

Corrosion behavior and mechanism of low-nickel austenitic stainless steel Q1803 in the atmospheric environment of the South China Sea

Chen Hao¹, Zhou Xuejie¹, Zhang Zhaoyi¹, Chen Zhijian¹

¹*China Academy of Machinery Wuhan Research Institute of Materials Protection Co., Ltd.*

No.126, Baofeng 2nd Road, Qiaokou District, Wuhan City, Hubei Province, China

chendex11@163.com

Abstract The goal of nitrogen alloying austenitic stainless steel is to substitute nitrogen for the element nickel in order to stabilize the austenitic phase. In the field of stainless steel, nitrogen's potent stabilizing properties and affordable cost have made it a popular research topic in recent years. The research object in this work is high nitrogen and low nickel austenitic stainless steel QN1803, as well as austenitic stainless steel 304. On-site exposure tests, analysis techniques like tissue composition, morphology, corrosion product, and electrochemical testing, as well as other analytical techniques, are used to investigate the reasons behind the differences in the corrosion behaviors of the two types of specimens in the South China Sea atmospheric environment. The corrosion mechanism of QN1803 stainless steel is clarified. The results demonstrate that: (1) the corrosion morphology analysis reveals that QN1803 stainless steel has a maximum pitting depth that is clearly smaller than 304 stainless steel, and that QN1803 stainless steel has a significantly better pitting resistance than 304 stainless steel in the marine atmospheric environment; (2) the corrosion product analysis reveals that QN1803 stainless steel has a higher surface corrosion product content of Cr than 304 stainless steel, and that the corrosion products of the two materials are composed of the same material; (3) the composition of atmospheric environment corrosion products consists of Fe₂O₃, Cr(OH)₃, Cr₂O₃, FeOOH, MnO, and MoO₃, with notable variations in the relative amounts of each phase; (4) the electrochemical analysis indicates that QN1803 stainless steel exhibits superior surface corrosion products for substrate protection, passivation film stability, and self-healing capabilities compared to 304 stainless steel. These findings demonstrate the superiority of QN1803 stainless steel over 304 stainless steel. Because QN1803 stainless steel is made of stainless steel, it exhibits superior resistance to air corrosion in the South China Sea.

Keywords low nickel austenitic stainless steel ; corrosion resistant property ; atmospheric corrosion; corrosion electrochemistry

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