

Inhibition of Al 7075 corrosion in Arabian Sea water using Cetirizine drug as a corrosion inhibitor

Pruthviraj R D^{1*}, Ramesha S¹ and Vishwanath²

¹Chemistry R&D Centre, Department of Chemistry, Raja Rajeswari College of Engineering, Bangalore, Karnataka, India.

²Mechanical R&D Centre, Department of Mechanical Engineering, Raja Rajeswari College of Engineering, Bangalore, Karnataka, India

Abstract

The inhibition of Cetirizine drug on corrosion of Al 7075 alloy in Arabian sea water medium became investigated by way of weight reduction measurement, Tafel Polarization, and Electrochemical Impedance Spectroscopy (EIS) techniques. The electrochemical outputs proved that the prepared Drug act as powerful corrosion drug. The outputs found from electrochemical, weight loss and Electrochemical Impedance Spectroscopy (EIS) studies showed exact consistency. The Present paper involves the examine of weight loss, Tafel polarization, EIS and microstructural behavior of Al 7075 alloy with and without drug. The corrosion research for Al 7075 has been executed with the aid of using electrochemical analyzer in Arabian sea water medium at different temperature with and without organized drug. From microstructural research, intergranular corrosion with lines of pitting was observed within the samples while immersed in the Arabian sea water solutions without drug.

Keywords: Cetirizine drug, Weight loss, Tafel polarization, EIS, SEM, EDS (Energy Dispersive Spectroscopy).

Introduction

Al 7075 alloy is the one of the well-known and limitlessly using alloy for industries and other critical functions like transportation of water, petroleum products and chemicals. Nevertheless, alloy is receptive toward corrosion, especially in the method of acid pickling, aiming at elimination of scale or rusts and for that reason provision smooth surface for pre-passivating treatment.[1-3] The problem has taken to deplete the corrosion manner of Mild metallic alloy in the discipline of academic and industries. This applies superb to economy, put an cease to ability disasters and bad social impacts. Though there are several ways present to retrad corrosion, the fine manner to combat against is, the usage of corrosion drugs had verified to be the only technique showing favors of high efficiency and robust practicability[4-6] The natural corrosion drugs are the compounds bearing O,N,S as heteroatoms and pi electrons in their structures. Due to ecofriendly behavior, powerful in low concentration and intense overall performance in their action on corrosion depletion, are especially occupying its position within the process of corrosion retardation. Constantly the utilization and selection of inorganic corrosion drugs to a smaller amount, because of their negativity such toxicity, less compatability with blanketed materials.[7-10] Badly, natural drugs are expensive because of the excessive manufactured processes and technology.

Nowadays researchers showing more intrest on the corrosion retardness belongings of medicine on special metallic matrixes in corosion medium. [11-13] The datas are revealing the first-class corrosion inhibitive actions/performances through the maximum of the medication. They are constructive inside the movement of absorption at the metal floor leads to foramtion of the protective molecular film to restriction active sites, this turns corrosion to quit. This motion of medication as natural drugs is because of skeletal residences inclusive of, the presence of hetroatoms and the shared pair of pi electrons of their ring system. Though the medication are extra powerful as corrosion drugs, in comparision with commercial corrosion drugs are costier in the components of economy. Nevertheless, the usage of outdated or vain capsules turns waste into income to economy. Gece published the review article concerning the categories of drugs used as metallic corrosion drugs beneath different corrosive environments.

[14] Especially the others of Penicillin bearing lactam organization are considerably used as antibacterial antibiotics and taken into consideration because the warriors in opposition to deterioration of metals and alloys, due to their fully fledged formation procedures, relative ecofriendly and morphology.[15-16]

Experimental Details

Materials

The Al 7075 alloy specimens are taken for test and composition (wt%) mentioned in Table 1. Prior to analysis, the glazed specimens had been completed with the assist of emery papers of diiferent grade (600, 800,1200&1500), and then specimens are degreased with distill water and aetone ,ultimately washed with distill water. Arabian sea waterare preaped from analytical grade, and Cetirizine drug is synthesized in the laboratory and have been used in acid & Neutral medium with corrosion drug respectively.

