iJRASET
International Journal For Research in
Applied Science and Engineering Technology

# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

**Volume:** 7 **Issue:** III **Month of publication:** March 2019

**DOI:** http://doi.org/10.22214/ijraset.2019.3420

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
*ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887*
*Volume 7 Issue III, Mar 2019- Available at www.ijraset.com*

# Expired Famotidine as an Effective Corrosion Inhibitor for Copper in 3 M HCl Solution: Weight Loss and Atomic Absorption Spectroscopy Investigations

Narasimha Raghavendra[1], Leena V Hublikar[2], Anjali S Bhinge[3], Pooja J Ganiger[4]
[1, 2, 3, 4]*Department of Chemistry, K.L.E. Society's P. C. Jabin Science College (Autonomous) Vidyanagar, Hubballi-580031, India.*

***Abstract: The inhibition of copper corrosion by expired Famotidine drug in the 3 M HCl solution was examined through weight loss and atomic absorption spectroscopy studies. Weight loss studies show that, the increased in the expired Famotidine drug amounts generally enhances the protection efficiency of the corrosion inhibitor. Atomic absorption spectroscopy study indicates that, the weight loss of copper metal decreases with a rise in the concentration of the expired Famotidine drug in the 3 M HCl solution. The protective film generated on the copper surface in the 3 M HCl solution responsible for the prevention of copper metal corrosion in the acidic system. The examined drug may be useful to solve the metal dissolution problem in many industrial units.***
***Keywords: Expired Famotidine drug, 3 M HCl solution, Weight loss, Atomic absorption spectroscopy***

## I. INTRODUCTION

Copper metal experience corrosion when it is exposed to the hydrochloric acid system. The copper corrosion destroys the physical and chemical property of copper metal. Corrosion inhibitors are species adsorbed physically or chemically or both in electrode-electrolyte solution, hence blocking the electrode (metal) from coming into contact with aggressive corrosive ions [1-3]. This is due to the presence of hetero-atoms (N, O, P and S) in their moieties. The geometry of single inhibitor species has an important effect in determining its adsorbability at the electrode-electrolyte solution interface. Molecules having a planar structure tendency to adsorb strongly on the surface of metal in the corrosive solution. The choice of eco-friendly corrosion inhibitors utmost important in order to prevent the dissolution of metal process without any toxicity to the environment [4-7]. The choice of expired drug species as corrosion inhibitors has numerous reasons, because they are ecological and do not contain heavy metals or other toxic species. There are many reports shows that, the use of expired drug products as a non-toxic corrosion inhibitor for many metals in the different corrosive environments. Hence, nowadays corrosion researchers focused on the exploration cheap and nontoxic corrosion inhibitors [8-10]. Therefore, in a current investigation selected, expired Famotidine drug. The expired Famotidine drug is not useful for the consumers. The Famotidine drug reduces the stomach acid production. Famotidine drug widely used to treat peptic ulcer disease, Zollinger-Ellison syndrome and gastroesophageal reflux disease. The chemical and optimized structure of Famotidine drug shown in the Figure 1 (a, b).

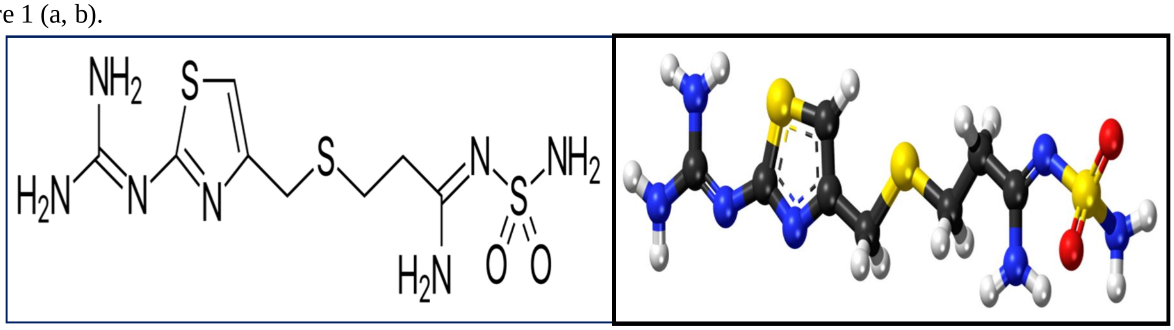

Figure 1 (a, b): a) Chemical structure of Famotidine drug, b) Optimized structure of Famotidine drug

The corrosion inhibition property of expired Famotidine drug on the copper metal in 3 M HCl was carried out by employing weight loss (gravimetric) and atomic absorption spectroscopy techniques.

