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Short Communication

INFLUENCE OF GOKHRU LEAVES EXTRACT ON CORROSION INHIBITION OF ALUMINIUM IN ACIDIC MEDIUM

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ABSTRACT

Now a days, industries are facing the problem of corrosion of metals and to control it, is a challenging job in industrial revolution. The plant Gokhru (*Tribulus terrestris*) can be used as eco-friendly corrosion inhibitor for aluminium in aggressive industrial environment. The corrosion inhibition efficacy of alcoholic extract of leaves of plant Gokhru for aluminium in sulphuric acid has been studied in relation to the concentration of inhibitor, concentration of acid and immersion time by mass loss method. Inhibition efficiency increases with inhibitor concentration and immersion time but decreases with increase of acid strength.

Keywords: Corrosion inhibitors, *Tribulus terrestris*, Aluminium, Mass loss.

1. INTRODUCTION

Aluminium is widely used in industrial sectors because of its good strength with thermal and electrical conductivity, lightness and its hygienic and non-toxic qualities**.** But mostly industries are facing the problem of corrosion of aluminium in acidic medium. To control and minimize the corrosion rate, presently used most methods are not only expensive but also toxic in nature. Therefore, a great need to investigate a non-toxic replacement that is compatible with current industrial technologies with their availability and relatively low cost, naturally substances. The use of plant extracts as corrosion inhibitors are economic, environmentally safe and readily available and it can be replaced the synthetic and toxic inhibitors. Extract of plants contain various organic compounds having hetero-atoms such as O [1], S [2] and N [2, 3]. These hetero-atoms coordinate with the metal atom through their π electrons and form a protective film on metal surface, therefore corrosion is prevented.

Many researchers have done to work out on natural plant extracts as corrosion inhibitors for Aluminium in sulphuric acid medium such as Tobacco (*Nicotiana*) and Kola tree (*Cola acuminata*) [4], *Newbouldia leavis* [5], *Chrysophyllum albidum* fruit extract (CAFE) [6].

In the present work, an attempt has been made to study the influence of various concentrations of alcoholic extracts of leaf of plant Gokhru (*Tribulus terrestris*) on aluminium in sulphuric acid as a powerful tool to reduce the cost of maintenance and increase the plant life. The *Tribulus terrestris* plant belongs to the family zygophyllaceae. It is an annual creeping herb widespread in large area of India. In India its usage in Ayurvedic medicine was for the purpose of impotency, poor appetite, jaundice, urogenital disorders, and cardio-vascular diseases [7]. Its common name is *Gokshura* or *Chhota Gokshura* or puncture vine.

2. MATERIAL AND METHODS

2.1. Mass Loss Method

To find out the suitability of plant *Tribulus terrestris* for corrosion preventive properties, initially the study of corrosion inhibition efficiency of *Tribulus terrestris* was analyzed by mass loss measurement.

2.2. Preparation of plant extract

The extracts of *Tribulus terrestris* were prepared by the leaves of plant which were dried in air and grained then formed them as dried powder. It was subjected to the Soxhlet extraction using 80% methanol, the solvent can be removed by boiling at constant temperature at 328 K in vacuum evaporator.

2.3. Specimen and Test Solution

The rectangular specimens of Al of size 3.0 cm x 2.5 cm x 0.025 cm were used. The weighed coupons were suspended with the help of glass hooks in borosil beakers containing 50 ml of H_2SO_4 solution with plant extracts at the desired concentrations range for predefined time and

temperature. At the end of the test, the coupons were taken out, washed with double distilled water, degreased with acetone, washed again with double distilled water, dried and then weighed using a weighing machine of precision ± 0.1 mg to calculate the mass loss.

The inhibition efficiency (IE%), degree of surface coverage (θ) and corrosion rate (CR) were calculated from the equation (1) and (2)

$$(IE\%) = Surface\ Coverage\ (\theta) x\ 100 = \left(\frac{\Delta W_0 - \Delta W}{\Delta W_0}\right) 100 \quad \ldots (1)$$

$$CR = \frac{mass\ loss\ x\ 8.76\ x\ 10^4}{Area\ x\ time\ x\ density} \quad \ldots (2)$$

Where, ΔW_0 and ΔW are the mass loss of metal in absence and presence of inhibitor respectively. Mass loss is in gram; CR is in millimeter per year (mmpy); Area is in cm^2 of metal surface; exposed time is expressed in hours and metal density is expressed in gram/cm^3.