Weight loss measurements

Before beginning the experiment, the Al 7075 alloy specimens having dimension (2.5 cm x 2 cm x 0.025cm) were wiped clean and kept ready for experiment. The specimens have been dipped in one-of-a-kind concentrations of inhbitor and Arabian sea waterare added inside the beakers. The test become continued inside the presence and lack of organized drug at 250 for twenty-four h and condition was aerated. After that, the immersed specimens have been taken out, wiped clean very well with the useful resource of double distilled water and acetone, and make sure that they are loose from moisture and weights recorded with the help of weighing balance. To gain good reproducibility, the

***Corresponding author:** Chemistry R&D Centre, Department of Chemistry, Raja Rajeswari College of Engineering, Bangalore, Karnataka, India, Tel: +9197428326781; E-mail: pruthvirajrd@gmail.com

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gravimetric readings had been recorded in triplicates. By the usage of following Equations, the corrosion price (CR), and inhibition efficiency (WL%) have been recorded:

$$CR = \frac{W_0 - W_1}{A \times t} \quad (1)$$

Where, the average weight loss of Al 7075alloy specimens without and with drugs are represented by W_0 and W_1 , respectively.

Tafel polarization measurements

The Polarization research changed into completed with the help of CH instrument (USA) version 608E prepared with 3-electrode system. The Al 7075alloy specimens were embedded in a Tafel holder with an exposed region of zero.5 cm² and used because the operating electrode, a platinum sheet and a saturated calomel electrode (SCE) were taken as counter and reference electrodes respectively. Before analysis, the operating elctrode became attained steady-kingdom open-circuit ability (OCP) via putting slight metal specimen in acid medium. The Tafel polarization sutdies have been accomplished in the capability variety from -250 to +250 mV with a sweep charge of zero.166 mV sec⁻¹. At room temperature the test changed into achieved under unstirred condition.

Results and Discussions

Weight loss measurement

The weight reduction measurements had been performed due to the drugy motion of prepared drug with the aid of various concentrations on the Al 7075alloy in Arabian sea waterat 250 C temperature. The recorded values of corrosion price (CR) and the inhibition efficiency (WL%) are arranged inside the Table 2. There is a reduction in CR values of Al 7075alloy. In addition to this, the WL values showing growing values upon growth in concentrations of the drug.

By this clean observation, the drug slowdown the corrosion manner of Al 7075alloy.

Tafel polarization measurement

Tafel polarization measurements were carried out to recognize about the anodic and cathodic reactions occurring at the steel surface. The measurements of Al 7075alloy with and without of the drug(S1) in Arabian sea water had been recorded within the shape of Tafel polarization curves and they may be shown in Figure 2.

The Tafel plots were extrapolated to get polarization parameters which include corrosion contemporary density (I_{corr}), cathodic (β_c) and anodic (β_a) Tafel slopes, corrosion capacity (E_{corr}). The inhibition efficiency of drug(s1) (Tafel, %) are provided in the following Table 3. With the assist of the following equation the inhibition efficiency become computed.

$$\eta_{Tafel\%} = \left(1 - \frac{I_{corr,0}}{I_{corr}}\right) \times 100^{(8-10)} \quad (2)$$

Where $I_{corr,0}$ and I_{corr} are the corrosion current densities of the Al 7075alloy immersed in 1.0 M solution in the presence and absence of corrosion drugs, respectively.

Electrochemical impedance studies

For the EIS examine CHI applied which incorporate three cathode frameworks. The instance with size1cmx1cmx1cm wiped clean with 320 evaluation sandpaper and washed with Acetone accompanied through twofold delicate water. This estimation could be executed in CHI-608E electrochemical analyser. Before completed the EIS an adjustment carried out for half-hour transformed into permitted. Which should get constant rate for (OCP) open circuit capacity. The electrochemical watch i.E CHI accommodates of 3 cathode framework, refrence, jogging and assistant platinum terminal which might also

Elements	Mg	Sn	Cr	Mn	Fe	Ni	Al
Percentage (wt %)	0.12	0.34	0.40	0.16	0.74	0.35	Balance

Table 1: Composition of Al 7075.

Drug	Temperature	Ppm	CR in mpy	Percentage of efficiency
Citrizine Drug	250C	Blank	3.112	----
		50	2.613	16%
		100	2.161	30%
		150	1.762	43%

Table 2: Corrosion rates of Al 7075in Arabian sea water and Inhibition efficiency for different concentration of Drug.

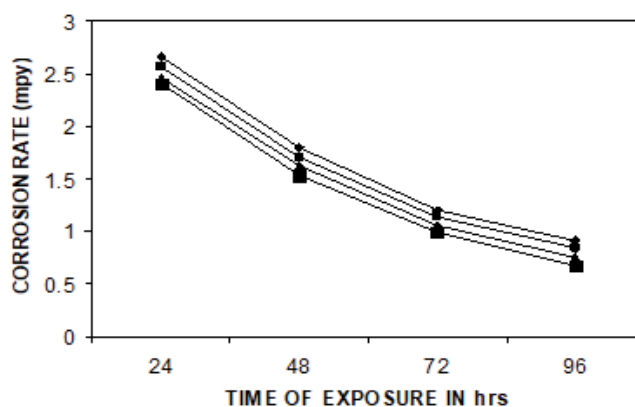


Figure 1. Mass loss Corrosion Test in 1M HCL & 3.5% NaCl using different Concentration of Drug.

