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A CORROSION INHIBITION STUDY OF A THIOPHENE DERIVATIVE ON COPPER IN NITRIC ACID

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INTRODUCTION

Corrosion is a harmful phenomenon that occurs when metals come into contact with an aggressive environment. The consequences due to corrosion, in particular the corrosion of metals, are numerous and significant, particularly in industry: loss of production…

In this study, the inhibition effect of 2-amino-4-*p*-tolylthiophene-3-carbonitrile on the corrosion of copper in solutions of nitric acid has been probed experimentally. Different parameters have been studied such as; concentration, temperature and immersion time in order to effectively study the inhibition effect. The kinetic and thermodynamic parameters of copper corrosion as well as inhibitor adsorption were determined and discussed.

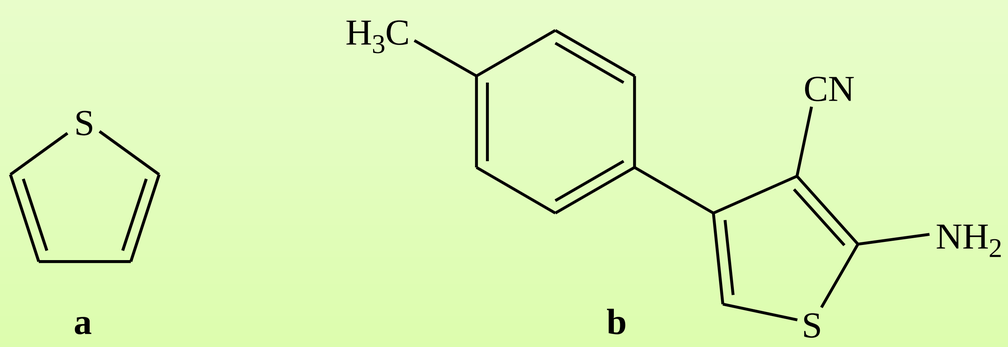

Figure 1: a) Thiophene structure, b) Thiophene derivative used in this study

MATERIAL AND METHODS

The blank solution 1 M nitric acid was prepared by diluting a concentrated solution of HNO_3. First of all, the samples of copper were mechanically abraded using different grades of emery paper, namely 100, 400, 600, 800, 1000, and 1200.

Then, the samples were washed with distilled water and degreased with acetone solution. Finally, they were air-dried and dipped into the corrosive or/and anti corrosive medium.

RESULTS AND DISCUSSION

In order to experimentally study the inhibition efficiency of a thiophene derivative on the copper corrosion in an acidic medium, which is nitric acid in this case, the gravimetric method has been used.

1. Concentration Effect :

Table 1: Concentration and temperature effect on inhibition efficiency.

Concentration C(g/L)	Temperature (C°)			
	25	**35**	**45**	**55**
10^{-4}	42,50	39,21	36,25	25,74
$2,5\times10^{-4}$	61,05	54,13	50,12	40,20
5×10^{-4}	67,22	64,56	56,17	42,77
$7,5\times10^{-4}$	77,80	69,19	62,24	51,84
10^{-3}	83,11	75,51	69,09	55,42

The more the concentration increases, the more the efficiency increases.

2. Temperature Effect :

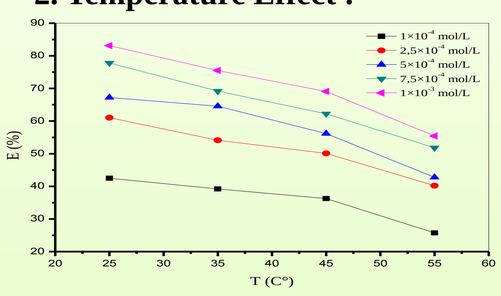

Figure 2: Inhibition efficiencies as a function of temperature variation at different concentrations of inhibitors

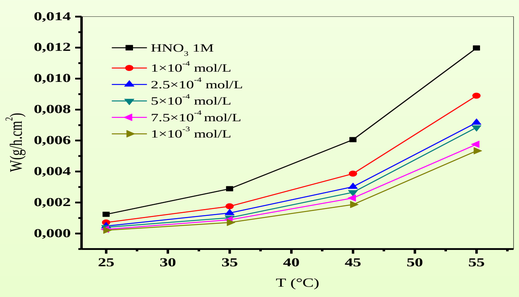

Figure 3: Variation of corrosion rate as a function of temperature.

Figure 2 shows that the inhibition efficiency decreases with increasing temperature. This may be due to the phenomenon of desorption.

Figure 3 shows that the corrosion rate in HNO_3 acid solution alone increases with increasing temperature. The more the concentration of the inhibitor increases, the lower the speed will be.

3. Effect of immersion time:

Table 2: The variation of the inhibition efficiency of the inhibitor as a function of the immersion time.

t (Hours)	**1**	**2**	**3**	**5**	**24**
IE% DT-CH_3	71,69	83,11	79,43	X	X

Table 2 shows that, for the studied inhibitor, the inhibition efficiency increases with the immersion time up to 2h then it decreases until the time 5h and between 5h and 24h remains almost constant.
This means that the inhibitor has an inhibition role so we must clearly see a difference in efficiency value with respect to an acid medium alone.

Table 3: Values of corrosion and inhibition rate, mass loss and efficiency for the three inhibitors used.

t(h)DT-CH_3	**W_{corr}(g.cm^{-2}.h^{-1})**	**$\Delta m/s_{corr}$**	**W_{inh}(g.cm^{-2}.h^{-1})**	**$\Delta m/s_{inh}$**	**E(%)**
1	$3,3.10^{-4}$	$3,29.10^{-4}$	$0,9.10^{-4}$	$0,9.10^{-4}$	71,69
2	$12,4.10^{-4}$	$24,8.10^{-4}$	$2,1.10^{-4}$	$4,2.10^{-4}$	83,11
3	$28,8.10^{-4}$	$86,4.10^{-4}$	$5,9.10^{-4}$	$17,8.10^{-4}$	79,43
5	$31,3.10^{-4}$	$156,5.10^{-4}$			
24	$60,4.10^{-4}$	$1449,6.10^{-4}$			

The values in Table 3 show that the corrosion rate decreased significantly in the presence of inhibitors by comparing it with that in the acid alone. This shows that the inhibitor has a protective effect against corrosion.

Table 4: R^2 values for the three isotherms.

T (K)	**R^2**		
	Langmuir	**Temkin**	**Frumkin**
293	0,991	0,920	-0,066
303	0,995	0,974	0,774
313	0,989	0,960	0,777
323	0,983	0,887	0,519

From Table 4, it can be seen that the R^2 values of Langmuir isotherm are close to unit which means that this isotherm is the best adopted to this study.

CONCLUSION

- The increase of the inhibition efficiency with the concentration shows that there is a strong interaction of inhibitor with the copper surface.
- This involves the formation of a protective layer that protects the copper against corrosion. The adsorption of this organic compound obeys to Langmuir isotherm.
- The 2-amino-4-*p*-tolylthiophene-3-carbonitrile is efficient as a corrosion inhibitor for copper in nitric acid.

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