Journal of Materials and Environmental Science
ISSN : 2028-2508
e-ISSN : 2737-890X
CODEN : JMESCN

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J. Mater. Environ. Sci., 2024, Volume 15, Issue 4, Page 579-594
http://www.jmaterenvironsci.com

Synergistic Effect of Iodide Ions on the Corrosion Inhibition of *Commelina Diffusa* Leaf Extract on Mild Steel in H_2SO_4 Solution

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Received *24 Mar 2024,*
Revised *15 Apr 2024,*
Accepted *16 Apr 2024*

Keywords:
- ✓ *Commelina diffusa,,*
- ✓ *iodide ions;*
- ✓ *Synergism,*
- ✓ *Physisorption*
- ✓ Langmuir isotherm

Citation*: Abakedi O. U., Aduak E. E., Anweting I. B. (2024) Synergistic effect of iodide ions on the corrosion inhibition of Commelina diffusa leaf extract on mild steel in H_2SO_4 solution J. Mater. Environ. Sci., 15(4), 579-594*

Abstract: The inhibition of corrosion of mild steel in 1 M H_2SO_4 solution in the presence of *Commelina diffusa* leaf extract (CE) and the effect of addition of potassium iodide to the extract (CE + 0.005 M KI mixtures) was investigated using weight loss and hydrogen evolution methods. Weight loss data reveal that the inhibition efficiency increases with increase in the concentration of CE and CE + 0.005 M KI, respectively. At 30 °C, the inhibition efficiency for CE followed the order: 1 g/L CE (86.46%) < 2 g/L CE (90.16%) < 3 g/L (91.93%) < 4 g/L CE (93.13%) while CE + 0.005 M KI mixtures increased in the order: 1 g/L CE + 0.005 M KI (88.15%) < 2 g/L CE + 0.005 M KI (91.61%) < 3 g/L CE + 0.005 M KI (92.81%) < 4 g/L CE + 0.005 M KI (94.24%). The inhibition efficiencies in the presence of CE + 0.005 M KI mixtures are higher than the corresponding CE, indicating a synergistic effect between CE (extract) and the iodide ions. The inhibition efficiencies decrease with increase in temperature. Hydrogen evolution studies indicate a drastic reduction in the volume of hydrogen gas evolved in the presence of CE + 0.005 M KI mixtures compared to the blank, CE and 0.005 M KI. Physical adsorption process has been proposed for the adsorption of CE and CE + 0.005 M KI mixtures onto mild steel surface. The calculated ΔH_{ads} values reveal the endothermic nature of the corrosion inhibition process. The adsorption of both CE and CE + 0.005 M KI mixtures onto mild steel surface obeyed the Langmuir adsorption isotherm

1. Introduction

The negative impact of corrosion on metals and alloys is well known to all and sundry. There are many methods of controlling the corrosion of metals (El Hajjaji *et al.*, 2023). However, the most cost – effective method of retarding the corrosion rates of metals and alloys deployed in aggressive environments is the use of corrosion inhibitors (Abakedi and Moses, 2016). Recently, natural compounds are employed as inhibitors in order to develop new cleaning chemicals for green environment. The use of these natural products such as extracted compounds from leaves or seeds as corrosion inhibitors have been highly promoted nowadays due to their eco – friendliness, biodegradability, low cost, and availability.

Some potential green inhibitors of mild steel corrosion in acidic medium extracted from plants include *Bifurcaria bifurcata extract* (Abboud *et al.,* 2009), *Lawsonia Inermis* (Nick *et al.,* 2011), *Argania spinosa Kernels Extract* (Afia *et al.,* 2011), *Kola nitida* seed extract *Lawsonia Inermis Chamaerops humilis L.* fruit extract (Fekkar *et al.,* 2020), *Microdesmis puberula* root extract (Abakedi, 2017a), *Piliostigma thoningii* extract (Sanusi *et al.,* 2024), *Chromolaena odorata* leaf extract (Mbamalu and Chinedu, 2023) and *Citrus sinensis* seed extract (Abakedi and Anweting, 2024). It has been reported that the addition of halide ions to some plant extracts enhanced their corrosion inhibition efficiencies. Some plant extract – halide mixtures that led to an enhancement (synergism) in the inhibition efficiencies of mild steel in acidic medium include *Sida acuta* leaves extract – iodide ions (Eduok *et al.,* 2012), *Chicoriumintybus* extract – iodide ions (El-Katori *et al.,* 2020), *Abelmoschus esculentus* seed extract – chloride ions (Priya *et al.,* 2013), coconut coir dust extract – iodide ions (Umoren *et al.,* 2014), and rice husk extract – iodide ions (Primidita *et al.,* 2019). *Justicia carnea* leaf extract (Ahanotu *et al.,* 2024),

Commelina diffusa is a medicinal plant belonging to the family Commelinaceae. It is called climbing dayflower in English language while the Efik people of Nigeria call it Ekpa – Ekpa Ikpaha. *C. diffusa* extracts have been reported to possess anti – inflammatory (Prima *et al.,* 2019), anti-bacterial (Oulowagbenga, 2017), antioxidant (Mensah *et al.,* 2006) and anti – fungal (Oulowagbenga, 2017) activities. The traditional medicinal uses and pharmacological importance of *C. diffusa* have been documented (Prima *et al.,* 2019; Rahman *et al.,* 2021). Preliminary phytochemical screening of *C. diffusa* leaf extract indicates the presence of ketonic compounds, anthraquinones, terpenoids and alkaloids (Khan *et al.,* 2011). Previous studies (Abakedi and Ekpo, 2017) (revealed that *Commelina diffusa* leaf extract is a good inhibitor of aluminium corrosion in acidic medium. The aim of this work is to assess the joint effect of *Commelina diffusa* leaf extract and iodide ions as mild steel corrosion inhibitor in 1 M H_2SO_4 solution.

Figure 1: Commelina diffusa plant

2. Methodology

2.1 Test Materials

The mild steel sheet used for this work had the following chemical composition (w/w %): Fe (98.83), C (0.12), Mn (0.85), S (0.06), Si (0.09) and P (0.05), it was mechanically press – cut into 4 cm x 5 cm coupons with a small hole near the upper edge for inserting of glass hooks. Each coupon had a total surface area of 40 cm^2. The coupons were polished to mirror finish by braiding with different grades of silicon carbide papers. They were degreased in ethanol, dipped into acetone and air – dried before storage in a dry, airtight desiccator prior to use for corrosion studies.

