

High Anti-Corrosive Self-Healing Coatings for Carbon Steel Using Nanofibers

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Summary

Carbon steel is used for seawater piping in salt production plants. Anti-corrosion painting and coating added pigments as corrosion inhibitors are generally carried out to prevent corrosion. However, corrosion is accelerated when defects are generated in the coatings. As a method to prevent the progress of corrosion by the defect, the self-healing anti-corrosion treatment in which the protective film is naturally formed in the defect part is effective. By adding corrosion inhibitors and cellulose nanofibers in the coatings, cellulose nanofibers become the release pathways of corrosion inhibitors, and a large amount of corrosion inhibitors are released quickly, resulting in high self-healing performance. It is important to control the release of corrosion inhibitors in order to achieve long-term self-healing. As the release process of the corrosion inhibitor, diffusion of water in polymer, dissolution of corrosion inhibitor, and release through cellulose nanofiber as a pathway are considered, and the dissolution process of the corrosion inhibitor is focused to control the release of corrosion inhibitors.

In this study, inorganic corrosion inhibitors with different solubility, which were zinc phosphate and zinc sulfate, and cellulose nanofibers were used to develop coatings that can maintain corrosion resistance in the long term as the purpose of preventing external corrosion of carbon steel used for seawater piping. The water absorption of polymer, dissolution of corrosion inhibitor, and release of corrosion inhibitor were measured. The self-healing performance of coatings by electrochemical measurement was confirmed.

The following results were obtained. The release rates of corrosion inhibitors from various polymer sheets were measured, and the release rate of zinc sulfate was fast in the early stage of immersion. It was found that the addition of cellulose nanofibers promoted the release of corrosion inhibitors. The self-healing test using these corrosion inhibitors was conducted, and the addition of cellulose nanofibers showed high self-healing performance. In addition, when corrosion inhibitors with different solubility were added in coating of two layers, higher self-healing performance was achieved.