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Corrosion Protection of Expired Perindopril and Expired Alprazolam Drug in Carbon Steel in the 3% NaCl Solution

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Abstract
Present study aimed at the application of expired Perindopril and Alprazolam drug as a corrosion inhibitor for the carbon steel in the 3 % NaCl solution. Two techniques (weight loss and atomic absorption spectroscopy) used to evaluate the corrosion inhibition mechanism. Weight loss technique revealed that, the corrosion inhibition property of expired Perindopril and expired Alprazolam drug is mainly depends upon the concentration of the expired species and solution temperature. The atomic absorption spectroscopy (AAS) technique fully supports the results of weight loss studies. Among the expired Perindopril and Alprazolam drug species, expired Perindopril drug exhibit the superior corrosion inhibition property on the carbon steel in the 3 % NaCl solution.

Keywords
Expired Perindopril drug, 3% NaCl solution, Atomic absorption spectroscopy, Solution temperature, Carbon steel.

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INTRODUCTION:
Worldwide carbon steel production enhanced in the last decades. As costs of carbon steel enhanced with decreasing the growth rate of other materials because of its increased applications in the several industries. In the acid, alkali or neutral corrosive environments, carbon steel (CS) experience severe corrosion [1-3]. This negatively effects on the nation's economy. Therefore, prevention of corrosion is very important. For this purpose, many methods employed to mitigate the carbon steel corrosion in the corrosive solutions. Among the many methods of corrosion protection, corrosion scientist selected corrosion inhibitors because of its cheap and effective adsorption property. Organic species possessing P, S, N and O atoms strongly interact with the metal surface and block the movement of corrosive ions. But, use of synthetic organic compounds as corrosion inhibitors restricted due to its toxic and expensive property. Therefore, nowadays research focused on the expired drugs and plant extract species [4-6]. Most of the expired drug products and plant extract species contains donor elements like P, S, N and O in their moieties. The

expired drug product containing double or triple bonds plays significant role in the adsorption process [7-10]. The interaction between the expired drug products and metal surface lowers the attack of corrosive ions on the surface of carbon steel. The scope of present research is to explore the corrosion inhibition property of expired Perindopril and Alprazolam drug on the carbon steel in the 3 % NaCl solution. The corrosion inhibition property of expired Perindopril and Alprazolam drug was thoroughly investigated by weight loss (gravimetric) and atomic absorption spectroscopy (AAS) techniques.

EXPERIMENTAL SECTION:

99 % of carbon steel (CS) was used in this research. The CS pieces were mechanically cut into about 2 × 2 × 0.2 cm dimensions for weight loss (gravimetric) and atomic absorption spectroscopy techniques. The CS was polished with using high grade sand papers and washed with double distilled water. The 3 % NaCl solution prepared as per the standard procedure. The weight loss (gravimetric) experiment was performed with 100 ml of 3 % NaCl solution without and with inhibitors (0.1 g/L, 0.2 g/L, 0.3 g/L and 0.4 g/L) at immersion period of one day. The effect of solution temperature on the corrosion inhibition property of expired Perindopril and expired Alprazolam drug by performing weight loss technique at 303 K, 313 K, 323 K, and 333 K.

The corrosion inhibition efficiency can be obtained by the following equation;

Corrosion inhibition efficiency (%) = $\frac{(W_1 - W_2)}{W_1} \times 100$, (gravimetric technique)

Where, W_1= Weight loss of CS in the unprotected system and W_2= Weight loss of CS in the protected system.

The atomic absorption spectroscopy (AAS) is an important tool for the investigation of corrosion inhibition property of inhibitors. The measurement of weight loss of iron content in the carbon steel was analyzed by AAS by performing the experiment with 100 ml of 3 % NaCl solution without and with inhibitor (0.1 g/L, 0.2 g/L, 0.3 g/L and 0.4 g/L).

The corrosion protection efficiency was calculated by using the following formula;

Corrosion protection efficiency = $\frac{B-A}{B} \times 100$,

Where, B= Amount of dissolved iron content without addition of corrosion inhibitor and A= Amount of dissolved iron content with the addition of corrosion inhibitor.

