Biannual Open Access Journal
Peer-Reviewed/Refereed International Journal
JOURNAL OF GLOBAL RESOURCES
Published by: ISDESR, Jaipur, India

www.isdesr.org

ISSN: 2395-3160 (Print)
ISSN: 2455-2445 (Online)
July 2022, Volume 08 (02)
DOI Prefix: 10.46587/JGR

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A STUDY OF CORROSION INHIBITION EFFECT OF PYRIDINE BASED SCHIFF BASE ON IRON METAL IN 0.5M HCl

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How to cite this paper:
Maharia Navin, Sanjay Kumar and Swami V. K. (2022) A Study of Corrosion Inhibition Effect of Pyridine Based Schiff Base on Iron Metal in 0.5M HCL, Journal of Global Resources, Vol. 08 (02)

DOI:
10.46587/JGR.2022.v08i02.013

Received: 15 May 2022
Reviewed: 30 May 2022
Revised: 11 June 2022
Final Accepted: 25 June 2022

Abstract: *In this research study Schiff base (E)-N-(5-bromopyridin-2-yl)-1-(4-ethylphenyl) methanimine (BPEPM) synthesized by condensation of 4-ethyl benzaldehyde and 2-amino-5-bromopyridine. The Schiff base was characterized by elemental analysis, IR and NMR spectroscopic methods. The corrosion inhibition effect of Schiff base BPEPM on the corrosion of iron in 0.5M HCl was studied by using mass loss method. The mass loss parameter like corrosion rate, inhibition efficiency and surface coverage show that Schiff base BPEPM is an efficient inhibitor for iron corrosion in 0.5M HCl solution. The surface coverage and inhibition efficiency increase with concentration of Schiff base BPEPM increases. In corrosive medium inhibitor instantaneously forms a protecting layer on iron surface and retards the corrosion reaction. The plot log (θ/1-θ) versus logC (mol/L) show linearity it means adsorption of inhibitor obey Langmuir adsorption isotherm pattern. The inhibition efficiency of inhibitor increases with time duration. In 72-hour time duration Maximum inhibition efficiency (95.7%) is shown towards iron corrosion at highest concentration of inhibitor ($5X10^{-5}$M).*

Key words: Schiff Base, Corrosion Rate, Adsorption, Iron, Mass Loss Method

Introduction

Corrosion of material is a most observed process which occurs in nature. In corrosion process metal reacts with its environment (humidity, gases, acid, alkaline etc.) and convert into the more stable form such as sulphide oxide etc. Corrosion has direct and indirect impact on economy, environment, materials and lives. It causes huge losses to building, automobiles, industries and their services [1-7]. Iron and its alloys which are widely used in a lot of industrial processes could corrode during these acidic applications particularly with the use of hydrochloric acid and sulphuric acid [8]. During acid handling in industrial processes metals get corroded. Different corrosion protection methods widely used in present time like using paints, coating and anodic protection. But these methods are costly, so the use of organic inhibitor is one of the most convenient methods for protection against corrosion to protect metal dissolution and acid consumption [9]. Those organic compounds which containing a heteroatom (N, O and S) and aromatic ring in their structure having excellent adsorption ability towards transition elements and act as efficient corrosion inhibitors for metal corrosion in acidic medium [10-11]. The use of synthetic inhibitors having environmental issues and they also modified structural properties of metal surface. Thus it is big challenge to the researcher towards developing low cost and environmentally safe corrosion inhibitors in present days [12-13].

