Effect of barnacle adhesion on the cathodic protection of high-strength steel and its potential risks related to hydrogen permeation

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Abstract Barnacles have been used as model organisms for macrofouling that can change the hydrogen permeation behavior of high-strength steel. To judge the primary effect of macrofouling adhesion on the service safety of high-strength steel. In this study, the cathodic protection and hydrogen permeation behavior of high-strength steel with barnacle adhesion in the tidal zone were studied using field exposure and laboratory simulation tests for 2 years.

Because of the shielding effect, barnacles can lead to an uneven calcareous deposition, a flatter morphology and a higher protection efficiency of steel. Meanwhile, barnacle adhesion can increase the cathodic protection current of steel at the edge of adhesion area. Barnacle adhesion manifests the effect of promoting hydrogen permeation, with significantly high hydrogen permeation current at the edge of adhesion area (**Fig. 1**).

According to the result of the hydrogen permeation current, the diffusible hydrogen content at the edge of adhesion area can lead to a risk of stress corrosion cracking and consequently the failure of the steel structure.

Keywords High-strength steel; Barnacle; Cathodic protection; Hydrogen permeation; Edge of adhesion area

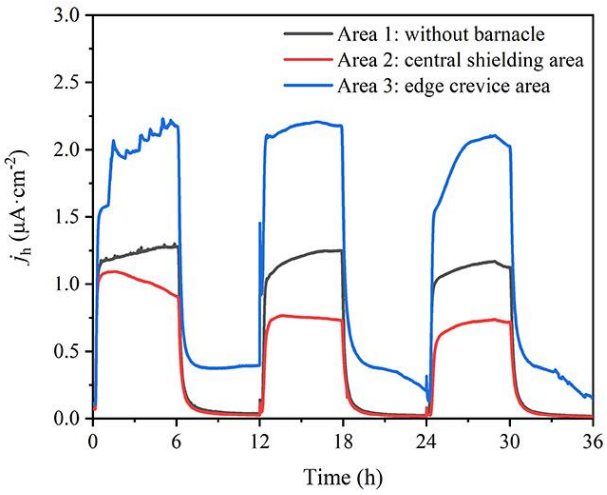

Fig. 1 Hydrogen permeation current density curves in different adhesion areas.

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