Available online at www.pelagiaresearchlibrary.com

Pelagia Research Library

Advances in Applied Science Research, 2011, 2 (4): 14-20

Pelagia Research Library

ISSN: 0976-8610
CODEN (USA): AASRFC

N-{[2-Pyridine-2-azo)-5-Hydroxyl] Phenyl}-4-Methoxy benzilidenimine (L_{PYA}) as a corrosion inhibitor of mild steel in 0.5M HCl

Kalada Hart, N.C Oforka and A.O James

Department of Pure and Industrial Chemistry, University of Port-Harcourt, Port-Harcourt, Nigeria

---

ABSTRACT

The weight loss technique has been used to study the corrosion inhibition of mild steel in 0.5 HCl acidic medium by the Schiff base N – {[- 2 Pyridine – 2 – azo) – 5 – Hydroxyl] Phenyl} – 4 – Methoxybenzilidenimine (L_{PYA}) at 303K, 313K, 323K, 333K and 353K. Increase in temperature increased the inhibition efficiency at the temperatures studied. Thus, maximum inhibition efficiency of 99.30% was obtained at an optimum concentration of (1.0×10^{-2}M) and at the highest temperature of 353K. The phenomenon of chemical adsorption has been proposed since an increase in temperature shows a corresponding increase in its inhibition efficiency.

Key words: Corrosion; Inhibition; Mild steel; Temperature; L_{PYA}; Hydrochloric acid.

INTRODUCTION

Corrosion is the destructive attacks of metals by its environment. Corrosion of metals is a major industrial problem that has attracted a lot of investigators in recent years [4]. Inhibitors are generally used to protect materials against deterioration from corrosion [10]. The corrosion inhibition is a surface process which involves the adsorption of the organic compounds on metal surface [3].

Many organic compounds containing oxygen, nitrogen and sulphur have been studied as corrosion inhibitors for metals. Corrosion inhibitors are of great practical importance, being extensively employed in minimizing metallic waste in engineering materials [1]. The efficiency of these compounds depends upon the electron density present around the hetero atoms. Inhibition efficiency also depends upon the number of active adsorption centres in the molecule, their charge density, molecular size, mode of adsorption and formation of metallic complexes. Hetero atoms such as N, O, S and some cases Se and P are capable of forming coordinate – covalent bond with metals owing to their free electron pairs [2]. Compounds with Π-bonds also generally exhibit good inhibitive properties due to interaction of Π-orbital with the metal surface

[3]. Schiff bases with -C=N- linkage (azomethine) have both the above features combined with their structure which make them effective potential corrosion inhibitors [11].

Some Schiff bases derived from aliphatic and aromatic monoamines and diamines have recently been reported as effective corrosion inhibitors for mild steel [2] .

This present paper deals with the study of the inhibitory action of a schiff base, N – {[- 2 Pyridine – 2 – azo) – 5 – Hydroxyl] Phenyl} – 4 – Methoxybenzilidenimine (L_{PYA}) on mild steel in 0.5M HCl acid solutions at different temperatures.

MATERIALS AND METHODS

Material preparation

A mild steel sheet of thickness 3.0cm was obtained from World Bank Engineering Workshop, University of Port-Harcourt, Choba and cut into a rectangular specimens of dimension 4.0 x 4.0 x 3.0 cm containing a small hole of about 2mm diameter near the upper edge. The chemical composition of the mild steel specimens was 0.12% C, 0.90% Mn, 0.066% S, 0.050% P, 0.10% Si and Fe 98.314%. The specimens were cleaned by buffing to produce a spotless finish and then degreased by dipping in absolute ethanol, rinsed with distilled water and dried in acetone. The process enabled mild scales to be removed from the coupons. The treated coupons were then stored over calcium chloride in moisture free desiccators to prevent contamination before use for corrosion studies.

The N –{[- 2 Pyridine – 2 – azo) – 5 – Hydroxyl] Phenyl} – 4 – Methoxybenzilidenimine (L_{PYA}) used as inhibitor was synthesized by Oforka and Mkpene, 2007 [9].

Weight loss measurement

Previously weighed mild steel coupons were immersed in 250ml open beakers containing 0.5M HCl solution (blank) without additive, and additive concentration of 1.0×10^{-2}M., 1.0×10^{-3}M, 1.0×10^{-4}M & 1.0×10^{-5}M in 0.5M HCl (corrodent) solutions at 303K, 313K, 323K, 333K and 353K. The variation of weight loss was follow at 24hours interval progressively for 168hours (7 days) at 303K, 313K, 323K, 333K and 353K.

