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An Overview: Drugs Used As Corrosion Inhibitors

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***Abstract*— Corrosion is the process in which any material deteriorates because of chemical reactions with its environment. It occurs due to the exposure of metal surface and comes in contact with a gas and a liquid and it becomes a major problem as it causes tremendous economic loss. To overcome this problematic and dangerous issue of corrosion, some researchers and scientists discovers some method to control corrosion , such as use of chemical inhibitors, protective surface coatings, cathodic protection , modify corrosive environment but the presence of toxic material is high in all the methods which affect environment so there is an urgent need of environmental friendly inhibitors like expired drugs or green plant extracts which attracting great interest in the corrosion field thanks to its safety, biodiversity, ecologically acceptability and renewability. Literature review disclose that various types of drugs (Antibacterial, Antifungal, Antibiotic, Anti-malarial, Analgesic, Anti-depressant, Anti-hypertensive, Antihistamine) and green plant extracts have been efficaciously vibrant as feasible inhibitors for decreasing the effect of corrosion on metals and alloys. The imminent sections deliver comprehensive overview of the application of drugs and green corrosion inhibitors and the literature on their corrosion inhibition studies.**

***Keywords*— Drugs, Corrosion, Inhibitors**

I. INTRODUCTION

Corrosion is the natural phenomenon of the decadence of a substance and its properties due to synergy between the substance and its environment [1]. The tendency of metal for corrosion to occur depends on the grain structure of the metal, its composition as formed during alloying, or the temperature for deformation of a single metal surface developed during fabrication. To prevent Corrosion would be more practical than eliminate it completely by different trial methods. Corrosion plays an crucial role in environment, the mechanisms of corrosion can be altered as the environments to which a substance is exposed and thus may be complex to understand. Corrosion depends upon these factors like metal reactivity, presence of impurities, presence of air, moisture, gases like sulphur dioxide and carbon dioxide, and presence of electrolytes [2]. Corrosion is considered as critical industrial problem as it causes deterioration of metals and alloys in the presence of an environment by chemical or electrochemical pathways.

Corrosion is associate degree irrecoverable reaction of a metal, ceramic, chemical compound with its surroundings which ends up in its consumption or dissolution into the fabric of a part of the surroundings.There is no single fixed amount for loss to the nation due to corrosion. It can be a minimum of 3.5% of the nation's GDP. Losses could be more than Rs.2.0 lakh crores per annum in India due to corrosion [3]. Corrosion costs glaring in the form untimely decadence or necessesary maintenance failures, repairs and replacement of damaged parts. Corrosion inhibition can be employed by using chemicals, however almost all chemicals/substances starts corrosion in the presence of air, water and soil.

A chemical which, when added to a corrosive environment and hence reduces the rate of reaction of metal with its corrosive environment is called as corrosion inhibitor. Corrosion control of metals is aesthetical, economical, environmental and technically important. The inhibitor uses is the best option to protect metals and alloys but there are some major limitations of organic inhibitors which has prompted the search for green corrosion inhibitors as they are less toxic, biodegradable, cost effective and ecological acceptable .In recent years, sol-gel coatings doped with inhibitors show good result. To replace these toxic and hazardous inhibitors with less toxic and less hazardous inhibitors, many research groups work on developing a green corrosion inhibitor where most of their extracts containing elements like O,C,N and S ,which are active in organic compounds. Numerous natural products and their applications as a corrosion inhibitor, especially in steel are discussed. Green inhibitors are a need of the time. Research on corrosion has been an interesting topic for quite a long time. Green inhibitors is an old dream in applied corrosion in industrial practice, but one of the challenges is to guarantee or to trust in the chemical stability of the compound. Most of the research groups infers that the inhibitor concentration required is on the higher side but it has its own disadvantages: The higher concentration cannot be guaranteed in real applications over a longer period of time. High concentrations of inexperienced (organic)

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corrosion inhibitors may scale back the barrier properties of a coating and should be not even compatible with the organic coating etc.

In the last few decades, the drugs makes their efficient role as a corrosion inhibitor which fascinate research attention. Literature review disclose that various types of drugs (Antibacterial, Antifungal, Antibiotic, Anti-malarial, Analgesic, Anti-depressant, Anti-hypertensive, Antihistamine) have been efficaciously vibrant as feasible inhibitors for decreasing the effect of corrosion on metals and alloys. The imminent sections deliver comprehensive overview of the application of drugs and the literature on their corrosion inhibition studies.

