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Inhibiting Properties of Hexamine as Corrosion Inhibitor for Zinc in (HNO_3 + H_3PO_4) Binary Acid Mixture

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Abstract: ***The inhibition of corrosion of zinc in (HNO_3+ H_3PO_4) binary acid mixture by hexamine has been investigated by using weight loss, temperature effect and polarization techniques. As acid concentration increases corrosion rate and inhibition efficiency (I.E.) increases. As inhibitor concentration increases corrosion rate decreases while percentage of I.E. increases. As temperature increases, corrosion rate increases while percentage of I.E. decreases. Maximum I.E. of Hexamine was found up to 81.00 % at 1.0 % inhibitor concentration in (0.10 N HNO_3 + 0.10 N H_3PO_4) solution. Higher values of mean energy of activation 'Ea' indicates physical adsorption of the inhibitor on metal. Positive value of entropy of adsorption 'ΔS_a" indicates that the corrosion process is entropically favourable. The plot of log (θ/1-θ) versus log C results in a straight line suggest that the inhibitor cover both the anodic and cathodic regions through general adsorption following Langmuir isotherm. Polarization curve indicates that inhibitor act as anodic type.***

Keywords: Corrosion, Zinc, (HNO_3 + H_3PO_4) acid mixture, Hexamine, Polarization.

I. INTRODUCTION

Corrosion is the deterioration of metal by chemical attack or by reaction with its environment. The problem of corrosion is of considerable importance, nowadays due to increase in uses of metals and alloys. Zinc is one of the most important non-ferrous metals, which finds extensive use in metallic coating. Nitric acid is very strong and highly corrosive mono protic acid having ability to dissolve metals, which are inert to most ordinary acids. The main use of nitric acid is for the production of fertilizers. Phosphoric acid is a major chemical product which has many important uses especially in the production of fertilizers [1,2]. One of the methods used to reduce the rate of metal corrosion is the addition of inhibitors. Aromatic, aliphatic and heterocyclic amines have been extensively investigated as corrosion inhibitors [3,4]. Many researchers [5-9] studied corrosion inhibition of zinc in different acids using various organic and green inhibitors. Hexamine was reported as effective corrosion inhibitor for different metal in various acids [10-15]. In the present work, the corrosion of zinc by (HNO_3+ H_3PO_4) binary acid mix containing hexamine as an inhibitor was evaluated by using weight loss, temperature and Electrochemical Polarization techniques.

II. EXPERIMENTAL SECTION

A. Preparation of Sample and Solution

The zinc specimens with a chemical composition of 98.50 % Zn, 0.03 % Pb,0.02 % Cd and 0.01% Fe were used in the present study. Rectangular specimens (5.5 x 2.5 x 0.2 cm) of zinc having an area of 0.2935 dm^2 were used. The specimens were cleaned by washing with distilled water, degreased by acetone and finally dried and weighted by using electronic balance. A binary acid mixture (HNO_3+ H_3PO_4) having concentration of 0.01, 0.05 and 0.10 N was used as corrosive solution prepared by diluting analytical grade purchased from Merck using double distilled water.

B. Weight loss Measurement

For weight-loss measurement, the zinc coupons were each suspended and completely immersed in 230 mL of 0.01, 0.05 and 0.10 N acid concentration in absence and presence of different concentrations of hexamine at 301± 1 K for 24 h immersion period. After the test, specimens were cleaned by 10% chromic acid solution having 0.2 % $BaCO_3$ for a period of about 2 minutes [16]. After cleaning, test specimens were washed with distilled water followed by acetone and dried with air. From the weight loss data, corrosion rate (CR) was calculated.