2.2 Preparation of Commelina diffusa leaf extract

Fresh leaves of *Commelina diffusa* were collected within the premises of the University of Uyo, Nigeria. They were plucked, washed and shade – dried for seven days before being ground to powder. The dried ground samples of *C. diffusa* leaves were macerated with 90% ethanol for three days at room temperature in a large glass trough with cover. The mixture was then filtered. The filtrate was evaporated at 40 °C in a thermostatic water bath to dryness, leaving a dark green extract in the beakers.

Stock *C. diffusa* leaf extract (CE) concentration (5 g/L) was prepared by dissolving 5.00 g of the extract in 1 M H_2SO_4 solution and made up to the 1 L mark in a volumetric flask. Different leaf extract concentrations (1 g/L, 2 g/L, 3 g/L and 4 g/L) were prepared by serial dilution. Another reagent prepared was 0.005 M KI solution. Additionally, CE + KI mixtures (1 g/L CE + 0.005 M KI, 2 g/L CE + 0.005 M KI, 3 g/L CE + 0.005 M KI and 4 g/L CE + 0.005 M KI) were also prepared.

2.3 Weight loss method

Previously cleaned and weighed mild steel coupons were each suspended by glass hooks and completely immersed in 1 M H_2SO_4 solution (blank) in separate 100 cm^3 beakers maintained at 30 °C, 40 °C, 50 °C and 60 °C, respectively, in a thermostatic water bath. The coupons were retrieved from the corrodent after four (4) hours, scrubbed with bristle brush under running water. The coupons were then dipped into acetone and air – dried before reweighing. The weight loss was recorded. The next stage of the weight loss method involved the use of inhibitors, namely, CE (1 g/L, 2 g/L, 3 g/L and 4 g/L), 0.005 M KI, and CE + KI mixtures (1 g/L CE + 0.005 M KI, 2 g/L + 0.005 M KI, 3 g/L + 0.005 M KI and 4 g/L + 0.005 M KI). Similarly, one mild steel coupon per beaker was suspended by a glass hook and completely immersed in 100 cm^3 of 1 M H_2SO_4 solution containing different concentrations of the additives. Each coupon was retrieved from the corrodent after four (4) hours, washed and reweighed. The weight loss was also recorded.

The weight loss was used to calculate the inhibition efficiency $I_{wL}(\%)$ using the Eqn. 1:

$$I_{WL}(\%) = \left(\frac{W_0 - W_1}{W_0}\right) \text{ x } 100 \qquad \textbf{Eqn. 1}$$

where w_1 and w_0 are weight losses of mild steel coupons in 1 M H_2SO_4 solution with and without inhibitors, respectively.

The corrosion rate, CR (mg cm^{-2} hr^{-1}), of mild steel was obtained using Eqn. 2 (Abakedi *et al.*, 2020):

$$CR = \frac{W}{A.t} \qquad \textbf{Eqn. 2}$$

where W is the weight loss of mild steel coupon (mg), A is the surface area (cm^2) and t is the immersion time (hours).

2.4 Hydrogen evolution method

The gasometric assembly used for the hydrogen evolution studies was the same reported previously (Abakedi and Asuquo, 2016; Abakedi, 2017b). The corrodent was 100 cm^3 of 1 M H_2SO_4 solution (blank). The initial volume of air in the burette was recorded. Mild steel coupons (8 g) were dropped into the corrodent and the reaction vessel quickly corked to prevent leakage of hydrogen gas. The volume of hydrogen gas evolved from the corrosion reaction was recorded every 30 seconds for 20 minutes. Duplicate readings were taken. The experiment was repeated using CE (1 g/L, 2 g/L, 3 g/L and 4 g/L), 0.005 M KI, and CE + KI mixtures (1 g/L CE + 0.005 M KI, 2 g/L CE + 0.005 M KI, 3 g/L CE + 0.005 M KI and 4 g/L 0.005 M KI,), respectively, as inhibitors. The hydrogen evolution rate was calculated using Eqn. 3 (Okafor *et al.*, 2008):

$$R_H(cm^3min^{-1}) = \frac{V_1 - V_0}{t_1 - t_0} \quad \textbf{Eqn. 3}$$

where V_0 and V_1 are the volumes of hydrogen gas evolved (cm^3) at time t_0 and t_1 (min), respectively. The inhibition efficiency I_{HE} (%) was calculated using Eqn. 4 (Abakedi, 2017b):

$$I_{HE}(\%) = \left(\frac{RH_0 - RH_1}{RH_0}\right) \times 100 \quad \textbf{Eqn. 4}$$

where RH_0 and RH_1 are the hydrogen evolution rates (cm^3/min) in the absence and presence of inhibitors, respectively.

3. Results and Discussion

3.1 Effect of Commelina diffusa leaf extract concentration (CE) and iodide ions on inhibition efficiency.

A study of the effectiveness of mild steel corrosion inhibition in a 1 M H2SO4 solution revealed interesting information about the synergistic effect between *Commelina diffusa* leaf extract (CE) and iodide ions (KI).

The variation of inhibition efficiency with *Commelina diffusa leaf extract* (CE) concentrations for mild steel corrosion in 1 M H_2SO_4 solution by weight loss method is shown in Figure 2. It is evident that, at a constant temperature, the inhibition efficiency rises with the increment in extract concentration (Ita *et al.*, 2013).. This observation aligns with previous research indicating a direct correlation between inhibitor concentration and inhibition efficiency, suggesting a stronger interaction between the mild steel surface and the inhibitor. Table 1 presents the calculated corrosion rates and inhibition efficiencies for different concentrations of CE at various temperatures. Notably, at 30 °C, the inhibition efficiency increased progressively with CE concentration: from 86.46% for 1 g/L CE to 93.13% for 4 g/L CE. This trend indicates the increasing effectiveness of CE as a corrosion inhibitor with higher concentrations.

Similarly, Figure 3 illustrates the variation in inhibition efficiency with CE + KI mixtures for mild steel corrosion in 1 M H_2SO_4 solution. Remarkably, the addition of iodide ions to CE resulted in a significant improvement in inhibition efficiency compared to CE alone. Table 1 illustrates this synergistic effect, showing that the inhibition efficiencies of CE + KI mixtures exceeded those of CE alone at all concentrations and temperatures tested.

