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# Anti corrosive studies of *Lantana camera* plant against mild steel surface

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## I.INTRODUCTION

Metallic corrosion can be defined as disintegration or degradation of a metal by chemical or electrochemical reaction with its surrounding environment. It is the degradation; deterioration of metal means reduction in the useful properties of the metal which includes weakening of the metal due to loss of cross sectional area [1], decaying of surfaces of metal and the local environment eg. formation of oxides, diffusion of metal cations into the coating matrix, local pH changes and electrochemical potential etc. The consequence of metallic corrosion is many and varied. In developing country like India, the economic growth is negatively affected due to the pronounced destruction effect of corrosion; the trophical climate also contributes to it. Therefore, it is necessary to reduce corrosion which can be done by application of protective coating, cathodic & anodic protection, alloying and use of inhibitors.

An 'Inhibitor' is a substance which when added in small amount to the corrosive environment of a metal or alloy, effectively reduces the rate of corrosion. The hazardous effects of most synthetic inhibitors are large and so there is a need to develop cheap, non toxic and eco-friendly processes. Recent awareness of the corrosion inhibiting abilities of tannins, alkaloids, organic and amino acid lie at the heart of organic chemistry. They can be commonly recognized as substances of macromolecular weight and great structural variety. In the present study, it is assumed that the plant based products can be used as corrosion inhibitors and hence are discussed below.

This has now urged researchers to focus on the use of natural products as green inhibitors. Organic compounds having heteroatom O, N and S are found to have huge basicity and electrode density thus assist in corrosion inhibition [2].

According to electrochemical theory of corrosion, it is a well established fact the metals corrode severely in acid solutions by evolution of hydrogen on cathodic site and forming respective metals site and forming respective metal salts. In case of mild steel, the film formed at the surface is very brittle and gives rise to more anodic and cathodic sites.

O, N and S are the active center for the adsorption on the metal surface. A recent trend of using herbal extracts has gained importance due to their basic nature, biodegradability, less toxicity, solubility and stability of the inhibitor film in acidic solution. Many studies have been carried out to find suitable compounds to use as corrosion inhibitors, most of these compounds are synthetic chemicals which may be very expensive and hazardous to living creatures and environments by the survey of literature. It is very important to choose cheap and safely handled compounds as corrosion inhibitors. Tamarind, beet root, saponins, pomegranate juice or peels, eucalyptus leaves, citrus juices, mango juice, heena powder, Embellice officianalis, honey, linchona alkaloids, Eugenia jambolans, pengamia glabra as well as very popular ayurvedic powder mahasudarshan churns and macro molecular structures like porphyrins and many more plants [3-7] have been reported as effective corrosion inhibitors in standard as well as stringent conditions.

**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 mixture solutions. The results reveal that the inhibition efficacy increases with the increase in inhibitors concentration of leaves, flower and fruits extracts from 0.12 to 0.60%.

**Material and methods-** The strips of mild steel with dimensions 2.5 X 1.5 X.03 $cm^3$ containing a small hole of 3mm diameter near the upper edge were employed for the determination of corrosion rate. Before each experiment the metal was polished to a mirror finish with the help of emery paper degreased with acetone and finally with distilled water. Each specimen was suspended by a glass hook and immersed in a beaker containing 50 ml of test solution at 300+0.1k and left exposed to air. Evaporation losses were made up with doubly distilled water. Duplicate experiments were made in each case and mean value of mass was calculated [8].

**Scanning Electron Microscopic Analysis (SEM)**

The SEM analysis of aluminium samples was carried out at different lines. The results are shown in the Figure. The SEM results reveal that the average roughness of the aluminium sample is lowest in case of mild steel (Figure 1) and when it is immersed in hydrochloric acid its roughness increase drastically [9].

**Result and Discussions**

The inhibition efficiency (%) calculated from the mass loss measurement for hydrochloric acid and inhibitors are given in tables. It is observed that the inhibition efficiency increases with increase in the concentration of inhibitor and decreases with increases in acid strength

The mass loss and % inhibition efficiency for various concentrations of acid and inhibitors are depicted in the table. It is observed that inhibitor. All the inhibitors display maximum efficiency at highest concentration of acid used. The fruit extract shows the maximum inhibition % of 98% at 1N in HCl solution. From mass loss data it is concluded that plant extracts act as a good indicator. For Flower extract the maximum inhibition % is 97.91% and the lowest is 57.56% with HCl. The leaves extract shows the maximum inhibition efficiency of 93.56%.

The adsorption of organic molecule on metallic surface involves O, N and S atoms. In case of plant extract of Lantana Camera the N and O of alkaloid may be responsible for adsorption. This process blocks the active sites and decreases the corrosion rate. Organic corrosion inhibitor may function by (a) chemisorption of molecules on a metallic surface, (b) complexing of the molecule with the metal ions (c) neutralizing the corrodent (d) adsorbing the corrodent. All this process block the active site and reduce the corrosion rate [10].

