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Expired drugs as corrosion inhibitors for metals and alloys

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ABSTRACT

Due to the high cost and the toxicity of widely used corrosion inhibitors and the ever-tightening environmental regulations surrounding their use and disposal, there is great interest in replacing harmful inhibitors with effective non-hazardous alternatives. Over the past two decades, extensive research and development have led to the discovery of new classes of corrosion inhibitors, and the importance on the use of several drugs as corrosion inhibitors has grown. There are great efforts to use drugs as corrosion inhibitors for metals, but the use of the expired drugs as corrosion inhibitors for metals is limited. The present review reports the new trends aimed to recycling of expired drugs and using it as corrosion inhibitors for metals in different corrosive media.

KEYWORDS

Metals;
Corrosion;
Weight loss;
Drugs;
Expired drug;
Polarization.

INTRODUCTION

Corrosion is an afflicting problem associated with every use of metals. The damage by corrosion results in highly cost for maintenance and protection of materials used. Metals generally tend to move to its original state by corrosion process because Corrosion is a thermodynamically feasible process as it is associated with decrease in Gibb's free energy. Development of methods to control corrosion is a challenge to scientists working in this area[1-12]. Amongst various methods developed for corrosion protection, use of inhibitor is an attractive and most practical method for the protection of metals in contact with corrosion medium. Inhibitors reduce the corrosion of metallic materials by controlling the metal dissolution and consumption[1-12].

Due to the toxicity of widely used corrosion inhibitors and the ever-tightening environmental regulations surrounding their use and disposal, there is great interest in replacing harmful inhibitors with effective non-hazardous alternatives. Over the past two decades, extensive research and development have led to the discovery of new classes of corrosion inhibitors, and the importance on the use of several drugs as corrosion inhibitors has grown[13]. Recently, the use of antibiotics and other drugs have been investigated and their inhibition efficiencies have been linked with their heterocyclic nature[14]. Most of heterocyclic drugs are environmentally friendly and can favorably complete with the natural products.

In recent years, the use of pharmaceutical compounds offer interesting possibilities for corrosion inhibition due to the presence of hetero atoms like nitrogen, sulphur, oxygen and π- bond in their structure and

are of particular interest because of their safe use, high solubility in water and high molecular size. Some of the azosulpha and antimalarial drugs have been reported as good corrosion inhibitors[18,19]. There are great efforts to use drugs as corrosion inhibitors for steel[14-18], but the use of the expired drugs as corrosion inhibitors for steel is limited. The present review reports the new trends aimed to recycling of expired drugs and using it as corrosion inhibitors for metals in different media.

EXPIRED DRUGS AS CORROSION INHIBITORS

The use of expired drugs as corrosion inhibitors can be traced back to 2009's when R.S.Abdel Hameed used the expired ranitidine as corrosion inhibitors for Al in HCl corrosive medium[15]. The survey of literature reveals that, Ranitidine is a non-toxic pharmaceutical compound used as a histamine H_2-receptor antagonist. Ranitidine is the commercial name of N[2-[[[5-[(dimethylamino)methyl]-2furanyl]methyl]thio]ethyl]-N'-methyl-2-nitro-1,1-ethenediamine, HCl. Ranitidine containing N- atoms,O-atoms,S-atom and ð- bond in its structure regarded as important factors for good inhibitor[19].

In 2011's, R.S.Abdel Hameed,[16]. reported the use of expired ranitidine drugs as non-toxic corrosion inhibitor for mild steel in hydrochloric acid medium[16], in this respect:

Expired ranitidine was tested as a corrosion inhibitor for mild steel in 1 M HCl using different techniques: weight loss, potentiodynamic polarization, open circuit potential and electrochemical impedance spectroscopy techniques. The polarization resistance (R_p) value increased with increase in the concentration of the inhibitor. Results obtained revealed that Ranitidine performed excellently as a corrosion inhibitor for mild steel in this medium at 303K. The protection efficiency increased with increase in inhibitor concentration, but decreased with increase in temperature. The activation and thermodynamic parameters of dissolution and adsorption were calculated and discussed. The inhibition was assumed to occur via adsorption of the expired drugs molecules on the metal surface. The adsorption of the inhibitor on the mild steel surface followed Langmuir adsorption isotherm model. Results obtained from polarization, EIS and weight loss measurements are in good agreement with each other. The study of expired Ranitidine drugs as non-toxic corrosion inhibitors for steel in HCl, have been offered the following conclusions:

