iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** V **Month of publication:** May 2019

DOI: https://doi.org/10.22214/ijraset.2019.5124

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 7 Issue V, May 2019- Available at www.ijraset.com

Expired Temazepam as a Corrosion Inhibitor for Mild Steel in Acidic Medium: Insight from Chemical and Surface Probe Researches

N. Raghavendra[1], Leena V Hublikar[2], B. N. Vasudeva Naik[3], Anjali S Bhinge[4], Pooja J Ganiger[5]
[1, 2, 4, 5]*Department of Chemistry, K.L.E. Society's P. C. Jabin Science College (Autonomous) Vidyanagar, Hubballi-580031, India.*
[3]*Department of Chemistry, K.L.E. Society's Gudleppa Hallikeri Arts, Science & Commerce College, Haveri-581110, India.*

Abstract: ***The influence of expired Temazepam drug on the corrosion of mild steel in 10 % HCl solution was studied with the help of weight loss, colorimetry and scanning electron microscopy studies. The studied inhibitor (Expired Temazepam) exhibits a protection efficiency of 96 % at 4 mg/L. The adsorption process is the backbone for the protection of mild steel from the aggressive 10 % HCl solution. Colorimetry studies reveal that, the examined expired drug effectively inhibits the weight loss of iron content in the mild steel with the help of a strong barrier layer, which is generated on the surface of mild steel. The barrier layer effectively isolates the mild steel surface from the 10 % HCl solution. Surface studies by scanning electron microscopy confirm that, expired Temazepam drug is a robust inhibitor for the corrosion of mild steel in the studied acid system.***
Keywords: Expired Temazepam drug, Colorimetry, Scanning electron microscopy studies, Mild steel, HCl solution

I. INTRODUCTION

The mild steel corrosion in hydrochloric acid solution is often a very dangerous problem in the several industrial installations, it is very much essential to moderate this negative phenomenon by the application of organic species as corrosion inhibitors. Several corrosion scientists worked together to discover the green corrosion inhibitor to protect the mild steel metallic property against the disintegration process [1-2]. The selection of suitable corrosion inhibitors, mainly depends on the formulation as practical application in use of various corrosive environments. Organic species are well characterized by heteroatoms (N, P, O and S) and distinct functional groups are considered to be an effective corrosion inhibitor to mitigate the mild steel corrosion process. The shape and orientation of the organic compound are the decisive parameters in the protection of mild steel metal from the corrosion process. The mode of action of organic compounds is generally results from the physical or chemical adsorption proceeds on the mild steel surface [3-5]. The process of adsorption mainly depends on the structural property, aromaticity, steric factor, heteroatoms and π-electrons, which favor the adsorption of organic compounds on the surface of mild steel surface. For these reason, investigation on the corrosion inhibition property and adsorption mode of organic species as corrosion inhibitors appears as a dynamic and continuous domain of research [6-9]. Many biologically important organic species exhibit anticorrosion, anti-cancer, antibiotic, antiepileptic, and antitumor activities. Nowadays expired drug products are widely used for the prevention metal corrosion in the hydrochloric acid system. That's why we selected expired Temazepam. This research paper contributes to the corrosion inhibition study of mild steel by expired Temazepam drug in 10 % HCl solution. The chemical structure of Temazepam is shown in the Figure 1.

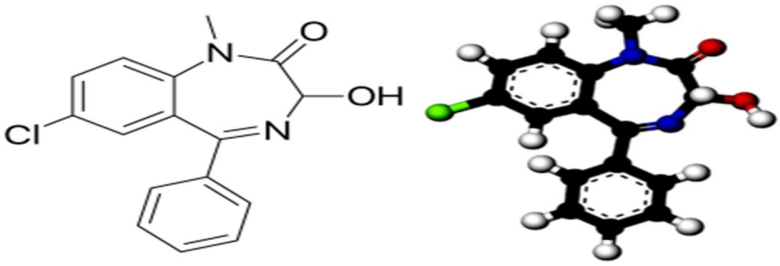


Figure 1: Chemical structure of Temazepam drug

To carry out present study, we employed weight loss at 313 K (with immersion time of 10, 20, 30 and 40 hours), colorimetry (with immersion time of 10 hours) and scanning electron microscopy studies.

