Effects of the addition of Ni and Cr on the corrosion behavior of pearlite steels in industrial environments

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Abstract Ni is considered to be an effective element to enhance the corrosion resistance of steel [1]. But high levels of Ni increase the cost of the material. Possible ways to reduce the cost are to reduce the Ni content as well as to add other alloying elements to improve the corrosion resistance by reducing the content or by synergizing the effect. This paper aims to use wet dry cycle tests to study the synergistic effect of a small amount of Ni and Cr elements on the corrosion mechanism of pearlite steels and the evolution of the rust layer during this process. It is expected that the alloying design of a small amount of Ni and Cr will become an effective method to improve the corrosion resistance of pearlite steels. The results of the study show that 0.2Ni steel has superior corrosion resistance. After adding a small amount of Ni, the content of Cr_2O_3 increases, and there is a synergistic effect between a small amount of Ni and Cr elements, which accelerates and promotes the transformation of corrosion products, and the $NiFe_2O_4$ generated during the corrosion process is electronegative, attracting the agglomeration of cations, promoting the refinement and aggregation of rust layer particles, and enhancing the densification of the rust layer. In addition, the interlamellar spacing of 0.2Ni steel is refined, and the residual cementite at the interface of the rust layer matrix effectively improves the local corrosion resistance.

Keywords Pearlite steel, Cementite, Corrosion-resistant mechanisms.

Reference

[1] B. Zhang, W. Liu, Y. Sun, W. Yang, L. Chen, J. Xie, W. Li, Corrosion behavior of the 3 wt.% Ni weathering steel with replacing 1 wt.% Cr in the simulated tropical marine atmospheric environment, J. Phys. Chem. Solids 175 (2023) 111221. https://doi.org/10.1016/j.jpcs.2023.111221.