II. DRUG INHIBITOR- EXPERIMENTAL TESTIMONY

Recently, toxic materials has been limited which are used as inhibitors because of their menancing environmental properties. The noxious materials damage living organisms and the environment also. Therefore, research works are being focused on various plant extracts, drugs, organic compounds and polymers which have a special and incredible inhibitive properties.

Numerous research work has been done for lookout the inhibition action of different type of drugs on different metals.

N.O.Eddy et al, 2009 [4] studied the inhibition characteristics of mild steel in H_2SO_4 with varying concentration of drug Penicillin G (inhibitor) using gasometric and thermometric methods. The experimental results of these studies showed that the inhibition efficiency increases with the concentration of Penicillin G but the efficiency decreases with increase in temperature. The data obtained from the experiment discloses that Langmuir adsorption isotherm was the best suitable adsorption model.

R.S.Abdel hameed et al, 2005 [5] demonstrated the inhibitory effect of Expired Voltaren drug in 1 M HCl by using weight loss and electrochemical method. The adsorption of the Expired Voltaren was found to obey the Langmuir adsorption isotherm. Results obtained from electrochemical methods showed that Expired Voltaren inhibition efficiency increases with increasing inhibitor concentration and decreasing with increasing temperature.

S.K Shukla et al, 2009 [6] was explored the drug Cefotaxime Sodium which is antibiotic which comes out to be corrosion inhibitor efficient in HCl for steel by using weight loss method, Tafel polarization methods. The result showed inhibition happens through natural action of drugs on metal surface whereas not modifying the mechanism of corrosion and it shows 86% inhibition potency. Now a days many research works were carried out by using expired drugs as corrosion inhibitor. The expired drugs shows much better behavior with environment as it has negligible effect on Humans, animals live in different adaptations like water, soil, deserts, air etc. as well as it meant to be very efficient in waste management and it also depresses economic losses. The reason behind this success is that the expired drugs used as corrosion inhibitor blocks the surface of metal which prevent the process of corrosion effectively. Streptomycin, Ciprofloxacin, Doxycycline were made useful corrosion inhibitors on metal surface like bronze. Although the above mentioned drugs which are also known for their antibacterial properties have less inhibition efficiency but for the waste management purpose which becomes extremely important they can be used to fulfill the need of today's scenario.

N.O. Eddy et al 2010 [7] examined the efficiency of erythromycin drug on zinc metal in 0.01 to 0.04 M H_2SO_4 by using weight loss and hydrogen evolution methods. The outcomes reveals that erythromycin act as good adsorption inhibitor in H_2SO_4 for the zinc and hence the result drawn that by suppressing the concentration of inhibitor , the corrosion inhibition efficiency also get suppressed but inhibition efficiency de-accelerated on increasing the temperature. R.S.Nathiya et al 2017 [8] studied moxifloxacin and betnesol drugs as corrosion inhibitors. On the basis of weight loss and potentiodynamic polarization studies, scanning electron microscopic analysis and electrochemical impedance spectroscopy it was revealed that moxifloxacin and betnesol worked as corrosion inhibitors on aluminium metal in 1 M H_2SO_4 as the inhibition efficiency increases with increase in drugs concentrations at variable temperatures. It was observed that both betnesol and moxifloxacin behave like mixed type inhibitors by potentiodynamic polarization curves. Moreover, calculations of thermodynamic and adsorption isotherm indicated that the drugs have both physisorption and chemisorption with aluminium and they followed isotherms called Langmuir. Narasimha Raghavendra 2019 [9] demonstrated the inhibition effect of Expire Naftifine drug on copper corrosion using weight loss, Tafel plots and AC impedance spectroscopy techniques. Results obtained from weight loss showed that increasing concentration of naftifine drug increases the inhibition efficiency of copper in HCl , but due to long immersion period inhibition efficiency decreases. Results from Tafel plots reveals that expired Naftifine drug act as mixed corrosion inhibitor over copper. SEM techniques showed the adsorption behavior of naftifine expired drug over copper. The inhibition effect of expired Phenytoin sodium drug on carbon steel corrosion in 1M hydrochloric acid was studied by Al-Shafeyand coworkers [10] using several experimental techniques. The phenytoin