The procedure for weight loss determination was similar to that reported previously [6].

The inhibition efficiency (%E) was calculated from the equation (1) below:

$$\%E = \frac{\Delta W - \Delta W_i}{\Delta W_B} \times \frac{100}{1} \qquad (1)$$

Where ΔW and ΔWi are the weight loss of the metal in uninhibited and inhibited solutions respectively.

The corrosion rates in mmpy (milli meter per year) are expressed as in Sethi, *et al* 2007[11].

$$\text{Corrosion rate (mmpy)} = \frac{\Delta M \times 87.6}{A \times D \times T}$$

Where Δ M is the weight loss of specimen in mg, A is the area of exposure of specimen in square cm, T is the time in hours and d is the density of specimen in gm/cm^3.

Each reading reported is an average of two readings recorded to the nearest 0.001g on an AB 54 AR digital analytical weighing balance.

RESULT AND DISCUSSION

Effect of L_{PYA} on the corrosion of mild steel in 0.5M HCl solution.

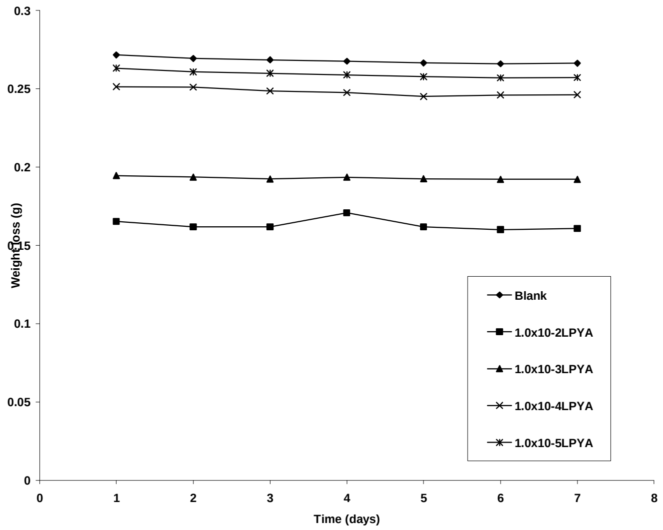

Figure 1: Variation of weight loss with time for mild steel coupons in 0.5M HCl solution containing various concentrations of L_{PYA} at 303K.

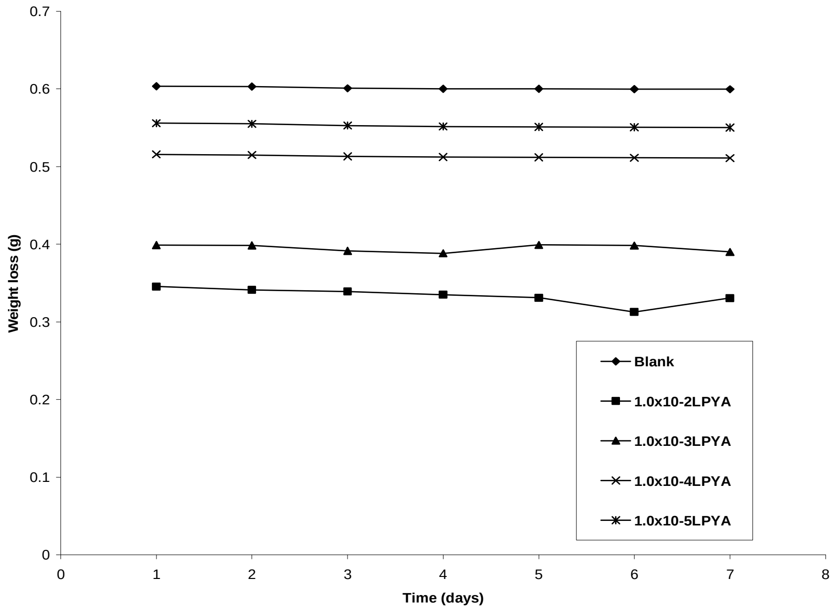

Figure 2: Variation of weight loss with time for mild steel coupons in 0.5M HCl solution containing various concentrations of L_{PYA} at 313K.

