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Efficacy of *Faidherbia Albida* Seed on Corrosion Inhibition of Mild Pipe Using Rain Water as Media

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Abstract: *The inhibitive effect of Faidherbia Albida seed extract on corrosion inhibition of mild steel pipe in Rain Water was studied using weight loss method. The weight loss results showed that the seed extract was an excellent corrosion inhibitor. It was observed that with increase in concentration of Faidherbia Albida seed extract from 0 ppm to 1000 ppm, the corrosion rate of mild steel decreases while it increases as the exposure time increases. The obtained results indicate that the Faidherbia Albida seed extract could act as an excellent corrosion inhibitor.*

Keywords: *Corrosion inhibition, Faidherbia Albida seed*, *Mild steel, Weight loss.*

ITRODUCTION

Corrosion of metals such as mild steel is chemical or electrochemical reaction which can cause the degradation and batter of the physical and chemical properties of the metal. The word mild steel (MS) stands for an alloy of carbon and iron in which carbon is present in less amount due to this less amount of carbon mild steel have wide range of applications in mechanical industries like water cooling system, pipelining, in welding etc. due to its properties like ductility, malleability etc. So, it preferred than other metals and steels with high amount of carbon but mild steel comes with a huge drawback that it can easily undergo corrosion. MS is also called as the carbon steel which is a low carbon (0.3%) steel with superior strength (Gaya *et al,* 2019). It is used when large amount of steel is needed and can be twisted and welded into an infinite range of shapes for uses in vehicles, construction material and vessels fabrication etc. In many industries, MS is the material of choice in the fabrication of reaction vessels, storage tanks etc. which get corroded easily in the presence of acids (Gaya *et al,* 2019). In spite of this, estimate shows that 25-30% of this could be avoided if corrosion prevention technologies are put in place (NACE, 2002).

Inorganic acids like HCl and H2SO4 are used in industries for many purposes like drilling, fracturing and acid stimulations at various stages in oil exploration, production and/or descaling operations. Wet acidic gases such as CO2, H2S and weak acetic and formic acids cause a significant amount of corrosion for steel pipelines and storage processing facilities used in the oil and gas production networks (Ibrahim *et al.,* 2011). 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 (Singh *et al.,* 2012). Inhibitors are added to many systems, namely, cooling systems, refinery units, chemicals, oil and gas production units, boiler, and so forth. Most of the effective inhibitors are used to contain heteroatom such as O, N, and S and multiple bonds in their molecules through which they are adsorbed on the metal surface. It has been observed that adsorption depends mainly on certain physicochemical properties of the inhibitor group, such as functional groups, electron density at the donor atom, π-orbital character, and the electronic structure of the molecule. Though many synthetic compounds showed good anticorrosive activity, most of them are highly toxic to both human beings and the environment. The use of chemical inhibitors has been limited because of the environmental threat, recently, due to environmental regulations. These inhibitors may cause reversible (temporary) or irreversible (permanent) damage to the organ system, namely, kidneys or liver, or disturbing a biochemical process or disturbing an enzyme system at some site in the body. The toxicity may be manifest either during the synthesis of the compound or its applications. These known hazardous effects of most synthetic corrosion inhibitors are the motivation for the use of some natural products as corrosion inhibitors. Plant extracts have become important because they are environmentally acceptable, inexpensive, readily available, and renewable sources of materials, and ecologically acceptable. Plant products are organic, and some of the constituents including tannins, organic and amino acids, alkaloids, and pigments are known to exhibit inhibiting action. Moreover, they can be extracted by simple procedures at low cost. In the present work, the effect of *Faidherbia Albida seed* on corrosion inhibition of structural members in acidic media was investigated using the weight loss method.

METHODOLOGY

Sample Collection

Fresh seed of Faidherbia Albida was collected from Ramat Polytechnic school farm, and was taken for identification by a Plant Taxonomist, in the Department of Biological Science Faculty of Science, University of Maiduguri.

Sample Preparation

The plant seed material was air-dried in the laboratory at room temperature. The seed of the plant was ground to a fine powder using wooden mortar and pestle and the sample was stored in the research laboratory of Science Laboratory Technology Department of Ramat Polytechnic Maiduguri Borno state for further analysis.