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sodium exhibited a maximum efficiency of 79% at 500 ppm concentration and behaved as a mixed type inhibitor. Adsorption of the phenytoin on the metallic surface followed Langmuir adsorption isotherm. Fouda et al. [11] investigated the inhibition performance of three drugs named as Actonel, Fosamax, and Etidron on carbon steel corrosion in 1M Hydrochloric acid solution using weight loss, electrochemical and surface (SEM, EDX) analyses. Results showed that all the studied drugs acted as mixed type inhibitors and their adsorption on the metallic surface obeyed the Langmuir isotherm [12]. Ebenso and coworkers [13] studied the inhibition effect of four rhodanineazo sulpha drugs on mild steel corrosion in hydrochloric acid solution using DFT based quantum chemical calculations. Several parameters were calculated and correlated with experimentally observed inhibition efficiencies of these drugs. Results of the theoretical calculations were in good agreement with the results obtained by experimental methods. Kumar and coworkers [14] studied the inhibition performance of an eco-friendly racemic mixture of amisulpride using electrochemical techniques. Results showed that inhibition performance of the drug increases with increasing concentration. The qualitative structure-activity relationship (QSAR) approach was also applied to correlate the results of quantum chemical calculations with results obtained experimentally. Polarization results showed that amisulpride acted as a mixed type inhibitor with cathodic predominance. Adsorption of the amisulpride on metallic surface obeyed the Langmuir adsorption isotherm. Amisulpride exhibited maximum inhibition efficiency of 91.3% at 600 ppm concentration.

The above mentioned experimental studies demonstrate that corrosion rate decreases as the concentration of inhibitor increases. All over research studies proves that the drugs are highly useful inhibitors for different type of metals like zinc, copper , mild steel, aluminium , bronze, carbon steel in various media at variable concentrations. Futhersome, the harmful effect on environment by the disposal of expired and unutilized drugs can be abolished to a large degree by utilizing them as corrosion inhibitors, thus depressing the economic losses.

Table 1: Chemical structures, names, nature of metals and electrolytes, techniques used and maximum inhibition efficiencies of the drugs used as corrosion inhibitors for mild steel in acid solution.

Drug name and Structure	Nature of metal/ electrolyte	Salient features / Techniques	Maximum efficiency/Conc	Ref. (s)
Donaxine	Mild steel/ 1M HCl	Inhibition efficiency increases with temperature	98% at 7.5 mM	[15]
Penicillin G (X, Y=H); ampicillin (X=H, Y=-NH2); amoxicillin (X=-OH, Y=-NH_2)	Carbon/ 1M HCl	The investigated drugs were highly soluble in the test medium	98.4%, 95.5% and 93% at 10 mM for Pen, Amp and Amo, respectively	[16]
Atenolol	Mild steel/ 1M HCl	Experimental results were supported by theoretical studies	93.8% at 300 ppm	[17]
Cephalothin	API 5L X52/ 1M HCl	Efficiency decreases with temperature	92% at 600 ppm	[18]
Telmisartan	Mild steel / 1M HCl	Mechanism of inhibition was explained with suitable modal	97.39% at 125 mgL-1	[19]
Metronidazole	Mild steel / 0.5M HCl	Theoretical studies were carried for protonated form of drug	80.01% at 10 µM	[20]
Tinidazole	Mild steel / 1M HCl	Exhibited maximum efficiency at 30 °C	90% at 400 ppm	[21]
Cimetidine	Mild steel / 1M HCl	Experimental results were supported by theoretical results	95.6% at 500 ppm	[22]
Amodiaquine	Mild steel / 1M HCl	LD50 value is 550 mg/Kg	44.33% at 0.006M	[23]
Sparfloxacin	Mild steel / 2.5M HCl	gravimetric, gasometric and thermometric	97.47% at 12 × 10-4 M	[24]
Fluconazole	Mild steel / 2.5M HCl	Electrochemical, AFM/ Chemically adsorbs and forms protective film	96% at 0.30 mM	[25]

