

Citrus Peel as an Eco-Friendly Corrosion Inhibitor

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Structured Abstract

Background: Corrosion presents a substantial industrial challenge, resulting in considerable economic losses, environmental risks, and safety issues. Conventional corrosion inhibitors, typically formulated with hazardous substances, present significant threats to human health and the environment. This research examines the efficacy of citrus peel extract as a sustainable corrosion inhibitor for mild steel in 0.5M H₂SO₄. Citrus peels possess bioactive compounds, including flavonoids, that can adhere to metal surfaces, creating a protective barrier that diminishes corrosion rates. The findings indicate that citrus peel extract is a cost-effective and sustainable substitute for synthetic corrosion inhibitors, thereby advancing green chemistry and industrial sustainability.

Methods: In Soxhlet extraction, dried and ground citrus peels were refluxed with a solvent to extract bioactive compounds. Functional groups that inhibit corrosion were identified using Fourier Transform Infrared Spectroscopy (FTIR) on the extract. Weight loss, EIS, and PDP were used to assess corrosion. Steel samples immersed in 0.5M H₂SO₄ with and without the inhibitor were compared for weight loss to determine corrosion rate and inhibition efficiency. EIS measured charge transfer resistance, R_{CT} and double-layer capacitance C_{dl} to reveal the extract's protective layer. PDP analysis determined whether the inhibitor was an anodic, cathodic, or mixed-type inhibitor.

Results: Weight loss analysis indicated that the corrosion of mild steel in 0.5M H₂SO₄ intensified with increased immersion time and temperature, as extended exposure to the acidic environment expedited metal deterioration. The incorporation of the citrus peel inhibitor significantly diminished weight loss, with increased concentrations of the inhibitor offering enhanced protection. The 0.4% concentration inhibitor demonstrated the least weight loss, signifying negligible corrosion, with 79% IE. Corrosion was more pronounced at 45°C than at 24°C, indicating that elevated temperatures exacerbated metal degradation. Characterization of the synthesis through FTIR confirmed the presence of organic compounds such as C-OH and C-N groups in flavonoids.

Conclusion: In conclusion, the findings of this study indicated that citrus peel extract effectively inhibited mild steel corrosion in 0.5M H₂SO₄, with higher concentrations reducing weight loss. Corrosion increased with time and temperature, but the inhibitor mitigated its effects, proving to be a sustainable and eco-friendly alternative to synthetic inhibitors.

Keywords: Corrosion, Inhibitor, Citrus Peel, Eco-Friendly, Mild Steel

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