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Research Article

STUDY OF CR(III), MN(II),FE(II),CO(II),NI(II) & CU(II) METAL ION CHELATES AS CORROSION INHIBITOR

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ABSTRACT

Present investigation deals with the corrosion inhibition study of 2-amino 4-methyl pyridine (AMPY)and its metal ion chelates on mild steel in 0.1N HNO_3,0.1N H_2SO_4 and 0.1 N HCl solution. All the corrosion inhibition studies were carried out by using weight loss method. The inhibition efficiency was found in AMPY and its metal ion chelates. The adsorption of 2-amino 4-methyl pyridine(AMPY) and its metal ion chelates on the surface of mild steel which shows increase in inhibition efficiency.

Keywords: Corrosion, Inhibition, Mild steel, AMPY and metal ion chelates in HNO_3, H_2SO_4 ,HCl.

INTRODUCTION

Corrosion is the slowest process of oxidation of metal. Corrosion is the gradual destruction of metal by chemical reaction with environment[1].The rusting of iron is an electrochemical process that begins with the transfer of electrons from iron to oxygen. Organic compounds containing sulphur, nitrogen and oxygen have been used as corrosion inhibitors in acid solutions[2-4].Some references indicates that certain Hetrocyclic compounds are corrosion inhibitors in acidic medium[5-8].Milld steel is widely employed in the constructional materials in many industries due to excellent mechanical properties and low cost[9,10].The corrosion inhibition efficiency (I.E.) of organic compound is connected with their adsorption properties. The application of the adsorbed inhibitor is to protect the metal from corrosion[11].The principal function of the inhibitor is to barrier the metal surface and to prevent the acess of aggressive ions in the corrosive environment on the metal substrate by the formation of adsorptive film[12,13]. Mild steel is an alloy of iron with carbon (carbon content 0.16-0.25%) which undergoes corrosion easily in acidic medium.The study of mild steel corrosion phenomenon has become important particularly in acidic media because of the increased industrial applications of acid solutions and also elevated levels of hydrogen ions in the atmosphere due to pollution [14].

EXPERIMENTAL

All the corrosion inhibition studies were carried out using weight loss method. All the solutions were prepared in distilled water. AR grade chemicals were used for this study**.** Iron wire is used to study the inhibition effect of chelating agent and metal chelate .Steel binding wire was purchased from local market.All the wires were cleaned by reghmal paper and washed with distilled water .After cleaning the wire was dried in an oven at 120^0c for about an one hour. The binding wire was cut into small pieces having length about 6 inch. The standard 0.1N solution of Nitric acid,0.1N solution of Sulphuric acid and 0.1N solution of Hydrochloric acid were prepared in distilled water.In this experiment 24 beakers are arranged and labeled them from 1-

24.In beaker no.1to 8 add 20 ml 0.1N HNO_3 solution in each beaker. Beaker no1.containing 0.1N HNO_3(control),beaker no.2 contains 20 ml 0.1N HNO_3 along with 20mg of 2-amino 4-methyl pyridine and in beaker no. 3,4,5,6,7&8 contains 20 ml of 0.1 N HNO_3 solution along with 20 mg Cr(III)AMPY Chelate, Mn(II)AMPY Chelate , Fe(II)AMPY Chelate ,CO(II)AMPY Chelate , Ni(II)AMPY Chelate , Cu(II)AMPY Chelate were added respectively.. Beaker no.9.contains 0.1N H_2SO_4(control),beaker no.10 contains 20 ml H_2SO_4 along with 20mg of of 2-amino 4-methyl pyridine and in beaker no. 11,12,13,14,15&16 contains 20 ml of H_2SO_4 solution along with 20 mg Cr(III)AMPY Chelate Mn(II)ABPY Chelate , Fe(II)AMPY Chelate , CO(II)AMPY Chelate ,Ni(II)AMPY Chelate, Cu(II)AMPY Chelate were added respectively. Beaker no 17 containing 20 ml of 0.1N HCl(control),beaker no.18 contains 20 ml 0.1N HCl along with 20mg of of 2-amino 4-methyl pyridine (AMPY) and in beaker no. 19,20,21,22,23&824 contains 20 ml of 0.1N HCl solution along with 20mg Cr(III)AMPY Chelate, Mn(II)AMPY Chelate , Fe(II)AMPY Chelate, CO(II)AMPY Chelate , Ni(II)AMPY Chelate ,Cu(II)AMPY Chelate were added respectively .The previously weighed binding wire were dipped for 72 hours. After 72 hours the binding wires were removed from beaker the binding wire were cleaned by reghmal paper and washed with distilled water.

