Proceedings of the 33rd Annual International Conference Abeokuta, Nieria

MOJISOLA. O. NKIKO
Department of Chemical Sciences, Olabisi Onabanjo University.
PMB 2002, Ago – Iwoye, Nigeria. chrismoj3@yahoo.co.uk

ABSTRACT
The inhibitive effect of corrosion of zinc – aluminium (ZA) alloy in 2M hydrochloric acid (HCl) solutions by ocimum gratissimum seed extract has been studied using gravimetric methods. Inhibition was observed to increase with increasing extract concentration and temperature. This observation implies that ocimum gratissimum seed extract is an effective and non toxic inhibitor of the corrosion of zinc – aluminium alloy.
Keywords: Corrosion inhibitor, gravimetric methods, inhibitor efficiency, ocimum gratissimum

INTRODUCTION

The current trend of using zinc – aluminium as an alternative to pure aluminium /zinc for fabrication of materials such as roofing sheets as kindled interest in the study of the properties of zinc – aluminium alloys. They consist of varying composition of zinc and aluminium which were originally designed for gravity casting. Distinguishing features of the alloys has been reported to include high as - cast strength, excellent bearing properties and low energy requirements for melting[1,2].

Pure aluminium is known for its passivity, excellent corrosion resistance which makes it a primary metal of commerce[3]. However pure zinc reacts slowly at room temperature with acids, strong acids such as hydrochloric acid are capable of removing the passive layer and subsequently its reaction with water releases hydrogen gas[4]. Zinc has its major application in corrosion in the plating of steel as a sacrificial metal[4].

Ekuma et al[5,6] has studied the service performance of aluminium – zinc alloys in various concentration sulphuric acid and has shown that the presence of zinc in aluminium acts as impurity and thus reduce the degree to which aluminium resist corrosion in the stimulated environment.

The use of naturally occurring substances of plant and animal origin known as green inhibitors has generated much interest in recent times. These plant/ animal extracts are cheap and abundant, less toxic, readily available and are environmentally friendly.

Recent investigations have shown the corrosion inhibitive effect of local plants which have exhibited good inhibitor efficiencies[7-13]. The present study investigates the inhibitive properties of the species ocimum gratissium known as African basil.

Ocimum gratissimum belongs to the family laminaceae. Phytochemical screening of the plant has shown that it consist of alkaloids, tannins, flavonoids, and tannins[14].

EXPERIMENTAL

Materials and Preparation:

Zinc – aluminium alloy was obtained from Midland Galvanizing Products Ltd, Abeokuta, Nigeria.

The weight percentage composition of the zinc – aluminium alloy as determined to be 30% Aluminium and 70% Zinc. Each sheet was mechanically pressed and cut into coupons of dimension 3cm by 1.5cm. Surface treatment of polished coupons involved degreasing with absolute ethanol and drying in acetone. The coupons were thereafter stored in a moisture free desiccator to avoid contamination prior to use.

All chemicals and reagents used were BDH grade. Blank corrodent is 2M HCl solution. The inhibitor, ocimum gratissium seed was collected from the fauna of Ago – Iwoye, Ogun state of Nigeria and was classified at the Forest Research Institute of Nigeria. FHI number 108361.

Stock solution of the plant extract was prepared by placing 0.5g 0f milled seed in 100ml of 2.0M hydrochloric acid and refluxed for 2.5 hours. The resulting solution was cooled, filtered and stored. Inhibitor test solutions (v/v) of the extract were prepared in the concentration range of 8 – 20%. The effect of halide additives was studied by combining 5.0mM of the salts of KCl, and KI respectively with solutions of the 10% extract. Previously prepared coupons of zinc – aluminium were weighed and submerged into the different concentrations of the test solution. The coupons were retrieved from the solution every 30 minutes for three hours, washed and reweighed. The differences in weight of the coupons were taken as the weight loss evaluated in grams

The inhibitor efficiency of ocimum gratissimum in 2M HCl was calculated using the equation

$$I\% = 1 - (W_i \; W_o^{-1}) \times 100 \quad (1)$$

Where W_i and W_o are weight losses of the zinc – aluminium coupons in the presence and absence of inhibitors, respectively at the same temperature.

The degree of surface coverage (θ) was calculated using equation

$$\theta = 1 - (W_i \; W_o^{-1}) \quad (2)$$

RESULTS AND DISCUSSION

TEMPERATURE DEPENDENCE OF CORROSION OF Al – Zn

Figure 1 shows the temperature dependence of corrosion of Al – Zn alloy. An increase in weight loss of the alloy was observed as the temperature increased from 30°C to 60°C. This implies that the corrosion of this alloy follows the general principle of chemical reactions: rate chemical reaction increases with increase in temperature.

