International Journal of Multidisciplinary Research and Growth Evaluation

International Journal of Multidisciplinary Research and Growth Evaluation
ISSN: 2582-7138
Received: 15-12-2020; Accepted: 19-01-2021
www.allmultidisciplinaryjournal.com
Volume 2; Issue 1; January-February 2021; Page No. 210-213

Evaluation of corrosion inhibition of analine and moringa oliefera methanol extract on mild steel in different acid media (HCl and HNO_3)

AA Garba[1], BA Oro[2], M Alhassan[3], M Suleiman[4], Y Nasiru[5], A Kasim A[6], B Usman[7]
[1-6] Department of Chemistry, Sokoto State University, Birnin Kebbi Road, Sokoto, Nigeria
[7] Department of Pure and Industrial Chemistry, Faculty of Physical Science Bayero University Kano, Nigeria

Corresponding Author: **AA Garba**

Abstract
The inhibitive actions of moringa oleifera methanol extract (MOME) and analine on corrosion of mild steel in two different acid media (HCl and HNO_3) solutions was investigated using weight loss method. The effect of inhibitor concentration, time and temperature on different acid concentration was investigated. The inhibition efficiency was determined by comparing the corrosion rate with inhibitor and without inhibitor. The study reveal that the percentage inhibition efficiency (%IE) is enhanced with increased in time, temperature as well as corrodent concentration. Scanning electron microscope (SEM) was carried out on the coupons before and after the analysis.

Keywords: Corrosion, Mild steel, HCl, HNO_3, coupons and SEM

1. Introduction
Corrosion is a natural process, which converts a refined metal to a more stable form, such as its oxide or hydroxide. It is the gradual destruction of materials (usually metals) by chemical reaction with their environment [1, 2]. Corrosion Engineering is the field dedicated to controlling and stopping corrosion. In the most common use of the word, this means electro chemical oxidation of metal in reaction with an oxidant such as oxygen [3, 4].

The use of corrosion inhibitors had been shown to be the most effective and efficient practical way of preventing metal corrosion [5]. The toxicity of most synthetic corrosion inhibitors have brought severe criticisms against their uses because they pose environmental hazards, therefore, the use of natural products of plant origin as corrosion inhibitors at present is encouraged because they are eco-friendly [6-7].

Rusting, the formation of iron oxides is a well-known example of electrochemical corrosion. This type of damage typically produces oxides or salts of the original metal, and results in a distinctive orange coloration. Corrosion degrades the useful properties of materials and structures including strength, appearance and permeability to liquid and gases [13].

Many structural alloys corrode merely from exposure to moisture in air, but the process can be strongly affected by exposure to certain substances [15]. Corrosion can be concentrated locally to form a pit or crack, or it can extend across a wide area more or less uniformly corroding the surface [9-11]. Because corrosion is a diffusion controlled process, it occurs on exposed surfaces. As a result, methods to reduce the activity of the exposed surface, such as passivation and chromate conversion, can increase a material's corrosion resistance.

2. Methodology
Coupons Preparation
Coupons was prepared from mild steel according to ASTM A29M-05 the mild steel was cut into coupons using 2cm ×2cm dimensions and polished with emery paper of 240-800 grades. The coupons were degreased with methanol, water and later dried in acetone and store in desicator before use.

Method of extraction
The leaves of moringa olifera was obtained from old market sokoto and dried into the oven, and grounded into powder using mortar and pestle. Soxlet extraction was used in the extraction.100g of the grounded moringa olifera sample was continuously and exhaustively extracted with 350ml of methanol. The extract obtained was pre concentrated using water bath at temperature of 50˚C.

Preparation of Reagent

0.2M Hydrochloric Acid Solution

About 16.70cm^3 of concentrated hydrochloric acid was measured with a graduated measuring cylinder and transferred in the 1000cm^3 volumetric flask containing 500cm^3 of distilled water. The solution was mixed and brought to the mark with distilled water.

