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Effect of Carbon Nanotubes on Ultraviolet and Immersion Stability of Diglycidyl Ether of Bisphenol A Epoxy Coating

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Abstract : The marine environment is very aggressive for a number of factors, such as moisture, temperature, winds, ultraviolet radiation, chloride ion concentration, oxygen concentration, pollution, and biofouling, all contributing to marine corrosion. Protective organic coatings provide protection either by a barrier action from the layer, which is limited due to permeability to water and oxygen or from active corrosion inhibition and cathodic protection due to the pigments in the coating. Carbon nanotubes can play not only barrier effect but also passivation effect via adsorbing molecular species of oxygen, hydroxyl, chloride and sulphate anions. Multiwall carbon nanotubes composite provide very important properties such as mechanical strength, non-cytotoxicity, outstanding thermal and electrical conductivity, and very strong absorption of ultraviolet radiation. The samples of stainless steel (316L) coated by epoxy resin with carbon nanotubes-based pigments were exposed to UV irradiation (340nm), and immersion to the sodium chloride solution for 1000h and corrosion behavior in 3.5 wt% sodium chloride (NaCl) solution was investigated. Experimental results showed that corrosion current significantly decreased in the presence of carbon nanotube-based materials, especially nitrogen-doped ones, in the composite coating. Importance of the structure and composition of the pigment materials and its composition was established, and the mechanism of the protection was described. Finally, the effect of nitrogen doping on the corrosion behavior was investigated. The pigment-polymer crosslinking improves the coating performance and the corrosion rate decreases in comparison with pure epoxy coating from 5.7E-05 to 1.4E-05mm/yr for the coating without any degradation; in more than 6 times for the coating after ultraviolet degradation; and more than 16% for the coatings after immersion degradation.

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