3. RESULTS AND DISCUSSION

Corrosion behavior of aluminium in various concentrations of sulphuric acid was studied in different concentrations of leaves of plant *Tribulus terrestris*. All the results for above study are depicted in table. Various factors like effect of acid strength, effect of inhibitor concentration and effect of immersion time were studied by mass loss method.

3.1. Effect of Acid concentration

It is observed from table that corrosion rate for Al in H_2SO_4 increases with increase in concentration of acid. The maximum corrosion rate is for uninhibited solution is obtained in 1.5N acid concentration. The inhibition efficiency for aluminium decreases with increases in acid strength and the inhibitor show maximum efficiency at the lowest concentration (0.5N) of acid solution for particular immersion period although in maximum acid concentration (1.5N) inhibitors have good property to inhibit the corrosion of Al. The decrease in IE with the increase in acid concentration is because of aggressiveness of the acid [8].

3.2. Effect of inhibitor concentration

The results from table reveal that the inhibition efficiency increases with increase in inhibitor concentration from 0.12% to 0.60%. The increase in inhibition efficiency may be due to the fact that the inhibition action takes place via adsorption of inhibitor molecule on metal surface. So the IE of any substance is mostly expressed as relative reduction in corrosion rate and that depends on the amount of adsorbed inhibitor on metal surface. It is presumed that the corrosion reactions are nullified from the active sites of metal surface by covering it adsorbed inhibitor species, whereas the corrosion reactions take place usually on the inhibitor free area. Therefore, the inhibition efficiency is directly proportional to the fraction of surface covered with adsorbed substances [9].

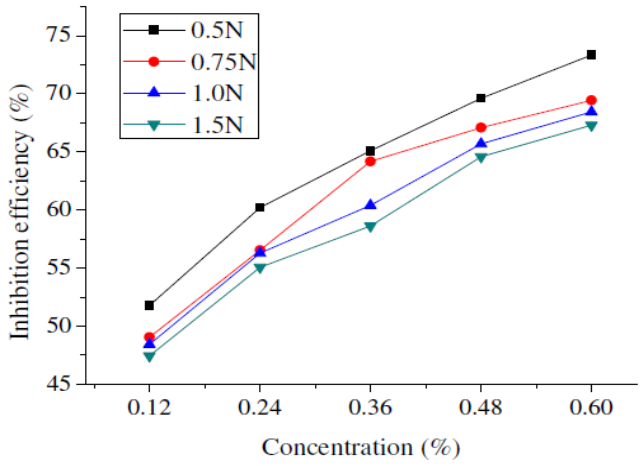

Fig. 1: Effect of inhibitor concentration on inhibition efficiency with change in acid concentration

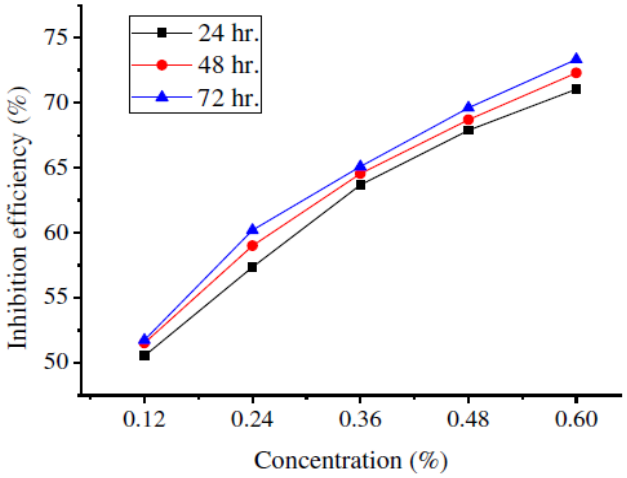

Fig. 2: Effect of inhibitor concentration on inhibition efficiency with change in immersion time

3.3. Effect of Immersion time

The obtained data of inhibition efficiency and corrosion rate for aluminium coupons at different time period explains the effectiveness of inhibitor action of plant *Tribulus terrestris* over a period of immersion time. The

values obtained in presence of inhibitor are much less than that of blank for all the immersion time indicates the existence of film on the corroding surface, although the corrosion reaction seemed to be uniform as mass loss varies regularly with increasing immersion time. It is observed that aluminium in H_2SO_4 the IE increases with increasing immersion time. This is due to fact that mass loss and hence corrosion rate in these conditions is much less, therefore inhibitor protects the metal more effectively for much longer time.