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Piperacillin Sodium	Mild steel / 1M HCl	Weight loss, electrochemical	93% at 7.2 × 10-4M	[26]
Ciprofloxacin	Mild steel / 1M HCl	weight loss technique	86% at 2.570 × 10−3 M	[27, 28]
Gliclazide	Mild steel / 1M HCl	Weight loss, electrochemical;	91% at 400 ppm	[29]
Acyclovir	Mild steel / 1M HCl	Weight loss, electrochemical; LD50 is 20000 mg/kg rat	92% at 500 ppm	[30]
Cefixime	Mild steel / 1M HCl	Weight loss, electrochemical; LD50 is 10000 mg/kg for rat	90% at 8.8 × 10−4M	[31]
Meclizine hydrochloride	Mild steel / 1M HCl	Weight loss, electrochemical, SEM; LD50 is 1600 mg/kg for rat	92.29% at 200 ppm	[32]
Metformin	Mild steel / 1M HCl	Weight loss, electrochemical, quantum chemical calculations	96% at 400 ppm	[33]
Cetirizine	Mild steel / 1M HCl	Weight loss, electrochemical, quantum chemical calculations;	95.2% at 100 ppm	[34]
Ketosulfone	Mild steel / 1M HCl	Weight loss, electrochemical, SEM, QC calculations;	96.61% at 200 ppm	[35]
Fexofenadine	Mild steel / 1M HCl	Weight loss, electrochemical, SEM, QC calculations; FT-IR	97% at 3.0×10−4M	[36]
Ceftriaxone	Mild steel / 1M HCl	Weight loss, electrochemical	90% at 400 ppm	[37]

II(B). THE IMPACT OF DRUG AS CORROSION INHIBITORS ON ALUMINIUM

Aluminium is the metal which shows quite good performance for corrosion inhibition. Aluminium use widely in various industries and it is found very high amount in Earth's crust. It is good conductor of electricity and heat, durable, lightweight, malleable metal with physical appearance varying from white silvery to gray hues, which depend on the roughness of the surface[38]. Aluminum is not a Ferro-magnetic material. Sometimes, it can be water-soluble.

Ishwara bhat J et.al, 2011 [39] studied the effect of Meclizine drug as Corrosion inhibitor of Aluminium in HCl and the result showed that the drug successfully inhibited the aluminium in the acidic medium and the adsorption of the inhibitor on the aluminium surface followed Langmuir adsorption isotherm model. Obot IB et al, 2009 [40] Investigated Clorimzole and Fluconazole as corrosion inhibitors of aluminium in HCl environment and the conclusion drawn as both the drugs serve as excellent corrosion inhibitors. At constant acid concentration, the inhibition efficiency increased with increase in the concentration of the inhibitors. Increase in temperature increased the corrosion rate in the absence and presence of the inhibitors but decreased the inhibition efficiency. Oki M et. al , 2013 [41] studied Amine compounds as corrosion inhibitors of aluminium in HCl medium and results indicated 92% inhibitive efficiency at 30°C and 83% at 60°C using 100ppm inhibitor concentration. The mechanism of inhibition is proposed by physical adsorption of the inhibitor species on the corroding aluminium surface.

Abdel Hameed RS, 2015 [42] investigated Expired Voltren drug as a inhibitor and concluded that as Corrosion potential (Ecorr) was shifted to the direction that is more noble by the Inhibitor

Molecules. The adsorption of the EV was found to obey the Langmuir adsorption isotherm. The inhibition efficiency of expired Voltaren, EV obtained by all methods was in good agreement with each other. El-Etre AY et al, 2016 [43] studied the Domiana Extract as inhibitor of Aluminium in Acidic medium and from the results, the inhibition efficiency displayed direct variation with inhibitor's concentration but demonstrated inverse relation with temperature. Corrosion Inhibition of Aluminum using Chloroquine in HCl Environment Media was studied by Adejoro IA et al, 2016 [44] and It was deduced that chloroquine excellently inhibited the aluminum in the acidic environment and the efficiency of the inhibitor increased with concentration of inhibitor but not favored by temperature. Gupta NK et al, 2017 [45] investigated curcumine Longa as corrosion inhibitor by using Weight loss and electrochemical techniques and results showed that inhibition efficiency of CUR increases with increase in the concentration and attained a maximum value of 89.60% at

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100 ppm concentration.

Table 2: Drugs used as corrosion inhibitors in acidic medium for Aluminium metal and their references.