Using the following relation inhibition efficiency of organic compound i.e. chelating agent and different metal ion chelates were calculated the obtained inhibition efficiency values are given in the different tables.

$$\text{I.E.} = \frac{Wu - Wi}{Wu} \times 100$$

Where,

I.E. = Inhibition efficiency
Wi = Loss in weight in inhibitor solution
Wu = weight loss in control solution

Table 1: Corrosion inhibition effect of 2-amino 4-methyl pyridine (AMPY) metal ion chelates on mild steel in 0.1N HNO_3 solution

Beaker No.	Compound	Initial weight	Final weight	Loss in weight	%Loss in weight	I.E.
1	Control(HNO3)	0.760	0.695	0.065	8.55	-
2	HNO3+AMPY	0.874	0.833	0.041	4.69	36.92
3	HNO3+Cr(III)AMPY Chelate	0.742	0.714	0.028	3.77	56.92
4	HNO3+Mn(II)AMPY Chelate	0.790	0.767	0.023	2.91	64.61
5	HNO3+Fe(II)AMPY Chelate	0.730	0.709	0.021	2.87	67.69
6	HNO3+Co(II)AMPY Chelate	0.720	0.696	0.024	3.33	63.07
7	HNO3+Ni(II)AMPY Chelate	0.760	0.725	0.035	4.60	46.15
8	HNO3+Cu(II)AMPY Chelate	0.754	0.718	0.036	4.77	44.61

Table 2: Corrosion inhibition effect of 2-amino 4-methyl pyridine (AMPY) metal ion chelates on mild steel in ,0.1N H2SO4 solution

Beaker No.	Compound	Initial weight	Final weight	Loss in weight	%Loss in weight	I.E.
9	Control(H_2SO_4)	0.742	0.679	0.063	8.49	-
10	H_2SO_4+AMPY	0.854	0.815	0.039	4.56	38.09
11	H_2SO_4+Cr(III)AMPY Chelate	0.806	0.777	0.029	3.59	53.96
12	H_2SO_4+Mn(II)AMPY Chelate	0.752	0.731	0.021	2.79	66.66
13	H_2SO_4+Fe(II)AMPY Chelate	0.730	0.706	0.024	3.28	61.90
14	H_2SO_4+Co(II)AMPY Chelate	0.812	0.794	0.018	2.21	71.42
15	H_2SO_4+Ni(II)AMPY Chelate	0.720	0.690	0.030	4.16	52.38
16	H_2SO_4+Cu(II)AMPY Chelate	0.722	0.691	0.031	4.29	50.79

Table 3: Corrosion inhibition effect of 2-amino 4-methyl pyridine (AMPY)Metal ion chelates on mild steel in 0.1N HCl solution

Beaker No.	Compound	Initial weight	Final weight	Loss in weight	%Loss in weight	I.E.
17	Control(HCl)	0.784	0.725	0.059	7.52	-
18	HCl+ AMPY	0.762	0.727	0.035	4.98	40.67
19	HCl +Cr(III)AMPY Chelate	0.740	0.716	0.024	3.24	59.32
20	HCl +Mn(II)AMPY Chelate	0.762	0.748	0.014	1.83	76.27
21	HCl +Fe(II)AMPY Chelate	0.728	0.712	0.016	2.19	72.88
22	HCl +Co(II)AMPY Chelate	0.712	0.694	0.018	2.52	69.49
23	HCl +Ni(II)AMPY Chelate	0.694	0.663	0.031	4.46	47.45
24	HCl +Cu(II)AMPY Chelate	0.720	0.687	0.033	4.58	44.06

