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Effect of 5-Amino-2-chloro-3-Picoloine Compound as Corrosion Inhibitor in Mild Steel Material

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ABSTRACT

The efficiency of 5-Amino-2-chloro-3-Picoloine (ACP) on preventing of mild steel material in 2N H_2SO_4 and 2N HCl in 2hrs at room temperature have been investigated using weight loss measurements studied. The efficiency of the inhibitor plays major role on minimizing the rate of corrosion in acidic medium. The values of the inhibition efficiency were calculated from this technique which shows a reasonably good agreement. These studies have shown that (ACP) is a good inhibitor in preventing corrosion on mild steel in 2N H_2SO_4 and in 2N HCl solutions at room temperature in 2 hrs. In 2N H_2SO_4 the inhibition efficiency was high than 2NHCl. Further the study was confirmed by Tafel studies.

Keywords: Corrosion, Inhibitor, Tafel curve, Adsorption, polarization

I. INTRODUCTION

Mostly MS-mild steel materials were used in industries like oil refineries and thermal power plants. The study of mild steel material was studied deeply by various researchers in various environments [1-3].Based on the common definition materials other than metal like plastic, ceramics and concrete also corroded. When no particular mention is made of material, however, it is normally understood that a metallic nature material being attacked. Expect noble metals all others are reactive and react with environment and form stable compounds, as their oxides, sulphides, chlorides and carbonates[4]. They exist in their form of stable compounds called ores and minerals. In the pure metallic state, the metals are more unstable as they are considerd in excited state that is in higher energy state [5]. Apart from its direct costs, corrosion poses a serious threat to our natural resources. Many inhibitors were studied to prevent mild steel materials. Due to the electron donating character and electron accepting chararater organic based inhibitor which has steric hindrance has been chosen for the corrosion studies. The rate of adsorption is high due to presence of π- electrons and heteroatoms which stimulate on the surface of mild steel [6-7]. Therefore, in this study, the corrosion inhibition of mild steel in 2N H_2SO_4 and in 2N HCl solution was studied in the presence and absence of two inhibitors namely 5-Amino-2-chloro-3-Picoloine (ACP).

II. METHODS AND MATERIAL

2.1 Material preparation

The mild steel material of composition (in percentage) % C=0.015; Si=0.009; Mn=0.193; S=0.016; P=0.009; Ni=0.013; Mo=0.015; Cr=0.040 and Fe=99.689 were cut into pieces of 5 cm × 1 cm strips for this study. Based on the procedure of ASTM procedure the metal were polished and using emery sheet of different grids, a hole at one end and numbered were punched over the surface of mild steel plate. The mils steel specimens were polished with various grades of SiC abrasive papers (from grits 120 to 1200) and degreased using Acetone.

2.2 Preparation of Solutions:

Preparation of Inhibitor

Inhibitor solution of 5-Amino-2-chloro-3-Picoloine (ACP) was prepared by dissolving 0.1gms of ACP in

100ml of test solution. Similarly 0.2%, 0.3%, 0.4% and 0.5% solutions were prepared.

2.3 Weight loss measurement:

Mild steel specimens were immersed in 2N H_2SO_4 and 2N HCl for two hours at room temperature (28 ± 2 ºC) at various concentration of ACP inhibitor solution. MS specimens were removed from the test solution and rinsed with distilled water and acetone. The difference in the initial weight and final weight were calculated. From this calculation we can determine the rate of Corrosion and Inhibiton efficiency.

Formula,
Corrosion rate

CR = 87.4 x W / 7.86 x A x t

Inhibiton Efficiency

$$IE\ \% = W_o – W_i \times 100 / W_o$$

Where, W_O and W_i (in g) are the values of the weight loss observed of mild steel in the absence and presence of inhibitor respectively.

2.4 Electrochemical Studies:

The coupons of MS material were cut into 1 x1 cm^2. The working electrode 1 cm^2 should expose into the test solution. The electrode was polished with 400-1200 grit emery papers and degreased with acetone. 100 ml of the test solution was taken in a three electrode polarization cell and the electrode was introduced into the test solution in the polarization cell and allowed to attain a steady potential value for 20 min. A constant potential was applied and the resultant current was measured. The experiments were carried out ± 200 mV from corrosion potential. Polarization measurements were carried out using electrochemical work station CHI 660 USA. The current density and Tafel slopes (βa and βc) values were obtained from the polarization curves by extrapolation of anodic and cathodic curves back to the corrosion potential. The experiments were performed with and without addition of inhibitors at different temperature. The percentage of the inhibition efficiency was calculated from the values of the current density (I_{corr}) with the help of the following formula,

$$IE\% = \frac{I_{corr} - I_{corr(i)}}{I_{corr}} \times 100 \qquad (2)$$

I_{corr} = Corrosion current density in the absence of inhibitor

$I_{corr(i)}$ = Corrosion current density in the presence of inhibitor.

