WEIGHT loss method was used to investigate the inhibition and adsorption behavior of phenylephrine drug for aluminum2024 alloy corrosion in 1 M acidic chloride solution at 293-303 Kelvin. Results obtained indicate that phenylephrine act as inhibitor for Al 2024 alloy in molar hydrochloric acid solution. Increasing both phenylephrine concentration and temperature lead to increase the inhibition efficiency, which is indicating the chemisorption mechanism. The adsorption of the phenylephrine onto the Al 2024 alloy surface follow Langmuir adsorption isotherm model. The mechanism of inhibition was additionally proved by the activation parameters results that obtained from the experimental data. SEM image shows a smoothed surface of Al2024 alloy in the presence of phenylephrine in acidic solution. Quantum chemical calculation was used to correlate inhibition efficiencies data of phenylephrine with its electronic structural parameters. Theoretical calculations support the experimental results and elucidate working mechanisms.

Keywords: Weight loss, Phenylephrine, Aluminum alloy, Acid hydrochloride.
Effect of Rhodanine azo-sulpha drugs as corrosion inhibitors on the corrosion of 304 stainless steel in HCl environment using gravimetric and potentiodynamic methods. Parallel adsorption technique was used for the inhibition process on the steel surface because of the presence of multiactive center within the molecules of the inhibitor. Solmaz et al. [19] have shown that Rhodanine is a good corrosion inhibitor for low carbon steel in hydrochloric acid. They used electrochemical techniques for the corrosion findings. The effect of a number of antibiotic drugs, like; spectinomycin, paromomycin and streptomycin on the corrosion performance of zinc metal in hydrochloric acid environment was studied by [20], using some electrochemical and gravimetric techniques. The percentage of inhibition efficiency was discovered to be increasing as the concentration of drug increases but decreases with temperature. It has been discovered that majority of the drugs used display vital roles in biological reactions due to their antibacterial, anticonvulsant, antidiabetic, and other properties [21,22]. Phenylephrine [23] is an antibiotic drug. It’s present in the formulations of several vasopressin medicines, in eye-washes, in medicines for relief of congestion, and in syrups. It’s a crystalline white or pale yellow salt that is fairly soluble in water.

The aims of this study is to examine the inhibition possibility of aluminum alloy (2024) corrosion in molar hydrochloric acid solution using phenylephrine drug by weight loss and computational methods. The temperature effect on the corrosion rate was studied in the extent of temperatures from 293 to 303 K. The adsorption thermodynamic parameters, such as enthalpy of adsorption, $\Delta H_{ads}$, entropy change of adsorption, $\Delta S_{ads}$, and adsorption of free energy change, $\Delta G_{ads}$, were determined.

### Experimental

**Inhibitor**

The IUPAC nomenclature of Phenylephrine drug is Benzene- methanol, 3- hydroxy- $\alpha$[(methylamino)methyl]-hydrochloride (R)[24], and it’s molecular formula (C$_9$H$_{10}$O$_2$N ) and weight of molecular structure of 368 g/mol. The chemical and optimized structures are shown in Scheme 1.

The Capsules of phenylephrine was obtained from Samarra Drugs Industry (SDI) with a purity exceeding 99% under the trade name “phenylephrine hydrochloride”. Different drug concentrations were prepared by dissolving appropriate weights of the phenylphrine in 50 ml of 1M HCl solution.

**Corrosion medium**

The aggressive 1 M HCl solution to be prepared by diluting the analar grade of 37% HCl with distilled water. The concentration of the drug solutions (inhibitor) ranges from (100 ppm) to (500 ppm) were prepared and used.

**Aluminum alloy (2024) Specimen**

Al2024 alloy have the following chemical compositions as (wt%) (Cr 0.1%), (Mn 0.3-0.9%), (Zn 0.25%), (Si 0.5%), (Fe 0.5%), (Cu 3.8-4.9%), (Mg 1.2-1.8%) and balance Al. Circular shape samples of Al2024 alloys were mechanically cut with dimensions of 2.5 cm diameter and 0.5 mm thickness was used in this study. Prior to each experiment, the test specimens were polished with emery silicon carbide paper in different grades (320, 500, 1000, 2400, 4000) with diamond product sprays that contain ethanol with different size of the diamond particles (1μm, 3μm, 6μm, 9μm), then washed with acetone and finally rinsed with distilled water and keep in a desiccator for further use.

