IJST EXPLORE International Journal of Science and Technology
CENTRE OF PROFESSIONAL RESEARCH PUBLICATIONS
ISSN 2049-7318

International Journal of Science and Technology Volume 2 No. 7, July, 2013

Corrosion Inhibition of Pulverized *Jatropha Curcas* Leaves on Medium Carbon Steel in 0.5 M H_2SO_4 and NaCl Environments

Omotoyinbo, J.A., Oloruntoba, D.T. , Olusegun, S. J.
Department of Metallurgical and Materials Engineering, Federal University of Technology,
PMB 704, Akure, Ondo State Nigeria.

ABSTRACT

The inhibitive effect of pulverized *Jatropha curcas* leaves on the corrosion of medium carbon steel in 0.5M NaCl and 0.5M H_2SO_4 solutions was investigated using gravimetric technique of monitoring corrosion rate. The leaves were dried and ground to powder. The concentration of the extract used ranges from 0.5 – 2.5 g in 300 ml of 0.5 M NaCl and 0.5M H_2SO_4 solutions. The inhibition efficiency of 92.1 % was obtained from the 1.5 g of the pulverized *Jatropha curcas* leaves in NaCl solution, while 55.5 % efficiency was obtained from 2.5 g extract in H_2SO_4 solution. The overall results obtained indicated that *Jatropha curcas* leaves extract could be used as inhibitor against the corrosion of medium carbon steel in both the alkaline and acid solutions.

Keywords: *Jatropha curcas, corrosion rate, inhibition efficiency, carbon steel*

1. INTRODUCTION

Jatropha curcas is a plant regarded as weeds or trees contributing to bushy environment in Nigeria. It is a self-propagating plant in an area which has not be fully inhabited. Although there has been a local use of its fluid to treat ring worm on children, and its seeds used for the production of biodiesel, but it seems to cause more harm than good to children playing around it. Like many other authors (Oloruntoba et al., 2012; Farooqi et al., 1999) that have carried out works in solving environmental problems caused by weeds, this research sought to find alternative use of *Jatropha curcas* in solving corrosion problems, which presents itself as a major cankerworm to industries. It is also thought that constant harvesting and removal of the trees for useful purposes will reduce its competition for nutrients in arable farm lands. Corrosion which is a metal degradation as a result of its reaction with environment has grounded so many industries in Nigeria although its role in this respect is not as obvious as that of the constant power failure experienced in the country. Possibly, the remote cause of power failures may be due to the corrosion of power plants which for a long time has not been checked.

Because of the toxic nature and/or high cost of some chemicals currently in use as inhibitors, for example nitrites and chromates, it is necessary to develop environmentally friendly and inexpensive ones. Natural or organic products can be considered as good sources for this purpose.

Quite a number of works have been done in the exploitation of plant extracts as corrosion inhibitors such as, lignin (Alaneme and Olusegun 2012), Henna, *Lawsonia inermis* (Al-Sehaibani, 2000), *Rosmarinous officinalis L.* (Kliskic et al., 2000), *Carica papaya* (Okafor and Ebenso, 2007), date palm, *phoenix dactylifera*, henna, *lawsonia inermis*, and corn, *Zea mays* (Rehan, 2003), water hyacinth (Oloruntoba et al., 2012) and *Nypa Fruticans Wurmb* (Orubite-Okorosaye and Oforka, 2004). Many of these have been found to be good corrosion inhibitors for many metals and alloys. Recently an excellent review of organic/natural products as corrosion inhibitors for metals in corrosive media has been published (Raja and Sethuraman, 2008).

Vinod et al, 2010 have worked on the seed husk extract of jatropha to inhibit mild steel, in hydrochloride acid environment, but this research work is aimed to investigate the effectiveness of jatropha leaves as inhibitor to the corrosion rate of medium carbon steel in sour environment.

2. MATERIALS AND METHOD

The material used for this study is a medium carbon steel sheet of elemental composition shown in the table below. The steel was mechanically cut to 12 coupons of dimensions 20 by 10 mm.