METAL	MEDIA	DRUG	REFERENCE
Al	HCl	Meclizine (Antihistaminic Drug)	Ishwara Bhat J, Alva VDP.[39]
Al	HCl	Clotrimazole and Fluconazole (Antifungal drugs)	Obot IB, Obi-Egbedi NO, Umoren SA.[40]
Al	HCl	Amine Compound	Oki M, Oki K, Otaigbe J, Otikor S.[41]
Al	HCl	Expired Voltaren	Abdel Hameed RS, Ismail EA, Abu-Nawwas AH, Al-Shafey HI.[42]
Al	H_2SO_4	Domiana Extract	El-Etre AY, Shahera M, Shohayeb MA, Elkomy S, Abdelhamed S.[43]
Al	HCl	Chloroquine	Adejoro IA[44]
Al	HCl	Curcumine longa	Gupta NK, Quraishi MA, Singh P, Srivastava V, Srivastava K, Verma C, Mukherjee AK.[45]

II(C). THE IMPACT OF DRUGS AS CORROSION INHIBITORS FOR ZINC IN ACIDIC SOLUTION

Zinc (Zn) is a metal of low-melting point lies in Group 12 of periodic table. It is essential to life and is one of the most extensively used element [46]. Zinc is of considerable commercial importance. Zinc is an important metal which is being utilized for several applications such as constructional material in structural and civil engineering. Zinc is also used as a material for sacrificial coating that is protection of iron and steel during their production. Like many other metals, zinc is much prone to corrosion, especially in acidic solution. The application of synthetic corrosion inhibitors is one of the most favorable methods in case of corrosion. These inhibitors soak up over metallic surface through different adsorption centers and form a protective surface film that detach and shield the metal from corrosion. Several drugs and their derivatives have been utilized as effective inhibitors for zinc corrosion in hydrochloric and sulphuric acid media [47]. The inhibition effect of three drugs named as paromomycin (compound I), streptomycin (compound II) and spectinomycin (compound III) are revealed by M. Abdallah [48] and coworkers. The corrosion of zinc in 1M HCl solution using weightloss, potentiodynamic polarization, electrochemical impedance (EIS) and gravimetric techniques was investigated. Polarization study divulged that the drugs behaved as mixed type inhibitors. The adsorption of these drugs over zinc surface stick to the Temkin isotherm. H.Adil et al.[49] investigated the inhibition effect of guaifenesin drug on zinc metal corrosion in 2M hydrochloric acid using weight loss studies. It was found that the drug act as good corrosion inhibitor and The inhibition efficiency of the drug increases with increase in its concentration and a maximum efficiency of 81% was obtained at 300 ppm concentration. Sani and Ameh et al.[50] studied the cefuroxime axetil drug as a green corrosion inhibitor for zinc corrosion in 1M sulphuric acid solution using weight loss and electrochemical methods. Results showed that the drug behaves as a mixed type inhibitor and it follows the Langmuir isotherm. The drug exhibited a maximum efficiency of 69.37% at a 0.01M concentration at 303K temperature. Hebbar et al. [51] demonstrated the corrosion inhibition effect of ketosulfone for zinc in acidic solution using polarization and AC impedance spectroscopic techniques. They concluded that the adsorption of the drug on the metallic surface followed the Langmuir isotherm. Polarization study shows that the ketosulfone is a mixed type inhibitor. The drug exhibited a maximum efficiency of 52.50% at 20 ppm concentration. Hebbar et al.[52] investigated the Floctafenine as corrosion inhibitor for zinc corrosion in 0.1M hydrochloric acid using empirical and theoretical methods. Adsorption of the drug on metallic surface followed the Langmuir isotherm. Polarization study revealed that the studied drug acted as a mixed type inhibitor and exhibited a maximum efficiency of 88.9% at 25 mgL-1 concentration at 323K.

Table 3: Drugs used as corrosion inhibitors in acidic medium for Zinc metal and their references.

S. NO.	METAL	INHIBITOR	MEDIA	REFERENCES
1.	**Zinc**	paromomycin (compound I), streptomycin (compound II) and spectinomycin (compound III)	HCl	M. Abdallah et al,2016 [48]
2.	**Zinc**	Guaifenesin	HCl	H.Adil et al,2015 [49]

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3.	**Zinc**	cefuroxime axetil	H_2SO_4	U.M. Sani, P. O.Ameh,2015 [50]
4.	**Zinc**	ketosulfone	HCl	N.Hebbar et al,2015 [51]
5.	**Zinc**	Floctafenine	HCl	N.Hebbar et al,2015 [52]

II(D). THE IMPACT OF DRUGS AS CORROSION INHIBITORS FOR COPPER

Copper is an element whose chemical formula is 'Cu' and atomic number 29. In Latin it is known as *cuprum* and it is soft, malleable, ductile and good conductor of electricity, it is also used as building material [53]. Copper does not react with water, but it does slowly reacts with atmospheric oxygen to form a layer of brown-black copper oxide which, unlike the rust that forms on iron in moist air, protects the underlying metal from further corrosion. Although it is reddish brown in colour in nature but when reacts with atmospheric oxygen, a green layer of copper carbonate can often be seen on old copper structures, such as the roofing of many older buildings and the monuments[54]. There are two known types of copper corrosion, which are uniform copper corrosion and non-uniform copper corrosion. Copper is also susceptible to crevice corrosion attack [55].