**TABLE 1-** Mass loss data for mild steel in 0.5N hydrochloric acid with methanol extract of leaves, flower and fruit of *Lantana camera*. Effective area of specimens $\overline{7}.5$ $cm^2$, Temperature $25+5^0C$. Immersion period – 24 Hours.

| Inhibitors concentration (%) | Mass loss (mg) | Corrosion rate (mmpy) | Inhibition efficiency (%) | Surface coverage ($\theta$) |
|---|---|---|---|---|
| Uninhibited Leaves | 0.0575 | | | |
| 0.12 | 0.0115 | 0.002891 | 80.00 | 0.80000 |
| 0.24 | 0.0100 | 0.02514 | 82.60 | 0.82608 |
| 0.36 | 0.0055 | 0.01382 | 90.43 | 0.90434 |
| 0.48 | 0.0043 | 0.01081 | 92.52 | 0.92521 |
| 0.60 | 0.0037 | 0.009303 | 93.56 | 0.93565 |
| FLOWER | | | | |
| 0.12 | 0.0244 | 0.006135 | 57.56 | 0.5756 |
| 0.24 | 0.0044 | 0.001106 | 92.34 | 0.9234 |

| | | | | |
|---|---|---|---|---|
| 0.36 | 0.0036 | 0.0009052 | 93.73 | 0.9373 |
| 0.48 | 0.0016 | 0.0004023 | 97.21 | 0.9721 |
| 0.60 | 0.0012 | 0.0003017 | 97.91 | 0.9791 |
| FRUIT | | | | |
| 0.12 | 0.0063 | 0.001584 | 89.04 | 0.8904 |
| 0.24 | 0.0030 | 0.0007543 | 94.78 | 0.9478 |
| 0.36 | 0.0028 | 0.0007040 | 95.13 | 0.9513 |
| 0.48 | 0.0025 | 0.0006286 | 95.65 | 0.9565 |
| 0.60 | 0.0023 | 0.0005783 | 96.00 | 0.9600 |

**Table -2** Mass loss data for mild steel in 1N hydrochloric acid with methanolic extract of leaves, flower and fruit of *Lantana camara*. Effective area of specimens 7.5 $cm^2$, Temperature 25+5°C. Immersion Period – 24 hours.

| Inhibitors concentration (%) | Mass loss (mg) | Corrosion rate (mmpy) | Inhibition efficiency (%) | Surface coverage($\theta$) |
|---|---|---|---|---|
| Uninhibited Leaves | 0.0701 | | | |
| 0.12 | 0.0073 | 0.001835 | 89.58 | 0.8958 |
| 0.24 | 0.0026 | 0.0006537 | 96.29 | 0.9629 |
| 0.36 | 0.0022 | 0.0005531 | 96.86 | 0.9686 |
| 0.48 | 0.0020 | 0.0005029 | 97.14 | 0.9714 |
| 0.60 | 0.0011 | 0.0002765 | 98.43 | 0.9843 |
| FLOWER | | | | |

| | | | | |
|---|---|---|---|---|
| 0.12 | 0.0586 | 0.01471 | 16.40 | 0.1640 |
| 0.24 | 0.0094 | 0.002363 | 86.59 | 0.8659 |
| 0.36 | 0.0053 | 0.001332 | 92.43 | 0.9243 |
| 0.48 | 0.0039 | 0.0009806 | 94.36 | 0.9443 |
| 0.60 | 0.0030 | 0.0007543 | 95.72 | 0.9572 |
| FRUIT | | | | |
| 0.12 | 0.0246 | 0.006180 | 64.90 | 0.6490 |
| 0.24 | 0.0088 | 0.002212 | 87.44 | 0.8744 |
| 0.36 | 0.0035 | 0.00088 | 95.00 | 0.9500 |
| 0.48 | 0.0026 | 0.0006537 | 96.39 | 0.9629 |
| 0.60 | 0.0023 | 0.0005783 | 96.71 | 0.9671 |

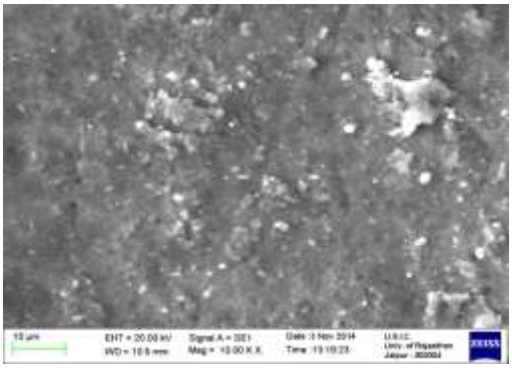

Figure-1. SEM image of mild steel metal in 1N $H_2SO_4$ in presence of *Lantana camara* leaves extract.

## II.CONCLUSION

The rate of corrosion of the mild steel in HCl is a function of the concentration of the plant extract. The inhibition by this additive increases with increasing additive concentration. The extracts are better inhibitors than the oxide film.

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