II. EXPERIMETAL SECTION

The chemical composition of mild steel was shown in the Table 1. The mild steel strips were cleaned with sand papers and washed with acetone. The 1 cm^2 of mild steel surface was exposed for weight loss, colorimetry and scanning electron microscopy studies. The 10 % HCl solution was prepared by the dilution of analytical grade HCl with elaborated triple distilled water. The expired Temazepam drug of 1 mg/L , 2 mg/L, 3 mg/L and 4 mg/L was prepared for chemical and surface studies at specific solution temperature. Weight loss technique was performed on the mild steel surface with 10 % HCl solution in the absence and presence of 1 mg/L, 2 mg/L, 3 mg/L and 4 mg/L of expired Temazepam drug at 313 K with an immersion period of 10, 20 30 and 40 hours. Colorimetry experiment was performed with immersion period of 10 hours. The protection efficiency can be evaluated as per the procedure stated in our previous investigations [10, 11]. Surface studies of mild steel were carried out by scanning electron microscopy technique without and with 4 mg/L of expired Temazepam drug at 10 hours immersion time.

Table 1 Chemical composition of mild steel

Element	Fe	Si	S	P	C	Mn
Wt%	(99.03%)	0.1	0.05	0.04	0.18	0.6

III. RESULTS AND DISCUSSION

A. Weight loss studies

Weight loss technique is an appropriate method for the monitoring the effect of organic compound on the metal corrosion process. The weight loss results are shown in the **Table 1**. It is observed from this data that, the introduction of expired Temazepam drug decreased the mild steel corrosion rate and enhanced the protection efficiency. The decreased mild steel corrosion rate and enhanced protection efficiency are due to the adsorption of expired Temazepam drug on the mild steel-10 % HCl solution interface. The highest protection efficiency observed at the concentration of 4 mg/L (96.634 %). The corrosion inhibition effect is more pronounced when the expired Temazepam drug amounts increased from the 1 mg/L to 4 mg/L. These results clearly show that, expired Temazepam drug blocks the both cathodic and anodic mild steel active sites with concentration dependent mode. The increased concentration of expired drug products greatly decreased the attack of H^+ or Cl^- ions on the mild steel surface. The increased immersion time decreases the protection efficiency of the expired Temazepam drug due to the desorption process. At higher contact period (more than 10 hours immersion time), greater interaction between the corrosive solution (10 % HCl solution) and protective film of an expired Temazepam drug takes place, which weakness the strength of protective layer over the surface of mild steel. As a result of this, low protection efficiency values observed at a higher immersion time (20, 30 and 40 hours).

Table 1 Weight loss (mass loss) results at 313 K

Concentration (mg/L)	Contact time (h)	Protection (corrosion inhibition) efficiency
Bare	10	
1		59.453
2		65.156
3		79.870
4		96.634
Bare	20	
1		54.113
2		60.001
3		75.140
4		94.064
Bare	30	
1		50.230
2		57.140
3		70.810
4		91.123
Bare	40	
1		48.128
2		54.357
3		67.007
4		88.142

B. Colorimetry

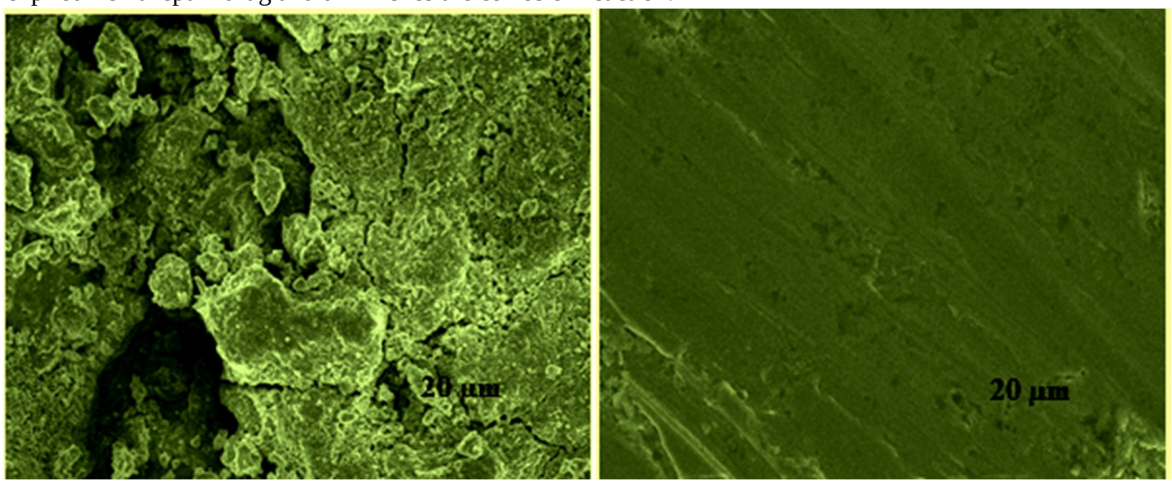
Colorimetry technique gives information about the film coverage ability of organic corrosion inhibitor on the surface of metal. The results obtained from the colorimetry technique are shown in the Table 2. From this table, it is clear that, weight loss of iron content in the mild steel is an inverse relationship with concentrations of the expired Temazepam drug (1 mg/L, 2 mg/L, 3 mg/L and 4 mg/L). This shows that, the increase in the concentration of expired Temazepam drug reduces the weight loss of iron content in the mild steel when it is submerged in the 10 % HCl solution. The corrosion inhibition action of expired Temazepam drug was occurred by the blocking the active anodic and cathodic sites of mild steel in the 10 % HCl solution, which lead to a reduce in the exposed mild steel surface area required for the dissolution process. The results of colorimetry follows the results of weight loss studies.

