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PROTECTION OF ALUMINIUM IN 0.75 M HCL SOLUTION BY ETHYLAMINE: THERMODYNAMIC, KINETIC AND ELECTRODE POTENTIAL STUDY

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ABSTRACT

The corrosion of aluminium in 0.75 HCl containing ethylamine as an inhibitor has been studied by weight loss, temperature effect and Open Circuit Potential (OCP) methods. Inhibitor concentration increases corrosion rate decreases while Inhibition Efficiency (I.E.) of ethylamine increases at constant acid concentration. As temperature increases, corrosion rate increases while I.E. decreases. The mode of inhibitor action followed by Langmuir adsorption isotherm. The maximum I.E. of 89.25 % was observed with 20 mM ethylamine in 0.75 M HCl.Higher the inhibitor concentrations higher the half-life period and lower the corrosion rate. In presence of inhibitor, the OCP values gradually increase with time towards the positive directions.

Keywords: Corrosion, Aluminium, HCl, Ethylamine, weight loss, OCP.

I. INTRODUCTION

Corrosion, an irreversible interfacial reaction of a material (metal, ceramic, and polymer) on exposure to aggressive environments, affects the performance efficiency of a material and also leads to reduction of its service life [1,2].

One of the methods usually employed to combat corrosion is the application of corrosion inhibitors and most of the well-known inhibitors are organic compounds. Most of the effective and efficient organic inhibitors are those hetero atoms containing elements such as oxygen, nitrogen, sulphur, and phosphorus, in their structures, which allow them to be adsorbed onto the metal surface [3,4]. Most inhibitors function by being adsorbed onto the metal surface to interact with anodic and/or cathodic reaction sites and influence the oxidation and reduction corrosion reaction, and prevent transportation of water and corrosion active species onto the metal surface [5,6].

Aluminium metal and its alloys are extensively used in automotive, aviation and aerospace, ship building, military hardware and household appliances. However, exposed of the metal to aggressive environments can lead to substantial loss due to corrosion. Industrial acid cleaning, acid descaling and acid pickling are some of the important fields of HCl applications. Various investigators [7-18] have studied ethylamine as corrosion inhibitor in different acid media. Present investigation was carried out to study the effect of ethylamine as corrosion inhibitor for Al in 0.75 M HCl solution by weight loss, temperature effect, rate constant and half-life as well as OCP methods.

II. EXPERIMENTAL

Preparation of sample and solution

The Al specimens with a chemical composition of 99.54 % Al, 0.090 % Si, 0.320 % Fe, 0.0012 % Cu, 0.0034 % Mn, 0.0014 % Mg, 0.0042 % Cr, 0.0046 % Ni, 0.0020 % Zn, 0.0079 % Ti, 0.0005 % Pb, and 0.0026 % Sn were used in the present study. The metal sheet, test specimens of size 5.0 x 2.50 x 0.198cm having an effective area of 0.2797 dm^2were used. Aluminium specimen was cleaned by washing with distilled water, degreased by acetone, dried and weighted by using electronic balance. HCl acid was used as corrosive solution having concentration of 0.75 M prepared by diluting analytical grade of HCl purchased from Merck using double distilled water.

Weight loss measurement

For weight-loss measurement, the Al coupons were completely immersed in 230 mL of 0.75 M acid concentration in without and with of 5, 10, 15 and 20 mM concentrations of ethylamine for 24 h immersion