Corrosion Inhibitive Properties of different plant extract

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Abstract

The natural products in acidic media were tested for corrosion inhibition of Cu, Al and Mild-Steel in 0.5N HCl acid solution at 30 to 40 ^{0}C temperature range by Weight Loss technique, it reveals that Natural Products works as a corrosion inhibitor in halide media and protect the metals from the corrosion with great efficiency.

Key words Natural Product, Inhibitors, HCl, Halide

Introduction

The serious consequence of corrosion tends to jeopardize safety and inhibit technology progress because of vital role of metals to the world economy [1]. The continuous panting of steel structure reveals that corrosion of metals is an ever increasing problem [2]. The inhibition of steel corrosion has continued to pose a lot of problem for scientists and Engineers [3]. The corrosion of mild steel and other metals is severe in the presence of an aggressive media such as acid. Therefore industrial process such as acid cleaning, etching of metal in which acidic solution is made to contact with the metal requires the use of an inhibitor. Several inhibitors have been synthesized and used for the inhibition most effective inhibitors are organic compound having hetero atom in their carbon chain systems. For these compounds, the presence of hetro atoms enhanced the electron donating ability of the inhibitor to metal. However, the short coming of these inhibitors is that they are not environment friendly. Therefore is needed to search green corrosion inhibitors. So far Several N- and S- containing organic compounds [4-8] have been employed as inhibitor for the corrosion of metals and alloy in acidic solution at certain concentration and temperature [9-12]. This present investigation is aimed at studying the inhibition of metal corrosion in acidic media by different natural products via weight loss method [13-20].
The weight loss method enables us to illustrate the importance of the environment in the process of rusting while the other method use to allows us to assess the effectiveness of

the inhibitors at high corrodent concentration . The relevant equation used in calculation of inhibition efficiency, IE% has the form:

$$IE\% = [(w_f - w_i)/w_f] \times 100 \quad \text{----------(1)}$$

And

$$IE = [(w_f - w_i)/w_f] \quad \text{----------(2)}$$

Where w_f and w_i are weight loss of metals in free and inhibited acid media respectively. This study is a continuation of our extensive studies on the efficiency of corrosion inhibition.

Materials and Methods

The strip of pure mild steel with dimensions of 1 x 2 x 1 cm was used in weight loss experiments. For Electrochemical technique a cylindrical rod of mild steel embedded in araldite with an exposed bottom area of 0.5 cm^2 was used. Before each experiment, the metal was polished to a mirror finish with different grades of emery papers, degreased with acetone and finally rinsed with distilled water. BDH grade HCl was used for the preparation of the test solution. Weight loss measurements were carried out by the same method as described elsewhere [13]. Each of the mild steel was immersed, for 24 hours, in 50 ml of 0.5 HCl solution containing of surfactants, at 40^0C.

Results and Discussion

Weight loss measurements

The losses of weight of metal sheets due to their immersion in solution of 0.5 M HCl containing different concentrations of the inhibitors were measured. It was found that the addition of any the used all compounds lowers the weight loss of the metal sheet than its value in the acid solution. This result indicates that all the natural products act as inhibitor for the corrosion of metals in acidic solution. The inhibitive action could be attributed to the adsorption of their molecules on the metal surface, forming a barrier between the bar metal and the corrosive environment. The surface activity of natural compounds as well as the presence of function group, in their structure facilitates such adsorption. The surfactant molecules adsorb on the surface via their functional group. Since the compounds mixed in to the solution they repel aggressive anions away from the metal surface and therefore inhibit the corrosion reaction. The inhibition efficiencies of different concentrations of the compounds are given in Table-1. The inhibition efficiency was calculated using the following equation:

$$IE\% = [(w_f - w_i)/w_f] \times 100$$

Where w_f and w_i are weight loss of metals in free and inhibited acid media respectively.

Inspection of Table-1 reveals that the inhibition efficiency increases as the inhibitor concentration is increased. This behavior could be attributed to the increases of the metal surface area covered by the adsorbed inhibitor molecules with the increasing inhibitor

concentration. Furthermore, data of Table-1 show that the extent of inhibition of different compounds on their structures. The inhibition efficiency increases in the following order:

Bixin < Zenthoxlum almauta < Echitamine < Nyctanthin

This sequence reflects the effect of type of the unit present in the compound and their inhibitive action.