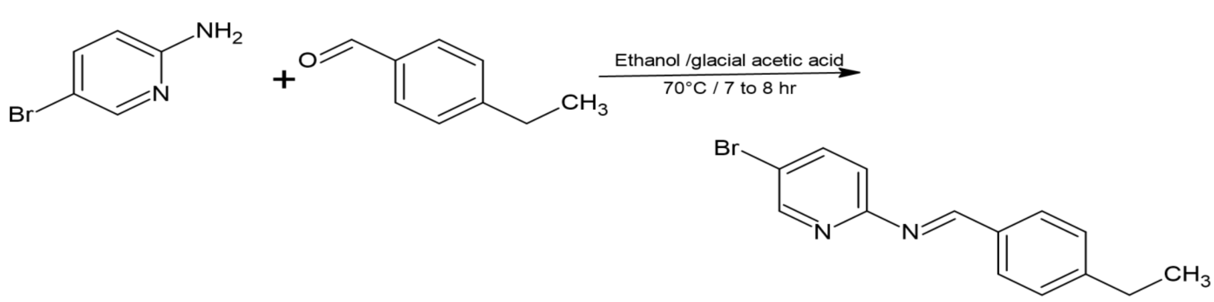
Schiff bases are most widely used organic compounds in different field of science. Schiff bases widely tested as corrosion inhibitor for metals in acidic medium by many researchers. In recent years, Thiourea, thiophene, pyridine, thiazole, phenol, thiasemicarbazide and its derivatives have been examined as corrosion inhibitor for metals in acidic medium for more than four decades [14-22]. The Schiff base of pyridine (BPEPM) is nontoxic, soluble in aqueous media, relatively cheap and easy to produce at high purity. These all properties would justify the use of Schiff base (*E*)-*N*-(5-bromopyridin-2-yl)-1-(4-ethylphenyl) methanimine (BPEPM) as corrosion inhibitor towards iron corrosion in acidic medium (0.5N HCl).

MATERIAL AND METHODS

Synthesis of (*E*)-*N*-(5-bromopyridin-2-yl)-1-(4-ethylphenyl) Methanimine (BPEPM)

Analytical grade reagents were used during synthesis. The Schiff base BPEPM was synthesized and characterized on the basis of past reported study [23-29]. Schiff base (*E*)-*N*-(5-bromopyridin-2-yl)-1-(4-ethylphenyl) methanimine (BPEPM) synthesized by condensation of 4-ethyl benzaldehyde with 2-amino-5-bromopyridine. During synthesis process 2-amino-5-bromopyridine (0.1mole) and 4-ethyl benzaldehyde (0.1mole) dissolved in minimum quantity of ethanol has been taken in round bottom flask. The mixture has been refluxed over heating mantle for 7 to 8 hours, it was then cooled and resulting bright yellow-colored crystals of BPEPM (M.P. 80^{o}C). The method of synthesis is summarized in fig. (1).

Figure 01: Reaction Scheme



Characterization of BPEPM

The Schiff base was characterized by elemental analysis, IR and NMR studies. The elemental study shows the presence of C (59.71%), H (4.20%), N (9.1%) and Br (26.40%) in the structure of synthesized Schiff base. In the IR (Infra-red) spectra (fig. 4) of Schiff base band of azomethine υ(C=N) group observed at 1599.2 cm^{-1}. In the NMR (Nuclear Magnetic Resonance) spectrum of BPEPM (fig. 5) various signals like $-CH_3$,$-CH_2$,-CH=N, Ar-H were observed at 1.2772, 2.7363, 7.3312, and 8.5232 $\delta(ppm)$.

Experimental

Mass loss method is a fundamental method to study the mass loss during corrosion process. In this method, iron specimens in the form of small coupons (size 3.0cm x 2.5cm x 0.1 cm) are exposed to the corrosive media 0.5N HCl [in presence and absence of Schiff base BPEPM (0.01N)] for a stipulated period of time (4 hrs. to 72 hrs.) and the loss in weight for the specimen is calculated. All corrosion parameters calculated by mass loss method shown in table 1.

The corrosion inhibition efficiency (η %) was calculated as

$$\eta\ \% = 100\ (\Delta M_A - \Delta M_{SB}) / \Delta M_A$$

Where, ΔM_A = Mass loss of metal in acidic medium solution.

ΔM_{SB}= Mass loss of metal in presence of Schiff base.

The degree of Surface coverage (θ) of metal specimen by inhibitor was calculated as:

$$\theta = (\Delta M_A - \Delta M_{SB}) / \Delta M_A$$

The corrosion rates can be calculated by the following equation:

$$\text{Corrosion rate (mm/yr)} = (\text{Mass loss} \times 87.6) / DAT$$

Where, D = density of iron

A = surface area of iron

T = immersion time

Result and Discussion

The corrosion inhibition of metals by organic inhibitors depends on various factors such as electronic structure of inhibitor, concentration of inhibitor and immersion time. In this research study we examine mainly effect of two factors namely immersion time and inhibitor concentration on corrosion inhibition process of iron metal in 0.5 N HCl. Immersion time can play an important role in the prevention of corrosion process. Inhibition performance of BPEPM increases by rising exposure time or immersion time. The surface coverage and inhibition efficiency increase with concentration of Schiff base BPEPM increases. Consequently, inhibition efficiency values increase with the increase the concentration of inhibitor and maximum Inhibition efficiency is 95.7% shown at 5% ($5X10^{-5}$M) inhibitor concentration. Inhibitor forms a monolayer by adsorption on iron surface and retards corrosion rate. The plot log ($\boldsymbol{\theta}$/1-$\boldsymbol{\theta}$) versus logC (mol/L) show linearity it means adsorption of inhibitor obey Langmuir adsorption isotherm pattern.

