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Research Article

Corrosion inhibition potential of isoniazid derivative N'-(3,4-dimethoxybenzylidene)pyridine-3-carbohydrazide on mild steel in acidic medium

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ARTICLENFO	ABSTRACT
	A Schiff base, N'-(3,4-dimethoxybenzylidene)pyridine-3-carbohydrazide (DPC), was synthesized, characterized, and evaluated as a corrosion inhibitor for IS 2062 E250 mild steel in 0.5 M trichloroacetic acid (TCA) solution. The inhibition performance of DPC was investigated using gravimetric (weight-loss) measurements, potentiodynamic polarization, and scanning electron microscopy (SEM). The results demonstrated that DPC effectively suppressed the corrosion of mild steel, and its inhibition efficiency increased with increasing inhibitor concentration due to the progressive adsorption of inhibitor molecules on the steel surface. The maximum inhibition efficiency of 96% was achieved at an optimum inhibitor concentration of 1.5 ppm under the investigated conditions. Potentiodynamic polarization studies revealed that DPC acts as a mixed-type inhibitor with a predominant influence on the cathodic hydrogen evolution reaction, while the relatively small shift in the corrosion potential confirmed that both anodic metal dissolution and cathodic reactions were inhibited. Thermodynamic and adsorption studies indicated that the adsorption of DPC on the mild steel surface is spontaneous and predominantly chemisorptive, following the Temkin adsorption isotherm. SEM observations further confirmed the formation of a compact and protective adsorbed film on the steel surface in the presence of DPC. The excellent inhibition performance is attributed to the presence of the azomethine (–C=N–) group, amide functionality, pyridine nitrogen atom, and methoxy substituents, which facilitate strong adsorption through donor–acceptor interactions with the iron surface.

Keywords: Corrosion inhibition; IS 2062 E250 mild steel; N'-(3,4-dimethoxybenzylidene) pyridine-3-carbohydrazide; Trichloroacetic acid; Potentiodynamic polarization; Gravimetric analysis; Scanning electron microscopy

1. Introduction

Metals are indispensable engineering materials owing to their excellent mechanical strength, durability, ease of fabrication, and cost-effectiveness. However, exposure to aggressive environments results in corrosion, leading to deterioration of mechanical properties, structural failure, safety hazards, and significant economic losses worldwide. It has been estimated that the global cost of corrosion exceeds 3–4% of the gross domestic product (GDP) of industrialized countries, emphasizing the need for effective corrosion control strategies [1–3].

Mild steel is one of the most widely used engineering materials because of its high strength, excellent machinability, low cost, and good weldability. It is extensively employed in structural components, pipelines,