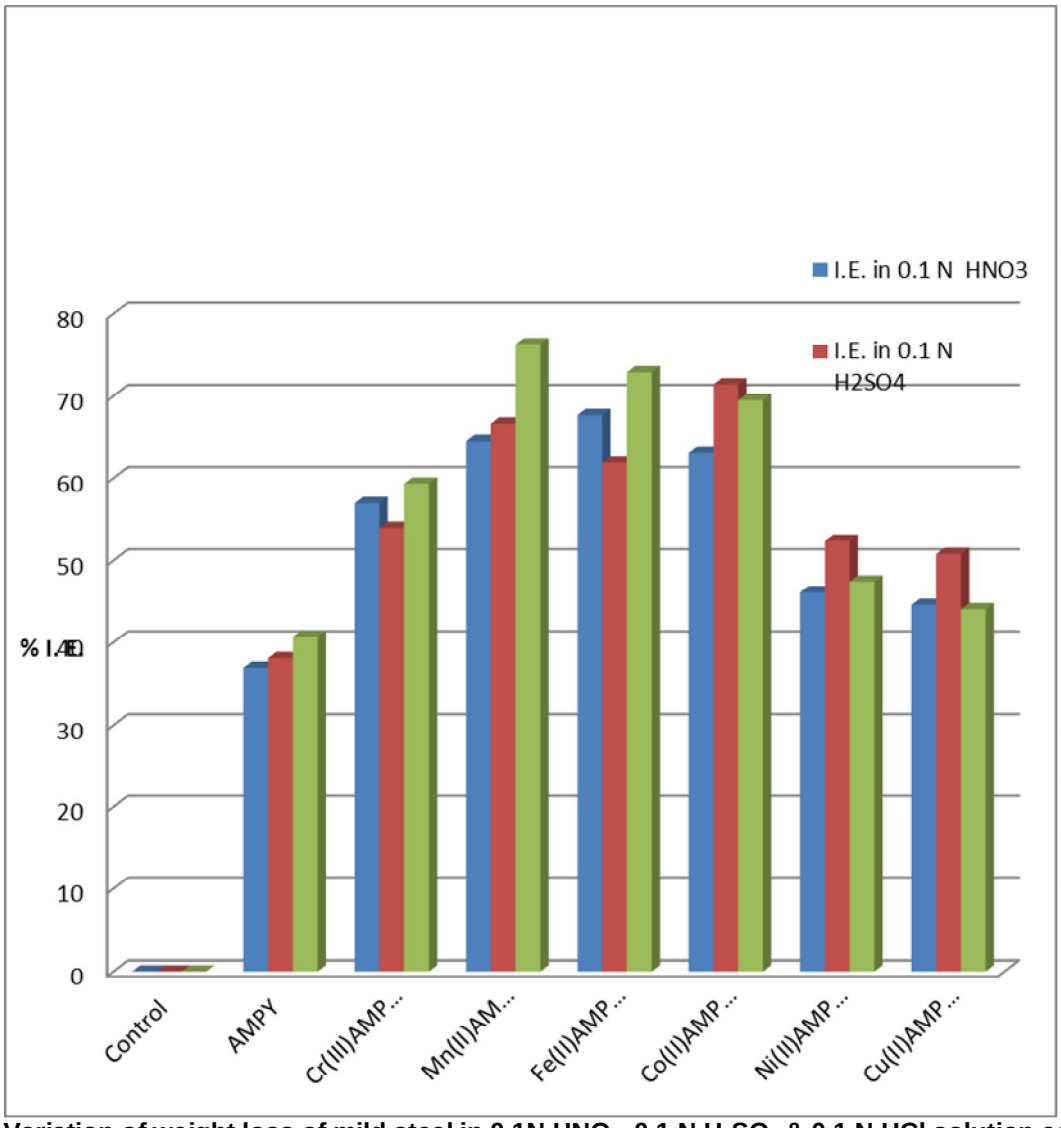

Fig.1: Variation of weight loss of mild steel in 0.1N HNO_3, 0.1 N H_2SO_4 & 0.1 N HCl solution contain 2-Amino 4-Methyl Pyridine (AMPY)metal ion chelates

RESULT AND DISCUSSION

The chelating agent i.e. 2-Amino 4-Methyl Pyridine is basic organic compound it inhibits the corrosion action of nitric acid.It is found that inhibition efficiency of 2-Amino 4-Methyl Pyridine (AMPY) is compaired to less than the remaining metal ion chelates.

For the study of inhibition efficiency the Cr^{+3},Mn^{+2},Fe^{+2},Co^{+2},Ni^{+2}&Cu^{+2}, 2-Amino 4-Methyl Pyridine(AMPY) metal ion chelates were used. Inhibition efficiency of each metal ion chelate were determined. It is found that Fe(II) Metal ion chelate act as good inhibitor as compaired to other metal ion chelates. Also Mn(II) AMPY metal ion chelate behave as corrosion inhibitor but this inhibition efficiency is less than Fe(II) AMPY metal ion chelate but more than Co(II) AMPY metal ion chelate,Cr(II) AMPY metal ion chelate,Ni(II) AMPY metal ion chelate,Cu(II) AMPY metal ion chelate.

In case of sulphuric acid medium the chelating agent 2-Amino 4-Methyl Pyridine (AMPY) inhibits the corrosion action in sulphuric acid medium.It is observed that inhibition efficiency of chelating agent 2-Amino 4-Methyl Pyridine (AMPY) is less as as compaired to remaining metal ion chelates. It is observed that Co(II)AMPY metal ion chelate have more inhibition efficiency as compaired to other metal ion chelates. The Mn(II)AMPY metal ion chelate behaves as corrosion inhibitor but more than Fe(II) AMPY metal ion chelate., Cr(II) AMPY metal ion chelate, Ni(II) AMPY metal ion chelate,Cu(II) AMPY metal ion chelate. The order of inhibition efficiency of chelating agent and metal chelates in hydrochloric acid medium as Mn(II) AMPY > Fe(II)AMPY> Co(II)AMPY> Cr(II) AMPY> Ni(II)AMPY) >Cu(II) AMPY> AMPY.

The values of inhibition efficiency indicates that after forming chelate with metal ion, the chelating agent 2-Amino 4-Methyl Pyridine (AMPY) increases inhibition efficiency. This may be due to more adsorption of metal ion chelate on the surface of metal. To have more inhibition efficiency in case of Fe(II) AMPY metal ion chelate, Mn(II) AMPY metal ion chelate & Co(II)AMPY metal ion chelate may be due to formation of multilayer.

CONCLUSION

The inhibition efficiency figures indicates that the inhibition efficiency of metal ion chelates is more than the chelating agent this may be due to increased in the adsorptive power between metal surface and metal ion chelates .The formation of multilayer of metal ion chelate on the surface of metal may be responsible to have increasing inhibition efficiency.

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