Table-1 Dependence of IE% of the inhibitors of their concentration as revealed from weight loss measurements

Concentration of inhibitor	Bixin	Zentheloxylum almauta	Echitamine	Nyctanthin
50ppm	49.58	57.43	78.9	82.9
100ppm	68.9	71.6	84.32	90.67
200ppm	80.21	81.65	94.1	95.34
300ppm	88.123	90.24	95.7	98.10
400ppm	92.30	94.6	96.12	98.673

It is observed that the inhibition efficiency increases with in the concentration of inhibitor and decrease with increase in acids strength. The corrosion decreases with increasing of concentration of inhibitor. The maximum efficiency was obtained in low acid concentration. The inhibitors have shown the efficiency in the range. All the inhibitors are very good inhibitors but Nyctanthin shows the maximum efficiency of inhibition (98.68%) in 0.5N HCL and for the sulphuric acid solution of 0.5 N is (96.16%) but for the 2N acid solution this efficiency reduced up to 69% and &72.1%.(Table-1 and 1.1) similarly other tested component also very good inhibitor for the corrosion it revel from Table-1.1.

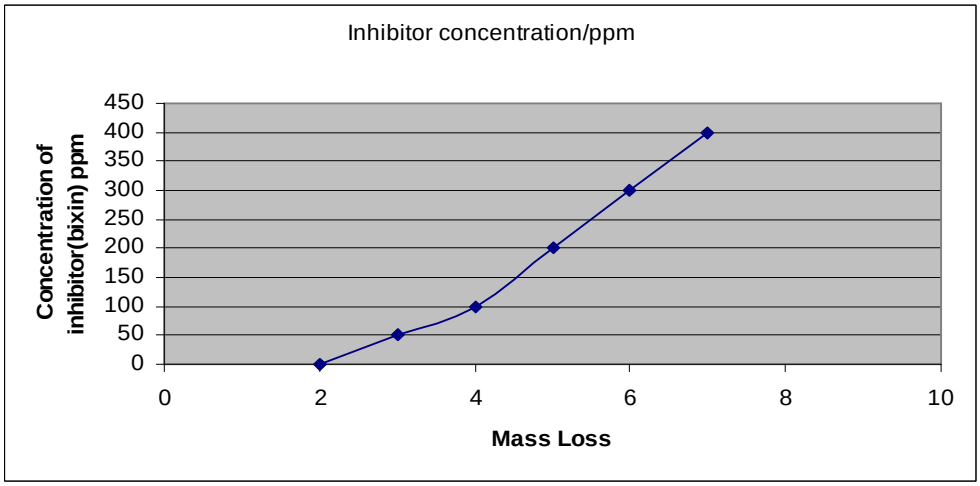

Fig-1: Corrosion Inhibition by Bixin

Table-1.1: Corrosion inhibition of Cu in 0.5N HCL Solution

Inhibitor concentration/ppm	Mass loss	Mmpy	Surface Coverage	Efficiency
0.0 Bixin	0.1740			
50	0.0832	0.0155	0.3040	30.40
100	0.0417	0.0067	0.4987	49.87
200	0.0289	0.0019	0.6513	65.13
300	0.0274	0.0020	0.9201	92.01
400	0.0263	0.0003	0.9330	93.30
1.0 Zenthoxylum Alatuma				
50	0.1054	0.0146	0.388	38.8
100	0.0852	0.0153	0.560	51.0
200	0.0552	0.0099	0.680	68.0
300	0.0300	0.0056	0.838	83.6
400	0.0112	0.0019	0.935	93.5
2.0 Echitamine				
50	0.1192	0.0214	0.3100	31.00
100	0.0874	0.0154	0.4780	47.80
200	0.0530	0.0096	0.6904	69.00
300	0.0288	0.0052	0.8310	83.10
400	0.0094	0.0016	0.9448	94.48
3.0 Nyctanthin	0.1729			
50	0.0830	0.0148	0.5190	51.90
100	0.0410	0.0074	0.7670	76.70
200	0.0280	0.0029	0.8400	84.00
300	0.0136	0.0020	0.9180	92.10
400	0.0027	0.0005	0.9867	98.67