Drug	Temperature	Concentration	I Corr.	E Corr.	η % Tafel
Citrizine drug	250C	Blank	1967	-0.505	----
		50	1366	-0.465	30%
		100	755	-0.497	61%
		150	512	-0.501	73%

Table 3: Tafel polarization parameters for the corrosion of Al 7075 in Arabian sea water Solution containing different concentration of prepared drug(s1) at 25°C.

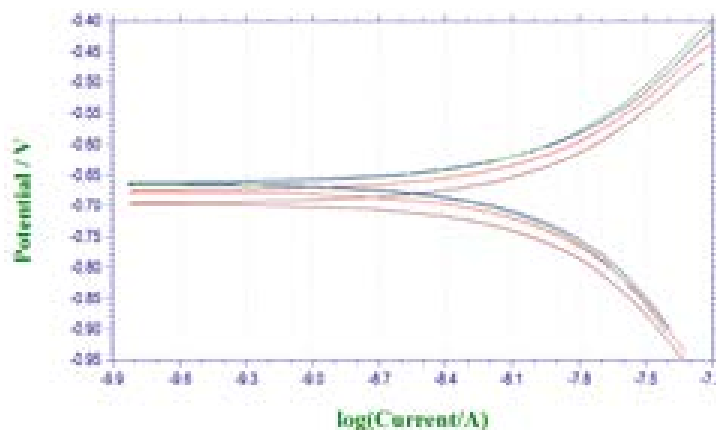


Figure 2. Tafel polarization curves for Al 7075alloy in Arabian sea water without and with drugs at 250C by using prepared drug.

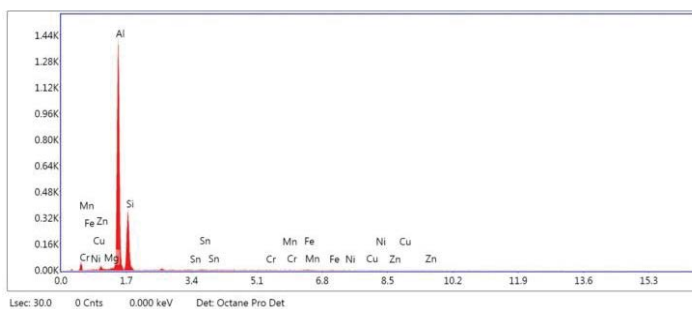
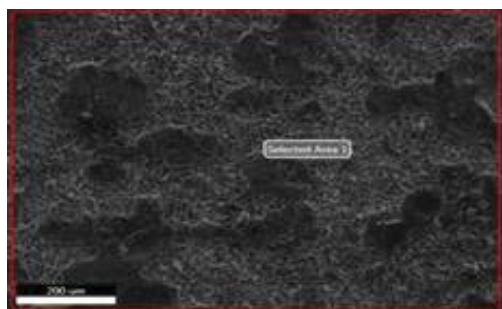
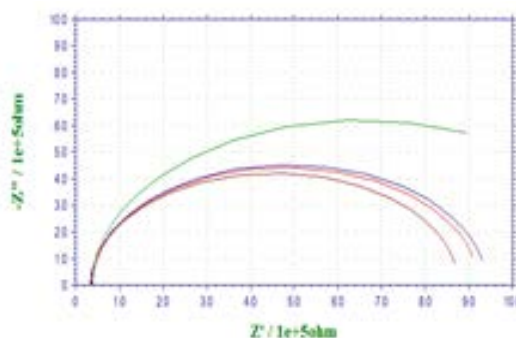


Figure 3. EIS curves for Al 7075alloy in Arabian sea water without and with different concentrations of drugs at 250C using prepared drug(s1).

be diagnosed with CHI, the trials should be finished at unmistakable temperature 250C with the aid of the usage of corrodent medium, The width of the capacitive circle is extra prominent with nearness of growth of fortification than lattice composite and which is increments with drug consideration and this recommends the repressed substance increments with the enlargement of the drug the nequist plot doesn't display the quality semicircle(nonperfect) demonstrating that discouraged capacitive circle.

