Preliminary corrosion behavior of zinc aluminum magnesium coating and pure zinc coating in typical soil environments

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Abstract The SEM, GDS, and XRD are used in this article to study the structure of zinc aluminum magnesium alloy (ZMA) coating steel and pure zinc (GI) coating steel. A comparative study is conducted on the corrosion rate and mechanism of GI coating and ZMA coating at two soil test stations in Korla Xinjiang and Dagang Tianjin. The results showed that after 1 year, the corrosion rate of Korla GI was 2.59 times that of ZMA, Dagang GI was 1.5 times that of ZMA. For GI and ZMA coatings, the corrosion rates are both in the order of Dagang>Korla. The corrosion rate of zinc and zinc alloys in soil is mainly influenced by conductivity, pH value, salt content, microorganisms, etc. The higher the soil conductivity, the stronger the corrosiveness, while the lower the pH value, the stronger the corrosiveness. The order of conductivity values for the two sites is: Korla<Dagang, and the order of pH values is: Dagang ≥ Korla. These factors also affect the corrosion rate of materials by affecting the composition of corrosion products. The different rust layer structures of corrosion products have different inhibitory effects on cathodic oxygen reduction. In alkaline environments, the corrosion products of GI coatings are easily transformed into loose and conductive ZnO. Due to the anodic dissolution of $MgZn_2$ in the coating, Mg^{2+} can react with OH^- to form magnesium hydroxide ($Mg(OH)_2$) on the surface of ZMA. Replacing zinc oxide with $Mg(OH)_2$ is believed to reduce the cathodic oxygen reduction reaction (ORR), and the increase in pH value at the cathode position is buffered, the alkaline zinc carbonate is stabilized , and the corrosion resistance is significantly improved. Therefore, ZMA coating material has broad application prospects in alkaline soil environments.

Keywords zinc aluminum magnesium, soil corrosion, corrosion mechanism