Conclusion

The efficiency of synthesized Schiff base BPEPM for corrosion inhibition of iron metal in acidic media have been studies. Conclusions of study are:

- The inhibition efficiency of inhibitor increases with concentration.
- The inhibition efficiency increases according increasing immersion time exposure it means it is effective over long range of time.
- The inhibitor obeys Langmuir adsorption isotherm pattern during inhibition process.
- This Schiff base act as effective inhibitor for iron corrosion in 0.5M HCl medium.

Table 01: Schiff base Concentration (SBC), Mass Loss (ΔM) in mg, Inhibition Efficiency (η), Surface Coverage (θ) and Corrosion Rate (CR) in mm/year for Iron Metal in presence of Schiff base BPEPM at different Time Interval

SBC (%)	4 hours				24 hours				48 hours				72 hours			
	ΔM (mg)	η (%)	θ	CR (mm/yr)	ΔM (mg)	η (%)	θ	CR (mm/yr)	ΔM (mg)	η (%)	θ	CR (mm/yr)	ΔM (mg)	η (%)	θ	CR (mm/yr)
Blank	1.89	…	…	7.0	3.8	…	…	2.34	4.5	…	…	1.39	5.7	…	…	1.17
1	.91	52	.52	3.3	1.7	55	.55	1.05	1.9	57	.57	.587	2.3	58.7	.58	.484
2	.66	65	.65	2.4	1.3	65	.65	.803	1.5	66	.66	.463	1.8	68.4	.68	.370
3	.50	73	.73	1.8	.90	76	.76	.556	.80	82	.82	.247	.95	83.3	.83	.195
5	.25	86	.86	.92	.40	89	.89	.247	.31	93	.93	.095	.24	95.7	.95	.049

Figure 02: The Graph Inhibition Efficiency v/s Concentration of Schiff base (%) at different Time Interval For Iron in 0.5M HCl

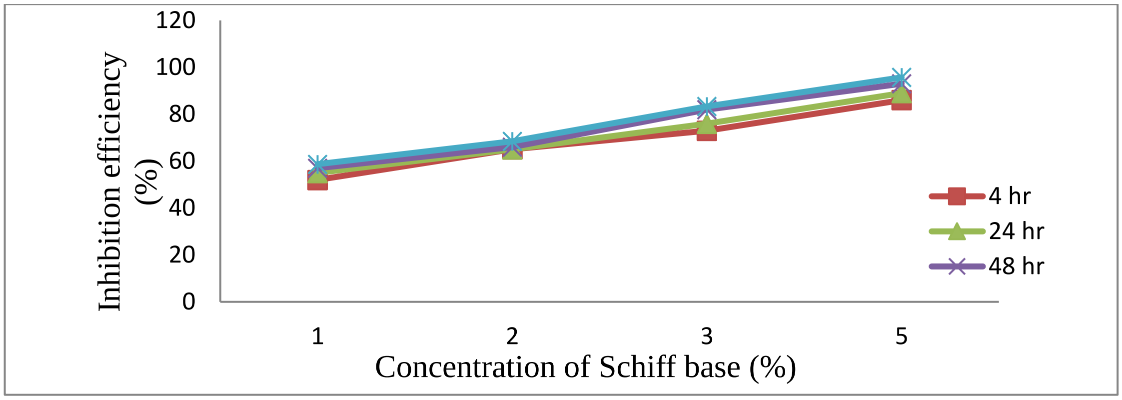


Figure 03: Langmuir Adsorption Isotherm for Iron at different Time Interval in Presence of Schiff Base in 0.5 M HCl

