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ABBREVIATIONS USED

$\eta_{WL}\%$ = Percentage inhibition efficiency obtained from weight loss measurements

$\eta_{Rct}\%$ = Percentage inhibition efficiency obtained from EIS measurements

$\eta_{i}\%$ = Percentage inhibition efficiency obtained from Tafel measurements

C_r = Corrosion rate in uninhibited system (mm year^{-1})

${}^{i}C_r$ = Corrosion rate in inhibited system (mm year^{-1})

D = Density of metal (g cm^{-3})

Y = amplitude of the CPE (Ω^{-1} s^{n} cm^{-2})

j = imaginary unit ($\sqrt{-1}$)

ω = angular frequency ($2\pi f$, f the frequency)

f = Frequency of component of impedance (s^{-1})

C_{dl} = Double layer capacitance (μF cm^{-2})

R_s = Solution resistance (Ω cm^2)

R_{ct} = charge transfer resistance in absence of inhibitor (Ω cm^2)

$R_{ct(i)}$ = charge transfer resistance in presence of inhibitor (Ω cm^2)

i_{corr} = Corrosion current density in uninhibited solution (mA cm^{-2})

${}^{i}i_{corr}$ = Corrosion current density in inhibited solution (mA cm^{-2})

E_{corr} = Corrosion potential (mV/SCE)

A = Arrhenius pre-exponential factor (mg cm^{-2} h^{-1})

E_a = Activation energy (kJ mol^{-1})

R = Universal gas constant (J K^{-1} mol^{-1})

T = Absolute temperature (K)

K_{ads} = Adsorption equilibrium constant (mol^{-1})

ΔG_{ads} = Gibbs free energy of adsorption (kJ mol^{-1})

θ = Degree of surface coverage of metal

C = Concentration of inhibitor (m mol, mol, mg L^{-1}, ppm)

E_{HOMO} = Energy of highest occupied molecular orbital

E_{LUMO} = Energy of lowest unoccupied molecular orbital

ΔE = Energy gap between HOMO and LUMO

ΔN = Number of electron transferred

χ_{Fe} = Electronegativity of iron

χ_{inh} = Electronegativity of inhibitor

η_{Fe} = Hardness of iron

η_{inh} = Hardness of inhibitor

f^{+} = Electrophilic Fukui indices

f^{-} = Nucleophilic Fukui indices

PREFACE

Corrosion is inevitable process. The cost of corrosion in the industrialized countries estimates annually up to about 3-4% of the gross national product. Corrosion causes serious materials problems in many technologies and adverse effect to the environment. The need to curtail corrosion losses and introduction of highly effective methods of increasing the corrosion resistance of metallic components are constantly emphasized on considering the main directions on scientific development.

The metals used in various aggressive environments of oil industries, pipelines, refineries, domestic central heating systems, industrial cooling systems, pickling of metals, and acidization of oil well results extremely wide diversity of corrosion problems. By the available methods, such as material selection, proper designing, coating, cathodic protection, anodic protection and inhibitors the corrosion of metals can be control. The use of corrosion inhibitors is one of the effective and economic methods for corrosion control. Corrosion inhibitors are chemical compounds whose presence in adequate quantities in an aggressive medium, inhibit corrosion by bringing down corrosion rate of metal.

The first chapter introduction starts with a brief discussion about corrosion and its economic impact. The different types of corrosion, theories of corrosion and corrosion control methods have been described to explain its mechanism. A brief outline for the principle of electrode kinetics and electrochemical thermodynamics, as relevant for aqueous corrosion process is given in this chapter with discussion about the basic essentials, indispensable for the understanding of corrosion kinetics in general, and of the origins of corrosion resistance as well as of corrosion failure in particular. Special attention has been given to corrosion inhibitors among the different corrosion control methods. The techniques used to evaluate the performance of corrosion inhibitor have been discussed in brief in this chapter. The literature survey regarding corrosion inhibitors for mild steel in acid medium has been given. The objectives of the research work have been elaborated.

The second chapter includes the details about materials and experimental techniques such as weight loss, electrochemical impedance spectroscopy (EIS), potentiodynamic polarization, surface analysis (SEM/AFM/XPS) and computational simulations have been used in the present work.

The third chapter deals with results and discussion on corrosion inhibition of mild steel in hydrochloric acid by organic corrosion inhibitors using weight loss, electrochemical impedance spectroscopy, potentiodynamic polarization. The surface morphology of mild steel in absence and presence of corrosion inhibitors have been given in this chapter. Quantum chemical calculations have been done in order to correlate various computed properties such as E_{HOMO}, E_{LUMO}, ΔE, global hardness (η), softness (σ), Mullikan charges, number of transferred electrons (ΔN) with experimentally determined inhibition efficiencies.

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