

Corrosion Protection of Mild Steel by Polyaniline Modified with Kaolinite in 0.5M of Sodium Chloride (NaCl) Solution

Athirah Alias^a, Sabrina M Yahaya^{a*}

Structured Abstract

Background: Among the conductive polymers used as an anti-corrosive coating, polyaniline (PANI) is the most studied conducting polymer. The addition of kaolinite into polyaniline-based coatings creates a protective barrier on the surface of mild steel, preventing moisture, oxygen, and other corrosive elements from permeating. This barrier inhibits the electrochemical processes that cause corrosion, extending the lifespan and durability of the coated mild steel substrate greatly.

Methods: In this study, PANI and PANI modified with kaolinite (PANI-K) were synthesized by the chemical polymerization method and were identified using Fourier Transform InfraRed (FTIR) Spectroscopy and Field Emission Scanning Electron Microscopy (FESEM). The weight loss method will be used to identify the corrosion rate (CR) of bare mild steel (MS) and the percentage inhibition efficiency (%IE) of the PANI and PANI-K coatings.

Results: The FESEM images show that the PANI-K coating has a smoother morphology and appears as dispersed particles within the polyaniline compared to PANI. The FTIR spectra of PANI show peaks appeared at 1636.7 cm^{-1} and 1530.5 cm^{-1} indicating the presence of C=C quinoid ring stretching and benzenoid stretching respectively, which proves the characteristic of the polymer. FTIR spectra of PANI-K revealed that there is a peak that appeared at 1162.6 cm^{-1} , 596 cm^{-1} , and 890 cm^{-1} which represent the Si-O stretch, Si-O-Al stretch, and Si-O-Si stretch respectively which indicates the presence of kaolinite in the PANI. The weight loss analysis demonstrates that PANI-K has a lower corrosion rate (3.91 mm/yr) than PANI (11.89 mm/yr) at 48 hours. On the other hand, the PANI-K coating has a higher percentage inhibition efficiency(%IE) than the PANI coating. The percentage inhibition efficiency of the PANI-K and PANI coatings after being immersed in 0.5M NaCl solution at 48 hours was 87.84% and 63% respectively.

Conclusion: The modification of the PANI polymer with kaolinite improves the barrier properties of mild steel and can handle corrosion effectively in industrial settings.

Keywords: Coating, corrosion, mild steel, polyaniline, kaolinite

*Correspondence: sabrina@uitm.edu.my

^aSchool of Chemistry and Environment, Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam, Malaysia