![Scheme 1. Chemical and optimized Structure of Phenylephrine drug.](image-url)
**Weight Loss Experiment**

Weight loss experiments were done under total immersion using 200 mL capacity beakers containing 100 mL 1M HCl solutions at 293–303 K maintained at thermostat with an accuracy of ±0.01 °C. The Al2024 alloy specimens were weighed and immersed in the beaker with the help of another smaller beaker with a capacity of 10 ml. The specimens were recaptured at half hour interval gradually for three hours, washed thoroughly in distilled water, dried with acetone, and then weighed again. The losses in weight, in mg, was taken as the difference in the weight of the Al2024 alloy specimens before and after flooding in different test solutions.

The corrosion rate (C_R) was determined using the following equation[25]:

\[
C_R (\text{mg/cm}^2 \cdot \text{h}) = \frac{(w \times A \times t)}{d} \quad \text{....(1)}
\]

where (w) is the average losses of weight for Al2024 alloy, the represents the surface area of an alloy, (t) is the flooding period in hour, (d) is the density of aluminum which is in g cm\(^{-3}\), inhibition efficiency (IE%) obtained by using the relation[25]

\[
\text{IE%} = \left(1 - \frac{C_R}{C_{R}^{o}}\right) \times 100 \quad \text{....(2)}
\]

C_R and C_{R}^{o} are respectively, the corrosion rate of Al2024 alloy specimen in the absence and presence of different concentrations of Phenylphrine as well as, in different temperatures of 293, 298 and 303 K. An expression of \((1 - C_R / C_{R}^{o})\) was used to determine the surface coverage (θ) of aluminum alloy (2024) by inhibitor molecules.

**Computational Details**

Gaussian 03 software were used for quantum chemical calculations. The Phenylphrine structure has been used as the performer one for theoretical studies. Density Functional Theory (DFT) was provided the Phenylphrine optimized structures which involve the Backe’s three Parameter hybrid functional and Lee-Yang-Paar Correlation functional (B3LYP) with 6–31G basis set. The evaluated parameters were: energy (TE), the highest filled molecular orbital energy (E_{HOMO}), the lowest unfilled molecular orbital energy (E_{LUMO}), the energy gap between E_{LUMO} and E_{HOMO} (ΔEgap), dipole moment (μ), The number of electrons transferred from the molecule to the surface (ΔN).

**Results and Discussion**

**Weight Loss Method**

**Effect of Inhibitor concentration**

The inhibitive effect of Phenylphrine addition at various concentrations on the Al2024 alloy corrosion in (1 M) HCl at varying temperatures at the range of 293 to 303 K were studied chemically using weight loss measurements. The obtained parameters from this study such as the corrosion rate (C_R) and protection efficiency (PE %) are tabulated in Table 1. The C_R values of Al2024 alloy in 1 M HCl decreases, while the PE values increases as increasing the concentrations of an inhibitor in 1 M HCl solution. At 500 ppm concentration, Phenylphrine exhibit maximum PE of 83.92%, which represent satisfactory inhibition ability. This behavior can be attributed to the adsorption and the coverage of the studied inhibitor on Al2024 alloy surface.

**TABLE 1.** Corrosion rate (C_R), Inhibition Efficiency (IE%) and Surface Coverage (θ) of Al2024 alloy corrosion in 1M HCl solution in the absence and presence of various concentrations of Phenylphrine drug at 3 hour immersion and at various temperatures in the range 293-303 K.