## II. EXPERIMENT MATERIALS AND METHODS

Copper metal piece mechanically cut into 5 × 4 × 0.3 cm. The copper piece polished with 1000 grade emery papers in order to get metal surface in smooth surface, washed with acetone and double distilled water and finally dried with warm air. The 3 M HCl solution prepared with analytical grade of HCl solution. The inhibitor of different concentrations namely 0.1 g/L, 0.2 g/L, 0.3 g/L and 0.4 g/L were prepared. Weight loss (gravimetric) technique was carried out with 100 ml of 3 M HCl solution without and with 0.1 g/L, 0.2 g/L, 0.3 g/L and 0.4 g/L of expired Famotidine drug at an immersion time of 1, 2, 3, and 4 days at 303 K.

The protection efficiency of expired Famotidine drug was calculated by using the following relation;

$$\text{Corrosion inhibition efficiency (\%)} = \frac{(W_1 - W_2)}{W_1} \times 100,$$

Where, $W_1$= Weight loss of copper metal in the absence of corrosion inhibitor, and $W_2$= Weight loss of copper metal in the presence of corrosion inhibitor.

The atomic absorption spectroscopy (AAS) experiment was carried out on the copper metal in the 3 M HCl solution without and with 0.1 g/L, 0.2 g/L, 0.3 g/L and 0.4 g/L of expired Famotidine drug at 303 K.

The expired Famotidine drug protection efficiency was calculated by following equation;

$$\text{Protection efficiency} = \frac{B-A}{B} \times 100,$$

Where, B= Amount of dissolved copper content in the unprotected system and A= Amount of dissolved copper content in protected system.

## III. RESULTS AND DISCUSSION

### A. *Weight loss (gravimetric) technique*

The weight loss (gravimetric) measurement was carried out by complete immersion of copper electrode in 100 ml of 3 M HCl solution without and with 0.1 g/L, 0.2 g/L, 0.3 g/L and 0.4 g/L at 303 K with the aid of thermostatic water bath. The copper electrodes are retrieved after the 1, 2, 3, and 4 days immersion time. The experiment was carried out three times and average values are reported. The weight loss results are shown in the Table 1 and Figure 2.

Table 1 Weight loss results

| Concentration (g/L) | Contact time (days) | Surface Coverage (Θ) | Protection (corrosion inhibition) efficiency |
|---|---|---|---|
| Bare | 1 | | |
| 0.1 | | 0. 844 | 84.456 |
| 0.2 | | 0. 865 | 86.576 |
| 0.3 | | 0. 936 | 93.654 |
| 0.4 | 2 | 0. 947 | 94.784 |
| Bare | | | |
| 0.1 | | 0. 828 | 82.845 |
| 0.2 | | 0. 842 | 84.255 |
| 0.3 | 3 | 0. 863 | 86.302 |
| 0.4 | | 0. 905 | 90.541 |
| Bare | | | |
| 0.1 | | 0. 784 | 78.445 |
| 0.2 | 4 | 0. 796 | 79.675 |
| 0.3 | | 0. 830 | 83.064 |
| 0.4 | | 0. 875 | 87.556 |
| Bare | | | |
| 0.1 | | 0.760 | 76.001 |
| 0.2 | | 0.780 | 78.043 |
| 0.3 | | 0. 832 | 83.200 |
| 0.4 | | 0. 860 | 86.000 |