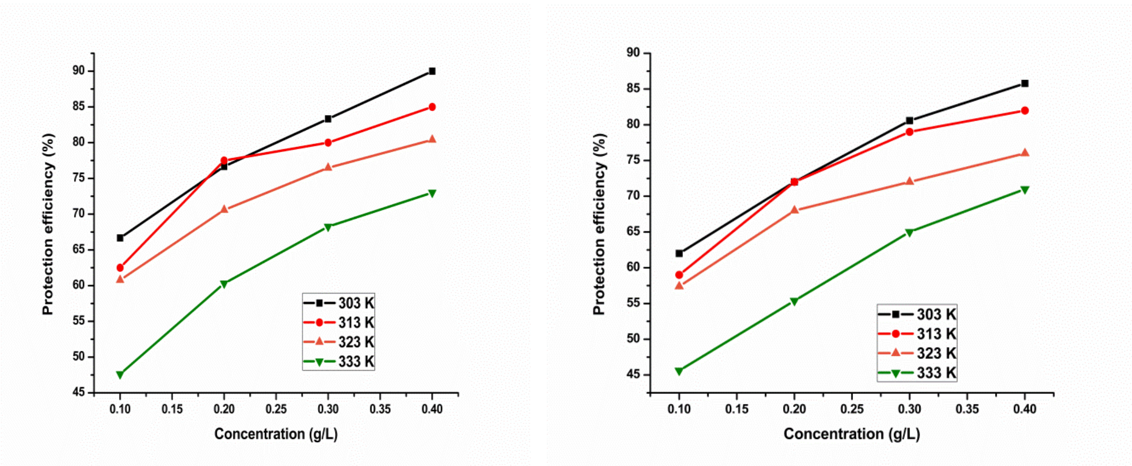
RESULTS AND DISCUSSION:

Weight loss (gravimetric) technique:

Table 1 and **Figure 1** shows the protection efficiency values of expired Perindopril and expired Alprazolam drug. Both the inhibitors (expired Perindopril drug and expired Alprazolam drug) exhibit good corrosion inhibition property on the carbon steel in the 3 % NaCl solution. The corrosion inhibition property is attributed due to the participation of heteroatom's in the adsorption process. The hetero atoms present in the expired Perindopril and expired Alprazolam drug strongly interact with the carbon steel in the 3 % NaCl solution. The adsorption leads to the formation of protective layer on the carbon steel in the studied corrosive system. The protective layer blocks the attack of corrosive ions. As a result of this, the weight loss of carbon steel decreases with a rise in the concentration of the corrosion inhibitor. The decrease in the weight loss of carbon steel with a rise in the concentration of the inhibitor clearly shows the corrosion inhibition property of expired Perindopril and expired Alprazolam drug on the studied metal in the 3 % NaCl solution. The increase in the concentration of the corrosion inhibitor increases the strong adsorption process. The strong adsorption process hinders the corrosion process. Further, the increase in the solution temperature has a negative effect on the corrosion inhibition efficiency of the corrosion inhibitors. This is due to the desorption of inhibitors molecules from the carbon steel surface in the 3 % NaCl solution. Hence, direct attack of sodium chloride on the surface of CS takes place. Therefore, more surface area of carbon steel exposed to the 3 % NaCl solution. As a result of this, corrosion rate of metal (carbon steel) enhances with a rise in the solution temperature. The maximum protection efficiency obtained at 303 K with an immersion period of one day. Among the two corrosion inhibitors, expired Perindopril drug shows the superior corrosion inhibition property on the carbon steel in the 3 % NaCl solution. This is due to the strong adsorption of expired Perindopril drug molecules on the carbon steel in the 3 % NaCl solution.