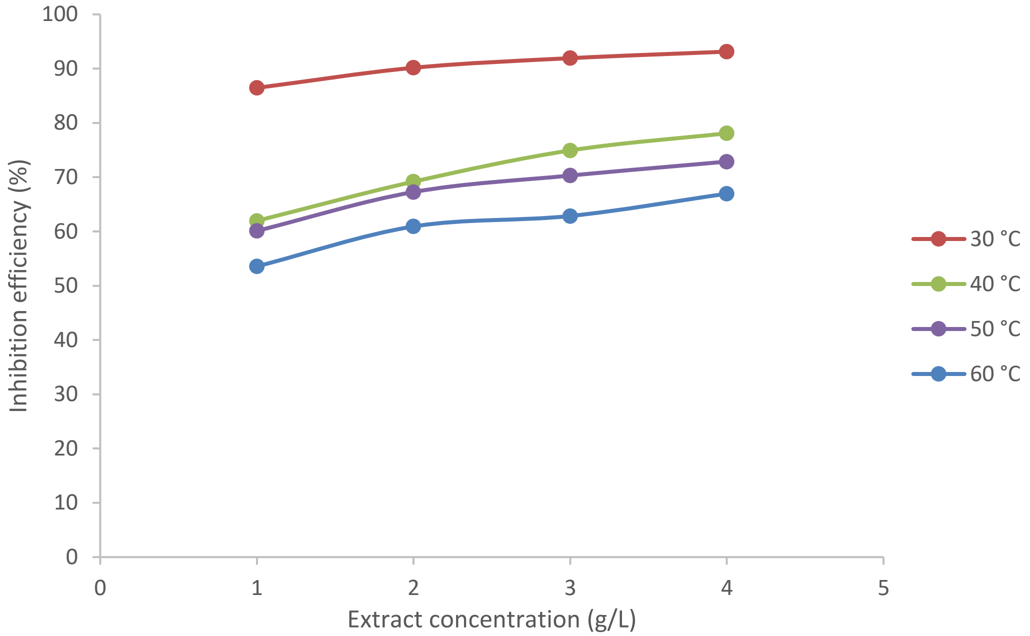


Figure 2: Variation of inhibition efficiency of *Commelina diffusa leaf extract* (CE) concentrations on mild steel corrosion in 1 M H_2SO_4 solution

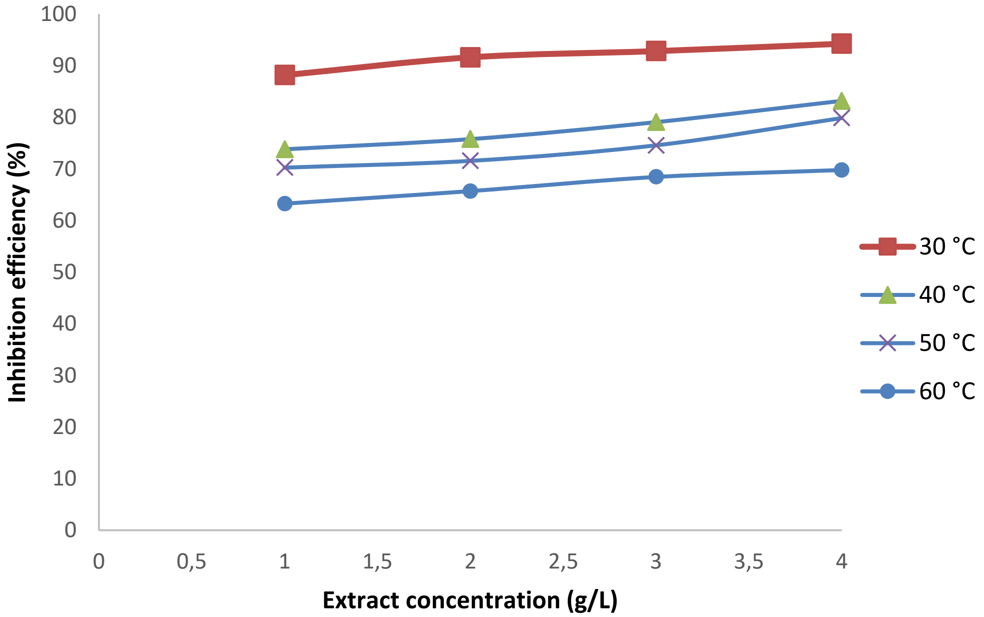


Figure 3: Variation of inhibition efficiency of CE + 0.005M KI mixture on mild steel corrosion in 1 M H_2SO_4 solution

For example, at 30 °C, the inhibition efficiency in the presence of CE followed the order: 1 g/L CE (86.46%) < 2 g/L CE (90.16%) < 3 g/L (91.93%) < 4 g/L CE (93.13%) while CE + KI mixtures increased in the order: 1 g/L CE + 0.005 M KI (88.15%) < 2 g/L CE + 0.005 M KI (91.61%) < 3 g/L

CE + 0.005 M KI (92.81%) < 4 g/L CE + 0.005 M KI (94.24%). The inhibition efficiencies in the presence of CE + KI mixtures are higher than the corresponding CE. This indicates that there was a synergistic effect between CE (extract) and the iodide ions. The synergistic effect observed between CE and iodide ions suggests a cooperative mechanism whereby iodide ions enhance the corrosion-inhibiting properties of CE on the mild steel surface. This phenomenon could be attributed to a number of factors, including improved adsorption characteristics, formation of a more stable protective layer or modification of the corrosion mechanism. Further research into the molecular interactions between CE constituents and iodide ions is warranted to elucidate the underlying mechanism.

Overall, the results indicate that the combined use of *Commelina diffusa* leaf extract and iodide ions is promising as an effective corrosion inhibition strategy for mild steel in acidic environments, offering enhanced protection compared to CE alone. These results contribute to the growing body of knowledge on green corrosion inhibitors, and underline the importance of synergistic approaches to corrosion prevention.

