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Inhibition Effect of Antigonon Leptopus Extract on Mild Steel in Sulphuric Acid Medium

KEYWORDS: Antigonon Leptopus , H2SO4, Mild steel and Inhibitor.

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ABSTRACT *The inhibitive action of Antigonon Leptopus acid extract on the corrosion of mild steel in 1M H2SO4 was studied by using weight loss measurements. Results demonstrated that the extract of Antigonon Leptopus acts as an effective corrosion inhibitor in the 1M H2SO4 acid medium. The inhibition efficiency of AL increased with increase in concentration and temperature. Thermodynamic parameter such as negative free energy value revealed that the spontaneous adsorption of inhibitors onto the mild steel surface.*

INTRODUCTION

Corrosion is defined as the continuous demolition of metals due to chemical or electrochemical reactions with the environment. Corrosion is the loss of useful properties such as malleability, ductility, electrical conductivity and optical reflectivity by metal due to attack of the environment . The caustic damage to equipment and structures caused by corrosion leads to sudden failure of equipments. In corrosion the loss is predictable to be very high. Mild steel is one of the most important Engineering materials are used particularly in the structural, automobile and industries. Because of its high strength ,malleability and easily available metal. Acid solutions are widely used in industry for acid pickling, industrial acid cleaning and acid descaling(1-2). Thus, mild steel is protect from the corrosion is an important problem. Out of some methods, use of inhibitors is one of the most practical method for the prevention of corrosion(3). It has been predictable that efficient inhibitors should hold plenty of π-electrons and unshared pair of electrons on nitrogen, sulphur and oxygen atoms of the inhibitors, which will be given to the vacant d –orbital of the metal, and chemical adsorption may occur on the metal surface due to transfer of electrons(4). Thus, the corrosion process may be suppressed by the protective film of inhibitor on the metal surface. The recent trend is to save human beings and environment by using eco-friendly inhibitors. Plant extracts are environmentally acceptable, inexpensive, readily available and ecologically acceptable(5-8). Plant products are organic in nature and some of the constituents including tannins, organic and amino acids, alkaloids and lignin are known to inhibiting action. Hence, the acid extract of AL are done with the aim of finding out effective phytochemical constituents which could be used as corrosion inhibitor in acid media(9-10).

METHODS AND MATERIALS

Preparation of Plant Extract

The AL leaves were collected, washed by water and then the leaves were shade dried And the dried leaves where ground to fine powder and stored into clean closed container. The mixture of 5 g AL powder and 100ml 1M H2SO4 ware taken in RB flask and refluxed for 3 hours and leaving it overnight. Next day it was filtered and the filtrate stored in clean standard flask.

Specimen Preparation

The rectangular mild steel specimens were mechanically cut from commercially available mildsteel sheets into coupons of 2cm × 5cm × 2 mm and holes are put on the top of MS strips. The specimens were polished in sequence using fine emery papers , then washed with distilled water , degreased with acetone and air dried .The specimens were then kept in desicator to avoid the adsorption of moisture.

Weight Loss Measurements

The MS specimens were pre-weighed and fully immersed with the glass hook in beakers containing 100 ml of each of 1M H_2SO_4 solution with and without different concentration of inhibitor at different time intervals and temperature. After the specified period of immersion, the specimen were removed, dried and reweighed. From this study ,the weight loss, inhibition efficiency(IE), surface coverage(θ) and corrosion rate were determined.

The inhibition efficiency was calculated using the following formula.

$$IE(\%) = \frac{W_U - W_I}{W_U} \times 100 \qquad (1)$$

W_u –weight loss in the absence of inhibitor

W_I –weight loss in the presence of inhibitor

Determination of corrosion rate

In this present study, the CR is expressed in American units, mpy (mils per year).

$$\text{Corrosion rate (CR)} = \frac{534 \times W}{D \cdot A \cdot T} \text{mpy} \qquad (2)$$

Where, mpy -mils per year, W -Weight loss in mg, D-Density in g / cm2 (7.9g / cm2 for mild steel) , A-Area in square inch and T- immersion time in hours

Determination of activation energy (Ea)

The Arrhenius plot obtained for the plot of log CR Vs 1/T

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with slope equal to Ea /2.303 R. Thus the Ea values can be calculated from the slope of the Arrhenius plot by using the equation,

Ea = - 2.303 RT x slope (3)

Where, Ea is the activation energy, T is the absolute temperature and R is the universal gas constant.

