Corrosion Inhibition of Mild Steel in Acid Medium by Moringa Oleifera and Lettucia Edibelia Extracts

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Abstract: Corrosion control of metal is of technical, economical and environmental importance. Investigation on corrosion inhibiting abilities of moringaoleifera and lettuciaedibelia has been done in acid medium by weight loss method. The significance of the corrosion inhibition in the 1N, 2N HCl medium and 1N, 2N H₂SO₄ medium has been discussed. The corrosion rate was found to decrease with increase in concentration of both the inhibitors in HCl medium. But the corrosion rate was observed to be high in the presence of inhibitors in H₂SO₄ medium.

Key words: corrosion inhibition, moringaoileifera, lettuciaedibelia, weight loss method

I. INTRODUCTION

A number of organic compounds [1-3] have been reported as corrosion inhibitors and the screening of synthetic organic compounds is still being continued. Several other inorganic inhibitors such as zinc, chromate, polyphosphate, and nitrite were used as corrosion inhibitors [4].

Though many synthetic compounds showed good anticorrosive activity, most of them are highly toxic to both human beings and environment. These toxic effects and ecological problems associated with the discharge of such materials have resulted in the development of other efficient and environmentally acceptable inhibitors. Hence, the recent trend is the search for environmental friendly inhibitors, by the researchers. Most of the natural products are non toxic, bio degradable and readily available in plenty. Various parts of the plants – seeds, fruits, leaves, flowers etc have been used as corrosion inhibitors [5,6].

In the present work, the corrosion inhibition efficiency of the extracts of moringaoleifera leaf and lettucia edibelia on mild steel in 1M, 2M hydrochloric and sulphuric acids by weight loss method was investigated.

II. EXPERIMENTAL

Preparation of Plant Extract

Moringaoleifera Lam is a small or medium sized tree, about 10m high, cultivated throughout India. It is a multipurpose tree, used as vegetable, spice, a source of cooking and cosmetic oil and as medicinal plant. It is reported to contain alkaloids, flavonoids, anthocyanins, proanthocyanidins and cinnamates. It possesses anti-inflammatory, antioxidant, antimicrobial, antihyperlipidaemic, anticancer, antihypertoxic and antiulcer activities. Bhoomika R Goyal et al. made an overview of chemical constituents present in the plant and their pharmacological action of Moringaoleifera using ethanolic extract of leaves[7].The same has been tried for corrosion inhibition of mild steel in acid medium. Similarly to have a comparative study with moringaoileifera, lettuciaedibelia was selected for controlling corrosion of mild steel.

Leaves of Moringaoleifera were air dried and powdered. The dry leaf powder 20 gms was extracted by refluxing in 200 ml ethanol for 2 hrs. The extract was filtered. The filtrate was then used for the study. The same procedure is carried out for lettucia edibelia.

Mass – Loss Measurements

Mild steel specimens (0.026% S, 0.06% P, 0.4% Mn, 0.1% C and the rest iron) of the dimensions 1.0 X 4.0 X 0.2 cm were polished to a mirror finish and degreased with acetone, and used for the weight-loss method in 100 ml acid solutionsmedium (1 normal and 2 normal solutions of both hydrochloric acid and sulphuric acid media) at room temperature in the absence and presence of inhibitor of various concentrations for a period of 1 hr. The mass of the specimens before and after immersion were determined.

Experiments were carried out in duplicate and the average values have been reported. The corrosion rate (CR) of the samples is calculated by the following equation [8]:

\[ C.R = 87.6 \times \frac{w}{DAt} \text{ mm/y} \]
where $D$ is the Density of the metal (7.86 g/cm$^3$), $A$ is the total area of the substrate (0.11 cm$^2$), $T$ is the time of exposure of the metal (1 hr) and $w$ is the average weight loss of the specimen. The percentage of inhibition efficiency (IE) is defined by

$$IE = 100 \left(1 - \frac{W_1}{W_2}\right) \%$$

Where $W_1$ and $W_2$ are the corrosion rates of uninhibited and inhibited specimens respectively.