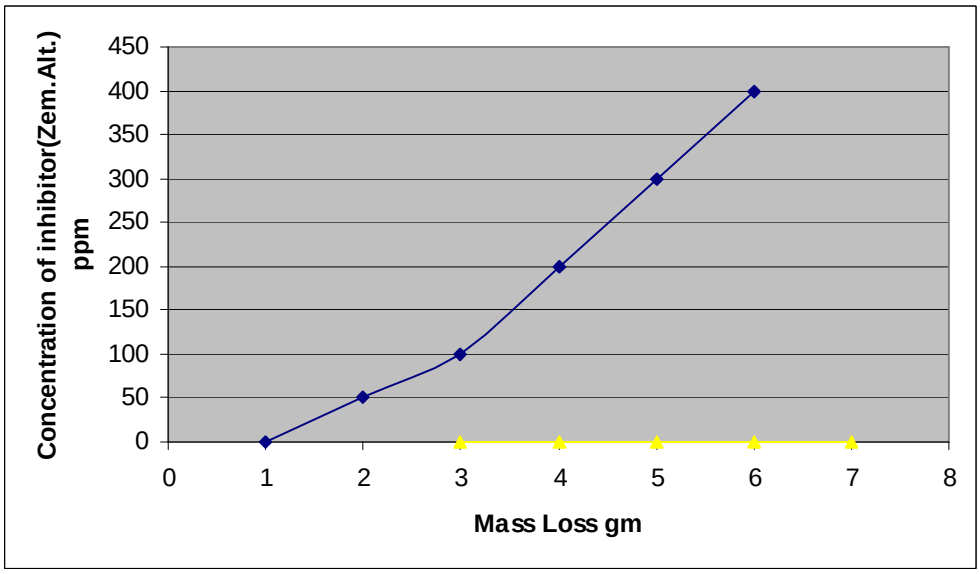

Fig-2: Corrosion Inhibition by Zenthoxylum Alatum of Cu metal

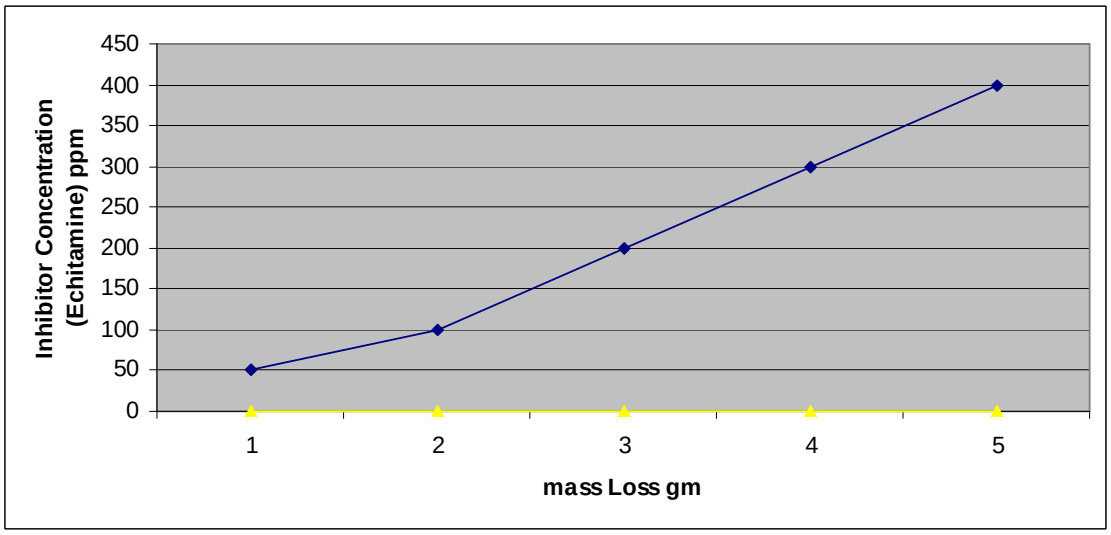

Fig-3: Corrosion Inhibition by Echitamine

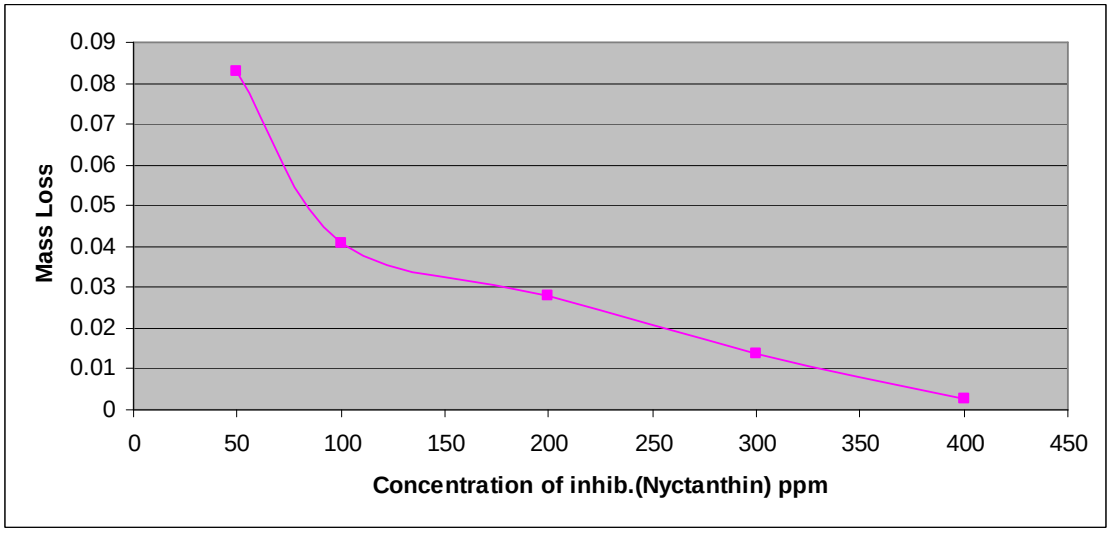

Fig-4: Corrosion Inhibition by Nyctanthin

Conclusion

The tested natural plant extracts are very good inhibitor for the metal and metal alloys in acidic media. These compounds are better inhibitor then the oxide film.

References

1. Abdallah M. *Corrosion Sc*., **2002**, 44**,**717-728.
2. Kish J.R., Ives M.B. and Koda J.R., *J. Electrochem. Soc.*, **2000**, 147, 3637.
3. Keddam M., Takenouti H. and Yu N., J. *Electrochem Soc. ,* **1985**, 132, 2561.
4. Emregul K.C. and Atakol, *Mater. Chem. Phys.* **2003**, 82, 188.
5. Raicheve S.N., A leksive B.V. and Sokolova E.I., *Corros. Sci.* **1993**, 34, 343.
6. Arab S., and Noor E.A., *Corrosion*, **1993**, 49,122.
7. Sayed E.I., *J. Appl. Electrochem*, **1997**, 27,193.
8. Cheng X.L., Ma H.Y., Chen S., Yu R., Chen X.,Yao Z.M., *Corros. Sci.*, **1993**, 41, 321.