III. RESULTS AND DISCUSSION

3.1 Weight loss method

The comparison graph of corrosion behaviour and inhibitor efficiency of mild steel in 2NH_2SO_4 and 2NHCl with ACP was shown in **Fig. 1 (a). Inhibition Efficiency of** ACP was given in **Fig. 2 (b)** which was studied by weight loss method at 2 h at room temperatures .From the graph, it was experientially verified that the weight loss of mild steel in the acid decreases with increasing concentration of additives and the values were tabulated in **Table 1** from which it clearly states that the corrosion rate has decreased with increasing concentration of inhibitor and inhibition efficiency increased with increasing the concentration of the inhibitor. The inhibition efficiency of ACP was 84.08% at 2N H_2SO_4 and in 2N HCl was 79.43 % respectively at optimum concentration of the inhibitor solution for two hours at room temperature.

Table 1. Comparison of Corrosion rate and Inhibiton efficiency of ACP inhibitor on two different acid medium

Concentration of the Inhibitor (%)	**Corrosion Rate**		**Inhibiton Efficiency (%)**	
	2N H_2SO4	**2N HCl**	**2N H_2SO4**	**2N HCl**
Blank	319.305	780.04	-	-
0.1	115.574	307.825	63.80	60.53
0.2	108.218	289.770	66.10	62.85
0.3	91.500	242.181	71.34	68.95
0.4	56.170	193.477	82.40	75.19
0.5	50.821	160.377	84.08	79.43

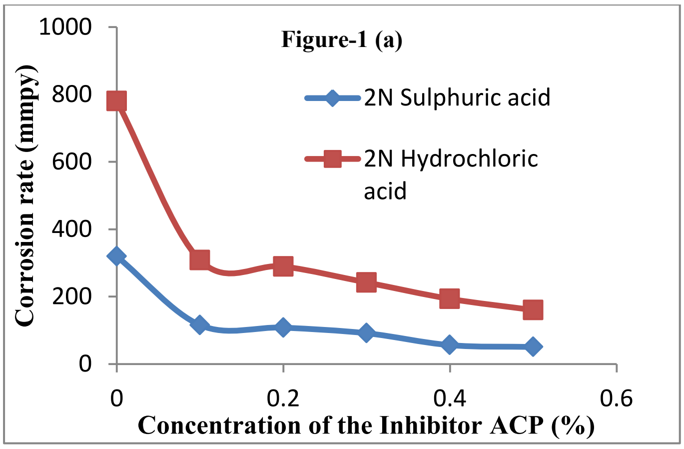


Figure 1(a) Comparison chart of Corrosion rate of ACP inhibitor in two different acidic medium

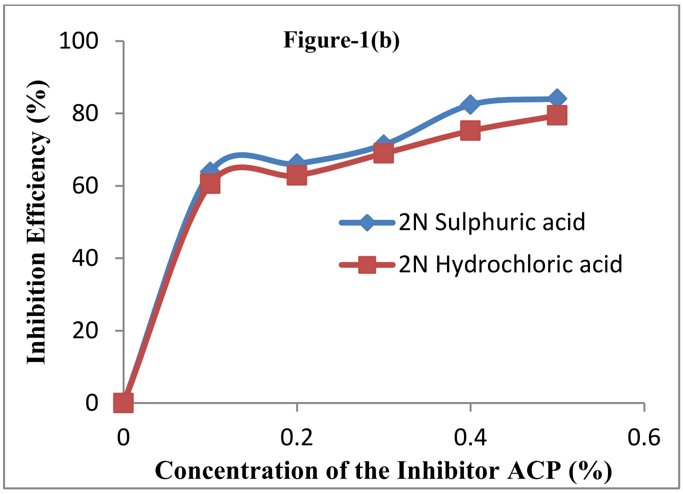
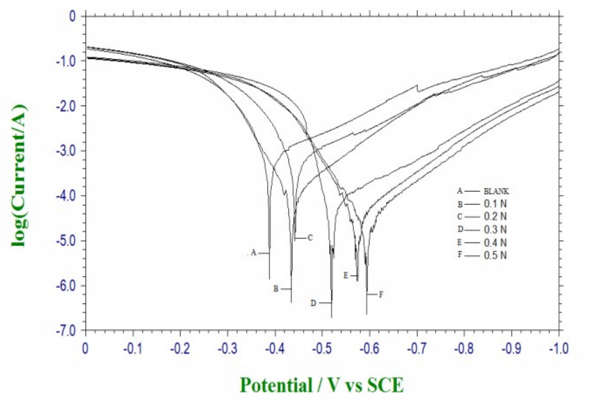


Figure 1 (b) Comparison chart of Inhibition Efficiency of ACP inhibitor in two different acidic medium