Table 1: Calculated values of corrosion rate and inhibition efficiency for mild steel in 1 M H_2SO_4 with 0.005M KI, *C. diffusa* leaf extract (CE), CE + 0.005M KI mixtures and blank at 30 °C – 60 °C

System	**Corrosion rate (mg cm^{-2} hr^{-1})**				**Inhibition efficiency (%)**			
	30 °C	40 °C	50 °C	60 °C	30 °C	40 °C	50 °C	60 °C
1 M H_2SO_4 (Blank)	2.40	4.77	6.18	11.94	-	-	-	-
0.005 M KI	0.63	1.38	1.87	4.63	73.65	71.15	69.66	61.21
1 g/L CE	0.33	1.81	2.46	5.54	86.46	61.96	60.11	53.57
2 g/L CE	0.23	1.47	2.02	4.67	90.16	69.18	67.27	60.92
3 g/L CE	0.19	1.20	1.84	4.44	91.93	74.93	70.30	62.85
4 g/L CE	0.17	1.05	1.68	3.95	93.13	78.09	72.87	66.96
1 g/L CE + 0.005M KI	0.28	1.25	1.84	4.39	88.15	73.79	70.24	63.26
2 g/L CE + 0.005M KI	0.20	1.16	1.76	4.10	91.61	75.76	71.55	65.69
3 g/L CE + 0.005M KI	0.17	0.99	1.57	3.77	92.81	79.05	74.56	68.43
4 g/L CE + 0.005M KI	0.14	0.80	1.25	3.60	94.24	83.18	79.84	69.78

3.2 Hydrogen evolution measurements

The assessment of hydrogen evolution provides additional insights into the corrosion inhibition performance of *Commelina diffusa* leaf extract (CE) and potassium iodide (KI) individually and in combination. The volume of hydrogen gas evolved for mild steel corrosion in 1 M H_2SO_4 solution in the presence and absence of different concentrations of CE are shown in Figure 4 while Figure 5 illustrates the volume of hydrogen gas evolved in the presence and absence of 0.005M KI and CE + 0.005M KI mixtures. It is evident in Figure 4 that the volume of hydrogen gas evolved in the blank was more than that in the presence of CE. Additionally, the higher the CE concentration, the lower the volume of hydrogen gas evolved. Figure 5 reveals a reduction in the volume of hydrogen gas evolved in the presence of 0.005M KI and CE + 0.005M KI mixtures, respectively, relative to the blank. This indicates that the additives (0.005M KI, CE, and CE + 0.005 M KI) inhibited the corrosion of mild steel in the aggressive medium. Table 2 contains the calculated values of inhibition efficiencies for mild steel corrosion in 1 M H_2SO_4 solution in the presence of the respective additives. It is worth noting that the inhibition efficiencies in the CE + KI mixtures are higher than their individual KI and CE counterparts, thus revealing an enhancement of the inhibition efficiencies by CE + KI mixtures compared to those of CE and KI. The inhibition efficiencies by the hydrogen evolution method follow a similar trend as those of the weight loss method.

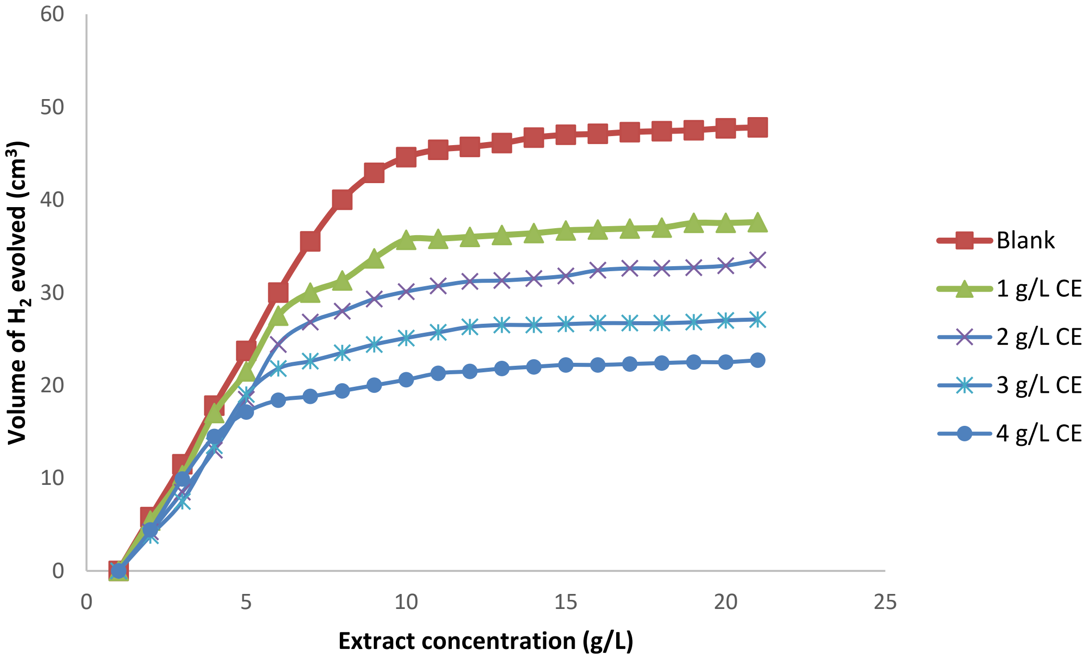


Figure 4: Variation of volume of H_2 gas evolved (cm^3) against time (min) on mild steel corrosion in 1 M H_2SO_4 in the absence and presence of different concentrations of CE at 30 °C

3.3 Effect of temperature on inhibition efficiency

The effect of temperature on the corrosion inhibition process was assessed by carrying out the weight loss measurements in the temperature range of 30 °C – 60 °C in 1 M H_2SO_4 solution in the absence and presence of various concentrations of CE and CE + 0.005 M KI mixtures, respectively. The results obtained are presented in Table 1. It is observed that the inhibition efficiencies decrease with increase in temperature at all concentrations of CE and CE + KI mixtures, respectively. This indicates that the compounds were better corrosion inhibitors for mild steel at lower temperatures than at higher temperatures, which is an indication of a physical adsorption (physisorption) process.