Microstructural Studies Of AL 7075 ALLOY before and after corrosion test

Scanning electron microscopy

To evaluate the conditions of the metal surface in contact with acid solution in the absence and presence of drug, a surface analysis was carried out, using scanning electron microscope, immediately after the corrosion tests. Al 7075samples in Arabian sea water solution with

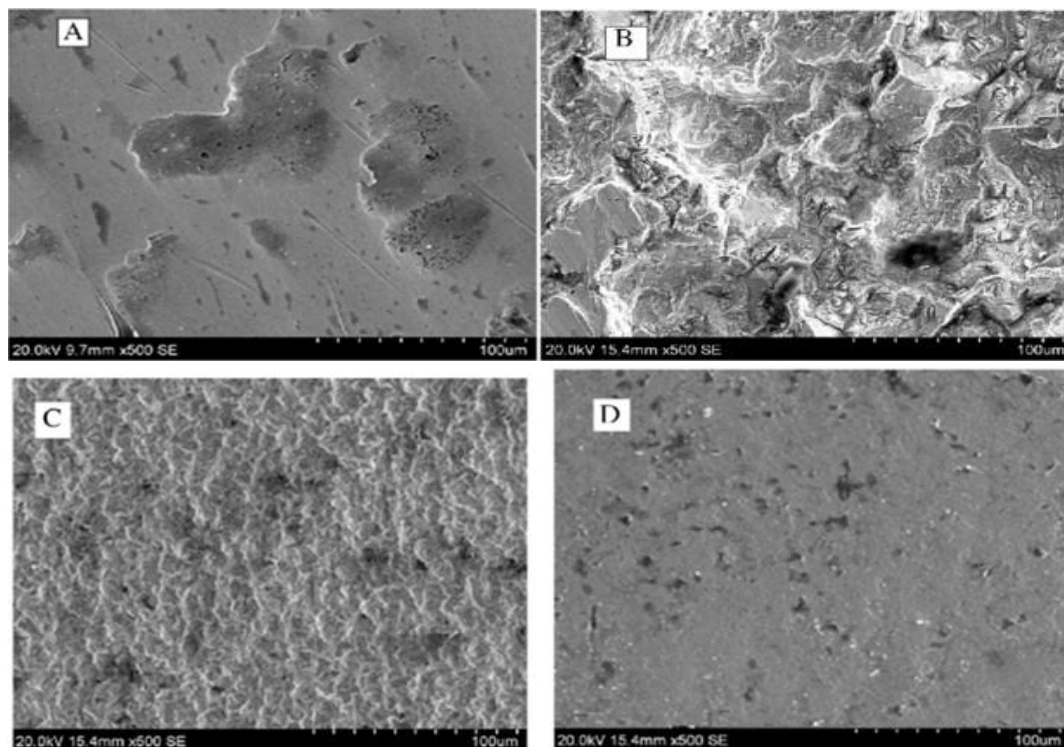


Figure 4. SEM images of a) polished surface of al-7075 alloy b) corrosion test without drug in sea water solution c) with drug 50ppm (sea water)d)with drug 100ppm.

and without optimal concentration of the drug(s) were subjected to analysis. SEM images are shown in a–d. It shows, surface corrosion of Al 7075 decreased remarkably in the presence of the drug [a]. Inspections of the figures reveal that there is severe damage, clear pits, and cavities on the surface of Al 7075 in the absence of drug [c] than in its presence and polished metal [a]. There are fewer pits and cracks observed in the inhibited surface. It conforms that the metal surface is fully covered with the drug molecules and a protective drug film was formed.

Conclusion

In this study, measurements including weight loss and Tafel polarization were adopted to investigate inhibitive properties of the drug as corrosion inhibitors on Al 7075. From the obtained results, the following conclusions are summarized:

The four inhibitor derivatives are all excellent mix-type inhibitors for the corrosion of Al 7075 in 1.0 M HCl and the inhibition efficiencies increase with increasing the concentration of the inhibitors. The inhibition suggests that the inhibitor derivatives spontaneously adsorb onto metal surface by the active adsorption centers within the molecules and provide the most stable adsorption configurations. The cetirizine is a better drug, because the inhibitor has got good efficiency and corrosion rate also decreases. This inhibitor can be used in the oil pipe industries to prevent corrosion. From weight loss measurements we determined that the corrosion inhibition efficiency changed into observed to be accelerated with increase in awareness of drug on the alloy floor and shows maximum in a 100 and 50 ppm concentration at 25°C. The very excessive closeness is executed a number of the chemical parameters in Tafel research because the concentration of the solution increases and corrosion rate decreases, then the drug is well suitable for corrosion studies. SEM snapshots proved that there is a formation of protective film at the slight metallic by using the drug.

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