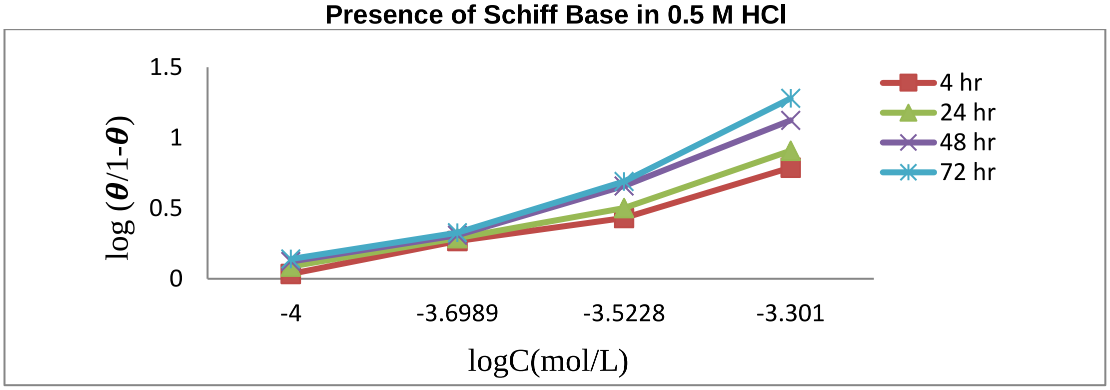


Figure 4: IR spectrum of BPEPM

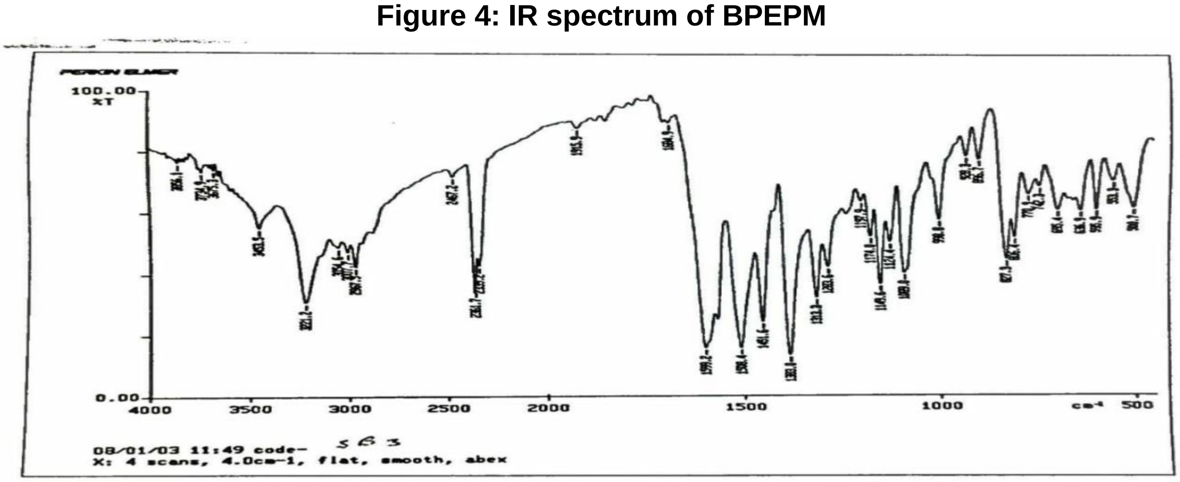
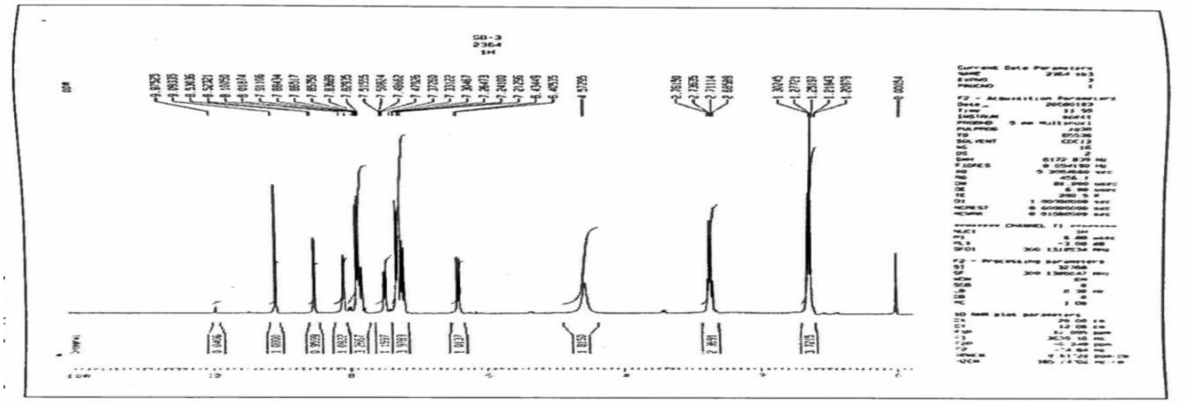