RESULT AND DISCUSSION

Preliminary phytochemical screening of 1M H2SO4 extract of Antigonon Leptopus

The extract of AL was found to contain alkaloids, terpenoids, Flavanoids,glycosides, Steroids and saponins(11).

Weight Loss Measurements

Effect of concentration of inhibitor and time of immersion

The inhibition efficiency was showed that increase with increasing acid extract of AL concentration and time(12-13) After reached 6 hours did not cause any considerable change in the performance of the inhibitor [6]. The maximum inhibition efficiency of 92.6% was noticed at a concentration 0.7% of the inhibitor at 6 hours in 1M H2SO4 thermic reaction.

medium.

Effect of temperature

Table 2 shows that the protective layer formed on MS surface, due to adsorption of AL extract was stable up to 323 K and after that there may be desorption of plant extract (14)occur.It is indicated that inhibition efficiency increases with the increase of AL concentration up to 94.58% at 323 K.

ThermodynamicConsideration

Figure 1 shows Arrhenius plot of the corrosion rate of mild steel in 1M H2SO4 in the presence and absence of AL extract at different temperatures. From the Table 3, it is evident that the Ea values of protected mild steel are lower than unprotected mild steel in 1 M H_2SO4 due to the adsorption of inhibitor molecules on the metal surface .The negative value of free energy of adsorption (ΔG_{ads}) indicates the spontaneous adsorption of the inhibitor on MS(15). The positive values of enthalpy indicate the endo-

Table 1: Influence of concentration of AL extract on the corrosion of MS in 1M H2SO4

Inhibitor Conc. (%v/v)	1/2 hr		2 hrs		4hrs		6hrs		8hrs		24hrs	
	CR (mpy)	IE (%)	CR (mpy)	IE (%)	CR (mpy)	IE (%)	CR (mpy)	IE (%)	CR (mpy)	IE (%)	CR (mpy)	IE (%)
Blank	260.13		397.32		509.05		534.40		597.23		635.27	
0.1	135.97	47.7	115.35	71.0	130.12	74.4	123.23	76.9	154.22	74.2	215.94	66.0
0.2	112.12	56.9	93.06	76.6	113.40	77.7	110.89	79.2	137.50	77.0	191.32	69.9
0.3	109.89	57.8	80.08	79.8	105.88	79.2	89.10	83.3	106.85	82.1	183.43	71.1
0.4	103.20	60.3	65.20	83.6	78.02	84.7	71.14	86.7	90.14	84.9	172.28	72.9
0.5	100.97	61.2	51.99	86.9	64.00	87.4	56.90	89.4	78.89	86.8	118.42	81.4
0.6	90.72	65.1	43.86	89.0	53.77	89.4	43.28	91.9	72.90	87.8	112.84	82.2
0.7	88.49	66.0	42.52	89.3	51.55	89.9	39.56	92.6	51.09	91.4	101.23	84.1
0.8	97.41	62.6	43.35	89.1	53.77	89.4	53.31	90.0	63.67	89.3	102.16	83.9
0.9	102.76	60.5	45.58	88.5	54.89	89.2	55.17	89.7	66.17	88.9	104.48	83.6

Table 2 : Effect of temperature on the corrosion of MS in the presence of various concentration of AL extract in 1M H2SO4

Inhibitor Conc. (%v/v)	303k		313k		323k		333k		343k	
	CR (mpy)	IE (%)	CR (mpy)	IE (%)	CR (mpy)	IE (%)	CR (mpy)	IE (%)	CR (mpy)	IE (%)
Blank	260.13		1872.37		1522.41		4435.73		6025.01	
0.1	135.97	47.68	847.38	54.74	378.93	75.11	1141.25	74.27	1997.19	66.49
0.2	112.12	56.90	425.74	77.26	251.88	83.46	1003.05	77.39	1433.25	76.21
0.3	109.89	57.75	401.22	78.57	231.08	84.82	925.04	79.15	1315.11	78.17
0.4	103.20	60.33	356.64	80.95	223.57	85.31	862.63	80.55	1248.24	79.28
0.5	100.97	61.18	323.21	82.74	202.84	86.68	639.73	85.58	936.18	84.46
0.6	90.72	65.12	193.92	89.64	148.67	90.23	481.47	89.15	862.63	85.68
0.7	88.49	65.98	149.34	92.02	82.47	94.58	385.62	91.31	623.23	89.66

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0.8	97.41	62.55	162.72	91.31	88.05	94.22	421.28	90.50	673.16	88.83
0.9	102.76	60.50	162.72	91.31	100.31	93.41	439.11	90.10	724.43	87.98

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