### III. RESULTS AND DISCUSSION

Analysis of weight loss method showed the inhibition efficiencies (IE) of various concentrations of the inhibitors Moringa oleifera and Lettucia edibelia in controlling corrosion of carbon steel immersed in 1N & 2N HCl and H$_2$SO$_4$ environments for a period of 1 hr in the presence and absence of inhibitors. The inhibition efficiencies determined by weight loss method are given in Table 5.1.1. The corrosion rates are also given in the same table.

The IE was found to increase with the increase in inhibitor concentration. 1N HCl environment shows highest IE of 96% with 8 mL extract. While H$_2$SO$_4$ environment shows minimum IE as SO$_4^{2-}$ from the acid might have reacted with some of the elements present in the extract to form precipitate which will prevent the diffusion of inhibitor towards the metal surface.

The active component found in *Moringa oleifera* was reported to be Arginine. Structural Formula of Arginine is represented below [9].

![Structure of Arginine](image)

It is well known that the surface of the metal is positively charged in acidic media [10]. It is believed that the Cl$^-$ ions could be specifically adsorbed on the metal surface and create an excess of negative charge on the surface. This will favour the adsorption of protonated inhibitor on the surface and hence reduce the dissolution of Fe [11]. On average, Moringa oleifera contained higher concentrations of Ca (18 500 mg/kg) and Mg (5500 mg/kg) [12]. Hence, from the medium of sulphuric acid, the SO$_4^{2-}$ might have precipitated as sulphates of the metals Ca and Mg which are highly insoluble and settles in the bulk of the medium preventing the inhibitor to get adsorbed on the metal surface. Similarly the Inhibition efficiency of *lettucia edibelia* is carried out for mild steel and found to show less inhibition efficiency than *Moringa oleifera*.

Table 1.1 Corrosion rates (CR) of mild steel immersed in various acid solutions in the absence and presence of inhibitors and the inhibition efficiencies (IE) obtained by mass loss method.

<table>
<thead>
<tr>
<th>Acid Medium</th>
<th>Volume of extract (mL)</th>
<th>Moringa oleifera CR (mpy)</th>
<th>IE %</th>
<th>Lettucia edibelia CR (mpy)</th>
<th>IE %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N HCl</td>
<td>0</td>
<td>2367</td>
<td>-</td>
<td>2367</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>268</td>
<td>89</td>
<td>189</td>
<td>92</td>
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<td></td>
<td>4</td>
<td>193</td>
<td>92</td>
<td>154</td>
<td>94</td>
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<td></td>
<td>8</td>
<td>92</td>
<td>96</td>
<td>66</td>
<td>97</td>
</tr>
<tr>
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<td>6</td>
<td>241</td>
<td>95</td>
<td>123</td>
<td>97</td>
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<tr>
<td></td>
<td>8</td>
<td>132</td>
<td>97</td>
<td>61</td>
<td>98</td>
</tr>
<tr>
<td>1N H$_2$SO$_4$</td>
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<td>329</td>
<td>-</td>
<td>329</td>
<td>-</td>
</tr>
<tr>
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<td>2</td>
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<td>-64</td>
<td>1246</td>
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<td>8</td>
<td>154</td>
<td>53</td>
<td>338</td>
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<tr>
<td>2N H$_2$SO$_4$</td>
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<td>-</td>
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<td>49</td>
<td>851</td>
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</tbody>
</table>

### IV. CONCLUSION

*Moringa Oleifera* is considered as a better inhibitor for the corrosion of mild steel in 1N, 2N HCl solution than H$_2$SO$_4$ solution. Inhibition efficiency increases with the inhibitor concentration and the protective film formed on metal surface is due to the adsorption of the inhibitor molecule on the metal surface through the hetero atoms present in the inhibitor molecules. The corrosion inhibition efficiency of the inhibitors is found to be very less in sulphuric acid medium. Comparatively *moringa oleifera* shows higher inhibition efficiency for the corrosion of mild steel than *lettucia edibelia*.

### REFERENCES


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