<table>
<thead>
<tr>
<th>Inhibitor conc./ppm</th>
<th>C_R (mg/cm^2.h)</th>
<th>IE %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>293</td>
<td>298</td>
</tr>
<tr>
<td>Blank</td>
<td>0.698</td>
<td>1.324</td>
</tr>
<tr>
<td>100</td>
<td>0.327</td>
<td>0.503</td>
</tr>
<tr>
<td>200</td>
<td>0.269</td>
<td>0.412</td>
</tr>
<tr>
<td>300</td>
<td>0.267</td>
<td>0.286</td>
</tr>
<tr>
<td>400</td>
<td>0.224</td>
<td>0.273</td>
</tr>
<tr>
<td>500</td>
<td>0.194</td>
<td>0.2256</td>
</tr>
</tbody>
</table>
The data obtained regarding the corrosion rate of Al2024 alloy in 1M HCl without and with varying concentrations of phenylphrine drug indicates that the rate of corrosion was decreased with the various concentrations of phenylphrine with the smallest quantity given at 500 ppm of phenylphrine that used at all temperatures that studied. Further examination in the table showed that the rate of corrosion of Al2024 alloy when the phenylephrine was presence increases as the temperature increases.

Figure 1 a, b and c are respectively, represent a plots of weight loss versus immersion time for Al2024 alloy in (1 M) HCl solution when the various concentrations of phenylphrine drug absence or presence at (293) to (303) K. It is clear from the plots that the weight loss of 2024 alloy in the different test media increases with time and decreases with increasing phenylphrine concentration. The non linearity of the weight loss curves plot may be indicates that the corrosion process of Al2024 alloy is heterogeneous and involving many steps. On the other hand, plots show that loss of weight for the 2024 alloy when addition of phenylphrine was depended on the concentration, that the loss of weight decrease as concentration of phenylphrine increase.

Inspection of temperature dependence of inhibition efficiency in the presence of inhibitor gives some insight into the possible mechanism of inhibitor adsorption [26]. Inhibition efficiency increase with increasing in temperature is may be attributed to the indicative with formation of adsorbed chemical layer, while inhibition efficiency decrease with an increase in temperature is revealed to mechanism of physical adsorption [26,27]. The inhibition efficiency was found to increase with increase in temperature as shown in figure 3. This trend in inhibition efficiency with temperature obtained suggesting chemical adsorption of the phenylphrine molecules on the Al2024 alloy surface.

Temperature Effect on Corrosion Rate

For corrosion reaction that in which corrosion rate increases with an increase in temperature, kinetics parameters were calculated by using Arrhenius equation [28].
log \( C_{r} = \log A - \frac{E_{a}}{RT} \) ....(3)

where \( C_{r} \) is corrosion rate, \( A \) and \( E_{a} \) are the pre-

exponential factor and energy of activation of the 
corrosion process respectively, \( R \) is constant of the 
gas in Joule and \( T \) the absolute temperature. A plot 
of (\( \log C_{r} \)) versus (1/T) for Al2024 alloy corrosion 
at (1 M) HCl if the various concentrations of 
phenylphrine is absence and presence that shown 
in Figure 4, linear relations were given. The \( E_{a} \) 
values were then tabulated at the table 3. From the 
data tabulated in the table, it is obviously seen that the \( E_{a} \) values were greater than 20 kJ mol\(^{-1}\) in the 
absence and presence of the inhibitor compoun, 
indicating that the corrosion reaction is surface 
controlled [29], \( E_{a} \) in the presence of inhibitors 
is lower than that in the uninhibited solution, this 
indicate that the corrosion reaction of 2024 alloy is 
inhibited by chemical adsorption of phenylephrine 
molecules on alloy surface [30]. Lower values of \( E_{a} \) 
when the inhibitor is present can be accumulated with 
decreasing the double layer thickness which 
impairs the \( E_{a} \) of the corrosion reaction [31]. It is an 
indication of a strong inhibitive effect of inhibitors 
by increasing energy barrier for the corrosion 
reaction, this emphasize that the chemical nature of the 
phenylephrine molecules adsorbed on 
the surface of Al2024 alloy [32]. Moreover, the 
values of \( E_{a} \) Confirm the electrostatic nature of the 
absorbing inhibitor on the surface of Al2024 alloy. 
Again, the observed decrease in activation energy 
phenomenon, \( E_{a} \), at the highest efficiency of the 
inhibitor may arise from the transformation from 
a net corrosion reaction from that on the exposed 
surface to one that involves adsorbing locations 
[33].