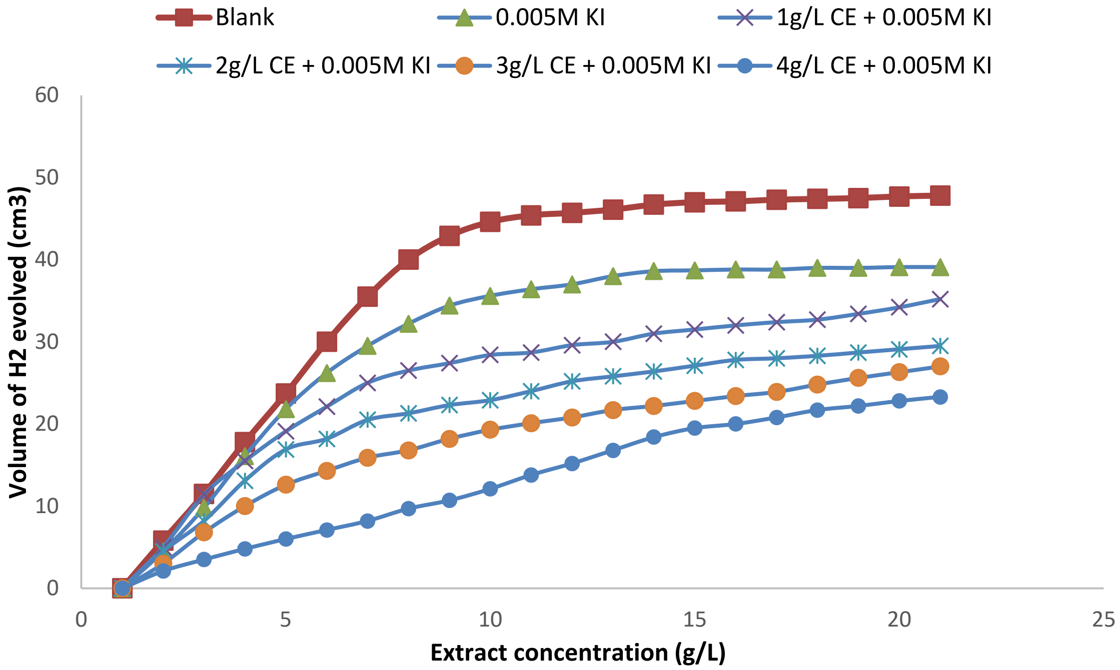


Figure 5: Variation of volume of H_2 gas evolved (cm^3) against time (min) of mild steel corrosion on 1 M H_2SO_4 in the absence and presence of 0.005 M KI and CE + 0.005M KI mixtures, respectively, at 30 °C

Table 2: Calculated values of hydrogen evolution rate and inhibition efficiency for mild steel corrosion in 1M H_2SO_4 solution in the absence and presence of 0.005 M KI, CE and CE + 0.005M KI mixture, respectively, at 30 °C

System	**H_2 evolution rate (cm^3 min^{-1})**	**Inhibition efficiency (%)**
1 M H_2SO_4 (Blank)	2.390	-
0.005 M KI	1.955	18.20
1 g/L CE	1.765	26.15
2 g/L CE	1.475	38.28
3 g/L CE	1.330	44.35
4 g/L CE	1.165	51.26
1 g/L CE + 0.005M KI	1.880	21.34
2 g/L CE + 0.005M KI	1.675	29.92
3 g/L CE + 0.005M KI	1.355	43.31
4 g/L CE + 0.005M KI	1.225	48.74

The activation energies (E_a) of the corrosion process in the absence and presence of CE, KI and CE + KI mixtures were evaluated using Eqn. 5 (Arrhenius equation):

$$\ln CR = \frac{-E_a}{RT} + \ln A$$ **Eqn. 5**

where CR is the corrosion rate, E_a is the activation energy, T is the absolute temperature, R is the universal gas constant and A is the Arrhenius pre-exponential factor.

Linear plots of ln CR vs. 1/T (Figures 6 and 7), with gradients of $-E_a/R$ and intercepts of ln A, for mild steel corrosion in 1 M H_2SO_4 solution in the absence and presence of CE, KI and CE + KI mixtures were obtained, thus confirming that the Arrhenius equation is obeyed.

The activation energies (E_a), evaluated from the gradients of the plots, are presented in Table 3. It is observed that the E_a values in the presence of CE, KI and CE + KI mixtures are higher than that of the blank. A higher E_a value in the presence of inhibitor relative to the blank signifies that the inhibitor increased the energy barrier of the system, thus slowing down the rate of metal dissolution process. Additionally, a higher E_a in the presence of inhibitor compared to the blank indicates a physical adsorption (Ashmawy *et al.*, 2023; Okewale and Adesina, 2020).

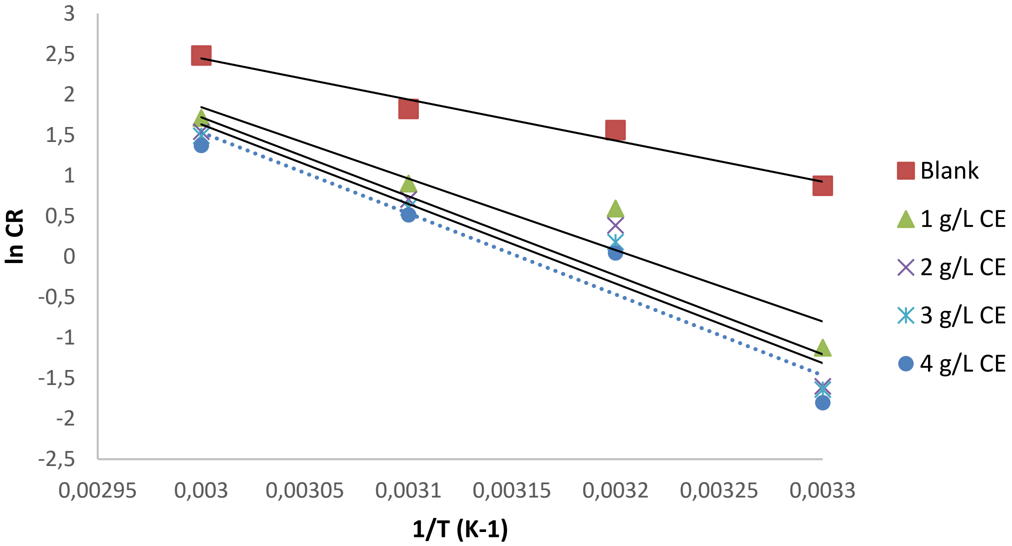


Figure 6: Variation of ln CR against 1/T for mild steel corrosion in 1 M H_2SO_4 in the absence and presence of *C. diffusa* leaf extract (CE)

The values of enthalpy of activation (ΔH°_{ads}) and entropy of activation (ΔS°_{ads}) were obtained from the alternative Transition State equation as shown in Eqn. 6 (Akpan *et al.*, 2018):

$$\ln\left(\frac{CR}{T}\right) = \left[\ln\left(\frac{R}{Nh}\right) + \frac{\Delta S^{\circ}_{ads}}{R}\right] - \frac{\Delta H^{\circ}_{ads}}{RT}$$ **Eqn. 6**

where CR is the corrosion rate, T is the absolute vtemperature, R is the universal gas constant, N is the Avogadro number and h is the Planck's constant.

