

Paracetamol-Incorporated Hybrid Sol-Gel Coating for Corrosion Mitigation

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Structured Abstract

Background: Mild steel is a commonly used structural material, however its corrosion resistance is restricted in saline environments. Coatings with green corrosion inhibitors caught interest as a solution to this problem. Paracetamol is a low-toxicity pharmaceutical drugs with hydroxyl (-OH) and amide (-NHCOCH₃) groups that can adsorb on metal surfaces and build protective coatings. But its direct employment as an inhibitor is limited due to rapidly desorption in corrosive conditions. The hybrid sol-gel approach allows for an incorporation of organic inhibitors such as paracetamol into an inorganic-organic matrix, resulting in more regulated release and improved adherence. The purpose of this study is to determine the optimal concentration of the paracetamol incorporated hybrid sol-gel matrix as inhibitor on mild steel in 0.5 M NaCl.

Methods: A hybrid sol-gel was prepared by combining TEOS and APTES in a 3:1 molar ratio and adding ethanol and HCl solutions. Paracetamol powder from Panadol 500 mg tablets was added at a concentration of 100, 150, 200 and 250 ppm. Mild steel samples were immersed in the prepared solution after 24 hours of stirring. After curing, the coated mild steels were immersed in 0.5 M NaCl. The inhibition efficiency (IE%) was calculated based on the mass loss of sample before and after immersion. In this study, the corrosion performance will be analysed by the weight loss method to determine the mass loss of mild steel samples over different concentration.

Results: The weight loss method showed a clear trend where corrosion rate decreased with increasing paracetamol concentration. The sample for 100 ppm paracetamol incorporated hybrid sol-gel exhibited the highest mass loss while 250 ppm coating showed the lowest corrosion rate that indicating effective inhibition. The calculated IE% increased from 58% at 100 ppm to 77.6% at 250 ppm, this confirm that higher concentration of paracetamol enhances protective performance.

Conclusion: In conclusion, from the weight loss results, its indicated that paracetamol incorporated hybrid sol-gel coatings significantly reduce corrosion of mild steel. Among all paracetamol concentrations that be tested, 250 ppm showed the highest IE%, make it the optimal concentration in this study. This encourages the potential of using pharmaceutical-based green inhibitor in sol-gel systems as effective corrosion mitigation strategy.

Keywords: Paracetamol, Hybrid Sol-Gel, Corrosion, Inhibitor

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