Entropy of activation, \( \Delta S^{*} \) and enthalpy of 
activation, \( \Delta H^{*} \) were obtained from the Arrhenius 
transition state equation [34].

\[
\log \left( \frac{C_{r}}{T} \right) = \log \left( \frac{R}{Nh} \right) + \log \left( \frac{\Delta S^{*}}{2.303R} \right) - \log \left( \frac{\Delta H^{*}}{2.303RT} \right)
\] ....(4)

where \( N \) is the Avogadro’s number, \( h \) is the 
Planck’s constant. A plot of log (CR/T) as a 
function for (1/T) was made for Al2024 alloy in 
(1 M) of HCl in the absence and presence of vary 
concentrations of phenylphrine. From drawing 
straight lines are found, the slope is -\( \Delta H^{*} /R \) and 
the intercept is (\( \log R/Nh + \Delta S^{*}/2.303R \)) from 
which the \( \Delta H^{*} \) and \( \Delta S^{*} \) values are computed and 
put them in table 4. If \( \Delta H^{*} \) have positive sign 
denote the endothermic nature of the corrosion 
process suggesting that the dissolution of 2024 
alloy is decelerate and slow. Also, lower values of 
\( \Delta H^{*} \) in the presence of phenylephrine molecules 
indicate that the inhibition efficiencies increase 
with increase in temperature [35]. On the other 
hands, the large negative value of \( \Delta S^{*} \) in the 
presence of inhibitor revealed that the formation 
of activated complex is the rate determining step, 
rather than the dissociation step. In the presence 
of the inhibitor, the values of \( \Delta S^{*} \) decreases and is 
generally interpreted as an increase in order as the 
reactants are converted to the activated complex 
[36]. It was also observed that small amount 
addition of phenylephrine to the acidic solution 
change the \( \Delta S^{*} \) (without presence of inhibitor) to 
a less negative values which reduces the corrosion 
rates. This observation can considered as indirect 
guide to support the proposed inhibition mechanism.
Fig. 3. Arrhenius plot for aluminum alloy (2024) corrosion in 1 M HCl in the absence and presence of different concentrations of phenylpherine drug.

Fig. 4. Transition state plot for Al2024 alloy corrosion in 1 M HCl in the absence and presence of various concentrations of phenylpherine drug.

TABLE 2. Activation energy (E_a), Pre-exponential factor (A), activation enthalpy (ΔH*), and the entropy of activation (ΔS*) of Al2024 alloy corrosion in (1 M) hydrochloric solution with the presence or not presence of varies concentrations of phenylpherine drug at range of temperatures from 293 K To 313 K.

<table>
<thead>
<tr>
<th>Inh. Conc. (ppm)</th>
<th>E_a (kJ.mol⁻¹)</th>
<th>A10²⁵× (molecules.cm².s⁻¹)</th>
<th>ΔH* (kJ.mol⁻¹)</th>
<th>-ΔS* (J.K⁻¹.mol⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>32.47</td>
<td>3.713</td>
<td>22.67</td>
<td>69.81</td>
</tr>
<tr>
<td>100</td>
<td>16.80</td>
<td>2.693</td>
<td>14.93</td>
<td>136.66</td>
</tr>
<tr>
<td>200</td>
<td>15.78</td>
<td>2.571</td>
<td>13.46</td>
<td>154.89</td>
</tr>
<tr>
<td>300</td>
<td>14.73</td>
<td>2.433</td>
<td>12.74</td>
<td>155.56</td>
</tr>
<tr>
<td>400</td>
<td>13.23</td>
<td>2.250</td>
<td>12.59</td>
<td>158.54</td>
</tr>
<tr>
<td>500</td>
<td>13.02</td>
<td>1.698</td>
<td>12.07</td>
<td>163.84</td>
</tr>
</tbody>
</table>

