1,4-Diaminobutane as a Corrosion Inhibitor for Mild Steel in Acidic Solutions

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Abstract- The corrosion inhibition activity of 1,4-diaminobutane for mild steel in 1N H_2SO_4 was investigated using weight loss and potentiodynamic polarization studies. Corrosion parameters such as inhibition efficiency, corrosion rates, corrosion potential and corrosion current were evaluated. The inhibition efficiency was found to increase with increase in the inhibitor concentration. The adsorption of the inhibitor on the mild steel surface follows Langmuir adsorption isotherm

Index Terms- 1,4-diaminobutane , acidic solutions, mild steel corrosion, weight loss , potentiodynamic polarization.

I. Introduction

The use of inhibitors is an important method of protecting the metals and alloys against corrosion. Usually organic compounds containing hetero atoms like sulphur, nitrogen and oxygen, multiple bonds and aromatic rings are used as corrosion inhibitors because of their electron richness, an important characteristic to be satisfied by the compounds to be employed as corrosion inhibitors. These compounds inhibit the corrosion of the metals and alloys by adsorption process. Many organic compounds were used as corrosion inhibitors for mild steel in various environments[1-9]. In this work, the influence of 1,4-diaminobutaneas a corrosion inhibitor for mild steel in 1N H_2SO_4acid solution was examined by weight loss and potentiodynamic polarization studies.

II. EXPERIMENTAL

The mild steel specimens of composition: carbon 0.07%, phosphorous 0.008%, manganese 0.34% and the remainder being iron and size of 5cm*2cm* 0.025cm were used for weight loss studies. Mild steel specimens were polished with a series of emery papers of various grades from 400-1200, degreased with absolute ethanol and air dried. For polarization studies mild steel rod of the same composition, embedded in araldite, with an exposed area of 0.502 cm^2 was used. The inhibitor compound, 1,4-diaminobutanewas obtained from the Alfa- Aesar chemicals of UK.. The corrosion medium was 1N H_2SO_4 prepared from A.R grade H_2SO_4 and deionised water.

Weight loss studies were carried out as reported earlier[10].From the weight loss experiments the % inhibition efficiency (I.E) and the degree of surface coverage (θ) were calculated by using the following equations.

$$I.E = \frac{Wo - Wi}{Wo} X\,100$$

$$\theta = \frac{Wo - Wi}{Wo}$$

Where W_o and W_i are the weight loss of mild steel in the absence and presence of the inhibitor respectively.

The corrosion rate (C.R) of the mild steel was calculated by using the following equation.

$$C.R(mmy) = \frac{87.6\,W}{A\,t\,D}$$

Where W is the weight loss of the mild steel (mg), A is the surface area of the mild steel specimen(cm^2), t is the exposure time (h) and D is the density of the mild steel (g/cm^3).

III. RESULTS AND DISCUSSION

Weight loss studies were carried out at four different concentrations of the inhibitor and the inhibition efficiency(%) and corrosion rate values were calculated and are presented in table-1.

Table 1Values of inhibition efficiency (%) and corrosion rates(mm/y) obtained from the weight loss experiments for the corrosion of mild steel in 1N H_2SO_4in the presence of different concentrations of the inhibitor.

Parameter	1,4-diaminobutane concentration (mM)			
	10	30	50	100
Inhibition efficiency	29.3	55.4	73.3	84.2
Corrosion rates	48.5	33.0	22.6	12.3

The results show that the inhibition efficiency increases and corrosion rates decreases with increase in the inhibitor concentration. The dependence of inhibition efficiency and corrosion rates on the concentration of the inhibitor is shown in figures-1and 2.

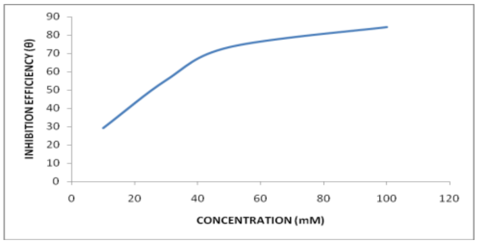

Figure 1 Variation of inhibition efficiency with concentration of the inhibitor.

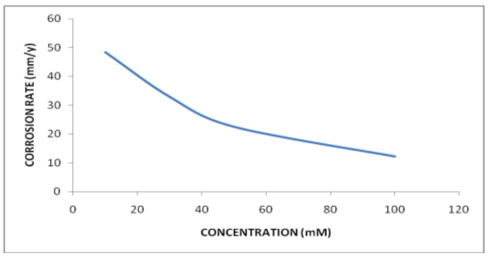

Figure 2 Variation of corrosion rates with concentration of the inhibitor.

Table-2 gives the various corrosion kinetic parmeters such as corrosion potential (E_{corr}), corrosion current(I_{corr}) and anodic and cathodicTafel slopes (b_a and b_c) obtained from the potentiodynamic polarization studies.

Table-2 The corrosion kinetic parameters obtained from polarization studies.

Inhibitor conc. (mM)	E_{corr} mV	Tafel slopes mV dec^{-1}		I_{corr} mA cm^{-1}	I.E (%)
		bc	ba		
Blank	-916	126	78	1.76	-
10	-884	168	81	1.24	29.9
30	-889	172	84	0.78	55.8
50	-897	197	87	0.48	72.7
100	-902	214	90	0.29	83.6

From the table it can be seen that the values of E_{corr} for mild steel becomes less negative with increase in the concentration of the inhibitor compound. This indicates the strong adsorption of the inhibitor molecules on the metal surface which leads to the reduction in the corrosion of the metal. The values of I_{corr} decreases with the increase in the concentration of the inhibitor. This also indicates the reduction in the corrosion of the mild steel in the presence of the inhibitor. The values of both ba and bc increases with increase in the concentration of the inhibitor, but increase in the value of bc is more than that for ba which indicates that the corrosion of mild steel in 1N H_2SO_4 is under mixed control , but predominantly under cathodic control.

IV. ADSORPTION ISOTHERMS

Adsorption of inhibitor molecules on the mild steel surface is characterized by various adsorption isotherms such as Langmuir, Temkin, Freundlisch etc., From the weight loss measurements the degree of surface coverage (θ) for various concentrations of the inhibitor were evaluated. Langmuir's isotherm was tested by plotting C/ θ vs C and a straight line was obtained which indicated that the adsorption of the inhibitor on the surface of the mild steel from 1N H_2SO_4 obey Langmuir's adsorption isotherm. Figure -3 shows the Langmuir's adsorption isotherm plot for mild steel in 1N H_2SO_4containing different concentrations of the inhibitor.

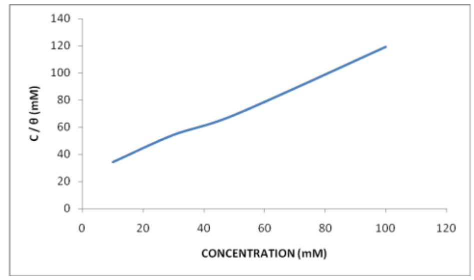

Figure 3 Langmuir's adsorption isotherm plot for mild steel in 1N H_2SO_4 containing different concentrations of the inhibitor

V. CONCLUSIONS

The 1,4-diaminobutane used as a corrosion inhibitor for mild steel in 1N H_2SO_4 performed well and gave high percentage of inhibition efficiency. The inhibition efficiency of the inhibitor increases with the increase in the concentration of the inhibitor. The adsorption of the inhibitor on mild steel surface obeyed Langmuir's adsorption isotherm.

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