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Adsorption and inhibition action of a novel green inhibitor on aluminium and 6063 aluminium alloy in 1.0 M H_3PO_4 solution

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Abstract

The corrosion inhibition characteristics of *Garcinia indica* extract (GIE) on the corrosion of aluminium and 6063 aluminium alloy in 1.0M phosphoric acid solution were studied by using potentiodynamic polarization using Tafel extrapolation technique and electrochemical impedance spectroscopy (EIS) techniques at different temperatures and at different concentrations of inhibitor. Kinetic parameters and thermodynamic parameters were evaluated and discussed in detail. Inhibition efficiency increased with extract concentration and increased with temperature. The adsorption of GIE on metal surface obeyed Langmuir adsorption isotherm. GIE acted as mixed inhibitor in phosphoric acid solution and followed chemisorption on the surface of both material. Results obtained from Tafel extrapolation technique and by A.C electrochemical impedance spectroscopy (EIS) technique were in good agreement with one another. This study highlights the utility of GIE extract as a potential green inhibitor for corrosion control of Al and 6063 Al alloy in 1.0M phosphoric acid environment.

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Keywords: Aluminium, 6063 Aluminium alloy; Garcinia indica; Tafel extrapolation technique; EIS technique

1. Introduction

Corrosion studies of Al and Al alloys have received considerable attention by researchers because of their industrial applications and economic considerations. The known hazardous effects of most synthetic organic inhibitors and the need to develop cheap, non-toxic and environmentally benign process now urged researchers to focus on the use of environmentally friendly and ecologically acceptable, plant products as corrosion inhibitor by Deepa et al. (2013). Till date lots of plant products have been used as effective corrosion inhibitor for steel and Al observed in a review article by Raja et al. (2008). As a contribution to the current interest of environment friendly

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corrosion inhibitors, our present work investigates the inhibiting effect of *Garcinia indica* on corrosion behavior of Al and 6063 Al in alloy in 1.0 M H_3PO_4medium.

2. Experimental

2.1. Material

The Al and 6063 Al alloy specimen were used in the study. The composition of the Al is 99.6% pure and 6063 Al alloy is Si (0.412%), Fe (0.118%), Cu (0.0570%), Mg (0.492%), Al (Balance).

2.2. Medium and Inhibitor

Phosphoric acid of exactly 1.0M was prepared by diluting the standard solution of 2.0M phosphoric acid with double distilled water. Seeds of *Garcinia indica* were finely powdered and aqueous extract was prepared according to Handa et al. (2008). The aqueous extract was filtered and the filtrate was evaporated to dryness to get solid residue. FTIR spectrum of the solid residue was taken using KBr pellet technique. The aqueous solution of the inhibitors of strength was prepared and used for the experiment. The experiments were carried out at temperatures 30℃, 35℃, 40℃, 45℃ and 50℃, (±0.5℃) in a calibrated thermostat.

2.3. Electrochemical measurements

Electrochemical measurements were carried out using an electrochemical work station (CH600D-series, U.S. Model with CH instrument beta software). The electrochemical cell used was a conventional three-electrode compartment having glass cell with a platinum counter electrode, a saturated calomel electrode (SCE) as reference and working electrode was made of Al and 6063 Al alloy.

3. Results and discussion

3.1 Fourier transform infrared (FTIR) spectroscopy

Fig.1 shows the FTIR spectroscopy of GIE. –OH stretching frequency appears at 3396.41 cm^{-1}. The aromatic stretching frequency appears at 2923.88 cm^{-1}. –C=O– stretching frequency is at 1785.96 cm^{-1}. –C=C– stretching frequency at 1608.52 cm^{-1}. $-CH_2$ bending frequency 1446.51 cm^{-1}. –C–H bending frequency at 1282.57 cm^{-1}. –C=C– bending frequency at 1099.35 cm^{-1}.

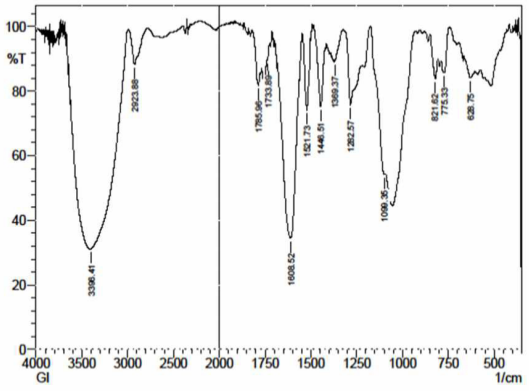

Fig. 1. FTIR spectra of solid residue of GIE.