WEIGHT LOSS AND INHIBITION EFFICIENCY

Weight loss measurement of Aluminium – Zinc alloy in 2 M HCl in the presence and absence of ocimum gratissimum at various concentrations after immersion for 150 hours at temperatures of 30°C is shown as figure 2; similar plots were obtained at 60°C. Weight loss of Al – Zn decreases in the presence of inhibitor and decreases as the concentration of inhibitor increases when compared to the acid solution without inhibitor. Figure 3 shows the variation of inhibition efficiency with time at various concentrations of ocimum gratissimum concentration at 30° C. The Inhibition efficiency increases with time and as the concentration of inhibitor increases. This observation implies that the surface area of alloy covered by the inhibitor increases as the concentration of inhibitor increases.

TEMPERATURE DEPENDENCE OF INHIBITION EFFICIENCY:

Figure 4 is the graphical representation of the temperature dependence of the inhibitor efficiency of ocimum gratissimum on the corrosion of Al – Zn at 30° C and 60° C in 2M HCl. Figure 4 shows that inhibitor efficiency of ocimum gratissimum decreases with an increase in temperature which suggests that the adsorption mechanism is physical. The inhibitive effect of ocimum gratissimum may be attributed to the presence of phytochemical constituents of the plant seed extract. Previous studies on the Phytochemical constituent of the plant has shown that it consist of alkaloids, tannins, flavonoids, and tannins, phenols and glycoprotein[14]. These compounds contain nitrogen and oxygen atoms which may possess lone pairs of electrons that may facilitate the formation of dative bonds which may act as centre for adsorption thus creating a barrier between the alloy surface and the corrosive medium.

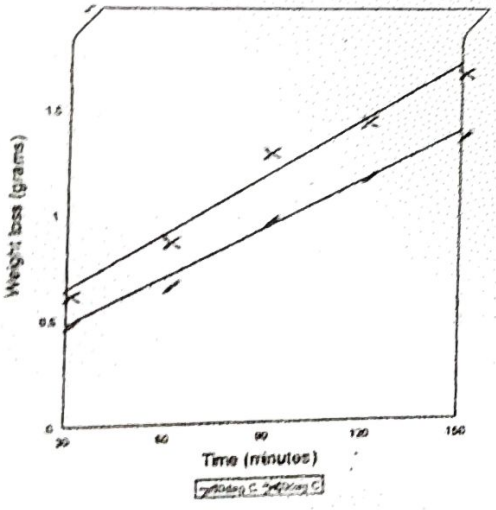

Figure 1 : Temperature dependence of corrosion of Al-Zn in 2 M HCl

ADSORPTION ISOTHERM OF CORROSION OF Al – Zn IN 2M HCl

The adsorption isotherm is shown as figure 5. The adsorption isotherm provides insight into the mechanism of corrosion inhibition. This determined empirically by plotting the data on the surface area of coverage (θ) as a function of the concentration of inhibitor. To ascertain the nature of adsorption, the surface coverage values for ocimum gratissimum extract for 30° C and 60° C were fitted into various adsorption isotherm models and correlation coefficients (R^2) were used to determine best fit which was obtained with Freundlich adsorption isotherm. The linear plots obtained ($R^2 > 0.86$) suggest that the experimental data fit the Freundlich adsorption isotherm which is given as by[15]

$$\theta = KC^n \quad (3)$$

Where $\theta < n < 1$ (4)

$$\ln \theta = \ln K + n \ln C \quad (5)$$

C is the concentration of the ocimum gratissimum extract and K is the adsorption equilibrium constant, n and K is temperature dependent.

CONCLUSIONS

- Extract from ocimum gratissium acts as an efficient inhibitor for Al – Zn corrosion in 2M HCl
- Corrosion increases with increase in temperature in the absence and presence of.
- Inhibitor efficiency of ocimum gratissimum extract increases with increase in concentration but decreases with increase in temperature which implies that the adsorption may be physical adsorption.
- Adsorption of the extract on the surface is observed to obey Freundlich adsorption isotherm

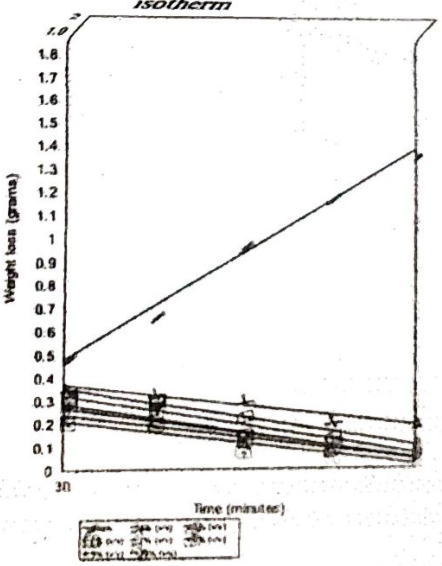

Figure 2: Variation of weight loss (grams) of Zn - gratissimum at 30°C in 2M HCl
alloy in the absence and presence of ocimum

