

Investigation of extracts of Plant *Cordia Dichotoma* as potential corrosion inhibitor for Mild Steel in Acid media

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ABSTRACT

The alcoholic extracts of fruit, leaves and stem of plant *Cordia Dichotoma* were studied for their corrosion inhibition efficiency for mild steel in acid media. The studies showed that the fruit extract of this plant is more potent corrosion inhibitor than the leaves and stem extracts of *Cordia dichotoma*. The corrosion inhibition of mild steel using extracts of *Cordia dichotoma* in different acid media was investigated by mass loss method. The experiments were carried out at 299 ± 0.2 K in presence of different concentrations of fruit, leaves and stem extracts of *Cordia dichotoma*. The results reveal that the alcoholic extracts of *Cordia dichotoma* are better corrosion inhibitor than that of toxic chemicals.

Keywords: Corrosion Inhibition, Allantoin, *Cordia Dichotoma*.

INTRODUCTION

Corrosion is the deterioration of metal by means of chemical or electrochemical reaction induced on its surface by its surrounding environment. Among the several methods of corrosion control and prevention, the use of corrosion inhibitors is very popular. Corrosion inhibitors are substances which when added in small concentrations to corrosive media decrease or prevent the reaction of the metal with the media. Inhibitors are added to many systems, namely, cooling systems, refinery units, chemicals, oil and gas production units, boiler, and so forth.¹ Plant extracts have become important as an environmentally acceptable, readily available renewable source for wide range of inhibitors. They are the rich sources of ingredients which have very high inhibition efficiency. Several researchers are trying to make use of natural products as corrosion inhibitors.²⁻⁷ The plant *Cordia dichotoma* belongs to family Boraginaceae. Its common name is Indian cherry, lasura. Its chemical constitutions are mono and polysachharides, Beta-sitosterol, flavonol glycoside, taxifotin, 3-rhamnoside, 3-5-dirhamnoside, distylin, 3-xyloside, allantoin. It is edible plant. Probably the alkaloid Allantoin (Fig. 1) and Flavanoids - Taxifolin (Fig. 2) present in *Cordia dichotoma* are effective for corrosion inhibition activity in acidic media for mild steel.

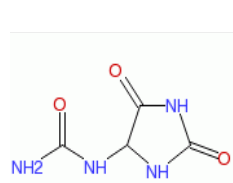


Figure 1 Allantoin

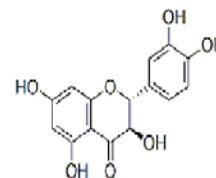


Figure 2 Taxifolin

EXPERIMENTAL

Mass Loss Method

Specimen preparation

Rectangular specimens of mild steel of dimensions 2.55 x 1.50 x 0.02 cm with a small hole of about 2mm diameter near the upper edge were employed for the determination of mass loss measurements. Specimens were cleaned by buffing to produce mirror finish with the help of emery paper and were then degreased with acetone. Each specimen was suspended by a glass hook and immersed in a beaker containing 50 mL of test solution and left expose to air.

Test solution preparation

The hydrochloric and sulfuric acid solutions of 1.0 N were prepared using doubly distilled water. The extracts of different parts of *Cordia dichotoma* were obtained by refluxing respective part in a soxhlet in ethanol.

To observe the influence of various parameters like inhibitor concentration, acid concentration and time, the corrosion inhibition efficiency (η %) of the compounds have been calculated by mass loss method using following equation.⁸

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Table 1. Comparative Mass loss data for mild steel in different acid media of 1.0 N concentration with alcoholic extracts of plant *Cordia dichotoma* 299 ± 0.1 K.