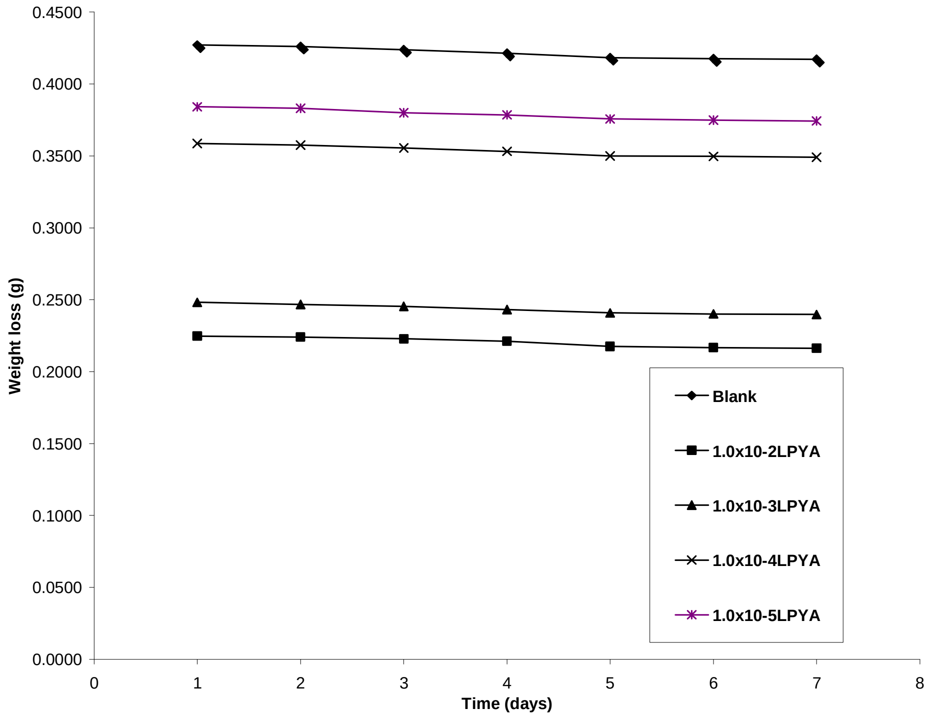

Figure 3: Variation of weight loss with time for mild steel coupons in 0.5M HCl solution containing various concentrations of L_{PYA} at 323K.

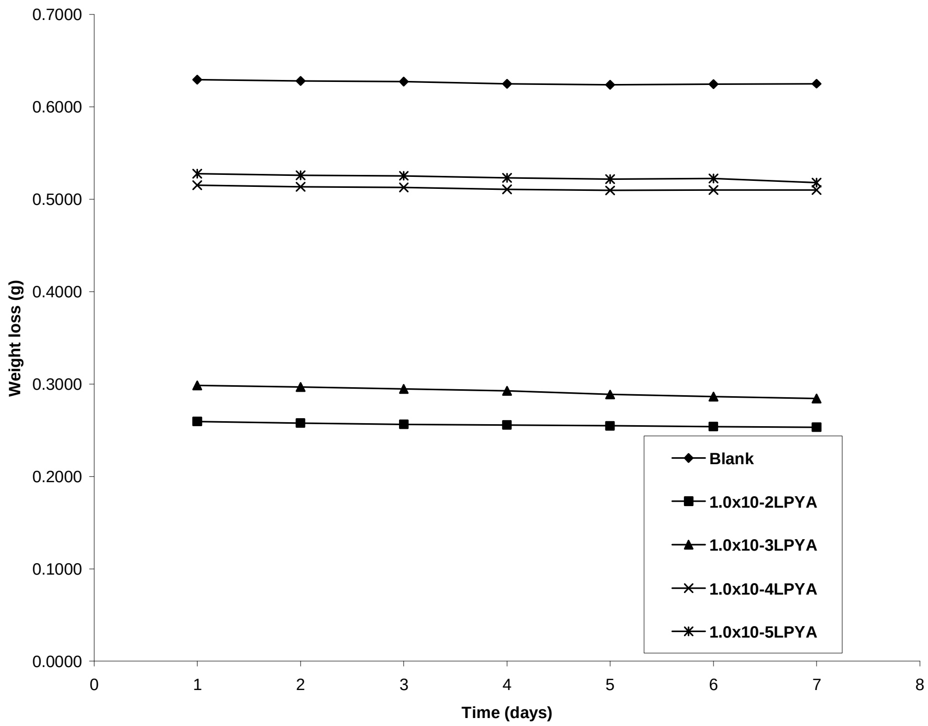

Figure 4: Variation of weight loss with time for mild steel coupons in 0.5M HCl solution containing various concentrations of L_{PYA} at 333K.