Table 1: Chemical composition of the medium carbon steel used

%C	%Mn	%Si	%P	%S	%Cr	%Mo	%V	%Cu	%Fe
0.510	0.19	0.12	0.016	0.015	0.178	0.018	0.005	0.3605	Balance

2.1 Preparation of Pulverized *Jatropha Curcas* Leaves

Jatropha leaves that were used for this study were obtained within Akure, Ondo State, Nigeria. The leaves were cut, sun dried and pulverized into fine particles using mechanical grinding machine. The pulverized leaves were sieved, using 850 micron diameter sieve.

2.2 Corrosion Monitoring by Gravimetric Method

The weight of each coupon was initially taken and thereafter the coupons were immersed into different beakers containing 0.5 M H_2SO_4 / inhibitor and 0.5 M NaCl/inhibitor media. The quantity of the pulverized leaves was varied from 0.5 – 2.5g/300ml of the electrolyte. The weight loss measurements were performed on the coupons by retrieving them from the media after 3 days and weighed with electronic balance model FA2104A. Corrosion rates were calculated from the data obtained using the formula:

$$CR = \frac{\Delta W}{A\frac{T}{365}} \quad (1)$$

ΔW, weight loss (mg)
A, total surface area (mm^2)
T/365, exposure time in days extrapolated to a year

3. RESULTS AND DISCUSSION

3.1 Effect of Pulverized Jatropha Leaves on the Corrosion Rates of Medium Carbon Steel in Sodium Chloride Solution

Figure 1 presents the effects of jatropha leaves extract on the corrosion behavior of medium carbon steel in 0.5 M NaCl solution. It was observed that the corrosion rate decreased from 0.9356 $mg/mm^2/yr$ for unhibited sample to 0.2094 $mg/mm^2/yr$ as a result of the addition of 1.5 g of the pulverized jatropha leaves inhibitor per 300ml of 0.5 M NaCl solution. This may be due to the capability of the extract to form a protective layer on the coupons. Corrosion rates decreases with increase in the exposure time for both inhibited and uninhibited samples but the cumulative weight loss for the uninhibited samples was much higher than that of the inhibited samples and this stood at an average of 52.6 mg and 18.8 mg for the uninhibited and inhibited samples respectively. This trend may be as result of the fact that adsorption and surface coverage increases with the concentration of the extract (Vijayalaskshmi et al., 2011). This shows that jatropha leaves possessed inhibitive power that could retard corrosion rate of medium carbon steel in the corrosive media used. Observed from Fig.2, 1.0 g of the extract in 0.5M NaCl has the highest inhibition efficiency of 70.1% on the first few days of exposure period. The inhibition efficiency of 92.1 % was obtained from the 1.5 g of the pulverized leaves in NaCl solution.