Plots of ln (CR/T) vs. 1/T (Figures 8 and 9) were made. Straight lines were obtained with gradients of $\left(-\Delta H^{\circ}_{ads}/R\right)$ and intercepts of $\left(\left[\ln\left(R/_{Nh}\right) + \Delta S^{\circ}_{ads}/_{R}\right]\right)$ from whigh values of ΔH°_{ads} and ΔS°_{ads}, respectively, were calculated and presented in Table 3

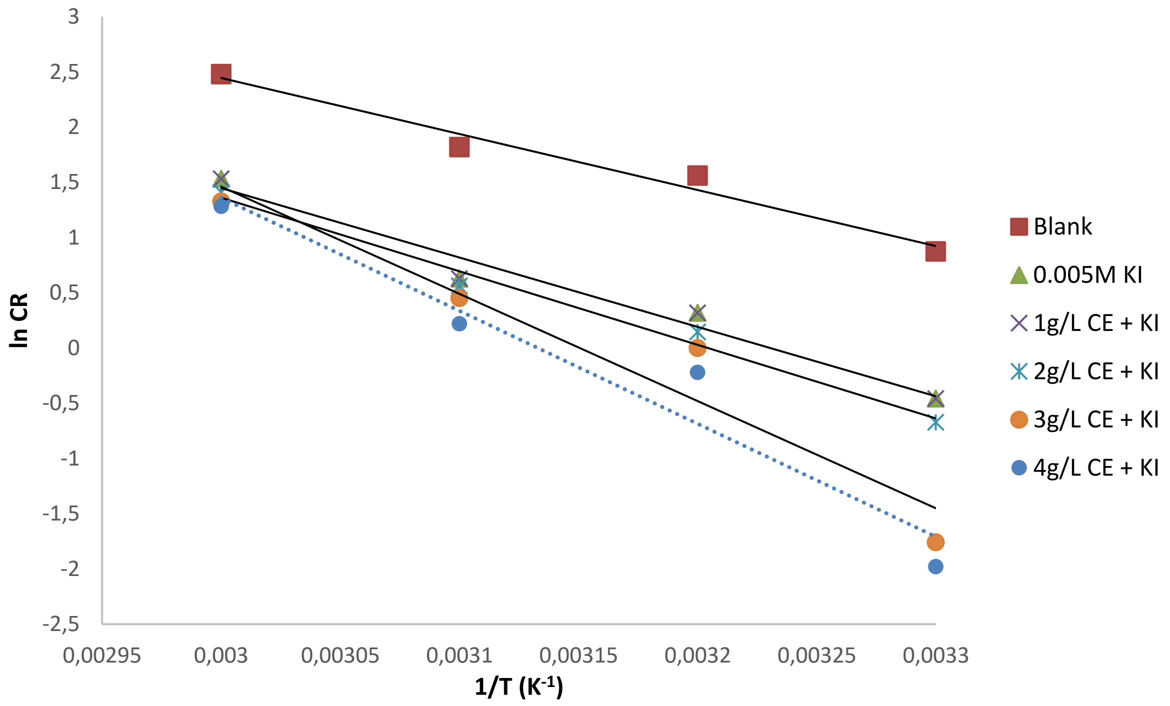


Figure 7: Variation of ln CR against 1/T for mild steel corrosion in 1 M H_2SO_4 in the absence and presence of KI and CE + KI mixtures, respectively.

Table 3: Calculated values of thermodynamic parameters for mild steel corrosion in 1 M H_2SO_4 solution in the absence and presence of CE, KI, and CE + KI mixtures

System	**E_a (kJ mol^{-1})**	**ΔH°_{ads}(kJ mol^{-1})**	**ΔS°_{ads}(JK^{-1} mol^{-1})**
1 M H_2SO_4 (Blank)	42.17	39.65	- 106.52
0.005 M KI	52.23	49.44	- 85.51
1 g/L CE	73.30	69.94	- 20.75
2 g/L CE	81.06	78.62	4.36
3 g/L CE	81.65	79.05	4.87
4 g/L CE	83.11	80.92	9.70
1 g/L CE + 0.005M KI	52.23	68.84	- 26.38
2 g/L CE + 0.005M KI	55.39	77.66	0.10
3 g/L CE + 0.005M KI	80.70	78.48	1.81
4 g/L CE + 0.005M KI	85.04	82.09	11.76

The values of ΔH°_{ads} both in the absence and presence of the additives are positive. The positive values of ΔH°_{ads} indicate that the corrosion inhibition process was endothermic. The values of ΔS°_{ads} for the adsorption of 1 g/L CE, 1 g/L CE + 0.005 M KI mixture on mild steel as well as that of the blank are negative, indicating a decrease in the degree of disorderliness in the presence of these additives. On the other hand, the positive values of ΔS°_{ads} of other additives being positive reflect an increase in the degree of disorderliness of the system.

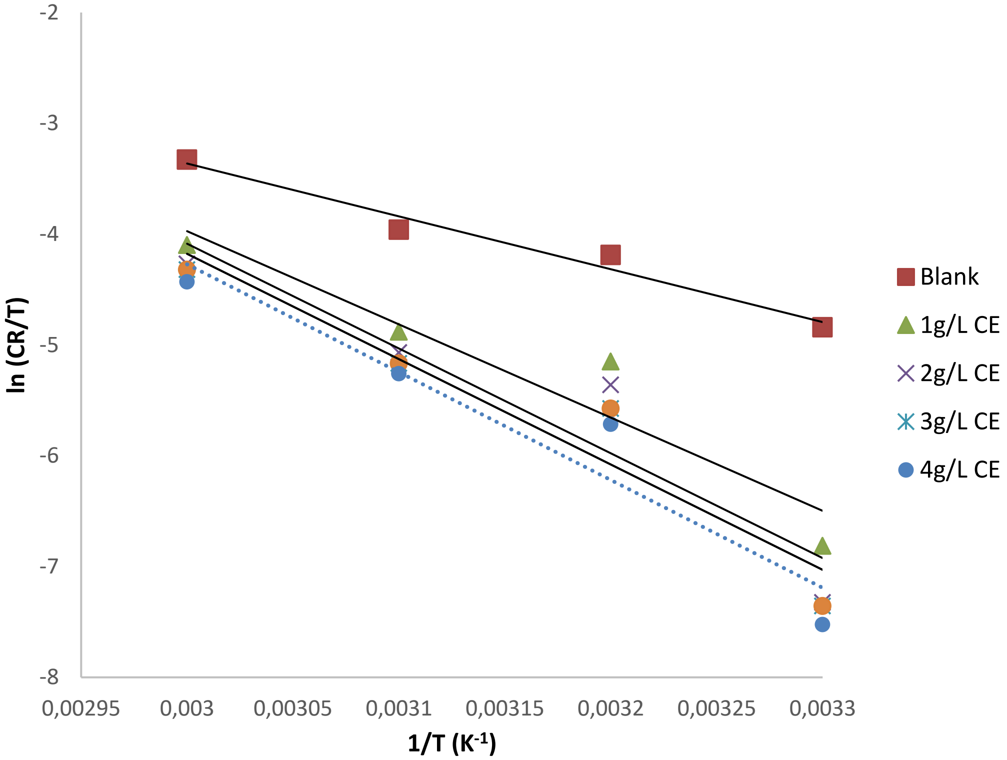


Figure 8: Variation of ln (CR/T) against 1/T for mild steel corrosion in 1 M H_2SO_4 in the absence and presence of CE