Table 1: Corrosion parameters for Al in various concentration of H_2SO_4 at different immersion time with leaf extract of plant

Conc. of inhibitor w/v (%)	24 hr.			48 hr.			72 hr.		
	Corrosion rate, CR (mmpy)	Surface coverage, θ	Inhibition efficiency IE (%)	Corrosion rate, CR (mmpy)	Surface coverage θ	Inhibition efficiency, IE (%)	Corrosion rate, CR (mmpy)	Surface coverage, θ	Inhibition efficiency, IE (%)
(0.5N)									
Blank	1.71			1.63			1.53		
0.12	0.85	0.5053	50.53	0.79	0.5152	51.52	0.74	0.5176	51.76
0.24	0.73	0.5737	57.37	0.67	0.5900	59.00	0.61	0.6020	60.20
0.36	0.62	0.6368	63.68	0.58	0.6454	64.54	0.53	0.6510	65.10
0.48	0.55	0.6789	67.89	0.51	0.6870	68.70	0.47	0.6961	69.61
0.60	0.50	0.7105	71.05	0.45	0.7230	72.30	0.41	0.7333	73.33
(0.75N)									
Blank	2.29			2.23			2.16		
0.12	1.22	0.4685	46.85	1.15	0.4831	48.31	1.1	0.4903	49.03
0.24	1.04	0.5472	54.72	0.99	0.5578	55.78	0.94	0.5653	56.53
0.36	0.87	0.6181	61.81	0.82	0.6325	63.25	0.78	0.6417	64.17
0.48	0.81	0.6457	64.57	0.76	0.6608	66.08	0.71	0.6708	67.08
0.60	0.77	0.6654	66.54	0.71	0.6810	68.10	0.66	0.6944	69.44
(1.0N)									
Blank	2.88			2.80			2.66		
0.12	1.58	0.4531	45.31	1.47	0.4734	47.34	1.37	0.4842	48.42
0.24	1.33	0.5375	53.75	1.26	0.5507	55.07	1.16	0.5622	56.22
0.36	1.23	0.5750	57.50	1.15	0.5894	58.94	1.05	0.6041	60.41
0.48	1.08	0.6250	62.50	0.99	0.6457	64.57	0.91	0.6572	65.72
0.60	0.98	0.6594	65.94	0.91	0.6747	67.47	0.84	0.6844	68.44
(1.5N)									
Blank	4.02			3.72			3.63		
0.12	2.21	0.4507	45.07	1.99	0.4655	46.55	1.91	0.4743	47.43
0.24	1.88	0.5314	53.14	1.70	0.5419	54.19	1.63	0.5505	55.05
0.36	1.75	0.5650	56.50	1.57	0.5782	57.82	1.50	0.5861	58.61
0.48	1.54	0.6166	61.66	1.36	0.6340	63.40	1.29	0.6457	64.57
0.60	1.40	0.6525	65.25	1.24	0.6655	66.55	1.19	0.6730	67.30

4. CONCLUSION

It is concluded that the leaf extract of plant Gokhru (*Tribulus terrestris*) is a good corrosion inhibitor for Al in H_2SO_4 solutions. The IE for above extract for Al decreases with increasing acid strength. Hence inhibitor shows maximum inhibition efficiency at lowest concentration (0.5N) of acid. Inhibition Efficiency (IE%) increases with inhibitor concentration and maximum IE% was observed 73.33% at the concentration of 0.60% at immersion time of 72 hours. The IE increases with increasing immersion time for Al in H_2SO_4 solutions. This type of inhibitor is eco-friendly, biodegradable and less toxic therefore, the inhibitor can be used to replace toxic chemicals.

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