈钢 点蚀 电化学方法

EFFECT OF ELECTROLYTIC TREATMENT OF BALLAST WATER ON THE CORROSION BEHAVIOR OF 316L STAINLESS STEEL

LIU Guangzhou, WANG Jianming, ZHANG Jianqing, CAO Chunan

Chemistry Department, Zhejiang University, Hangzhou 310027

Abstract: The introduction of invasive marine species into new environments by the ballast water of ships has been identified as one of the four greatest threats to the world’ s oceans. Many technologies have been developed for ballast water treatment among which electrolytic treatment method has been taken as the most promising one. However, the corrosion problem of metals in treated seawater was seriously concerned by international maritime organization (IMO) and ship owners, especially the corrosion of 316L stainless steel which is widely used in the monitoring equipments of the ballast system of ships. In this study, the variation of environmental parameters of the seawater before and after electrolytic treatment was monitored. The corrosion behaviors of 316L stainless steel in both natural and treated seawater were investigated by electrochemical methods such as open – circuit potential (EOCP) measurements, electrochemical impedance spectroscopy (EIS) and potentiodynamic polarization. The results showed that the pH value of the seawater increased and the dissolved oxygen content decreased slightly after electrolytic treatment, and the contents of dissolved organic carbon and particulate organic carbon decreased significantly in treated seawater. The corrosion test results showed that the resistance of 316L stainless steel to pitting corrosion was enhanced in treated seawater. Compared to the system in natural seawater, the open – circuit potential of the steel in treated seawater shifted about 0.4 V positively, and charge transfer resistance of the steel greatly increased. The breakdown potential of passivation films in treated seawater positively shifted more than 0.37 V. Our experimental results suggested that the corrosion resistance of 316L stainless steel in treated seawater was improved, which was ascribed to the thickening and compactness of the passivation film formed in treated seawater. It is safe for 316L stainless steel to be used in treated ballast water with the total residual chlorine (TRC) concentration of 9.50 mg/L.

Keywords: ballast water electrolytic treatment 316L stainless steel pitting corrosion electrochemical method

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通讯作者: 王建明

作者简介: 刘光洲, 男, 1969年生, 博士生

通讯作者E-mail: liugz_2009@sina.com

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