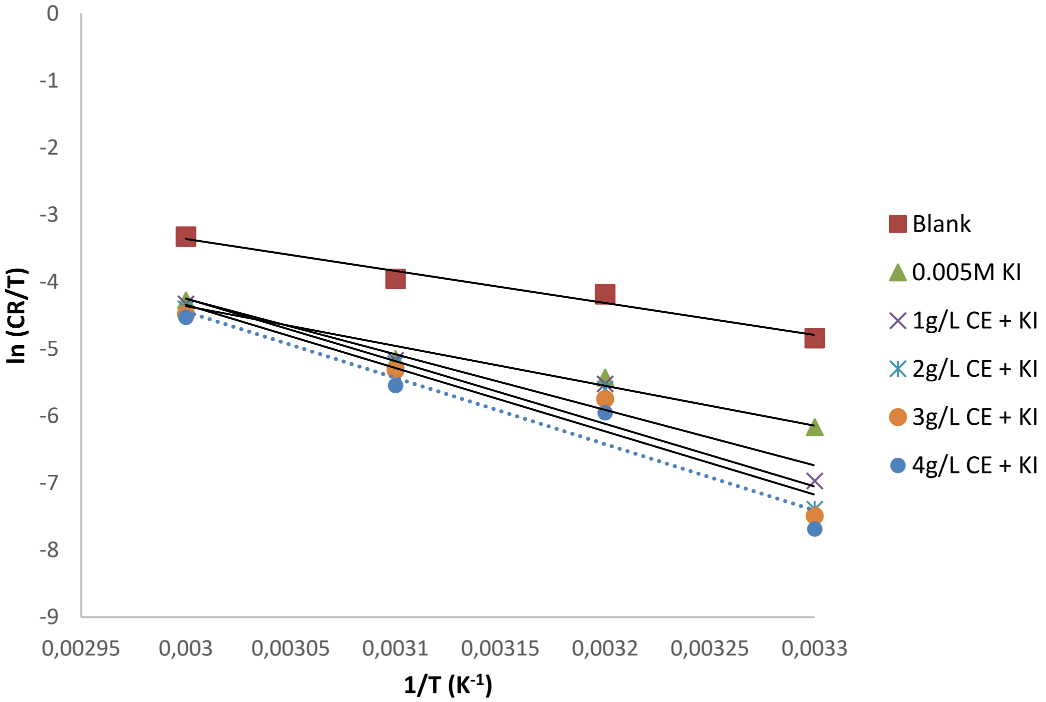


Figure 9: Variation of ln (CR/T) against 1/T for mild steel corrosion in 1 M H_2SO_4 in the absence and presence of KI and CE + KI mixtures, respectively

3.4 Adsorption studies

The best fit for the adsorption of CE and CE + KI mixtures, respectively, on mild steel surface was obtained by the modified Langmuir adsorption isotherm given by Eqn. 7 (Villiami *et al.*, 1999; Oladunni *et al.*, 2020; Lazrak *et al.*, 2022):

$$\frac{C}{\theta} = \frac{n}{K_{ads}} + nC \qquad \textbf{Eqn. 7}$$

where C is the inhibitor concentration, θ is the degree of surface coverage (I%/100) and K_{ads} is the equilibrium constant of the adsorption process.

Linear plots of C/θ vs. C with R^2 values close to 1 signify that the adsorption of CE (Figure 10) and CE + KI mixtures (Figure 11) on mild steel surface obeyed the Langmuir adsorption isotherm. The parameters of the linear regression of Langmuir adsorption isotherm for mild steel corrosion in the presence of the additives are presented in Table 4.

The data in Table 4 reveals that the values of K_{ads} at 30 °C in the presence of CE (9.94 g^{-I} L) and CE + KI mixtures (10.69 g^{-I} L) are bigger than their values at 40 °C, 50°C and 60 °C, respectively. The bigger the K_{ads} value is at a particular temperature, the more strongly the inhibitor adsorbs on the metal surface. Consequently, higher K_{ads} values at 30°C indicate stronger adsorption of CE and CE + KI mixtures, suggesting greater protection of the mild steel surface at this temperature compared with higher temperatures. This observation is consistent with the decrease in inhibition efficiency observed with increasing temperature, indicating a physisorption process. Overall, the data in Table 4 demonstrate the temperature-dependent nature of inhibitor adsorption and its impact on corrosion protection, showing that the mechanism that governs the corrosion inhibition process in this system is physisorption.

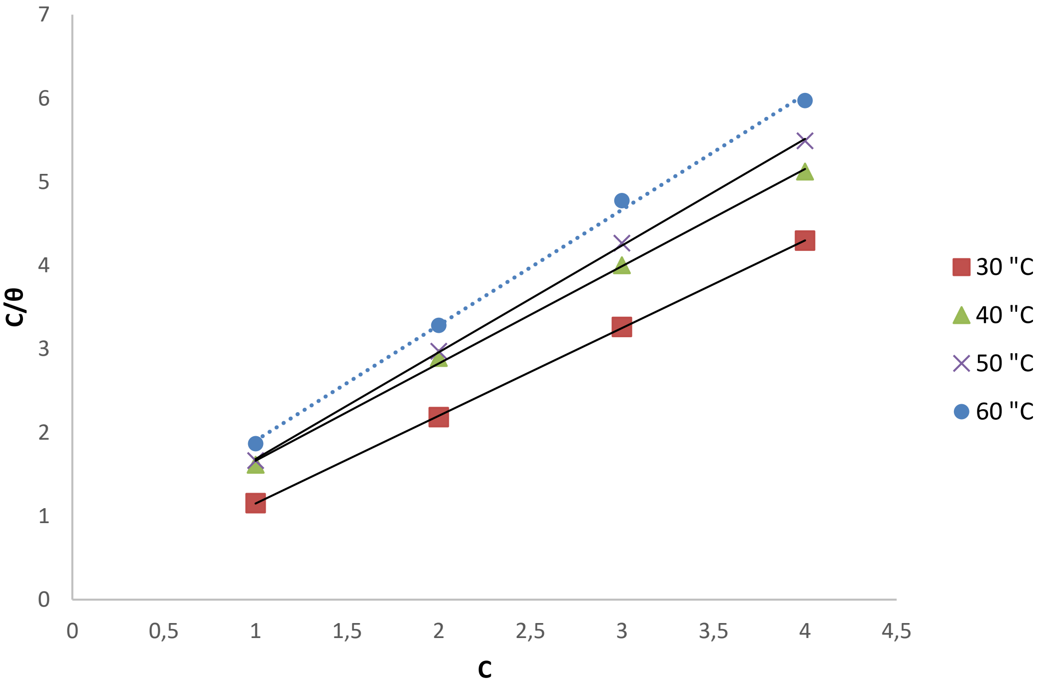


Figure 10: Plot of C/θ vs. C (Langmuir isotherm) for mild steel corrosion in 1 M H_2SO_4 solution containing CE at 30 °C – 60 °C

