

BANANA PEEL POWDER AS A GREEN CORROSION INHIBITOR FOR STAINLESS STEEL GRADE 202 IN HYDROCHLORIC ACID MEDIUM

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Corrosion is a persistent issue in acidic environments, especially for stainless steel (SS) Grade 202, which is prone to localized attack in the presence of chloride ions. While synthetic corrosion inhibitors are widely used, their toxicity and environmental impact have prompted the need for green and sustainable alternatives. In this study, the corrosion inhibition potential of banana peel powder (BPP) was evaluated for SS Grade 202 in 0.50 mol L⁻¹ HCl medium. BPP extract was prepared by mixing 10.0 g of dry powder with 80.0 mL of distilled water, followed by refluxing to enhance the release of active compounds, such as tannins, flavonoids and polyphenols, which are known for their surface-adsorbing and corrosion-inhibiting properties. Fourier transform infrared spectroscopy of the extract identified characteristic functional groups at 1700 cm⁻¹ for C=O and 3300 – 3500 cm⁻¹ for O-H involved in corrosion inhibition through surface adsorption, while verifying the refluxing process preserved the chemical integrity of the extract. Mass loss measurements demonstrate significant reduction in corrosion rate from 50% to 15% with increase in the extent of the BPP extract, where the addition of 2.0 – 4.0 mL extract to 40.0 mL of 0.5 mol L⁻¹ HCl solution showed 70% inhibition efficiency. Electrochemical impedance spectroscopy revealed an increase in polarization resistance from 1.70 Ω cm² to 3.40 Ω cm², with the diameter of the semi-circle increasing proportionally, indicating the formation of a protective layer on the metal surface. Tafel slope analysis showed a decrease in corrosion current density from 20.80 μA cm⁻² to 6.20 μA cm⁻² along with modified slope values, confirming the ability to suppress both anodic metal dissolution and cathodic reactions through corrosion inhibition. Open circuit potential measurements displayed positive potential shifts, reflecting enhanced thermodynamic stability of the metal surface in BPP containing solutions. Atomic absorption spectroscopy confirmed the release of metal ions into the corrosive medium during corrosion. Overall, the results establish BPP as an effective, biodegradable, and environmentally friendly corrosion inhibitor for SS Grade 202 in HCl medium.

Keywords: BPP, Corrosion inhibition, Electrochemical analysis, Extraction, SS Grade 202