Table 2. Colorimetry results

Concentration (mg/L)	Protection efficiency (corrosion inhibition)
Bare	
1	55.436
2	60.116
3	83.877
4	98.960

C. Scanning Electron Microscopy Technique

The mild steel surface topography was screened by scanning electron microscopy technique. Figure 2 (a, b) shows the scanning electron microscopy topography of mild steel surface. In the absence of expired Temazepam drug, mild steel surface have corrosive products and pits, but in the presence of 4 mg/L of expired Temazepam drug, the roughness minimized on the surface of mild steel. It clearly shows the formation of barrier layer on the surface of mild steel by which the dissolution rate is reduced in the presence of 4 mg/L of expired Temazepam drug and diminishes the corrosion reaction.



a) b)

Figure 2 (a, b): a) Unprotected mild steel surface b) Protected mild steel surface

IV. CONCLUSION

Expired Temazepam drug found to be good mild steel corrosion inhibitor in 10 % HCl solution. The protection efficiency rises with an increase in the concentration from 1 mg/L to 4 mg/L of expired Temazepam drug and decreases with an increase in the immersion time from 10 hours to 40 hours. The corrosion inhibition property of expired Temazepam drug is due to the adsorption process. Surface study by scanning electron microscopy technique fully supports the colorimetry and weight loss results. Hence, expired Temazepam drug is a robust mild steel inhibitor in 10 % HCl solution and could find promising applications in several industrial units.

REFERENCES

[1] Laabaissi T, Benhiba F, Rouifi Z, Missioui M, Ourrak K, Oudda H, Ramli Y, Warad I, Allali M, Zarrouk A (2019) New quinoxaline derivative as a green corrosion inhibitor for mild steel in mild acidic medium: Electrochemical and theoretical studies. Int J Corros Scale Inhib 8: 241–256.

[2] Shweta Pal, Hassane Lgaz, Preeti Tiwari, Ill-Min Chung, Gopal Ji, Rajiv Prakash (2019) Experimental and theoretical investigation of aqueous and methanolic extracts of Prunus dulcis peels as green corrosion inhibitors of mild steel in aggressive chloride media. J Mol Liq 276: 347-361

[3] Bahrami MJ, Hosseini SMA, Pilvar P (2010) Experimental and theoretical investigation of organic compounds as inhibitors for mild steel corrosion in sulfuric acid medium. Corros Sci 52:2793–2803

[4] Lebrini M, Lagrenee M, Vezin H, Gengembre L, Bentiss F (2005) Electrochemical and quantum chemical studies of new thiadiazole derivatives adsorption on mild steel in normal hydrochloric acid medium. Corros Sci 47:485–505.

[5] Kamal C, Sethuraman M (2012) Caulerpin—a bis-indole alkaloid as a green inhibitor for the corrosion of mild steel in 1 M HCl solution from the marine alga Caulerpa racemosa. Ind Eng Chem Res 51:10399–10407.

[6] Eddy NO, Odoemelam SA, Odiongenyi AO (2009) Joint effect of halides and ethanol extract of Lasianthera africana on inhibition of corrosion of mild steel in H_2SO_4. J Appl Electrochem 39:849–857.