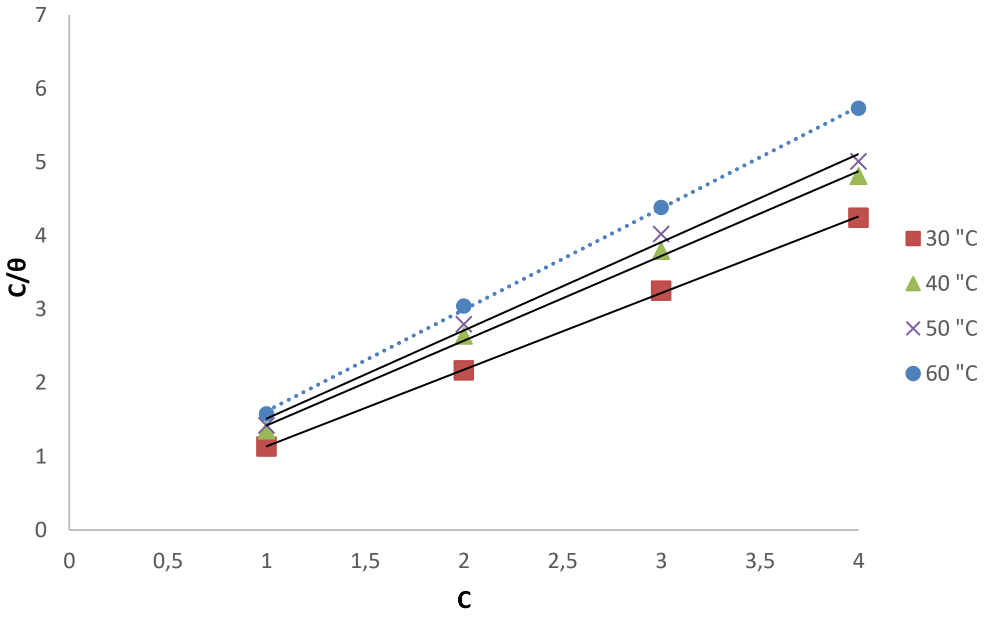
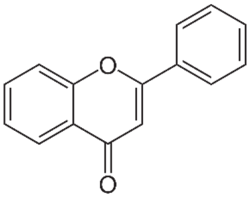
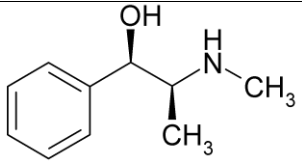
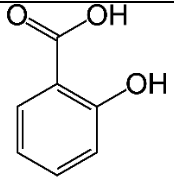
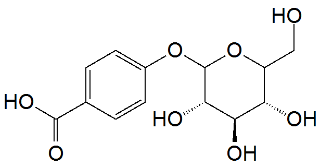


Figure 11: Plot of C/θ vs. C (Langmuir isotherm) for mild steel corrosion in 1 M H_2SO_4 solution containing CE + 0.005M KI mixtures at 30 °C – 60 °C

Table 4: Some parameters of the linear regression of Langmuir adsorption isotherm for mild steel corrosion in 1 M H_2SO_4 solution containing CE, KI and CE + KI mixtures

Temperature	**R^2**	**n**	**$1/K_{ads}$ ($g\ L^{-1}$)**	**K_{ads} ($g^{-I}\ L$)**
		CE		
30 °C	0.9999	1.05	0.1006	9.94
40 °C	0.9989	1.16	0.4983	2.01
50 °C	0.9997	1.28	0.4056	2.47
60 °C	0.9981	1.38	0.5213	1.92
		CE + 0.005 M KI mixtures		
30 °C	0.9997	1.04	0.0973	10.69
40 °C	0.9972	1.15	0.2708	3.69
50 °C	0.9948	1.20	0.3163	3.16
60 °C	0.9996	1.38	0.2369	4.22

The examinations of literature indicated that *C. diffusa* leaves contain 38 flavonoids, 38 alkaloids, 40 phenolic acids and 18 glycosides (Ekeke and Ogazie 2018). The chemical formula of flavonoids, alkaloids, phenolic acids and glycosides, shown below, may be an excellent tool to explain the inhibitory action of the natural extract via the various active centers of adsorption in these chemical structures and then ensure a barrier against the arrival of aggressive H^+ ion responsible of the corrosion damage of steel in acidic media. In other words, this inhibition process is called "synergistic intermolecular effect" of the different components of the natural inhibitor (Lrhoul *et al.*, 2023; Eziuka *et al.*, 2023)

			
flavonoid	alkaloid	phenolic acid	glycoside

Conclusion

Based on the data and analysis presented in this study, several conclusions can be drawn regarding the corrosion inhibition performance of *Commelina diffusa* leaf extract (CE) and its interaction with potassium iodide (KI) for mild steel in sulfuric acid (H_2SO_4) solution:

i. *Commelina diffusa* leaf extract demonstrates significant inhibitory properties against mild steel corrosion in H_2SO_4 solution, indicating its potential as a corrosion inhibitor.
ii. The inhibition efficiency of CE exhibits a direct correlation with the concentration of the extract, showing an increase as the concentration of CE increases. However, the inhibition efficiency decreases as the temperature rises, suggesting a temperature-dependent behavior.
iii. The addition of potassium iodide (KI) to CE results in higher inhibition efficiencies compared to CE alone, indicating a synergistic effect between CE and iodide ions. This enhancement in inhibition efficiency suggests that iodide ions play a crucial role in boosting the corrosion inhibition performance of CE.
iv. The calculated thermodynamic parameters indicate that the corrosion inhibition process facilitated by CE and CE + KI mixtures is endothermic in nature, suggesting that energy is absorbed during the inhibition process.

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