0.5M Hydrochloric Acid Solution

About 41.77cm^3 of concentrated hydrochloric acid was measured with a graduated measuring cylinder and transferred in the 1000cm^3 volumetric flask containing 700cm^3 of distilled water. The solution was then mixed and brought to the mark with distilled water.

0.2M Nitric Acid Solution

About 12.05cm^3 of concentrated nitric acid was measured with a graduated measuring cylinder and transferred in the 1000cm^3 volumetric flask containing 500cm^3 of distilled water. The solution was mixed and brought to the mark with distilled water.

0.5M nitric acid solution

About 31.25cm^3 of concentrated nitric acid was measured with a graduated measuring cylinder and transferred in the 1000cm^3 volumetric flask containing 700cm^3 of distilled water. The solution was mixed and brought to the mark with distilled water.

Experimental method

Coupons were immersed completely in 100cm^3 beaker containing 50cm^3 of the 0.2 and 0.5M HCl i.e corrodent concentration, with and without inhibitor. The beaker containing the coupons and corrodent concentration was covered with aluminum foil to avoid particles from entering and avoid the evaporation of the corrosive media. mixture was put in to a water bath at a desired to up repeat this for 0.2 and 0.5M of HNO_3 using the same inhibitor. Coupons ware removed after a given time interval, finally the weight loss, the corrosion rate and % inhibitors efficiency (%IE) was calculated using equation below;

$$CR = \frac{\Delta W}{A \times t}$$

$$\%IE = \frac{CRun - CRI}{CRun} \times 100$$

Weight loss

The weight of coupons was measured before immersion into the test solution as W_1 and final weight (W_2) after immersion.

$$\Delta w = \frac{W2 - W1}{2}$$

Effect of Temperature

The temperature was varied in to the range of 30, 60, 90 degrees

Effect of Concentration of Inhibitor

The concentration of the inhibitor was varied from 0.2, 0.4, 0.6M for analine and 0.2g 0.4g and 0.6g for Moringa oleifera.

3. Result and Discussion

Table 1: Weight loss, Corrosion rate and % Inhibition efficiency of 0.2M HCl at different time.

	Moringa			Analine		
Time (hr)	**Weight loss**	**Corrosion rate**	**% IE**	**Weight loss**	**Corrosion rate**	**% I**
24	0.014	0.00014	78.12	0.0386	0.00040	37.50
48	0.00506	0.00017	82.29	0.0337	0.00017	81.72
72	0.012	0.00006	93.54	0.0517	0.00017	82.29

Table 2: Weight loss, Corrosion rate and % Inhibition Efficiency of 0.5M HCl at different time

	Moringa			Analine		
Time (hr)	**Weight loss**	**Corrosion rate**	**% IE**	**Weight loss**	**Corrosion rate**	**% IE**
24	0.1284	0.00133	66.66	0.0479	0.00049	37.179
48	0.0135	0.00006	82.52	0.0603	0.00031	65.65
72	0.0688	0.00023	92.92	0.5165	0.00179	86.95

Table 3: Weight loss, Corrosion rate and% Inhibition Efficiency of 0.2M HNO_3 at different time

	Moringa			Analine		
Time (hr)	**Weight loss**	**Corrosion rate**	**I. E (%)**	**Weight loss**	**Corrosion rate**	**I.E (%)**
24	0.1456	0.00151	66.60	0.00871	0.00090	40.00
48	0.0256	0.00013	88.18	0.0844	0.00043	60.90
72	0.2345	0.00081	95.45	0.2538	0.00088	66.60

Table 4: Weight loss, Corrosion rate and % Inhibition Efficiency of 0.5M HNO_3 at different time

	Moringa			Analine		
Time (hr)	**Weight loss**	**Corrosion rate**	**% IE**	**Weight loss**	**Corrosion rate**	**% IE**
24	0.2676	0.00278	69.74	0.2758	0.00287	5.81
48	0.0928	0.00048	78.37	0.4177	0.00217	7.25
72	0.0448	0.00015	90.25	0.4855	0.00168	9.09

Table 1,2,3 and 4 shows a variation of corrosion rate and percentage inhibition efficiency of 0.2M HCl, 0.5M HCl, 0.2M HNO_3 and 0.5M HNO_3 of both Moringa and Analine at different time interval. From the tables it was observed that the corrosion rate and percentage inhibition efficiency increases with increase in time.