**Langmuir isotherm analysis**

In order to investigate the adsorption behavior of the Phenylephrine drug on Al2024 alloy surface, Langmuir isotherm was applied on the experimental data. The best fit obtained for results supposes that the surface of Al2024 alloy contains a constant number of sites of adsorption and every site carried one adsorbed sort [37]. Langmuir isotherm suggests that each site holds one adsorbed species and can be represented by Equation

\[
K_{\text{ads}} = \theta / [C (1-\theta)], \quad \ldots (5)
\]

The equilibrium adsorption constant (\(K_{\text{ads}}\)) and the Gibbs free energy at standard circumstances (\(\Delta G_{\text{ads}}^o\)) for adsorption values which, respectively, obtained by using the following relations,

\[
\Delta G_{\text{ads}}^o = -RT \ln (55.5 K_{\text{ads}}) \quad \ldots (6)
\]

where 55.5 represents the concentration of water in solution. A plot of concentration of phenylphrine (C) versus C/θ data leads to a longitudinal line for R² quantity that is almost equal to one as showed in Figure 6. This suggested that adsorption of phenylphrine drug obeyed Langmuir isotherm. The adsorption parameters were presented in Table 5. It is seen from the table that the \(K_{\text{ads}}\) values increases with increasing temperature showed that phenylphrine compound was chemically reacted with surface of the Al2024 alloy. It is also own that when the \(\Delta G_{\text{ads}}^o\) values reached (-20) kJ mol⁻¹ propose permanently adsorption that called physical adsorption then reach (-40) kJ mol⁻¹ propose permanent adsorption that is called chemical adsorption. The average quantities of \(\Delta G_{\text{ads}}^o\) to phenylphrine drug is (-31.53) kJ mol⁻¹, denoted that the inhibitor when adsorbed on the surface of Al 2024 alloy to became general a chemical adsorption [38].

A \(\Delta S_{\text{ads}}\) and \(\Delta H_{\text{ads}}\) values were determined, respectively by a slope and linear plot of intercept of \(\Delta G_{\text{ads}}\) against different temperatures (T) for the corrosion of Al2024 alloy in 1 M HCl as shown in figure 7, and data obtained are put in table 5. The values of \(\Delta H_{\text{ads}}\) are positive indicates the adsorption process is an endothermic one. Generally, for endothermic process, by considering the value of \(\Delta H_{\text{ads}}\) in order to differentiated between chemical and physical adsorption. For physical adsorption process, the enthalpy of adsorption is lower than (41) kJ mol⁻¹ while that for chemical adsorption approaches 100 kJ mol⁻¹ [39]. \(\Delta H_{\text{ads}}\) value of phenylphrine is 81.42 kJ mol⁻¹ indicate a chemical adsorption of this inhibitor on alloy surface. The adsorption of inhibitor molecules is accompanied by positive values of \(\Delta S_{\text{ads}}\).

**Mechanism of corrosion and inhibition**

The mechanism of aluminum and its alloys corrosion in hydrochloric acid medium was explained based on the proposed mechanism. Due to this mechanism, the anodic and cathodic reactions can be expressed as:

\[
\begin{align*}
A1_{(s)} & \rightarrow A1^{3+} + 3e & \quad \text{(oxidation)} \\
2H^+ + 2e & \rightarrow H_2(g) & \quad \text{(reduction)}
\end{align*}
\]

The overall electrochemical reaction is

\[
2A1 +6H^+ \rightarrow 2A1^{3+} + 3H_2(g)
\]

The chemisorbed hydrogen atoms produce from cathode reaction when selecting the electron which be free in the oxidation reaction, \(H^+ + e = H_{\text{adsorbed}}\) in corrosion of aluminum in hydrochloric acid. In similar acidic media, chemisorbed hydrogen atoms that appear on the aluminum roof are interacts with adsorbed hydrogen atom to obtain hydrogen gas on the roof of aluminum. Small amount of the unreacted adsorbed hydrogen atoms will still uncombined; So, this quantity does not effect on the process. Conformable data gave it for the rates of corrosion that calculated from the method of weight loss which shown in Table 1.