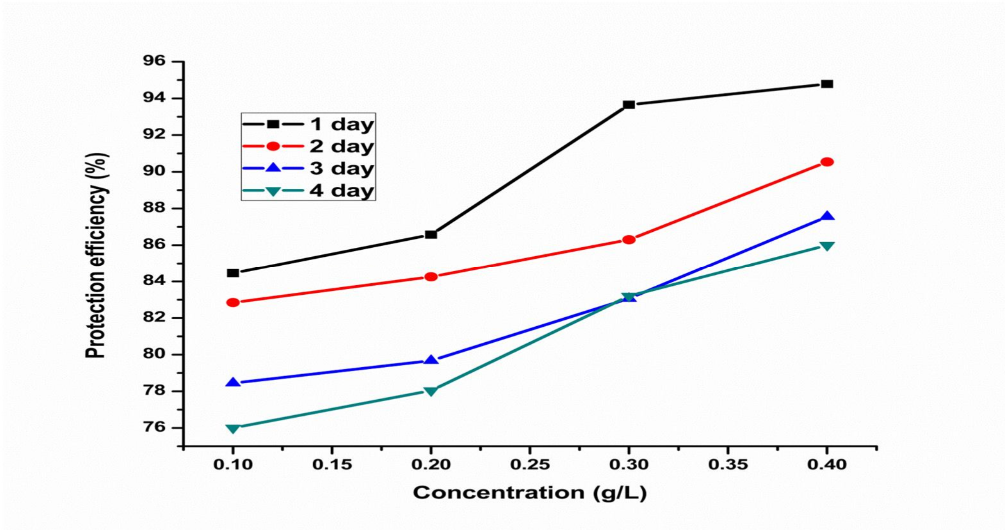

Figure 2: Variation of protection efficiency with different contact time

Weight loss measurement provides a direct report on visual and physical effect of disintegration at the metal-corrosive solution interphase in the presence of different amounts of inhibitor. The rate of copper dissolution coupons in protected and unprotected system was evaluated by examined by measuring the weight loss of metal during the dissolution process. Careful analysis of weight loss results showed that, weight loss of copper decreases with a rise in the concentration of expired Famotidine drug on the copper surface in 3 M HCl solution. This behavior clearly shows the formation of a stable protective film on the copper surface in the acid system. The stable inhibitive film blocks the attack of hydrochloric acid on the copper surface. The maximum protection efficiency observed at 1 day immersion time with 0.4 g/L of expired Famotidine drug. It also observed that, the protection efficiency has an inverse relationship with contact time, means the protection efficiency decreases with a rise in the contact time from one day to 4 days. This nature is due to unstable protective layer on the copper surface in 3 M HCl solution. The stability of protective layer decreases with a rise in the contact time from one day to four days. Hence, the copper metal easily exposed to the 3 M HCl solution. As a result of this, weight loss of copper metal increases with rise in the contact time from one day to four days. Therefore, copper corrosion rate enhances and protection efficiency decreases with a rise in the contact time from one day to 4 days.

### *B. Atomic Absorption spectroscopy (AAS) studies*

To support the weight loss (gravimetric) results, the atomic absorption spectroscopy experiment was also carried out at 303 K. In weight loss technique, the maximum protection efficiency observed at 1 day immersion time with 0.4 g/L of expired Famotidine drug. Hence, atomic absorption spectroscopy technique was carried out at 303 K with an immersion period of one day. The results of atomic absorption spectroscopy (AAS) are shown in the **Table 2** and **Figure 3**. From this, it is clear that, the weight loss of copper in the 3 M HCl solution decreases with a rise in the amount of expired Famotidine drug in 3 M HCl solution. The electron rich species in the expired Famotidine drug hinder the copper dissolution process by simply blocking the active copper electrode sites. Hence, weight loss of copper decreases in the presence of different amounts of expired Famotidine drug. The protection efficiency obtained from the weight loss technique is in good agreement with atomic absorption spectroscopy technique **[Figure 4]**.