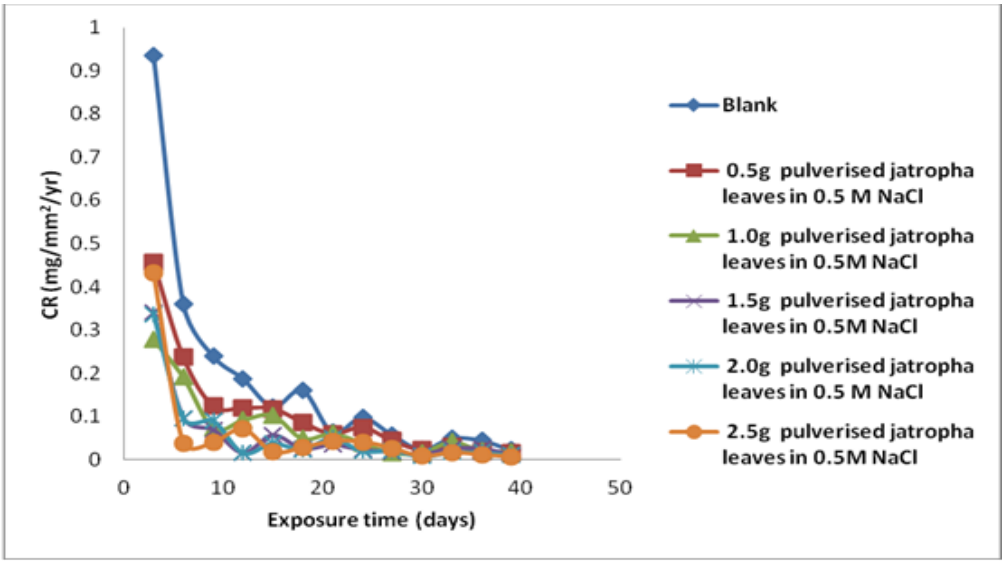

Fig.1: Plot of corrosion rates against exposure time for medium carbon steel immersed in 0.5M NaCl solution with and without pulverized jatropha leaves as inhibitor

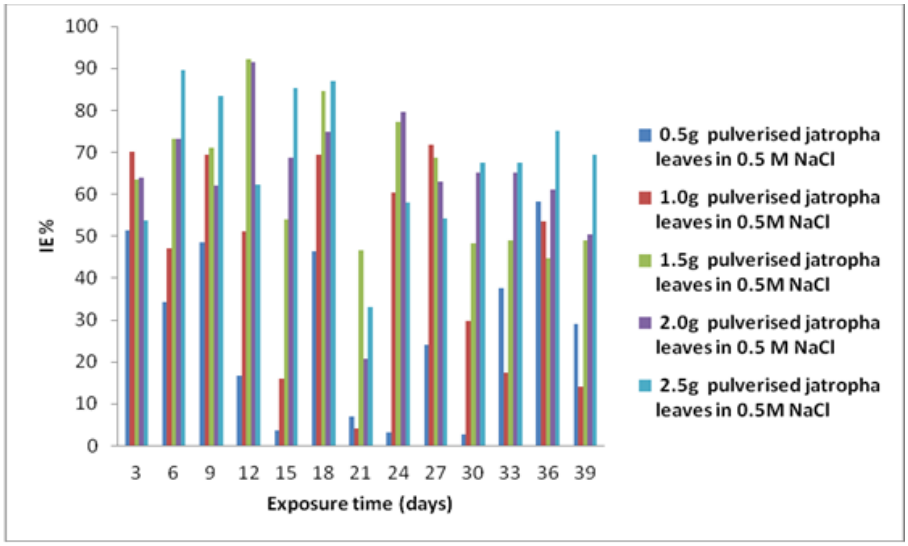

Fig. 2: Plot of inhibition efficiency against exposure time for medium carbon steel immersed in 0.5M NaCl solution with and without pulverized jatropha leaves as inhibitor

3.2 Effect of Pulverized Jatropha Leaves on the Corrosion Rates of the Medium Carbon Steel in Sulphuric Acid Solution

From Figure 3, the corrosion rate of the coupon without inhibitor has the highest value of 88.3 mg/mm2/yr on the first few days of the immersion time. This retarded to 42.85 mg/mm2/yr by addition of 1.0 g pulverized jatropha leaves per 300ml of 0.5M H_2SO_4. The trend of the results was not consistent. This trend was also reported by Okafor et. al 2010 having negative values for inhibition efficiency. Corrosion of metals in acidic medium has been attributed to the presence of water, air and H^+, which accelerate the corrosion process (James and Akaranta 2009). Higher concentration of H^+ in 0.5M H_2SO_4 makes the corrosion rate to be higher with lesser inhibition efficiency. Nonetheless, jatropha leaves extract retarded the corrosion rate of the medium carbon steel in the concentration of the sulphuric acid solution used in the experiment. It was observed that the addition of 2.5 g pulverized jatropha leaves to the 0.5M H_2SO_4 solution brought the corrosion rates to minimal compared with the uninhibited solution for the period of exposure. From Fig.4, 55.5 % efficiency was obtained from 2.5 g extract in H_2SO_4 solution. The inhibition efficiency of the extract in 0.5M H_2SO_4 fluctuated as the immersion time increased.