Table 5: Weight loss, Corrosion rate and % Inhibition Efficiency of 0.2M HCl at different temperature

	Moringa			Analine		
Temperature(k)	**Weight loss**	**Corrosion rate**	**% IE**	**Weight loss**	**Corrosion rate**	**% IE**
303	0.014	0.00014	78.12	0.0386	0.00040	37.5
310	0.0196	0.00020	83.11	0.0979	0.00101	4. 42.27
317	0.0365	0.00038	89.36	0.1998	0.00208	51.22

Table 6: Weight loss, Corrosion rate and % Inhibition Efficiency of 0.5m HCl at different temperature

	Moringa			Analine		
Temperature(k)	**Weight loss**	**Corrosion rate**	**% IE**	**Weight loss**	**Corrosion rate**	**% IE**
303	0.1284	0.00133	66.66	0.0479	0.00049	37.17
310	0.0151	0.000151	83.24	0.0679	0.00070	41.37
317	0.0291	0.00030	85.29	0.0724	0.000754	57.87

Table 7: Weight loss, Corrosion rate and % Inhibition Efficiency of 0.2M HNO_3 at different temperature

	Moringa			Analine		
Temperature(k)	**Weight loss**	**Corrosion rate**	**% IE**	**Weight loss**	**Corrosion rate**	**% IE**
303	0.1456	0.00151	31.66	0.0871	0.00090	40.00
310	0.1414	0.00147	99.12	0.2049	0.00213	34.25
317	0.1594	0.00166	99.14	0.1145	0.00119	38.31

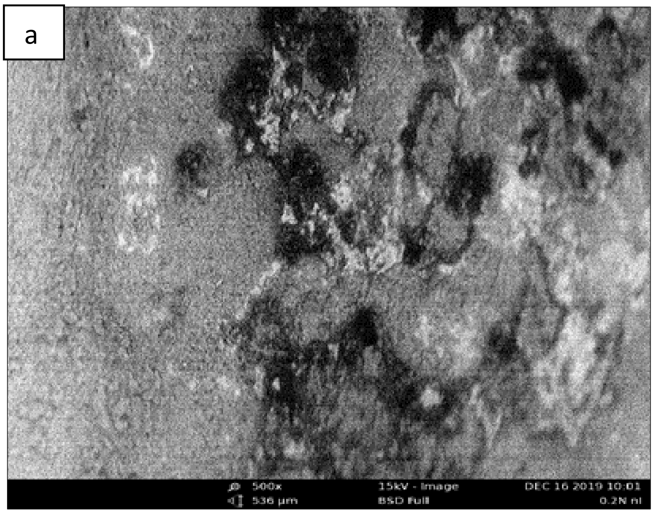
Table 8: Weight loss, Corrosion rate and % Inhibition Efficiency of 0.5M HNO_3 at different temperature

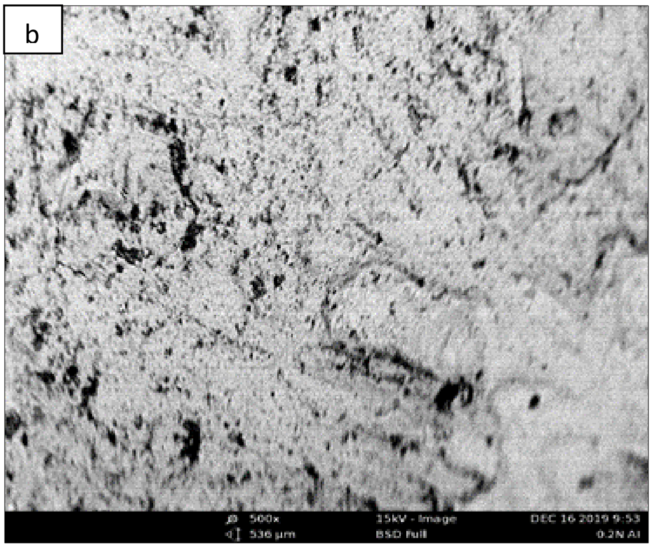
	Moringa			Analine		
Temperature(k)	**Wight loss**	**Corrosion rate**	**% IE**	**Wight loss**	**Corrosion rate**	**% IE**
303	0.2676	0.00278	59.74	0.2758	0.00287	6.81
	0.3635	0.00378	68.28	0.2971	0.00309	10.69
317	0.4924	0.00129	72.13	0.4272	0.00445	13.46