Table 2. Atomic absorption spectroscopy results

| Concentration (g/L) | Amount of dissolved iron content in 3 M HCl solution | Protection efficiency in percentage |
|---|---|---|
| Bare | 0.041 | |
| 0.1 | 0.020 | 51.219 |
| 0.2 | 0.010 | 75.609 |
| 0.3 | 0.0032 | 92.195 |
| 0.4 | 0.0018 | 95.609 |

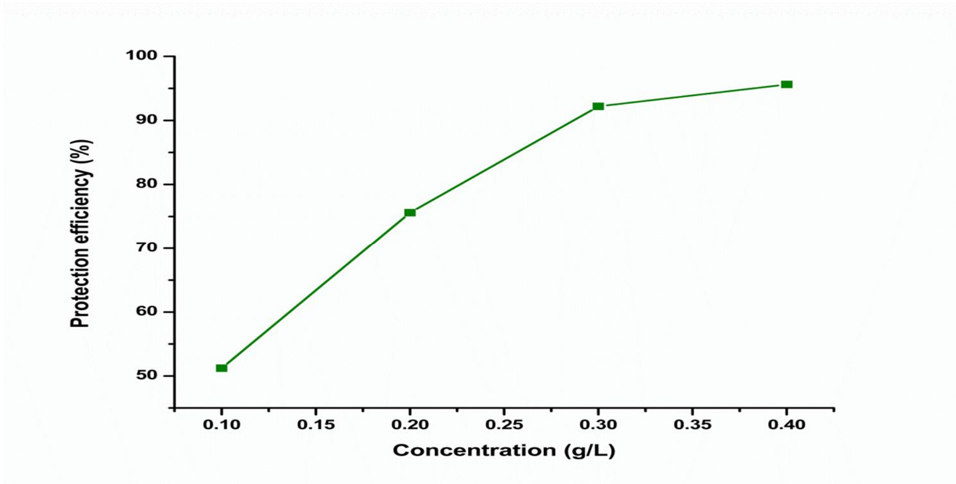


Figure 3: Variation of protection efficiency with different amount of inhibitor

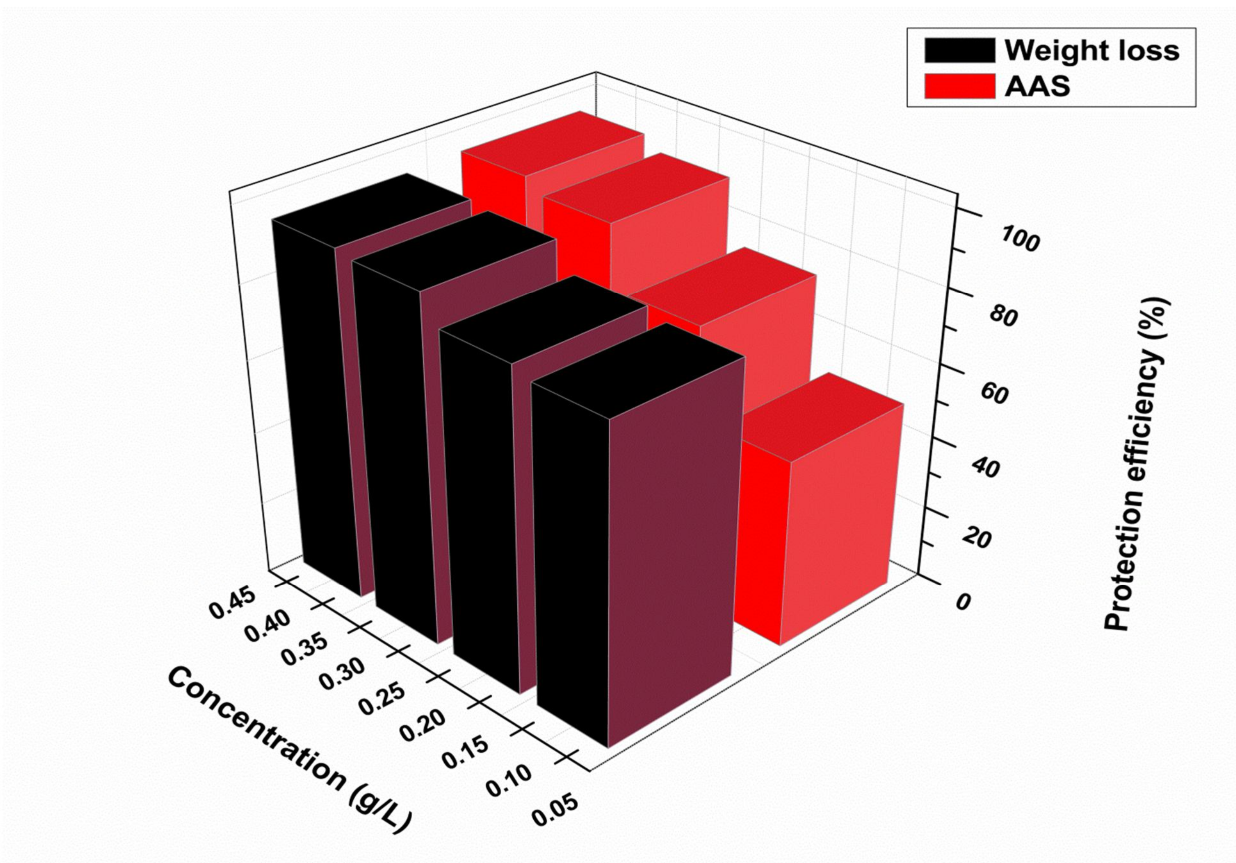


Figure 4: Protection efficiency obtained from weight loss and atomic absorption spectroscopy technique

## IV. CONCLUSION

The involvement of weight loss (gravimetric) and atomic absorption spectroscopy (AAS) technique in the study of corrosion of copper in the 3 M HCl solution confirmed the good corrosion inhibitive property of expired Famotidine drug. Results of weight loss (gravimetric) technique show that, corrosion protection role of expired Famotidine drug on the copper surface in the 3 M HCl solution. The protection efficiency enhances with a rise in the corrosion inhibitor concentration and decreases with a rise in the contact time. The atomic absorption spectroscopy (AAS) results fully support the weight loss results.

## REFERENCES

[1] S. C. Nwanonenyi, H. C. Obasi1 · I. O. Eze (2019) Hydroxypropyl cellulose as an efficient corrosion inhibitor for aluminium in acidic environments: Experimental and theoretical approach. Chemistry Africa. https://doi.org/10.1007/s42250-019-00062-1
[2] Wu J, Zheng X, Li W, Yin L, Zhang S (2015) Copper corrosion inhibition by combined effect of inhibitor and passive film in alkaline solution. Res Chem Intermed 41:8557–8570