1) Results obtained from the experimental data shows that expired Ranitidine. Hydrochloride is a good inhibitor for the corrosion of mild steel in 1M HCl and inhibition efficiency was more pronounced with increase in the inhibitor concentration.
2) The inhibition efficiency decreased with increase in temperature, leading to the conclusion that the protective film of these compounds formed on the mild steel surface is less stable at higher temperature.
3) The values of "G_{ads} indicate adsorption of the inhibitor by both physical and chemical process while the decrease in inhibition efficiency with increase in temperature indicated predominate physisorption of the inhibitor.
4) The potentiodynamic polarisation curves imply that, expired Ranitidine. Hydrochoride acts as a mixed type inhibitor, but under prominent anodic control, for corrosion of mild steel in 1M HCl.
5) The adsorption of inhibitor on the mild steel surface obeys Langmuir adsorption isotherm.
6) The polarization resistance (R_p) value increased with increase in the concentration of the inhibitor.
7) Results obtained from polarization, EIS and weight loss measurements are in good agreement with each other.
8) The corrosion inhibition efficiency of Expired ranitidine drugs reached to 92% by using 400ppm of the of the used expired drugs.

In 2012's Vaszilcsin N, Ordodi V, Borza A[17], have been studied the Corrosion inhibitors from expired drugs, and introduce a method of expired or unused drugs valorization as corrosion inhibitors for metals in various media. Cyclic voltammograms were drawn on platinum in order to assess the stability of pharmaceutically active substances from drugs at the metal-corrosive environment interface. Tafel slope method was used to determine corrosion rates of steel in the absence and presence of inhibitors. Expired Carbamazepine and Paracetamol tablets were used to obtain corrosion inhibitors. For the former, the corrosion inhibition of carbon steel in 0.1 mol $L^{(-1)}$ sulfuric acid solution was about

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90%, whereas for the latter, the corrosion inhibition efficiency of the same material in the 0.25 mol $L^{(-1)}$ acetic acid-0.25 mol $L^{(-1)}$ sodium acetate buffer solution was about 85%. Generally the use of expired drugs as corrosion inhibitors for steel are scanty, and show real promise. the chemical structural formula for the most used drugs as corrosion inhibitors for metals are showing in figures (1-3).

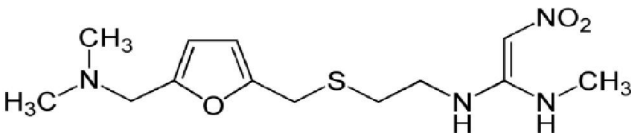

Figure 1 : The chemical molecular structure of ranitidine

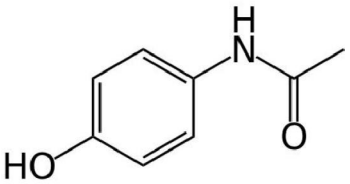

Figure 2 : The chemical molecular structure of paracetamol

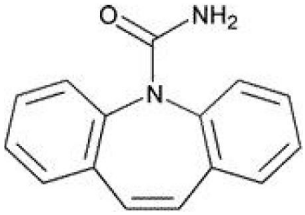

Figure 3 : The chemical molecular structure of carbamazepine

CONCLUSIONS

All the reported drugs showed good inhibition efficiency for corrosion of metals, Expired Ranitidine showed inhibition efficiency above 90 % for steel and above 82% for aluminum, the corrosion inhibition of carbon steel in sulfuric acid solution was about 90% using Expired Carbamazepine. The expired Paracetamol showed inhibition efficiency of 85 % for steel in acetic acid. Generally the use of expired drugs as corrosion inhibitors for metals are scanty, and show real promise.

REFERENCES

[1] R.S.Abdel Hameed; Aminolysis of polyethylene terephthalate waste as corrosioninhibitor for carbon steel in HCl corrosive medium, Advances in Applied Science Research, **2(3)**, 483-499 **(2011)**.

[2] R.S.Abd El-Hameed, H.I.Al-Shafey, O.A.Farghaly; Corrosion of Mild Steel in NaCl solutions and Effect of Recycled Plastic Waste Inhibitors, Research and reviews in Electrochemistry, **3(2)**, 41-49 **(2012)**.