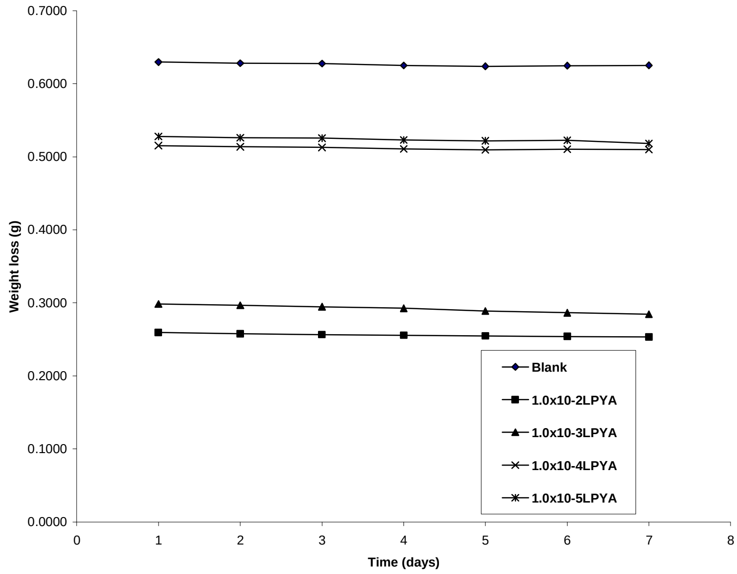

Figure 5: Variation of weight loss with time for mild steel coupons in 0.5M HCl solution containing various concentrations of L_{PYA} at 353K.

Figures 1-5 show that L_{PYA} actually inhibited the corrosion of mild steel in 0.5M HCl solution since there was a decrease in the original weight of mild steel with the use of this additive at all the temperature studied. It is also observed from the figures that as the concentration of the additives increased, the weight loss decreased signifying an increased inhibition. Similar observations have been reported several researchers [5,7-8].

Effect of temperature on the corrosion of mild steel.

Table 1: The inhibition efficiencies (%) of L_{PYA} in 0.5M HCl solution on mild steel corrosion at different temperatures

Concentration (M)	INHIBITION EFFICIENCY (%)				
	303K	313K	323K	333K	353K
$1.0x10^{-5}$	43.23	48.06	60.17	76.29	78.52
$1.0x10^{-4}$	57.51	54.66	66.18	78.27	83.29
$1.0x10^{-3}$	58.00	58.27	72.27	83.42	89.10
$1.0x10^{-2}$	59.11	64.07	77.71	89.13	99.30

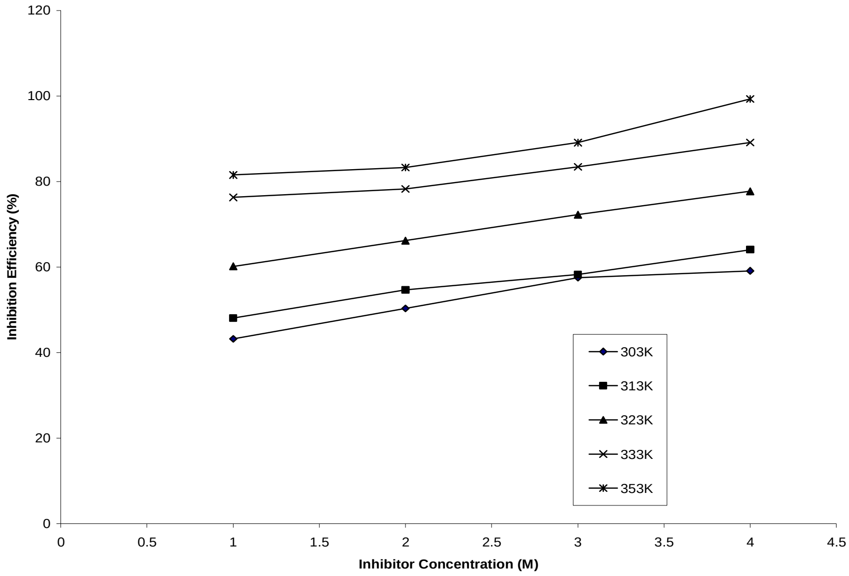

Figure 6: Variation of inhibition efficiency (%) with inhibitor concentrations (M) for mild steel coupons in 0.5M HCl solution containing L_{PYA} at different temperatures.

