Applied Surface Science 254 (2008) 5927–5935

Contents lists available at ScienceDirect

Applied Surface Science

journal homepage: www.elsevier.com/locate/apsusc

Adsorption and kinetic studies of L-leucine as an inhibitor on mild steel in acidic media

Puja Singh, Kalpana Bhrara, Gurmeet Singh *

Department of Chemistry, University of Delhi, Delhi 110007, India

ARTICLE INFO

Article history:
Received 23 August 2007
Received in revised form 5 February 2008
Accepted 25 March 2008
Available online 8 April 2008

Keywords:
Hot rolled mild steel IS226
Acid corrosion
L-Leucine

ABSTRACT

L-Leucine is evaluated as a potential inhibitor for mild steel in acidic medium by galvanostatic polarization and potentiostatic polarization techniques. The electrochemical results were supplemented by scanning electron microscopy (SEM) and infrared studies (IR).

The electrochemical polarization results show that L-leucine is most effective at 10^{-1} M concentration at room temperature (298 K). The efficiencies were found to decrease with decrease in concentration and increase in temperature. Electrochemical results also show that L-leucine acts as a mixed type of inhibitor (blocks the cathodic and anodic sites to same extent) which is evident from insignificant shift of open circuit potential.

Potentiostatic polarization data shows that they are passivating type of inhibitors. The effect of this inhibitor on anodic reaction is mainly attributed to physical adsorption of the additive on the anodic metal surface and the electron pairs on oxygen atoms. This additive exists in the protonated form (a positive charge on nitrogen atom) in the present acid medium. Therefore, on the cathodic sites, the interaction between additive and metal surface is thought to be electrostatic in nature.

The results of SEM and IR data supplement the results obtained by electrochemical techniques.

1. Introduction

There are number of ways of protecting the metal from corrosion, most important out of them is use of inhibitors [1–3]. Use of inhibitors for the prevention of metal against corrosion in acid media was known as far back as in middle ages when various organic products such as bran, yeast, flour were added to acids for pickling of materials. Inhibitors generally include triple bonded hydrocarbons [4], acetylenic alcohol [5], sulphoxides, aliphatic, aromatic or heterocyclic compounds [6] containing nitrogen and oxygen.

These inhibitors get adsorbed over the surface of metal and provide a coating to metal surface thus preventing it from the direct attack of the environment. This adsorbed layer of inhibitor may act in one or more of the following ways:

1. It may form a protective film over the metal surface,
2. anodic or cathodic decomposition of adsorbed additives could occur, and/or,
3. anodic or cathodic reactions could be catalyzed on the metal surface without any resultant change in additive molecules.

The first possibility gives effective inhibition, while the other two reactions may increase the rate of corrosion reaction considerably. In the presence of both protective and catalytic action the observed corrosion rate depends on the resultant effect of the two processes.

In the presence of adsorbing species corrosion reactions become even more complicated because of preferential and often strong adsorption of these additives over corroding surface. The effect of temperature on acid corrosion of metals in the presence and absence of organic additives has also been studied by number of investigators [7–16].

In this study, we report the adsorption and inhibition characteristics of L-leucine, a non-toxic inhibitor [17], at various temperatures during corrosion of mild steel in acidic media.

2. Experimental

2.1. Mild steel specimen

Hot rolled mild steel specimen grade IS-226 (sample taken from market, analyzed in the laboratory resulted in composition

* Corresponding author. Tel.: +91 11 27667828; fax: +91 11 27662780.
E-mail addresses: drpujasingh@hotmail.com (P. Singh), kbhrara@yahoo.com (K. Bhrara), gurmeet123@yahoo.com (G. Singh).

0169-4332/$ – see front matter © 2008 Elsevier B.V. All rights reserved.
doi:10.1016/j.apsusc.2008.03.154