



THE CORROSION INHIBITION OF ISONICOTINAMIDE (ISN) - Zn²⁺ SYSTEM CONTROLS THE CORROSION OF CARBON STEEL IN 1 M HYDROCHLORIC ACID SOLUTION

C. Rajarathinam^[a], A. John Amalraj^{[b]*}, C. Kumar^[c], A. Peter Pascal Regis^[a],
Susai Rajendran^[d,e], S. Maria Michael^[f] and J. Wilson Sahayaraj^[g]

Keywords: Corrosion, carbon steel, Isonicotinamide, synergistic effect.

The corrosion inhibition efficiency of Isonicotinamide (ISN) in controlling the corrosion of carbon steel in 1 M hydrochloric acid solution (HCl) in absence and presence of Zn²⁺ has been studied by weight loss method. Weight Loss study reveals that the formulation consisting of 10 ppm of ISN and 10 ppm of Zn²⁺ has 78% inhibition efficiency. The results of polarisation study shows that the formulation function controls the anodic reaction predominantly. The AC impedance spectra reveal that a protective film formed on the metal surface. FTIR spectrum reveal that the protective film consists of Fe²⁺-ISN complex on the anodic sites of metal surface and Zn(OH)₂ formed on cathodic sites of metal surface.

* Corresponding Authors

Fax: 91-0431-2332010

E-Mail: amalrajevr@gmail.com

- [a] PG and Research Department of Chemistry, St. Joseph's College (Autonomous), Trichy - 620002, Tamil Nadu, India.
- [b] PG and Research Department of Chemistry, Periyar E.V.R college (Autonomous), Trichy - 620023, Tamil Nadu, India.
- [c] Bharathiar Matric higher secondary school, Elumalai, Madurai - 625535, Tamil Nadu, India.
- [d] PG and Research Department of Chemistry, GTN Arts College, Dindigul-624 005, Tamilnadu, India.
- [e] Research Centre, RVS School of Engineering and Technology, Dindigul -624 005, Tamilnadu, India
- [f] M/S. Light alloy products limited, Vellore district – 632505, Tamilnadu, India
- [g] Department of Chemistry, Jeppiaar Engineering College, Chennai- 600119, Tamil Nadu, India.

INTRODUCTION

Corrosion is a natural phenomenon involving the reversion from metallic to compound state. So it becomes evident that corrosion cannot be fully prevented instead it can be controlled to a greater extent. Many researchers have used various nitrogen-containing compounds in their corrosion inhibition investigations. These compounds included quaternary ammonium salts,¹⁻⁷ polyamino-benzoquinone polymers,⁸ azoles,⁹⁻¹⁶ substituted aniline-N-salicylidene,¹⁷ amides,^{18,19} heterocyclic compounds²⁰, and cationic surfactants.^{21,22}

The present work is undertaken:

-To evaluate the influence of isonicotinamide (ISN) with Zn²⁺ on corrosion behavior of carbon steel immersed in 1 M HCl solution by weight-loss method.

-To evaluate the type of inhibitor by polarization study.

-To evaluate the protective film by AC impedance spectroscopic study.

-To analyze the nature of protective film formed on the carbon steel by FTIR spectra.

METHODS AND MATERIALS

Preparation of specimens

Carbon steel specimens (0.0267% sulphur, 0.06% phosphorous, 0.4% manganese, 0.1% carbon and the rest iron) of dimensions 1.0 cm x 4.0 cm x 0.2 cm were polished to a mirror finish and degreased with trichloroethylene.

Weight-loss method

Carbon steel specimens in triplicate were immersed in 100 ml of 1 M HCl solutions containing various concentrations of the inhibitor in the presence and absence of Zn²⁺ for one hour. The weight of the specimens before and after immersion was determined using Shimadzu balance, AY62 model. The corrosion products were cleansed with Clarke's solution.²³ From the change in weight of the specimens, corrosion rates were calculated with the help of the following relationship:

$$CR = \frac{\Delta m}{A * t} \quad (1)$$

where

CR - corrosion rate

Δm - loss in weight (mg)

A - surface area of the specimen (dm²)

t - period of immersion (days)]

The inhibition efficiency (IE, %) was then calculated using the equation

$$IE = 100 \left(1 - \frac{W_2}{W_1} \right) \quad (2)$$

where W₁ and W₂ are the corrosion rates in the absence and presence of the inhibitor, respectively.