S.No.	Inhibitor conc. (%)	1.0 N HCl		1.0 N H ₂ SO ₄		1.0 N (HCl + H ₂ SO ₄)	
Fruits extract		(m)	(η %)	(m)	(η %)	(m)	(η %)
1	BLANK	58	-	485	-	592	-
2	0.12	33	43.10	398	17.94	115	80.57
3	0.36	24	58.62	272	43.91	81	86.32
4	0.60	14	75.86	218	55.05	31	94.76
Leaves extract							
1	BLANK	58	-	485	-	592	-
2	0.12	34	41.37	378	22.06	118	80.07
3	0.36	28	51.72	276	43.09	85	85.64
4	0.60	19	67.24	168	65.36	35	94.09
Stem extract							
1	BLANK	58	-	485	-	592	-
2	0.12	57	1.72	465	04.12	125	78.89
3	0.36	51	12.06	337	30.51	87	85.30
4	0.60	31	46.55	201	58.56	38	93.58

$$\eta \% = (\Delta \text{Mu} - \Delta \text{Mi}) / \Delta \text{Mu} \times 100$$

Where ΔMu is mass loss without inhibitor and ΔMi is mass loss with inhibitor. The degree of surface coverage (θ) can be calculated as

$$(\theta) = (\Delta \text{Mu} - \Delta \text{Mi}) / \Delta \text{Mu}$$

The corrosion rate in millimeter penetration per year (mmpy) can be obtained by following equation.⁹

Corrosion rate (mmpy) = $(\Delta M \times 87.6) / \text{area} \times \text{time} \times \text{metal density}$

RESULTS AND DISCUSSION

Corrosion behaviour of mild steel in various concentrations of hydrochloric acid, sulphuric acid with and without inhibitor has been studied and the results are depicted in the Tables1 and figure 3.

The results revealed that these extracts effectively reduce the corrosion rate of mild steel in acid solutions, by showing inhibition efficacy upto 94.76% and can be safely used without hydrogen damage, toxic effects and pollution. On viewing the structures of extract of *Cordia dichotoma* figure 1 and 2 it is clear that all these contain N and O in their structures, these hetero atoms due to their higher electro negativity, bind with the active sites of metal and form a barrier and hence corrosion rate decreases in presence of inhibitor.

Effect of Inhibitor Concentration

The inhibition efficacy (IE) has been calculated from the mass loss and thermometric measurements for different concentrations of hydrochloric acid, sulphuric acid and acid mixture solutions. The results revealed that the inhibition efficacy increases with the increase in inhibitors concentration of fruits, leaves and stem extracts from 0.12 to 0.60%. Thus,

$$\text{Inhibition Efficacy} \propto \text{Inhibitor Concentration}$$

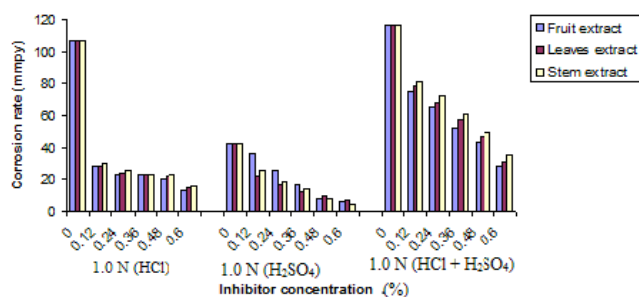


Figure 3: Effect of inhibitor concentration on corrosion rate of mild steel in different acid media

This is due to the fact that more extract is adsorbed on the surface of metals, thus decreases the active sites on the surface and decreases the cathodic and anodic reactions.

CONCLUSIONS

1. The extracts of *Cordia dichotoma* are effective corrosion inhibitors.
2. The inhibition efficacy of all the extracts increases with increase in its concentration. Thus,

Inhibition efficacy \propto Concentration of inhibitor

3. The inhibition efficacy of the extracts of *Cordia dichotoma* decreases with the increase in the concentration of acid.

Thus, it is concluded that the present investigation is successful in finding out the extracts of *Cordia dichotoma* as an ecofriendly economic corrosion inhibitor for mild steel and aluminium in presence of different concentrations of hydrochloric acid and sulphuric acid acid.

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