Figure 5: NMR spectrum of BPEPM



References

1. Ahamad, I., Prasad, R., Quraishi, M.A. (2010). *Corrosion Science,* 52, 3033-3041.
2. Al–Bayati S, Rasheed A, Zuhair E, Abid K and Khamis W, (2018). *American Journal of Chemistry,* 8(1)
3. Ansari K R, Quraishi M A and Singh A, (2014). *Corrosion Science,* 79, 5-15.
4. Chetana P R, Somashekar M N, Srinatha B S, Policegoudra R S, Aradhya S M and Rao R, (2013). *ISRN Inorganic Chemistry,* 1-11.
5. Desai P S and Indorwala N S, (2015). *Research Journal of Chemical Sciences,* 5(3) 30-36.
6. Fareles M, Keles H and Keles M, (2015). *Corrosion Science,* 98, 223-232.
7. Ghazoui A, Bencaht N, Al-Deyab S, Zarrouk A, Hammouti B, Ramdani M and Guenbour M, (2013). *Int. J. Electrochem. Sci.,* 8 2272 – 2292.
8. Jevaprabha C, Sathiyaharayanan S and Venkatacha G J, (2006). *Appl. Polymer Science,* 101(4) 2144.
9. Joseph X, Rajendra N, (2011). *Inter J of Electrochem Science*, 6 348.
10. Kajal A, Bala S, Kamboj S, Sharma N and Saini V, (2013). *Journal of Catalysts,* 1-14.
11. Karthiga N, Rajendran S, Prabhakar P and Rathish R J, (2015). *Int. J. Nano Corrosion Science & Engineering,* 2(4) 31-49.
12. Karthik G and Sundaravadivelu M, (2016). *Egyptian Journal of Petroleum,* 25 183-191.
13. Khaleel H, Ateeq A and Ali A, (2018). *International Journal of Applied Engineering Research,* 13(6).
14. Koch G, (2016). *NACE International IMPACT*, Houston, Texas, USA, 1-10.
15. Kosaria A, Moayeda M H, Davoodib A, Parvizia R, Momenia M, Eshghic H and Moradic H, (2014). *Corrosion Science,* 78,138–150.
16. Kumar S and Swami V K, (2020). *Journal of Advanced Scientific Research,* 11(4) 337-340.
17. Mathur R, Pareek M and Swami V K, (2018). *Global Journal for Res. Ana.*, 7(2) 2277-8160.
18. Pareek M and Swami V K, (2018). *Indian Journal of Research*, 7(7) 2250-1991.
19. Parrey I R and Hashmi A, *Canadian Chemical Transactions,* 3(2015) 65-71.
20. Popoola L T, Grema A S, Latinwo G K, Gutti B and Balogun A S, (2013). *International Journal of Industrial Chemistry,* 4 2-15.
21. Roberge R, (2020). *Corrosion Accidents, Corrosion Doctors*.
22. Shukla S N, Gaur P, Vaidya P, Chaurasia B, Jhariya S and Dehariya D, (2018). *International Journal of Basic and Applied Chemical Sciences,* 8(2) 1-19.
23. Sonnekar V S, Jadhav W N, Dake S A, Dhole S G, Narwade S and Pawar R P, (2014). *Eur. Chem. Bull.,* 3(8) 792-797.
24. Sorkabi H A, Seifzadeh D and Hosseini M G, (2008). *Corrosion Science*, 50, 3363.
25. Takjoo R, Akbari A, Ahmadi M, Rudbari H A and Bruno G, (2013). *Cent. Eur. J. Chem.,* 11(11) 1844.
26. Xu B, Yang W, Liu Y, Yin X, Gong W and Chen Y, (2014). *Corrosion Science*, 78, 260-268.