Table 1. Weight loss results

Concentration (g/L)	Solution temperature (K)	Protection (corrosion inhibition) efficiency of expired Perindopril drug	Protection (corrosion inhibition) efficiency of expired Alprazolam drug
Bare			
0.1		66.666	62.000
0.2	303 K	76.666	72.005
0.3		83.333	80.581
0.4		90.000	85.781
Bare			
0.1	313 K	62.500	59.003
0.2		77.500	72.004
0.3		80.000	79.005
0.4		85.000	82.001
Bare	323 K		
0.1		60.780	57.385
0.2		70.580	68.001
0.3		76.470	72.001
0.4	333 K	80.390	76.005
Bare			
0.1		47.619	45.613
0.2		60.310	55.381
0.3		68.253	65.005
0.4		73.015	71.005



(a) (b)

Figure 1: Protection efficiency of inhibitors (a) expired Perindopril drug, (b) expired Alprazolam drug

Atomic absorption spectroscopy (AAS) results:
AAS results are shown in the **Table 2** and **Figure 2**. The loss in the weight of iron was observed in the absence and presence of corrosion inhibitors. In the presence of corrosion inhibitors (both expired Perindopril and expired Alprazolam drug), the loss in the weight of iron decreases with rise in the concentration of the inhibitors. The decrease in the weight loss of iron content in the presence of corrosion inhibitor clearly hint the corrosion inhibition property of expired Perindopril and expired Alprazolam drug over the carbon steel in the 3 % NaCl solution. The adsorption layer hinders the weight loss of iron content in the 3 % NaCl solution. The atomic absorption spectroscopy (AAS) results fully support the weight loss results.

Table 2. Atomic absorption spectroscopy results

Concentration (g/L)	Protection (corrosion inhibition) efficiency of expired Perindopril drug	Protection (corrosion inhibition) efficiency of expired Alprazolam drug
Bare		
0.1	65.000	60.000
0.2	75.481	72.000
0.3	82.503	78.000
0.4	91.532	85.000

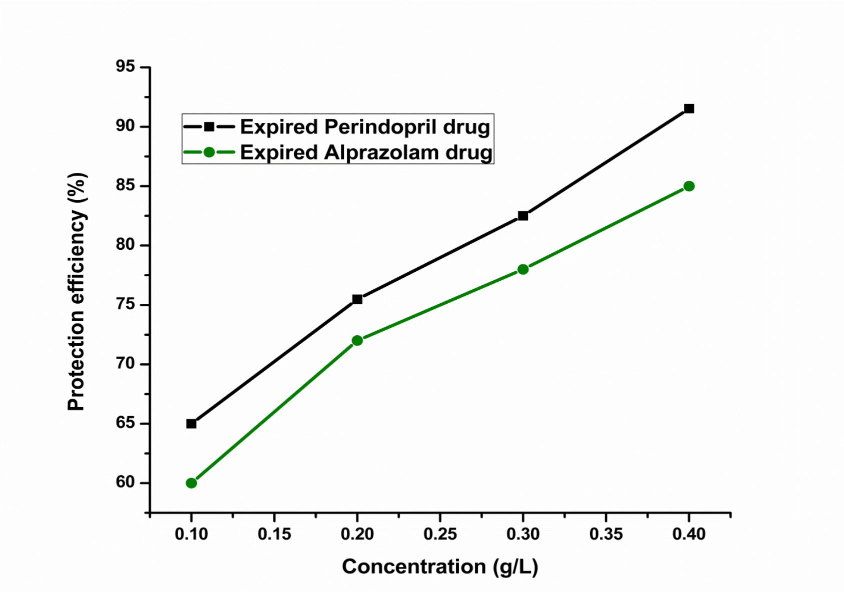


Figure 2: Protection efficiency of the corrosion inhibitors with four different amounts

CONCLUSION:

The investigated expired Perindopril and expired Alprazolam drug is good inhibitor for the carbon steel in the 3 % NaCl solution, the protection inhibition efficiency enhances with rise in the concentrations of expired drug species and reduces with rise in the solution temperature. The results obtained from the weight loss (gravimetric) and atomic absorption spectroscopy (AAS) techniques are in good agreement. Among the two inhibitors, expired Perindopril drug shows the superior corrosion inhibition property on the carbon steel in the 3 % NaCl solution.

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