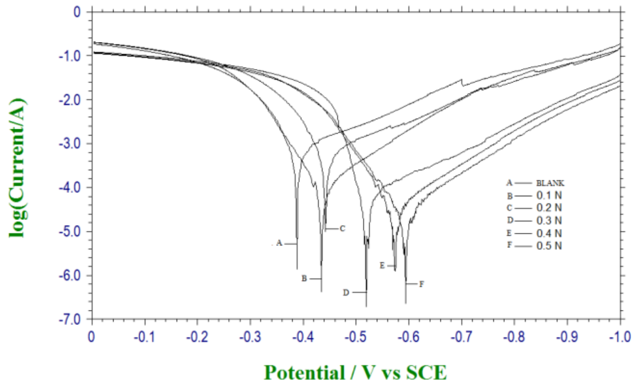


Figure 2. Tafel curves of MS electrode immersed in 2N HCl in absence and presence of ACP

Figure 3. Tafel curves of MS electrode in 2N H_2SO_4 in absence and presence of ACP

3.2 Potentiodynamic polarization studies

Potentiodynamic polarizations curves of mild steel in 2N HCl and 2N H_2SO_4 in the absence and presence of inhibitor ACP have been studied and shown in the Figure.2 and 3.

The influence of ACP inhibitor on the polarization behaviour of mild steel in 2N HCl and 2N H_2SO_4 is shown in Figure.2 and 3. The corresponding Tafel parameters are summarized in Table 2 and 3. In both the acid medium from the Table it is observed that the E_{corr} values are shifted slightly towards negative side in presence of inhibitors suggesting that the inhibitors inhibit the corrosion of mild steel in acids solution by controlling cathodic reactions due to the blocking of active sites on the metal surface.

Table-2: Polarization parameters of MS electrode immersed in 2NHCl in the absence and presence of the inhibitors

S.NO	Inhibitors	β_c (V dec^{-1})	β_a (V dec^{-1})	E_{Corr} (V)	I_{Corr} $x10^{-4}$ (A)	Corrosion Rate (mmpy)	Inhibition Efficiency (%)
1.	Blank	5.026	10.632	-0.493	3.913	18.810	---
2.	0.1 N	4.496	7.525	-0.428	1.570	7.545	59.87
3.	0.2 N	5.182	9.062	-0.515	1.448	6.960	62.99
4.	0.3 N	7.595	15.685	-0.505	1.261	6.058	67.77
5.	0.4 N	6.302	11.854	-0.563	1.123	5.458	71.30
6.	0.5 N	5.905	9.103	-0.514	0.9472	4.552	75.79

Table 3: Polarization parameters of MS electrode immersed in 2 N H_2SO_4 in the absence and presence of the inhibitors

S.NO	Inhibitors	β_c (V dec^{-1})	β_a (V dec^{-1})	E_{Corr} (V)	I_{Corr} $x10^{-4}$ (A)	Corrosion Rate (mmpy)	Inhibition Efficiency (%)
1.	Blank	4.015	15.354	-0.398	7.832	37.64	---
2.	0.1 N	4.627	10.135	-0.490	3.730	17.93	52.37
3.	0.2 N	7.515	18.159	-0.399	2.886	13.87	63.15
4.	0.3 N	6.182	18.771	-0.515	2.653	12.75	66.12
5.	0.4 N	7.509	16.397	-0.564	2.132	9.234	72.77
6.	0.5N	7.610	14.740	-0.599	1.354	6.466	82.71

It is evident that inhibitors bring about considerable polarization of the cathode. It was, therefore, inferred that the inhibitive action is of cathodic type in both the acidic medium. The non-constancy of Tafel slopes for studied inhibitor at all concentration reveals that the inhibitor action due to the interference in the mechanism of the corrosion processes at cathode. ACP shows inhibition efficiency (75.79%) in 2N HCl and (82.71%) in 2N H_2SO_4.

IV. CONCLUSION

5-Amino-2-chloro-3-Picoloine(ACP) shows a better inhibiton efficiency in both 2N HCl and in 2N H_2SO_4. Based on the weight loss method inhibitor efficiency in 2N HCl was 79.43% whereas in 2N H_2SO_4 it was 84.08%. From the result it revealed that the efficiency was high in 2N H_2SO_4 than 2N HCl. Polarization measurements demonstrate that the compound under investigation ACP inhibitor inhibits cathodic reaction and hence it act as cathodic type inhibitor.

V. REFERENCES

[1]. S.G.Ning ,M.L. Shi (1990), J Chin Soc Corros Prot.,10:383

[2]. EI Mehdia B, Mernari B, Traisnel M, Bentiss F, Lagrenee M (2002), Mater Chem Phys., 77:489

[3]. B.Zerga, M. Sfaria, Z. Rasis, B. Elbachiri A (2009), Mater Tech., 97, 297

[4]. E. Chaieb, A. Bouyanzer, B. Hammouti, M. Benkadour (2005), Appl Surf Sci., 246:199

[5]. M. Bouklah, B. Hammouti, (2006), Port Electrochim Acta., 24,457

[6]. A.Bouyanzer, L. Majidi , B. Hammouti, (2007), Phys Chem News., 37, 70

[7]. H. Akrout, S. Maximovitch, L. Bousselmi, E. Triki, F. Dalard (2007), Mater Corros., 58:202

[8]. F.Bentiss ,M. Lebrini, M. Lagrene M, (2005), Corros Sci., 47:2915.