It is well known [40] provided that an inhibitor can effect on the rate of corrosion of metals in a corrosive medium if it is capable to effect on the kinetics of dissolution or change electrochemical behavior position. This behavior is occurring when the inhibitor formed as thin film at a surface of the metal by the processes of adsorption. The formation of this film is usually resulted by adsorption for anionic inhibitors at positive locations produced at aluminum roof which resulting by resealed of electrons at the oxidation process. The protective coating film will separate a metal of aluminum from the medium which corrosive and, keeps more aluminum atoms from departure the metal roof to the medium which decreased the rate of corrosion. As a result, the oxidation interaction may be regarded as the rate-determining step in the corrosion reaction.

Khairou and El-Sayed [41] found that a rate of corrosion decreases when the inhibitor molecules contained hydroxyl groups, as these groups have...
Fig. 5. Langmuir adsorption isotherm model for Al2024 alloy in 1 M HCl containing phenylephrine at different temperatures in the range 293-303 K.

Fig. 6. Gibbs free energy of adsorption versus temperature for Al2024 alloy in 1 M HCl containing phenylephrine drug.

TABLE 3. Thermodynamic parameters for adsorption of the Phenylephrine drug on the surface of Al2024 alloy in 1M HCl solution.

<table>
<thead>
<tr>
<th>T (K)</th>
<th>$R^2$</th>
<th>$K_{ads}$ (M$^{-1}$)</th>
<th>$\Delta G_{ads}$ (kJ.mol$^{-1}$)</th>
<th>$\Delta H_{ads}$ (kJ.mol$^{-1}$)</th>
<th>$\Delta S_{ads}$ (J.K$^{-1}$.mol$^{-1}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>293</td>
<td>0.9997</td>
<td>3468.80</td>
<td>29.64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>298</td>
<td>0.9997</td>
<td>6604.72</td>
<td>31.74</td>
<td></td>
<td>81.42</td>
</tr>
<tr>
<td>303</td>
<td>0.9998</td>
<td>11061.95</td>
<td>33.57</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

INHIBITION STUDIES OF ALUMINIUM ALLOY (2024) CORROSION IN ACID

...where the high value of it indicates a high ability to give electrons while $E_{\text{LUMO}}$ indicates the ability of the compound to accept electrons and therefore the ability of compounds increases with increase $E_{\text{HOMO}}$ and decrease of $E_{\text{LUMO}}$ and $\Delta E$ [44]. In this work, the results obtained indicate that the compound is a good inhibitor. The dipole moment of the molecule is a good parameter to describe the polarity [45]. Thus, inhibitor with higher dipole moment value refers to large ability of it to be adsorbed on the metal surface [16]. The estimated value of the dipole moment of phenylephrine is 3.0546 Debye and this value is more than the dipole moment of water (1.88 D).

The number of electrons that transferred from the inhibitor molecules to the metal surface is defined by $\Delta N$ which shows the inhibition efficiency[47]. Depending to researchers [48], if the estimated value of $\Delta N$ is lower than 3.6, so this indicates that the inhibition efficiency increase with increasing the ability of electron donating of the inhibitor molecules to the surface of a metal. The value of $\Delta N$ is -0.017025 as shown in Table 4, this indicates that the phenylephrine molecules is electron donors to the surface of the (2024) aluminum alloy which is an acceptor. The obtained data from theoretical quantum chemical calculations relieves good evidence to the obtained experimental results by weight loss technique.
TABLE 4. The parameters of quantum chemical
Calculated for inhibitor compound