From table 5,6,7 and 8 shows the variation of corrosion rate for the corrosion inhibition of mild steel in acid solution and inhibitors at different temperature. The results showed that the corrosion rate and percentage inhibition efficiency increases in temperature. At least temperatures used (303K) in 0.2 M Moringa extract, the corrosion rate of mild steel in HCl and HNO_3 system were (0.00014 gcm^{-1} hr^{-1}) and (0.00151gcm^{-1} hr^{-1}) and that in Analine with the same corrodent solution (0.2 M) were (0.00040) and (0.00090 gcm^{-1} hr^{-1}). With increasing the temperature to 310 K the corrosion rate of mild steel in HCl and HNO_3 system increased to (0.00020 gcm^{-1} hr^{-1}) and (0.00213 gcm^{-1} hr^{-1}) and that in Analine were found to be (0.00101 gcm^{-1} hr^{-1}) and (0.00070 gcm^{-1} hr^{-1}). At highest temperature 317K corrosion rate were found to be (0.0365 gcm^{-1} hr^{-1}) and (0.00119 gcm^{-1} hr^{-1}). It can be observed from the results that the highest corrosion rate of mild steel was observed at the highest temperature (317 K). This observation is due to the fact that chemical reaction rates generally increases with rising temperature. Increase in temperature leads to increase in the kinetic energy possessed by the reacting molecules thereby making the molecules to overcome the energy barrier faster as reported by Udom *et al.* (2017) during the study for the effect of *acanthus montanus*leaves extract on corrosion of aluminium in hydrochloric acid medium and result of the corrosion rate was found to increase from 7.27 to 17.67 $mgcm^{-2}day^{-1}$ at a temperature of 303 and 333 K.

In some table 1, 4, 5, and 8 it was observed that analine have the highest corrosion rate across all corrodent concentrations while moringa extract has the lowest. This indicates that moringa has the highest inhibition efficiency when compared with analine inhibitor. The decrease in corrosion rate and increase in inhibition efficiency of moringa may be due to the presence of flavonoids compounds presence in its which possibly contains functional groups that help in eliminating corrosion [16]. And also in table 2, 3, 6 and 7 it was observed that moringa extract has the highest corrosion rate and analine has the lowest. This also demonstrate clearly that the lower the corrosion rate the higher is the inhibition efficiency and vice visa.

a





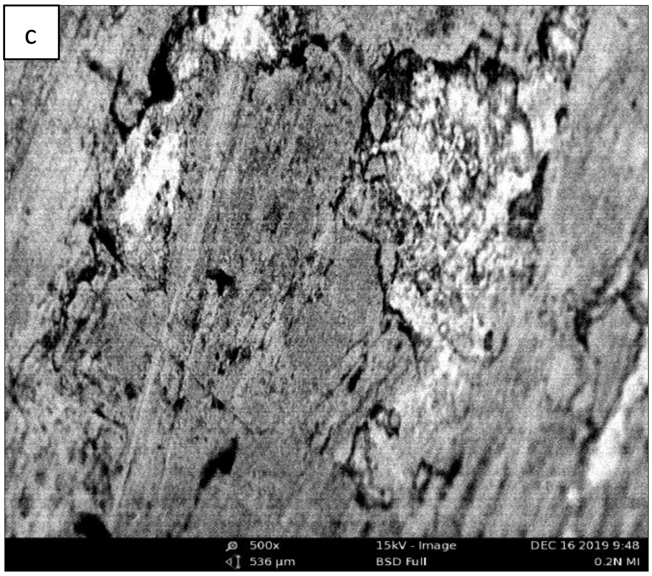


Fig 1: Macro image of (a) 0.2M HNO_3 Analine inhibited (b) 0.2M HNO_3 Moringa inhibited (c) 0.2M HNO_3 Non inhibited coupons respectively.

