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Corrosion inhibition of mild steel surface by isoxazoles in HCl solution: Electrochemical studies

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ABSTRACT

The corrosion inhibition efficiency of (3-(4-chlorophenyl isoxazole-5-yl) methanol (CPIM) and (3-(2,4 dichlorophenolisoxazole-5-yl) methanol (DCPIM) for mild steel in 1 M HCl has been studied using electrochemical methods at 40 and 50 °C. Polarization studies showed that the inhibitors are efficient mixed-type corrosion inhibitors, and their inhibition performance increased with the rise of inhibitor concentration and decrease of temperature. The result of EIS measurements was analyzed through an appropriate equivalent circuit model to model the corrosion inhibition.

1. Introduction

Inhibitors are promising materials to delay the corrosion process and keep its rate to a minimum amount. In order to reduce the corrosion rate, small quantities of inhibitors were used against corrosion in many environments for various metals like steel [1, 2], iron [3], copper [4], aluminum [5], and zinc [6]. The development of low price, low toxicity, and easy-to-make inhibitors are one of the most demanded methods for protecting metal surfaces against corrosion particularly in industrial centers [7-10]. The chemicals that can act as corrosion inhibitors may be inorganic or organic. Organic molecules are introduced to be effective corrosion inhibitors for many metals and alloys surfaces [11,12]. The experimental studies reported from several literatures have pointed out that the greatest of the effective organic inhibitors used contain nitrogen, oxygen, and sulfur-like hetero-atoms and unsaturated bonds in their structures through which they are formed a protective layer of adsorbed species on the metal surface [13-15]. Coordinate covalent bonds are easily formed between their electron pair and/or π electron cloud and the low-lying vacant d-orbital of metals. The efficiency of the inhibitor molecule on metallic corrosion was dependent on the strength of the newly formed bonds [8,16,17]. The interest in the Schiff-base compounds has grown over the last few years, due to the role of imine bond in their adsorption ability and corrosion inhibition efficiency. Schiff-bases were formed via condensation of an amine with a ketone or aldehyde, which having general formula R-C=N-R′ where R and R′ are aryl, alkyl, or cycloalkyl or heterocyclic groups. Furthermore, the Schiff-bases had a larger inhibition efficiency than the corresponding amines and aldehyde because of both heteroatoms and π electrons have been combined within the same molecule [18,19]. Schiff-bases inhibitors have been previously reported as effective corrosion inhibitors on steel in acid media, such as Schiff-bases such asbenzylidene-pyridine-2-yl-amine [14], 2,2′-[bis-N(4-choloro benzaldimin)]-1,1′-dithio (BCBD) [18], 5-((E)-4-phenylbuta-1,3-dienylideneamino)-1,3,4-thiadiazole-2-thiol (PDTT) [20], furoin thiosemicarbazone (FTSC) [21], 2-(2 hydroxyphenyl)-2,5-diaza-4,6-dimethyl-8-hydroxy-1,5,7-nonatriene [22], (NE)-4-phenoxy-N-(3-phenylallylidene) aniline (PAC) [23], 3-((phenylimino) methyl) quinoline-2-thiol (PMQ) [7], chitosan thiophene carboxaldehyde (ChTSB) [24], 13-bis-[(2-

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