<table>
<thead>
<tr>
<th>parameters</th>
<th>Inhibitor compound</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E_{\text{HOMO}}$ (eV)</td>
<td>-6.0993</td>
</tr>
<tr>
<td>$E_{\text{LUMO}}$ (eV)</td>
<td>-0.1170</td>
</tr>
<tr>
<td>$\Delta E_{\text{LUMO-HOMO}}$ (eV)</td>
<td>5.9823</td>
</tr>
<tr>
<td>dipole moment (μ)</td>
<td>3.0546</td>
</tr>
<tr>
<td>$E_\pi = - E_{\text{HOMO}}$</td>
<td>6.0993</td>
</tr>
<tr>
<td>$E_\sigma = - E_{\text{LUMO}}$</td>
<td>0.1170</td>
</tr>
<tr>
<td>η</td>
<td>2.99115</td>
</tr>
<tr>
<td>S</td>
<td>0.33432</td>
</tr>
<tr>
<td>Z</td>
<td>3.10815</td>
</tr>
<tr>
<td>W</td>
<td>0.49139</td>
</tr>
<tr>
<td>ΔN</td>
<td>-0.017025</td>
</tr>
</tbody>
</table>

Conclusion

Based on the results obtained from this study, the following conclusions obtained:

- Various concentrations of phenylephrine drug were used successfully as corrosion inhibitors for Al 2024 alloy in HCl solution at different temperatures in the range 293-313 K.
- Corrosion current density data were decreased significantly with increasing of the phenylephrine drug concentration and increase with increasing studied temperature.
- The inhibition efficiencies of this inhibitor increase with increasing both concentration and temperature indicating chemical adsorption mechanism of drug molecules on aluminum surface.
- The kinetic results confirmed the chemical adsorption of phenylephrine drug on aluminum surface.
- Adsorbed phenylephrine drug molecules on the surface of Al2024 alloy obey Langmuir isotherm adsorption.
- A good agreement was obtained between theoretically calculated parameters and experimentally determined inhibition efficiencies for corrosion process of phenylephrine drug in HCl solution by using density function theory.

References

INHIBITION STUDIES OF ALUMINIUM ALLOY (2024) CORROSION IN ACID ...


 دراسة امتزاز و تثبيط دواء الفنيلفرين على تآكل سبيكة الالمنيوم (2024) في محلول حمض الهيدروكلوريك المولاري. تؤدي زيادة تركيز الفنيلفرين ودرجة الحرارة إلى زيادة كفاءة تثبيط الفنيلفرين. تتيح امتزاز الفنيلفرين على سطح سبيكة الالمنيوم نموذج لانكماشر آزونيوم. تم إثبات آلية تثبيط عن طريق الاختبارات التي تم الحصول عليها من البيانات التجريبية. تظهر صورة المجهر الالكتروني سطحًا ناعمًا لسبيكة الالمنيوم في وجود الفنيلفرين في محلول الحامضي. تم استخراج الحساب الكيميائي الكمي لربط بيانات كفاءة تثبيط الفنيلفرين مع التحاليل النظرية. تدعم الحسابات النظرية النتائج التجريبية وتوضح آلية العمل.

تم استخدام طريقة فقدان الوزن للتحقيق في سلوك تثبيط وامتصاص عقار فينيلفرين لسبيكة الالمنيوم 2024 في محلول واحد مولاري من حمض الهيدروكلوريك في مدى درجات الحرارة 303-293 كلفن. تشير النتائج التي تم الحصول عليها إلى أن فينيلفرين يعمل كمثبط نشط لسبيكة الالمنيوم 2024 في محلول حمض الهيدروكلوريك المولاري. تؤدي زيادة تركيز الفنيلفرين ودرجة الحرارة إلى زيادة كفاءة تثبيط الفنيلفرين على سطح سبيكة الالمنيوم المولاري. تدعم امتزاز الفنيلفرين على سطح سبيكة الالمنيوم نموذج لانكماشر آزونيوم. تم إثبات آلية تثبيط عن طريق الاختبارات التي تم الحصول عليها من البيانات التجريبية. تظهر صورة المجهر الالكتروني سطحًا ناعمًا لسبيكة الالمنيوم في وجود الفنيلفرين في محلول الحامضي. تم استخراج الحساب الكيميائي الكمي لربط بيانات كفاءة تثبيط الفنيلفرين مع التحاليل النظرية. تدعم الحسابات النظرية النتائج التجريبية وتوضح آلية العمل.