Sample Extraction

The ground seed material (2,000g) was extracted with 85% ethanol using Soxhlet technique. The crude extract was concentrated under reduced temperature. The crude extract was then stored in a desiccator. The chaff was socked in distilled water for three hours and the mixture was filtered, concentrated and stored under pressure and reduced temperature.

Corrosion Efficiency

Weight loss method was used for the evaluation of corrosion inhibition efficiency of the extracts.

Weight Loss Method

cylindrical coupons of 10mm diameter and 10mm in length was used in this research for Four solutions of 250. 500, 750 and 1000 ppm of extract concentration. In each test media of Rain Water, 0.025g: 0.05g, 0.075g and 0.1g of Faidherbia Albida seed extract was dissolved in different beaker containing 100ml of 1M Rain water. In addition, one beaker containing 100ml of 1M Rain water will be used as control. The corrosion inhibition and immersion test will be

carried out in accordance with ASTM G3 1 -72. The coupons removed from the desiccator six each as a group, after individual weighing, was introduced into each beaker ranging from the control to the inhibited Rain water solutions as thread aided suspensions, at ambient temperature. An exposure period of 432hr (18 days) total was observed, at 72hr (3days) interval of measurement respectively. Unit specimen removed from each beaker at this interval was cleaned off corrosion products, dried and reweighed. The change in weight recorded, was used to calculate the rate of corrosion measured in millimeter per year (mmpy) as described by Yawas, (2005):

Corrosion rate (CR) = $\frac{87.6\ x\ W}{P\ x\ A\ x\ T}\ (mmpy)$ ... ….1

Where:

W = The weight loss in mg, P = The metal density in g/cm^3.

A = The exposed area of the test coupon in cm^2.

T = The exposure time in hrs.

However, the inhibition performance can also be calculated as follows (Ibrahim et al., 2011):

Inhibition Efficiency (IE) = $\frac{CR_0 - CR}{CR_0}$ x 100% ... ….2

The surface degree of coverage ($\emptyset$) at each inhibitor concentration, defined as the degree of surface of material coverage by the inhibitor will be calculated as;

Degree of Surface Coverage ($\emptyset$) = $\frac{CR_0 - CR}{CR_0}$ ……3

Where;

CR_0 = The corrosion rates without inhibitor

CR = The corrosion rates with inhibitor.

RESULTS AND CONCLUSION

As presented in Table 1 the corrosion parameters such as corrosion rate and inhibition efficiency were studied for five different concentrations of inhibitor ranging from 0 ppm to 1000 ppm in Rainwater for the time intervals 72hr, 192hrs, 312hrs, 432hrs, 504hrs and 576hrs as shown in figure 1 & 2. It was shown that with increase in the concentration of *Faidherbia Albida seed* extract from 0 ppm to 1000 ppm, the corrosion rate of mild steel decreases while it increases as the exposure time increases. The obtained results indicate that the *Faidherbia Albida seed* extract could act as an excellent corrosion inhibitor. Even with increase in the immersion period, *Faidherbia Albida seed* extract showed maximum inhibition efficiency. This could be due to the maximum adsorption of inhibitor molecules on to the metal surface.

Table :1 Variation of corrosion rate against exposure time (hrs) of mild steel in Rain Water at different concentrations of seed extract.

S/N	Exposure time (hrs)	Weight Loss (g)	Corrosion Rate (mm/yr)	Ɵ	IE (%)
1	72	0.089	0.671	0.652	65.2
2	192	0.142	0.536	0.593	59.3
3	312	0.186	0.468	0.561	56.1
4	432	0.221	0.417	0.545	54.5
5	504	0.255	0.385	0.513	51.3
6	576	0.261	0.379	0.493	50