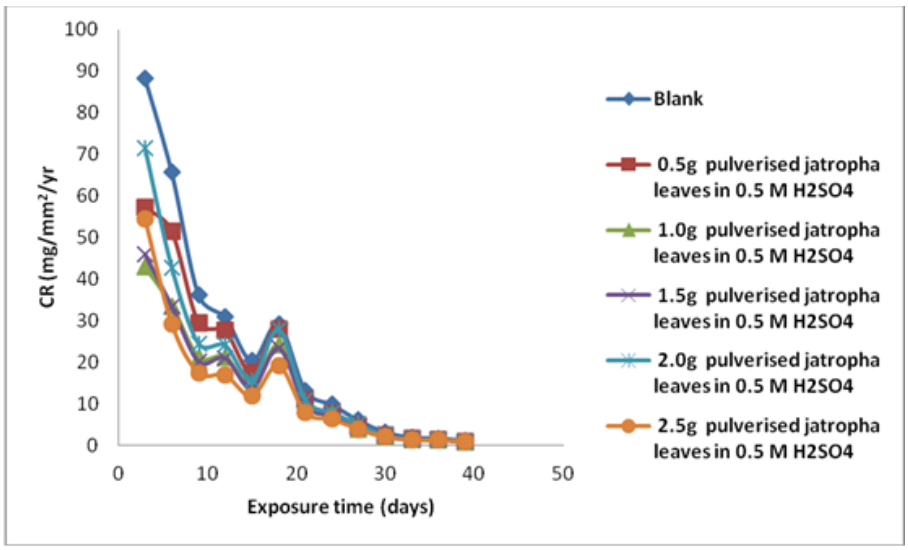

Fig. 3: Plot of corrosion rates against exposure time for medium carbon steel immersed in 0.5M H_2SO_4 solution with and without pulverized jatropha leaves as inhibitor

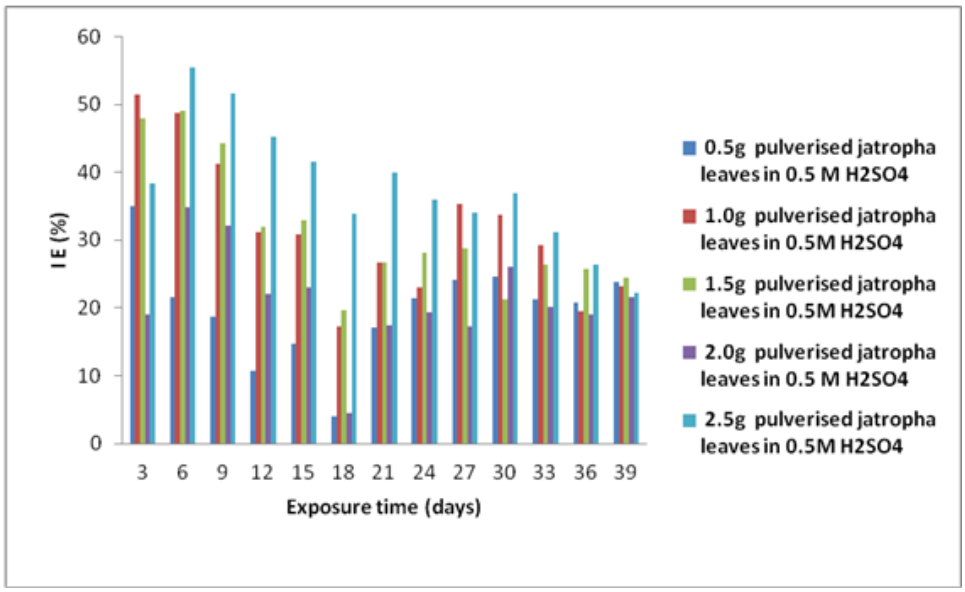

Fig. 4: Plot of inhibition efficiency against exposure time for medium carbon steel immersed in 0.5M H_2SO_4 solution with and without pulverized jatropha leaves as inhibitor

4. CONCLUSION

Jatropha leaves extract has good tendency of inhibiting the corrosion rate of medium carbon steel in NaCl and H_2SO_4 solution. Less than 2.0 g pulverized jatropha leaves per 300ml of 0.5M NaCl solution is sufficient to inhibit the corrosion rate of medium carbon steel in NaCl solution. The efficiency of the pulverized jatropha leaves was comparatively low in H_2SO_4 solution; nevertheless, it retarded the corrosion rate of the medium carbon steel by more than 50%.