9. Acharya S., Upadhyay S.N., *Trans. Indian Inst. Met.* **2004**, 57(3), 297-306.
10. Ashassi-Sorkhabi H., Shaabani B., Aligholipour, Selfzadesh D. *Appl. Surff. Sci*. **2006**, 252, 58-70.
11. Atkins P., *Physical Chemistry*, 7th edition. *Oxford: Oxford press* (**2003**).
12. Eddy N.O., "Inhibition of the corrosion of mild steel in acidic medium by some antibiotics". *Ph.D. thesis University of Calabar* (**2008**).
13. Eddy N.O., Ebenso E.E., *J.Pure Appl. Chem*., **2008**, 2(6), 46-54.
14. Aksut A.A. and Bilgic S. *Corrosion Sci.*, **1992,** 33, 379.
15. Khamis E., Bellucci F., Latanision R.M. and El-Ashry, *Corrosion*, **1991**, 47,677.
16. Chauhan J.S., and Gupta D.K., *AJChem.* **2009,** 21(3), 1975-1978.
17. T. Ohtsuka, K.E. Husler, *J. Electro anal. Chem*. **1979**, 102**,**175.
18. N. Sato, K. Kudo, *Electrochim. Acta*. **1974**, 19, 461.
19. P. Borea, F. Zucchi, G. Trabanelli, *Corros. Sci.* **1973,** 13, 585.
20. A.A. Aksut, S. Bilgic. Corros. Sci. **1992,** 33, 38-37.