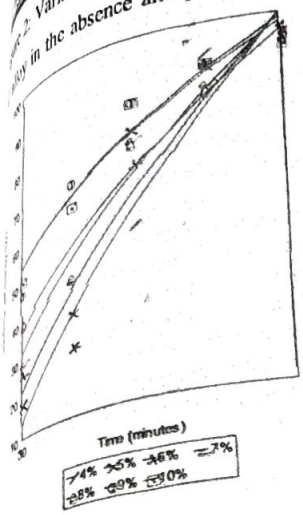

Figure 3: Variation of Inhibitor efficiency (%) with Time in 2M HCl

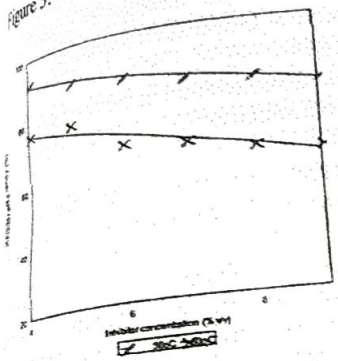

Figure 4: Temperature dependence of Inhibitor efficiency

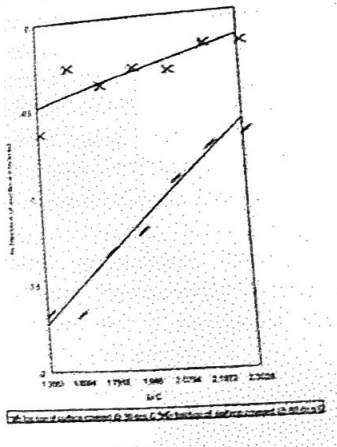

Figure 5: Freundlich isotherm for the corrosion inhibition of Aluminium - Zinc Alloy in the presence of ocimum gratissimum extract

R = 0.9830334
R^2 = 0.9663546
Standard deviation = 0.376400535

FERENCES
J Randolph Kissel and Roert L Ferry (2002)
minium Studies: a guide to their specification
d designs 2nd ed: Link
Degarma,E.Paul, Black,J.T, Kosher, Ronald.A
03) Materials Processes in manufacturing. 9th
Wiley Press, 133,
SN 0- 471- 65653-4
R.E Sanders (2001) : Technology innovation in
minum products.
nal of the Minerals, 53(2) 21 - 25
Ijeoma, M.N.C (1991) Elements of corrosion
protection theory. Auto century puplishing co.
Enugu, 112 – 128
C.E. Ekuma and N. E. Idenyi (2007)
of the corrosion Susceptibility of Al – Zn
ys in Tetraoxosulphate (VI) acid environment.
Applied Sciences Research 2 (1): 66 – 70
C.E. Ekuma and N. E. Idenyi and A. E. Umahi
7)
fects of Zinc additions on the corrosion
eptibility of Aluminium Alloys
as Tetraoxosulphate (VI) acid environments.
Umoren, S.A. (2007) , Studies on the
itive effect of Exudate gum from Dacroydes
s on the acid corrosion of Aluminium.
ae Electrochimica Acta 26, 199 – 209
El-Etre, A. Y. Abdallah, M. and Tantawwy, E.
5). Corrosion Inhibition- the natural way.
osion Science, 47, (2), 385 – 387.
9. Oguzie, E, E , Onuoha, G. W, Onuchukwu, A.I (2004)
Ecofriendly corrosion inhibitor : inhibitive action on quinine for corrosion of low carbon steel in 1M HCl. Matter chem..phys, 89, 305
10. El-Etre, A. Y (2003); Inhibition of aluminium corrosion using opuntia extract.
Corrosion Science, 45, 2485
11. Abdallah, M (2004) ; Guargum as corrosion inhibitor from carbon steel in sulphuric acid solution.
Portugaliae Electrochimica Acta 22, 161 – 175
12. Martinez, S. Stern, I. (2001): Inhibitory Mechanism of low carbon steel corrosion by mumosa tannin in sulphuric acid solution.
J. Appl. Electrochem. 31, 973-978
13. Ebenso, E.E, Ibok, U.J, Umoren, S.A, Abiola, O. K. (2004): Corrosion inhibitive effect and adsorption behaviour of Hibiscus sabdariffa extract on mild steel in acidic media. NC, Trans SAEST 39, 117.
14 Edeoga, H. O and Eriata, O.O (2006): Chemical composition of hyptis suaveolens and ocimum gratissimum hybrid from Nigeria.
J. med. Aromatic plants Sci. 23, 224- 349
15. Oguzie, E, E, (2007): Corrosion Sci. 49, 1527