Comparative study of corrosion inhibition of aluminium in HCl and H_2SO_4 media by *prosopis cineraria.*

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Received: February 03, 2019 Accepted: March 14, 2019

ABSTRACT: *An attempt has been made to investigate and compare the anti-corrosive property of ethanolic extract of Prosopis cineraria fruit in 1M HCl and 0.5M H_2SO_4 at temperatures 303K, so as to replace the use of toxic chemicals as corrosion inhibitors. Mitigation of aluminium corrosion in 1M hydrochloric acid and 0.5M sulphuricacid was studied in absence and presence of Prosopis cineraria fruit extract by using weight loss method. The inhibition efficiency is found to increase with increasing concentration of extract. The maximum inhibition efficiency 86.67% was obtained in 1M HCl and 80.06% in 0.5M H_2SO_4 at 303K temperature . The adsorption of inhibitor on aluminium surface was observed to be exothermic, physical, and spontaneous. The inhibition efficiency of the extract was seen more in HCl in comparison to H_2SO_4.*

Key Words: : *Corrosion, Prosopis cineraria, HCl, H_2SO_4.*

INTRODUCTION

Aluminium and alloy find extensive applications in industries where they are used in a variety of aggressive and corrosive service environments. Aluminium, a light weight metal and is used in fabricating various reaction vessels, reaction tanks and pipes etc. for industrial uses due to their availability and low cost[1-4]. However in aggressive media, the unprotected metal surface sites gets dissolved causing severe loss and malfunctioning of industrial equipment. Therefore it is necessary to protect from getting corrode and the best method is employing inhibitors. Organic compounds containing N, S, or O has been found adequate for this purpose and their inhibiting action is widely attributed to their adsorption onto the metal/solution interface[5-8]. Now-a-days, due to environmental regulations, the organic or inorganic inhibitors causing environmental threat must be restricted and must be replaced by green inhibitors[9-12]. In present study, *Prosopis cineraria* fruits extract has been used to inhibit the acid corrosion of aluminium.

Prosopis cineraria is a prickly tree or shrub and commonly found in dry and arid regions of north western India, southern India, Pakistan, Afganistan and Arabia. The dried green sangri is used as delicious dried vegetables and in preparation of curries and pickles. Sangri contains alkaloids, saponin, tannins, aspartic acid, glutamic acid, serine, glycine, histidine, threonine, arginine, alanine, proline, tyrosine, valine, methionine, cysteine, isoleucine, leusine, lysine and phenyalanine.

MATERIALS AND METHOD

1. Preparation of *prosopis cineraria* sangri pods extract

Air and shade dried pods of *prosopis cineraria* were grinded and powdered. The finely powdered dried material was taken in 500ml round bottom flask and soaked in sufficient quantity of distilled ethyl alcohol. On completion of soaking period, the ethanolic solution was refluxed, thereafter, distilled to concentrate the inhibiting chemicals and finally filtered to remove any suspended impurities. The mass of plant extract was dried and evaluated as corrosion inhibitor for the present study.

2. Preparation of specimen

Aluminiumsheets(3 mm thick) with normal composition 0.8% Si, 0.7% Fe, 0.4% Cu, 1.2% Mg, 0.35% Cr, 0.25% Zn, 0.15% Ti and the rest aluminium was taken for experiments. The sheet was cut into 1.0×4.0×0.2 cm rectangular coupons. The surface of the cuts were thoroughly polished with emery paper, from lower grade- 150 to water, degreased with acetone, wrapped within folds of filter paper and desiccated overnight and then weighing was done.

3. Weight loss method

Weight loss measurements were conducted under total immersion using 250 ml capacity beakers containing 200 ml test solution at 303K maintained in a thermostat water bath. Aluminium coupons were weighed and suspended in the beaker with the help of rod and hook. The coupons were retrieved at

different inhibitor concentration at 303 K, washed thoroughly with distilled water, wrapped within fold of filter paper and desiccated overnight. The final weights of the coupons were than obtained by weighing. The weight loss, in grains, was taken as the difference in the weight of the aluminium coupons before and after immersion in different test solutions determined using digital balance with sensitivity of ±0.1 mg. Than the test were repeated at different temperature. In order to get good reproducibility, experiments were carried out in triplicate.

The weight loss was calculated using the equation:

$\Delta W = W_1 - W_2$ (1)

Where

W_1= Initial weight of coupons before immersion

W_2= Final weight of coupons after immersion

ΔW= Weight loss of coupons.

The percentage inhibition efficiency (%IE) was than calculated from the resulting weight loss data as follows:

"$\%IE. = [1 - W_{Li}/W_{Lb}] \times 100$" (2)

W_{Li}= Weight loss of coupons in inhibited solution.

W_{Lb}= Weight loss of coupons in blank/uninhibited solution.

RESULT AND DISCUSSION

1.Effect of inhibitor concentration

The inhibition efficiency(%IE) and the corrosion penetration rate calculated from the weight loss measurement of hydrochloric acid and suphuric acid. Figure 1 represents the effect of prosopis cineraria pod extract concentration on weight loss in 1M HCl and 0.5M H_2SO_4.The weight loss and the corrosion rate decreases with increase in the concentration of inhibitor upto their optimum level after which further increase in inhibitor concentration did not cause any significant change in inhibition efficiency and corrosion rate. The inhibitor showed maximum efficiency of 86.67%in HCl and 80.06% in H_2SO_4 at an optimum concentration of 50ppm. Further increase in extract concentration did not cause any significant change in the inhibition efficiency. The values of percentage efficiency an corrosion rate obtained from weight loss method at different concentration of pod extract at 303 K are shown in figure 1.