- **Uniform corrosion**, which is identified by the presence of a relatively uniform layer of copper corrosion byproducts across the inner surface of a pipe wall. It is typically associated with elevated copper levels at the taps [56].
- **Non-uniform corrosion**, which is the isolated development of corrosion cells across the inner surface of a pipe wall. Excessive pitting corrosion can lead to pinhole leaks in the pipe and result in water damage and mold growth [57].

To prevent corrosion of copper many researchers studied behavior of selective corrosion inhibitors which may help to depress the effect of corrosion successfully. Some are discussed below table.

Table 4: Drugs used as corrosion inhibitors in acidic medium for copper metal and their references.

S.NO.	METAL	INHIBITOR	MEDIA	REFERENCE
1.	COPPER	Losartan Potassium (LP)	HNO_3	Hao Li et al., 2020 [58]
2.	COPPER	Meropenem	HNO_3	Fouda et al.2016 [59]
3.	COPPER	Streptoquin	HCl	Fouda and Gadow, 2014 [60]
4.	COPPER	Cefotaxime	HCl	El-Haddad et al. 2016 [61]
5.	COPPER	septazole	HCl	Fouda et al.2014 [62]

Losartan Potassium (LP) drug was investigated as corrosion inhibitor by Hao Li et. al [58] and they concluded that LP has good Anti-corrosion effect with high efficiency of 94.9% . In this study, the corrosion inhibition performance of LP on copper in 0.5 M H_2SO_4 was investigated using electrochemical methods, surface morphological observation, X-ray photoelectron spectroscopy (XPS), quantum chemical calculation and molecular dynamics (MD) simulation. Fouda et al. [59] studied the inhibition effect of unused Meropenem drug on copper corrosion in 1M HNO3 using EIS, polarization, EFM and mass reduction techniques. Polarization study revealed that the studied drug acted as a mixed type inhibitor. Adsorption of the drug over metallic surface followed the Temkin isotherm. The Meropenem drug exhibited a maximum efficiency of 98.7% at 300 ppm concentration.The inhibition effect of two antibiotic drugs namely, streptoquin and septazole on copper corrosion in 0.1 M HCl has been demonstrated by Fouda and Gadow [60] using electrochemical techniques. The adsorption of both the drugs followed the Langmuir isotherm, and polarization study revealed that both the drugs acted as mixed type inhibitors. Some quantum chemical calculation parameters were derived in order to explain the mechanism of inhibition. The experimental and computational results were in good agreement. El-Haddad [61] illustrated the adsorption behavior of Cefotaxime drug on the copper surface in 0.1 M hydrochloric acid solution by potentiodynamic polarization, electrochemical frequency modulation (EFM), electrochemical impedance spectroscopy (EIS), scanning electron microscopy (SEM) and energy dispersive X-ray (EDX) and quantum chemical calculation methods. Results showed that the studied drug acted as a good corrosion inhibitor and its adsorption followed the Langmuir isotherm. Fouda and coworkers [62] investigated the inhibition effect of septazole, an antibacterial drug on copper corrosion in 0.1M hydrochloric acid using electrochemical techniques. Results showed that septazole acts as mixed type inhibitor and its adsorption on copper surface follows the Langmuir isotherm. Quantum chemical calculations carried out using semi-empirical model provide good insight on the inhibition mechanism of the drug. The drug exhibited a maximum efficiency of 84.8% at 900 ppm concentration.

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III. CONCLUSION

The present review marks the collection of a few untimely works on drugs that have been explored as effective corrosion inhibitors for metallic corrosion in acid solutions. From the present discussion, it is understandable that the drugs are optimal and environmental friendly contender to replace the established toxic corrosion inhibitors. Considerable literature survey exposed that several drugs and their derivatives have been productively investigated as corrosion inhibitors for mild steel, aluminum, zinc, and copper alloys as well as for their alloys in acidic solution. The drugs exhibited remarkably higher inhibition efficiency due to their complicated molecular structures and the presence of several heteroatoms such as nitrogen, oxygen and sulfur atoms as well as due to the presence of non-bonding and π-electrons in their structures.

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