

Weight Loss Analysis of Pectin-Incorporated Hybrid Sol-Gel Coatings for Corrosion Mitigation

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Structured Abstract

Background: The vulnerability of mild steel to corrosion in saline conditions requires adequate protective measures. Hybrid sol-gel coatings present a viable alternative, and the integration of natural inhibitors such as pectin can improve their efficacy. The objective of utilizing weight loss approach in this work was to quantitatively evaluate the anti-corrosive effectiveness of pectin-infused hybrid sol-gel coatings on mild steel. This method facilitated the direct assessment of material degradation and the evaluation of inhibitory efficiency at different pectin concentrations (500-2000 ppm), yielding essential data on the protective efficacy of the coatings.

Methods: Mild steel samples were carefully prepared and coated with pectin-infused hybrid sol-gel at various concentrations (500-2000 ppm). Both uncoated and coated specimens were precisely weighed (W_1) before immersed in 0.5 M NaCl solution (24 hours). After immersion, samples were dried and reweighed (W_2). Weight loss was determined using the formula $\Delta W = W_1 - W_2$. The corrosion rate was calculated utilizing ΔW , surface area, immersion time, and density of mild steel. The inhibition efficiency was computed by comparing the corrosion rate of coated to uncoated sample.

Results: The weight loss analysis demonstrated a distinct association between pectin concentration in hybrid sol-gel coating and its efficacy in corrosion inhibition. With the escalation of pectin concentration from 500 to 2000 ppm, a gradual decrease in corrosion rate was noted following immersion in 0.5 M NaCl. This signified improved resistance to corrosion. The optimal inhibitory efficiency was attained with the 2000 ppm pectin-infused coating, indicating a substantial decrease in the corrosion rate relative to the uncoated mild steel. The 2000 ppm concentration demonstrated a notable 73.1% inhibition efficiency, affirming its optimal efficacy at this level.

Conclusion: In conclusion, the weight loss analysis definitively showed the efficacy of pectin-infused hybrid sol-gel coatings in reducing mild steel corrosion in 0.5 M NaCl. The incremental increase in pectin content correspondingly improved inhibitory efficiency, with the 2000 ppm coating demonstrating superior performance by giving out values of 73.1%. These findings confirm that pectin serves as an efficient corrosion inhibitor when included into the sol-gel matrix, offering a protective barrier against corrosive damage.

Keywords: Pectin, Hybrid Sol-Gel coating, Mild Steel, Weight Loss Analysis

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