The image from figure 1a, showed a clear morphology of coupons with moringa inhibitor of 500X magnification. While the images from figure 1b and 1c shows the morphology of non-inhibited coupons and analine respectively. From the figures it clear that figure 1b shows a clear image than figure 1a and 1c, this shows that Moringa Oleifera methanol extract is a good and promising inhibitor than analine with high corrosives pores in the coupons image.

4. Conclusion

From the above discussion its quite obvious that natural plant extracts are effective green corrosion ihibitors against mild steel. Weight loss, time and temperature were mainly used to confirmed corrosion inhibition in nitric acid and hydrochloric acid media.

5. References

1. Popoola LT. Corrosion problems during oil and gas production and its mitigation, corrosion science, A.S Grema, G.K Grema, G.K Latinwo, B. Gutti and A.S Balogun, 2013, 157-168.
2. Chidiebere AM. Corrosion Inhibition and Adsorpsion Behavior of Punica Granatum Extract on Mild Steel in Acidic Environments, C.E Ogukwe, K.L. Oguzie, C.N. Oneh, and E.E. Oguzie, Experimental and Theoretical Studies, 2011, 58-287.
3. Cardenas-Valencia AM. X Analysis and Prevention of Corrosion –Related failures. Millennium Metallurgy, C.E Ogukwe, K.L Oguzie, C.N. Eneh, and E.E. Oguzie, 2002, 415-422.
4. Oguzie EE, Iyeh KL, Onuchukwu AI. Inhibition of mild steel corrosion in acidic media by aqueous extracts from garcina kola seed. 2006; 6(48):1646-1665.
5. Obot IB, Obi-Egbedi NO, Umoren SA. Antifungal drugs as corrosion inhibitors for mild steel in 0.1M HCl, Corrosion Science. 2009; 8(51):1868-1875.
6. Dariva CG, Galio AF. Corrosion Inhibitors- Principles, Mechanisms and Applications. 2014; 5(1):25-32.
7. Ju H, Kai Z, Li Y. Aminic nitrogen-bearing polydentate Schiff base compounds as corrosion inhibitors for iron in acidic media., Corrosion Science. 2004; 3(50):865-871.
8. CSB, 2002. http://www.csb.gov/assets/1/19/Movita-Final-Report.pdf/chemical safety and hazard. 2001-05-1-DE. (accessed)
9. CSPC, 1977. http://www.cpsc.gov/en/Recalls/1977/ CPSC-Announces-Final-Ban-On.Html, (accessed).
10. Koch GH. Corrosion Cost and preventive Strategies in the United States, M.P.H. Brongers., N.G. Thompson., Y.P. Virmani., and J.H. Payer, 2002, 81-156.
11. CIA word factbook, 2019. www.cia.gov/cia/publications /factbook/geos/ni.html, (accessed)
12. Bradford SA. Corrosion Control, Van Nostrand Reihold, New York, 1993.
13. Perez N. Electrochemistry and Corrosion Science, Kluwer Academic Published, New York, 2004.
14. Iloameka IM, Onuegbu TU, Ajiwe VE, Ugochukwu U. J. Chem. Eng. 2012; 6:7-14.
15. Ajayi OO, Joseph OO, Omotosho OA, Olabowale TO, J. Corrosion Science. 2015; 29:10-15.
16. Nithya Shanthy P, Vijaya N, Joseph Rathish R, Santhana Prebba S, Joany RM, Rajendran S. Int. J. Nano Corrosion Science. Eng. 2015; 21:1-13.