Table 1 and figure 6 show the effect temperature on the corrosion inhibitory property of L_{PYA} on mild steel. From the table and the figure, it is evident that at constant concentration of HCl, (0.5M), an increase in temperature leads to an increase in the inhibitory action of L_{PYA} at all concentrations of the additive. A chemical adsorption mechanism has been proposed for the inhibition since an increase in temperature shows a corresponding increase in its inhibition efficiency.

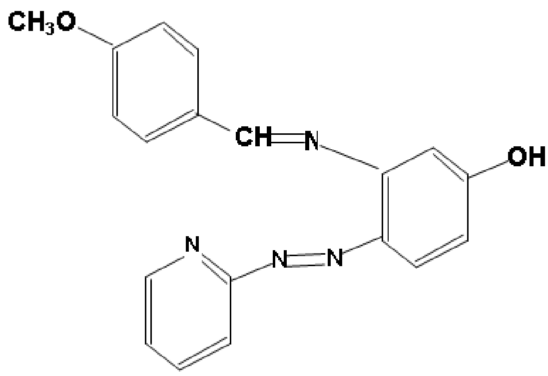

Figure 7: Structure of N – {[- 2 Pyridine – 2 – azo) – 5 – Hydroxyl] Phenyl} –4 – Methoxy benzilidenimine (L_{PYA})

Corrosion inhibition and Adsorption behavior of N – {[- 2 Pyridine – 2 – azo) – 5 – Hydroxyl] Phenyl} – 4 – Methoxy benzilidenimine (L_{PYA}) on mild steel surface in HCl acid solution.

The inhibitive property of L_{PYA} may be explained by considering the adsorption of L_{PYA} molecule through the azo, azomethine (moieties) and nitrogen attachment on the benzene ring which accounts for the functional groups blanket preventing mild steel from coming in contact with the acid and the corrosive environment.

CONCLUSION

The inhibitor used in this investigation (L_{PYA}) inhibits the acid corrosion of mild steel to a reasonable extent. The inhibition efficiency increases with increasing inhibitor concentration and temperature. A chemical adsorption mechanism was proposed for the inhibition on the basis of the temperature effect on the inhibition efficiency of $L_{PYA.}$

L_{PYA} could be a good replacement for corrosion inhibitors that not withstand higher temperatures.

REFERENCES

[1] Abiola O.K. and N.C. Oforka (**2002**) *Journal of Corrosion Science Engineering* 2: (21**)** 25-31.
[2] Bansiwal, A. Anthony, P. and Mathur S. P. (**2000**) *British corrosion Journal* 35 :(4) 301-310.
[3] Ebenso, E.E.; Okafor, P.C.; Ofiong, O.E.; Ita, B.I.; Ibok, U.J. and Ekpe, U.J. (*2001*) *Bulletin of Electrochemistry* 17: (10) 459 – 464.
[4] Ekpe, U.J.; Ibok, U.J.; Ita, B.I.; Offiong, O.E. and Ebenso, E.E. (**1995**) *Material Chemistry and Physics* 40: 87 – 93.
[5] Ita,B.I. and Offiong,O.E. (**1997**) *Material Chemistry and Physics* 48: 164-169.
[6] James A.O.and Umoh Iniofon E (**2009**, *International Journal of Pure and Applied Chemistry* 4 :(1) 55 – 58.
[7] James A.O., Oforka, N. C. and Abiola, O.K. (**2008**) *Material Science* 4: (1) 1-10.
[8] Noor, E.A (**2007**) *International journal of Electrochemical Science.* 2: 966-1017.
[9] Oforka, N.C and V.N .Mkpene (**2007**) *Chin.Jour.Chem.* 25: 869-871.
[10] Orubite,K.O. and Oforka N.C.(**2004**) *Material Letters* 58: 1103-1108.
[11] Sethi. T, A. Chaturvedi, R. K. Upadyay and S. P. Marthur. (**2007**) *Journal of Chilean chemical society* 52: 1206-1213.