Table 1:

S. No.	Inhibitor Concentration(in ppm)	% Inhibition Efficiency(1M HCl)	% Inhibition Efficiency(0.5M H_2SO_4)
1.	10	43.75	41.6
2.	20	59.01	56.65
3.	30	62.63	60.3
4.	40	78.86	71.6
5.	50	86.67	80.5

2.Explanation of inhibition

The probable mechanism can be explained on the basis of adsorption process and the structure of the constituent present in extract. The inhibition may be due to the adsorption of phytochemical constituents present in the extract through oxygen atoms on to the surface of the metal. The weight loss decreases and on the other hand corrosion rate decreases with increase in the concentration of prosopis cineraria leaf extract upto their optimum level after which a further increase in inhibitor concentration did not cause any significant change.

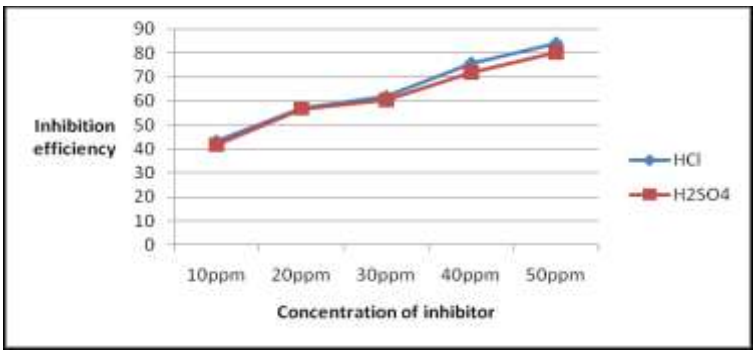

Figure 1: variation in efficiency with different concentration of inhibitor

CONCLUSIONS

From the result of this study, following conclusions can be drawn-

1. Pod extract of prosopis cineraria was found to be an effective inhibitor for the corrosion of aluminium in acidic medium.
2. Extract was found to be more effective in 1MHCl in comparison to 0.5M H_2SO_4 at 303K temperature.
3. Gravimetric measurements revealed that the inhibition efficiency reached 86.67% at a concentration as low as 50ppm of the extract for HCl and 80.06% for H_2SO_4.
4. The inhibition efficiency increased with increased concentration of extract to an optimum concentration of inhibitor.

REFERENCES

1. Desai, P.S. (2017): AzardirachtaIndica leaves arks as green corrosion inhibitor for aluminium in HCl medium, International journal of emerging research in management and technology, 6(6),159-164.
2. Al-Sehaibani, H. (2000):Evaluation of extracts of Henna leaves as environmentally friendly corrosion inhibitors for metals. Mat.-wiss u. Werkstofftech., 31(12), 1060-1063.
3. Alinor, I.J., and Ejikene, P.M. (2012): Corrosion inhibition of aluminium in acidic medium by different extracts of ocimumgratissimum, American chemical science journal, 2(6), 122-135.
4. Abiola, O.K., Okafor, N.C., Ebenso, E.E. and Nwinuk, N.M. (2007): Eco-friendly corrosion inhibitors: inhibitive action of delonixregia extract for the corrosion of aluminium in acidic medium. Anti-corrosion methods and materials,54, 219- 224.
5. Abdul rahman, A.S. Kareem, A.G. Ibrahim, H.K., Awei, I.(2015): The corrosion inhibition of mild steel in H2SO4 solution by adsorption of African perquetina leaves extract. International journal pf innovative research in science engineering and technology, 4(4), 1809-1821
6. Ateya, B.G., El-Anadouli, B.E. and El-Nizamy, F.M.(1984):The effect of thiourea on the corrosion kinetics of mild steel in H_2SO_4. Corrosion Science, 24 ,497–507.
7. Bendahou, M.A., Benadellah, M.B.E and Hammouti, B.B.(2006): A Study of Resomary Oil as A Green Corrosion Inhibitor for Steel in 2M H_3P0_4. Pigment and Resin Technology. 35,95-100.
8. Finsgar, M. and Jackson, J. (2014) Application of corrosion inhibitors for steels in acidic media for oil and gas industry a review. Corrosion science, 86, 17-41.
9. Eddy, N.O. and Ebenso, E.E. (2008): Adsorption and Inhibitive Properties of Ethanol Extracts of Musa Sapientum Peels as A Green Corrosion Inhibitor for Mild Steel in H2S04. African Journal of Pure and Applied Chemistry,2,46-54.
10. Bouyanzer, A. and Hammouti, B. (2004): A study of Anticorrosion Effects of Artemisia Oil on Steel. Pigment and Resin Technology,33, 287-292.
11. Chetouani, A., Hammouti, B. and Benkaddour, M. (2004): Corrosion Inhibition of Iron in Hydrochloric Acid Solution by Jojoba Oil. Pigment and Resin Technology, 33, 26-31.
12. Bentiss, F., Lagren´ee, M., Elmehdi, B., Mernari, B., Traisnel, M. and Vezin, H.(2002) :Electrochemical and quantum chemical studies of 3,5-di (n-tolyl)-4-amino-1,2,4-triazole adsorption on mild steel in acidic media. Corrosion, 58, 399–407.