AKNOWLEDGEMENT

Mr Otuisi is hereby acknowledged for data collection.

REFERENCES

[1] Alaneme K.K and Sunday J.O. (2012) Corrosion Inhibition Performance of Lignin Extract of Sun Flower (*Tithonia Diversifolia*) on Medium Carbon Low Alloy Steel Immersed in H2SO4 Solution. Leonardo Journal of Sciences 20, p. 59-70

[2] Al-Sehaibani H. (2000). Evaluation of extracts of Henna leaves as environmentally friendly corrosion inhibitors for metals‖. Mat.-wissu. Werkstofftech., 31(12), pp. 1060-1063.

[3] Farooqi I.H., Aqbal Hussain, and P.A. Saini. (1999) ―Study of low cost eco-friendly compounds as corrosion inhibitors for cooling systems‖. Anti-Corrosion Methods and Materials, 46(5) 328- 331.

[4] James A. O. and O. Akaranta (2009) Corrosion inhibition of aluminum in 2.0 M hydrochloric acid solution by the acetone extract of red onion skin. African Journal of Pure and Applied Chemistry Vol. 3 (12), pp. 262-268,

[5] Kliskic M., J. Radosevic, S. Gudic, and V. Katalinic(2000) Aqueous extract of Rosmarinus officinalis L. as inhibitor of Al–Mg alloy corrosion in chloride‖, Journal of Applied Electrochemistry, 30(7), pp. 823-830.

[6] Okafor P.C., and E.E. Ebenso. (2007) Inhibitive action of Carica papaya extracts on the corrosion of mild steel in acidic media and their adsorption characteristics‖. Pigments & Resin Technology, 36(3), pp. 134-140.

[7] Oloruntoba D T, Abbas JA, Olusegun SJ (2012). Water Hyacinth (eichhornia crassipes) Leaves Extract as Corrosion Inhibitor for AISI 1030 Steel in Sea Water, *In*: Laryea, S., Agyyepong, S.A. Leiringer,R and Huhges,W. (Eds) Procs 4th West Africa Built Environment Reseaerch (WABER) Conference, 24-26 July, 2012, Abuja, Nigeria, 1129-1138.

[8] Orubite-Okorosaye K., and N.C., Oforka. (2004) Inhibition of the corrosion of mild steel in hydrochloric acid solutions by the extracts of leaves of Nypa fruticans Wurmb‖. Materials Letters 58 (11), pp. 1768-1772.

[9] Raja, P.B. and Sethuraman, M. G. (2008). Natural products as corrosion inhibitor for metals in corrosive media – A review' Materials letters, 62(1): 113-116

[10] Rehan H.H.. (2003) Corrosion Control by water-soluble extracts from leaves of economic plants‖. Mat.-wiss u. Werkstofftech., 34(2), pp. 232-237.

[11] Vijayalakshmi P.R., Rajalakshmi R.2 and S. Subhashini (2011) "Corrosion Inhibition of Aqueous Extract of Cocos nucifera - Coconut Palm - Petiole Extract from Destructive Distillation for the Corrosion of Mild Steel in Acidic Medium" Portugaliae Electrochimica Acta, 29(1), 9-21

[12] Vinod Kumar K.P., M. Sankara Narayanan Pillai, G. Rexin Thusnavis Inhibition of mild steel corrosion in hydrochloric acid by the seed husk extract of Jatropha curcas J. Mater. Environ. Sci. 1 (2) (2010) 119-128