[3] M.Atta Ayman, H.A.Shehata, H.M.Abd El Bary; Samer Abdel Salam, Reda Abdel Hameed, Recycled poly (ethylene terephthalate) wasteoligomers as corrosion inhibitors of steel, Progress in Rubber, Plastics and Recycling Technology, **23(4)**, 209-226 **(2007)**.

[4] Reda Abdel Hameed; Evaluation of some water - based surfactants derived from plastic waste as Corrosion inhibitors, for carbon steel alloy, Ph.D., Thesis, Al Azhar Uni., **(2006)**.

[5] Reda S.Abd El Hameed, H.I.Al Shafey, S.A.Soliman, M.S.Metwally; Corrosion of C-steel alloy in (0.1M)Nitric acid in the presence of plastic waste as corrosion inhibitors, Al Azhar Bull.Sci., **19**, 283 **(2008)**.

[6] Reda S.Abd el Hameed, H.I.Al Shafey, E.A.Ismail; Studies on corrosion inhibition of C- steel in 1M Acetic acid solutions by ethoxylated poly (ethylene terphthalate) derived from plastic waste, Al-Azhar Bull.Sci., **20(1)**, 185-197 **(2009)**.

[7] H.I.Al- Shafy, R.S.Abdel Hameed, Ayman M.Atta; Modified poly (ethylenterphthalate)as corrosion inhibitors forC-steel in 1M HCl The 12th international Conference on petroleum, Mineral wealth and development, **(2009)**.

[8] Reda Abdel Hammeed, H.S.Ismail; Recycling of plastic waste as corrosion inhibitors for steel in 0.5 M sulfuric acid, (AISC'08) Al- AzharInternational Scientific Conference, **(2008)**.

[9] H.AShehata, H.M.Abdelbary, S.A.Soliman, A.M.Salem, A.M.Atta, Reda S.Abdel-Hameed; Evaluation of Nonionic Surfactants from Plastic Wasteas Corrosion Inhibitors of Carbon steel in 1M HCl, Materials Science, **8(7)**, 289-302 **(2012)**.

[10] R.S.Abdel Hameed, H.I.Al-Shafey, A.S.Abul Magd, H.A.Shehata; Pyrazole Derivatives as Corrosion Inhibitor for C- Steel in Hydrochloric Acid Medium, Journal of Materials and Environmental Science, **3(2)**, 294-305 **(2012)**.

[11] R.S.AbdelHameed, H.I.Al-Shafey; Recycling of some plastic waste as green corrosion inhibitors for steel in 1 M Phosphoric acid corrosive medium, Eurasia 12 conference, oral representation, **(2012)**.

[12] A.Y.El-Etre; Natural honey as Corrosion of metals and alloys, Corrosion Science, **40(11)**, 1845-1850 **(1998)**.

[13] Gökhan Gece; Drugs: A review of promising novel corrosion inhibitors, Corrosion Science, **53(12)**, 3873-3898 **(2011)**.

[14] N.O.Eddy, S.A.Odoemelam, P.Ekwumemgbo; Inhibition of the corrosion of mild steel in H_2SO_4 by penicillin G, Scientific Research and Essay, **4(1)**, 033-038 **(2009)**.

[15] R.S.Abdel Hameed; Expired Ranitidine drugs as corrosion inhibitor for aluminum in 1M Hydrochloric acid, Al-Azhar Bull.Sci., **20(1)**, 151-163 (June) **(2009)**.

[16] R.S.Abdel Hameed; Ranitidine Drugs as Non-Toxic Corrosion Inhibitor for Mild Steel in Hydrochloric Acid Medium, Portugaliea Electrochimica Acta, **29(4)**, 273-285 **(2011)**.

[17] N.Vaszilcsin, V.Ordodi, A.Borza; Corrosion inhibitors from expired drugs, Int.J.Pharm., **15**, 241-244 **(2012)**.

[18] A.S.Fouda, H.A.Mostafa, H.A.Mostafa, H.M.Elabbasy; Antibacterial drugs as inhibitors for corrosion of stainless steeltype304in HCl solution, Journal of applied electrochemistry, **40(1)**, 163-173 **(2010)**.

[19] J.Ishwara Bhat, Vijaya D.P.Alva; Meclizine hydrochloride as potential non-toxic corrosion inhibitor for mild steel in hydrochloric acid medium, Archives of Applied Science research, **3(1)**, 343-356 **(2011)**.