The influence of microstructure on the corrosion resistance of a novel Cu-P weathering steel

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Abstract

A hot-rolled Cu-P weathering steel (WS) with a new microstructure was subjected to different cooling speeds for heat treatment, resulting in three microstructures: ferrite (F), ferrite+granular bainite (F+GB), and lath bainite (LB). The corrosion resistance of these microstructures under simulated industrial atmospheric corrosion conditions was evaluated by a cyclic immersion accelerated corrosion test. All the microstructures showed two stages in their mass loss curves, with a slow decrease in corrosion rate in the early stage of the cyclic immersion (0-48 h), during which the formed rust layer had limited inhibition on corrosion.Subsequently, the rapid decline in corrosion rate during the latter part of the cyclic immersion period (48-96 h) indicates that stable rust layers are beginning to form. During the entire cyclic immersion process, the average corrosion rate of the LB steel was slightly lower than that of the F+GB steel, but the corrosion kinetics of the two were similar. Compared with the F steel, the corrosion kinetics of the other two steels showed obvious differences. The average corrosion rate of the F steel was the smallest at the beginning and end of the cyclic immersion, but the difference was not significant. It was much lower than that of the other two steels at 48 h, indicating that the rust layer formed by the F steel in the early stage of cyclic immersion had certain protective properties, but the stability of the rust layer was poor in the latter stage. This was attributed to the change in the composition of the corrosion products formed on the different microstructure matrix. The proportion of α-FeOOH in the F steel was the highest at 24 h and 96 h of cyclic immersion, while that in the LB steel and the F+GB steel was lower. At the same time, the surface roughness of the F steel after descaling was the smallest, while that of the LB steel and the F+GB steel was larger. The high α-FeOOH content in the F steel inhibited pitting corrosion and improved the uniformity of corrosion. However, the lower corrosion potential and increased corrosion heterogeneity in the LB steel and the F+GB steel were attributed

to the higher proportion of small-angle grain boundaries and higher dislocation density in the microstructure.

Keywords *:*Weathering steel; Microstructure; Atmospheric corrosion; Rust layer; Industrial atmosphere