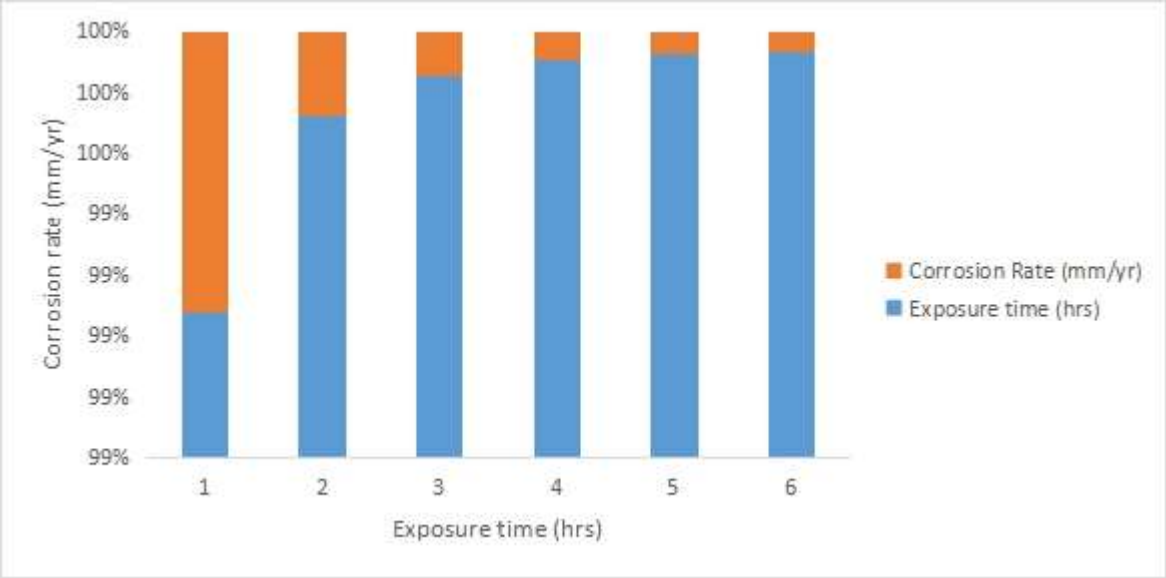

Figure :1 Variation of corrosion rate against exposure time (hrs) of mild steel in Rain Water at different concentration of seed extract.

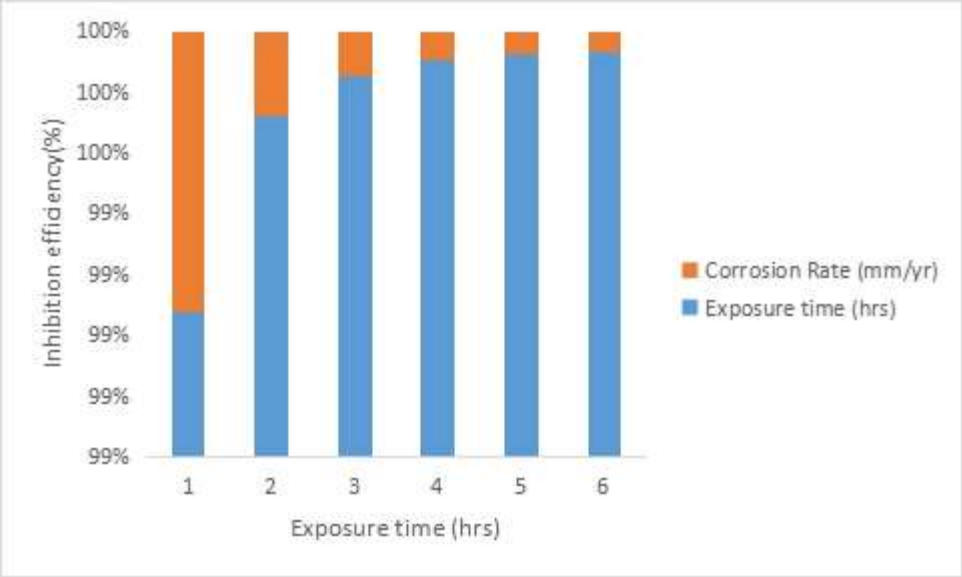

Figure:2 Variation of IE against exposure time (hrs) of mild steel in Rain Water at different concentrations of seed extract.

CONCLUSION

From the result of the weight loss measurement for the investigation of the corrosion inhibition properties of the plant extract of *Faidherbia Albida seed* in Rain water solution, the following conclusions were made:

i. *Faidherbia Albida seed* extract is effective corrosion inhibitor for mild steel in Rain water medium.

ii. An increase in inhibitor exposure time from 72 hrs to 576 hrs shows a decrease in the corrosion
rate but the inhibitor performed best at 72 hrs of exposed time.

iii. Finally, the extract of *Faidherbia Albida seed* serve as a good corrosion inhibitor.

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