[3] Kuruvilla M, John S, Joseph A (2016) Electroanalytical studies on the interaction of l-serine- based schiff base, hhdmp, with copper in sulphuric acid. J Bio Tribo Corros 2:19
[4] N.Raghavendra and J .Ishwara Bhat (2017) Inhibition of Al corrosion in 0.5 M HCl solution by Areca flower extract.
[5] N.Raghavendra and J .Ishwara Bhat (2018) An Environmentally Friendly Approach Towards Mitigation of Al Corrosion in Hydrochloric Acid by Yellow Colour Ripe Arecanut Husk Extract: Introducing Potential and Sustainable Inhibitor for Material Protection. J Bio Tribo Corros 4: 2
[6] Singh P, Chauhan DS, Srivastava K, Srivastava V, Quraishi MA (2017) Expired atorvastatin drug as corrosion inhibitor for mild steel in hydrochloric acid solution. Int J Ind Chem 8:363– 372
[7] N. Raghavendra (2019) Expired Lorazepam Drug: A Medicinal Compound as Green Corrosion Inhibitor for Mild Steel in Hydrochloric Acid System Chemistry Africa, https://doi.org/10.1007/s42250-019-00061-2
[8] Benabbouha T, Siniti M, El Attari H, Chefira K, Chibi F, Nmila R, Rchid H (2018) Red Algae Halopitys Incurvus extract as a green corrosion inhibitor of carbon steel in hydrochloric acid. J Bio Tribo Corros 4:39
[9] Bhuvaneswari TK, Vasantha VS, Jeyaprabha C (2018) Pongamia Pinnata as a green corrosion inhibitor for mild steel in 1N sulfuric acid medium. Silicon 10:1793–1807
[10] Fidrusli A, Suryanto MM (2018) Ginger extract as green corrosion inhibitor of mild steel in hydrochloric acid solution. IOP Conf Ser Mater Sci Eng 290:012087