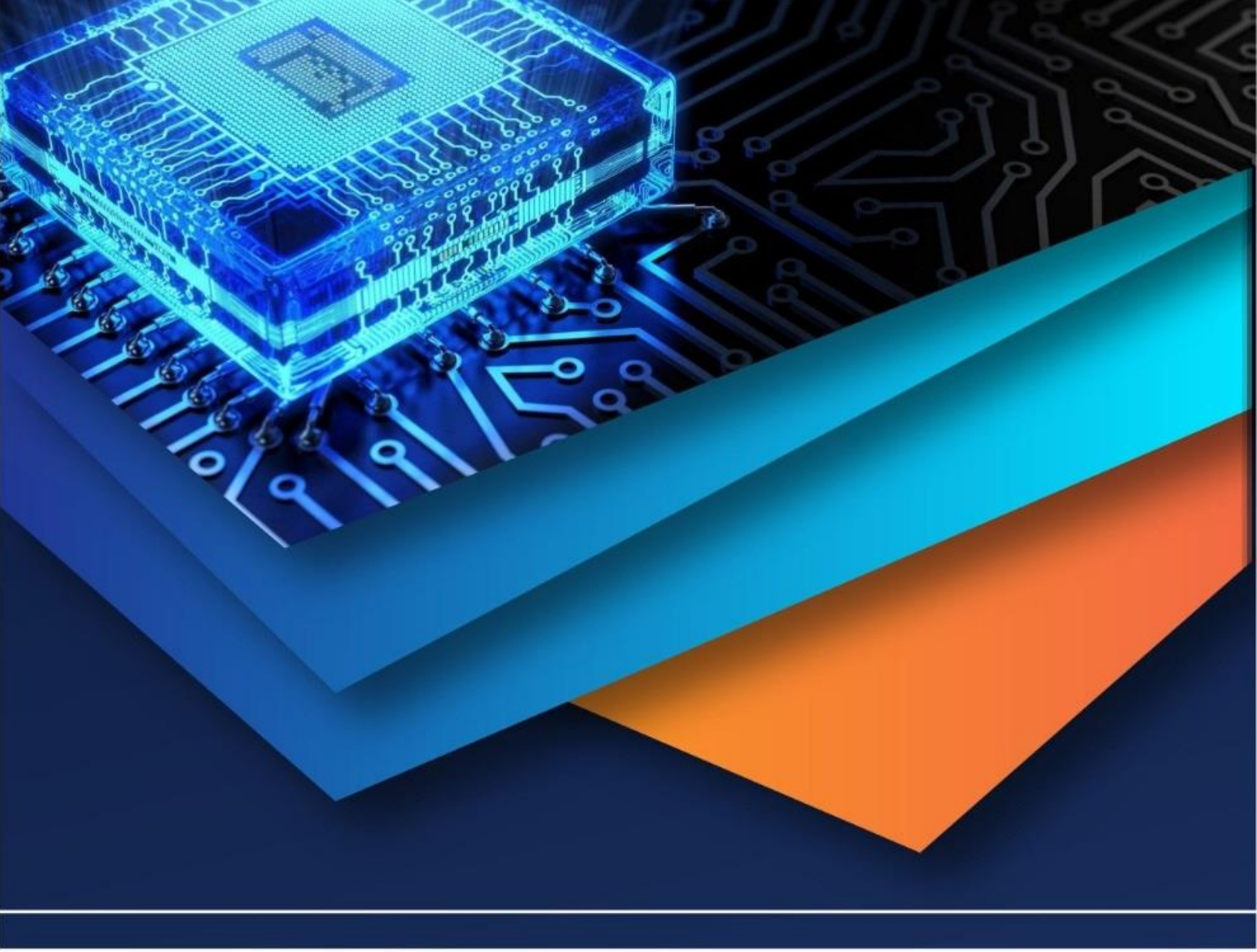
[7] Anupama KK, Shainy KM, Joseph A (2016) Excellent anticorrosion behavior of Ruta Graveolens extract (RGE) for mild steel in hydrochloric acid: electro analytical studies on the effect of time, temperature, and inhibitor concentration. J Bio Tribo Corros 2:2.

[8] Sobhi M, Abdallah M, Khairou KS (2012) Sildenafil citrate (Viagra) as a corrosion inhibitor for carbon steel in hydrochloric acid solutions. Monatsh Chem 143:1379–1387.

[9] Mistry BM, Patel NS, Patel MJ, Jauhari S (2011) Corrosion inhibition performance of 1,3,5- triazinyl urea derivatives as a corrosion inhibitor for mild steel in 1 N HCl. Res Chem Intermed 37:659–671.

[10] Raghavendra, N. and Ishwara Bhat, J. (2018) "Red Arecanut Seed Extract as a Sustainable Corrosion Inhibitor for Aluminum Submerged in Acidic Corrodent: An Experimental Approach Towards Zero Environmental Impact", Period Polytech-Chem Eng 62: 351-358.

[11] Narasimha Raghavendra (2019) Areca Plant Extracts as a Green Corrosion Inhibitor of Carbon Steel Metal in 3 M Hydrochloric Acid: Gasometric, Colorimetry and Atomic Absorption Spectroscopy Views. J Mol and Eng Mater. 10.1142/S2251237318500041



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY