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New corrosion inhibitor derived from coumarin

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Abstract: New corrosion inhibitor derived from coumarin-3-amine namely 3-((2-chlorobenzylidene)amino)coumarin was synthesized and characterized by CHN elemental analysis in addition to Fourier transform infrared and nuclear magnetic resonance techniques. The anti-corrosion ability of 3-((2-chlorobenzylidene)amino)coumarin to inhibit the impacts of corrosion has been demonstrated and damage reduction of the mild steel also. 3-((2-chlorobenzylidene)amino)coumarin, has been employed as a good corrosion inhibitor for mild steel in HCL solution. The efficiency of the inhibition was figured according to weight loss method and it was 74.6%.

Keywords: 3-((2-chlorobenzylidene)amino)coumarin; corrosion inhibitor; damage reduction

1. Introduction

Coumarins become one of the most significant compounds having considerable, medicinal activities [1–3]. Many of these coumarins were proven to be efficient as anti-bacterial [4–6], anti-fungal [7], anti-inflammatory [8], anti-coagulant [9], anti-HIV [10] and anti-cancer [11]. Coumarins are quite, utilized in foods and/or cosmetics as additives [12], in addition to optics [13] and dyes [14]. Some coumarin derivatives were proven to be a superior antioxidant agent [15]. Structure modification of coumarin moiety exhibit inhibition of unit enzyme both in vitro and in vivo [16–20]. Corrosion inhibitors increase the impedance of mild steel toward corrosive solutions and inhibit or retard the corrosion through adsorbing the molecules of inhibitor on the surface of mild steel [21-27] in order to generate a barrier on the surface that block dynamic sites for mild steel [28-30]. Natural or synthesized organic corrosion inhibitors may have adsorbed on metal surface. This issue influenced by various factors. These factors are the nature of the metal surface, second the kinds of electrolyte and the final factor was the composition of the of inhibitor [31,32]. The inhibitors could be bond with mild steel surface to prepare a stable complex which act as barrier to protect the mild steel surface in basic or acidic solutions [33]. To broaden my prior studies on preparation of novel applicable organic chemical compounds [34–39], a new one synthesized as coumarin derivative namely 3-((2-chlorobenzylidene)amino)coumarin which was identified by CHN elemental analysis technique in addition to infrared IR and Nuclear magnetic resonance NMR spectroscopies. The inhibitor in acidic solution has the ability to inhibits the corrosions of mild steel based on weight loss method.

2. Materials and Methods

Materials: Polar solvents that required for this investigation and other chemical compounds have been bought and employed with no additional purifications. Infra-red spectrum was complete through instrument namely Shimadzu FTIR-8300 spectrometer. Micro-elemental analyses were performed through instrument namely Carlo Erba 5500. NMR spectra were gotten by Bruker instrument at 300MHz Ultra/Shield magnets with two solvents that were dimethylsulfoxied-d6 and TMS as solvent and internal standard, respectively.

Synthesis of corrosion Inhibitor: 3-Aminecoumarin in ethanol and 2-chlorobenzaldehyde with molar ratio (1:1) have been refluxed for eight hours. Reaction mixture was cooled, filtration and used ethanol for recrystallization. 1H NMR: 7.05-7.95 (m, 1H, Ar-H), 8.74 (d, 1H, H-C=N). Elemental analysis (CHN): C 68.07% (67.74%), H 3.51% (3.55%), N 5.26 (4.94).

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Corrosion technique: Samples of mild steel that were using for this study as an electrode which supplied from metal samples company. Portion of the iron was 99.21%, portion of carbon was 0.21%, portion of silicon was 0.38%, portion of phosphorous was 0.09%, portion of sulfur was 0.05%, portion of manganese was 0.05% and portion of aluminum was 0.01%. The efficient investigations of the studied mild steel surface were 4.5 cm^2 in aria and cleaned based on reference [40]. Duplicate suspension specimens of mild steel regarding to typical methodology and in 0.2 L of corrosive solution namely hydrochloric acid at 1M concentration without of 3-((2-chlorobenzylidene)amino) coumarin as inhibitor and also in presence of 3-((2-chlorobenzylidene)amino)coumarin at investigated concentrations 0.001, 0.05, 0.10, 0.15, 0.2.0, 0.25 and 0.50 g/L for (1, 3, 5, 10, 24 and 72 h). The inhibition activities have been figured based on equation 1:

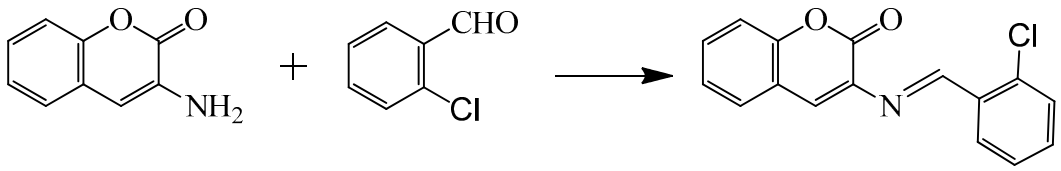
$$IE(\%) = \left(1 - \frac{W_2}{W_1}\right) \times 100 \qquad \mathbf{1}$$

where W1 and W2 pointing to weight samples of mild steel with and without of 3-((2-chlorobenzylidene)amino)coumarin respectively.

3. Results and discussion

Synthesis: The inhibitor 3-((2-chlorobenzylidene)amino)coumarin was prepared in excellent in good yield by reflection reaction of same molar ratio of 4-nitrobenzaldehyde and coumarin-3-amine. The molecular formula of 3-((2-chlorobenzylidene)amino)coumarin was figured based on chemical formula (C16H10N1O2) that confirmed regarding to elemental analysis. In infrared spectrum of 3-((2-chlorobenzylidene)amino)coumarin no amino absorption bands were appeared for 3-((2-chlorobenzylidene)amino)coumarin. The Nuclear magnetic resonance spectrum demonstrated doublate at δ 8.74 ppm, due to the proton of C=N). 3-((2-chlorobenzylidene)amino)coumarin was prepared from coumarin-3-amine as in Scheme 1.

Scheme 1: 3-((2-chlorobenzylidene)amino)coumarin synthesis



3-aminocoumarin 2-chlorobenzaldehyde 3-((2-chlorobenzylidene)amino)coumarin

Results of weight loss technique: In industry, the employment of corrosion inhibitors still the considerable economic style because of the protection of surface of mild steel againest acidic solutions [41]. Corrosion inhibitors naturaly or synthetic were dominant, tools used in oil and gas industries due to barriers formation to protect the alloys and metals surfacesf against corrosive acids or bases solutions. The majority of used inhibitors that have one or more nitrogen, oxygen and/or sulfur atoms, such as pyridines, imidazoles rings [42-44] in addition to polymers with heterocyclic rings [45].

Concentration effect: Weight loss studies that were employed to figured the inhibition efficiency of 3-((2-chlorobenzylidene)amino)coumarin at concentrations (0.05, 0.1, 0.15, 0.2, 0.25 and 0.5 g/L) for the time (1, 3, 5, 10, 24 and 72 h) and 303K as temperature degree in solution of hydrochloric acid for mild steel surface. The 3-((2-chlorobenzylidene)amino)coumarin results, which weredisplayed in Figure 1, point to the capability of 3-((2-chlorobenzylidene)amino)coumarin for reducing corrosion which were done through the acidic solution of mild steel surface with higher inhibition efficiency 74.6% based on highest studied.

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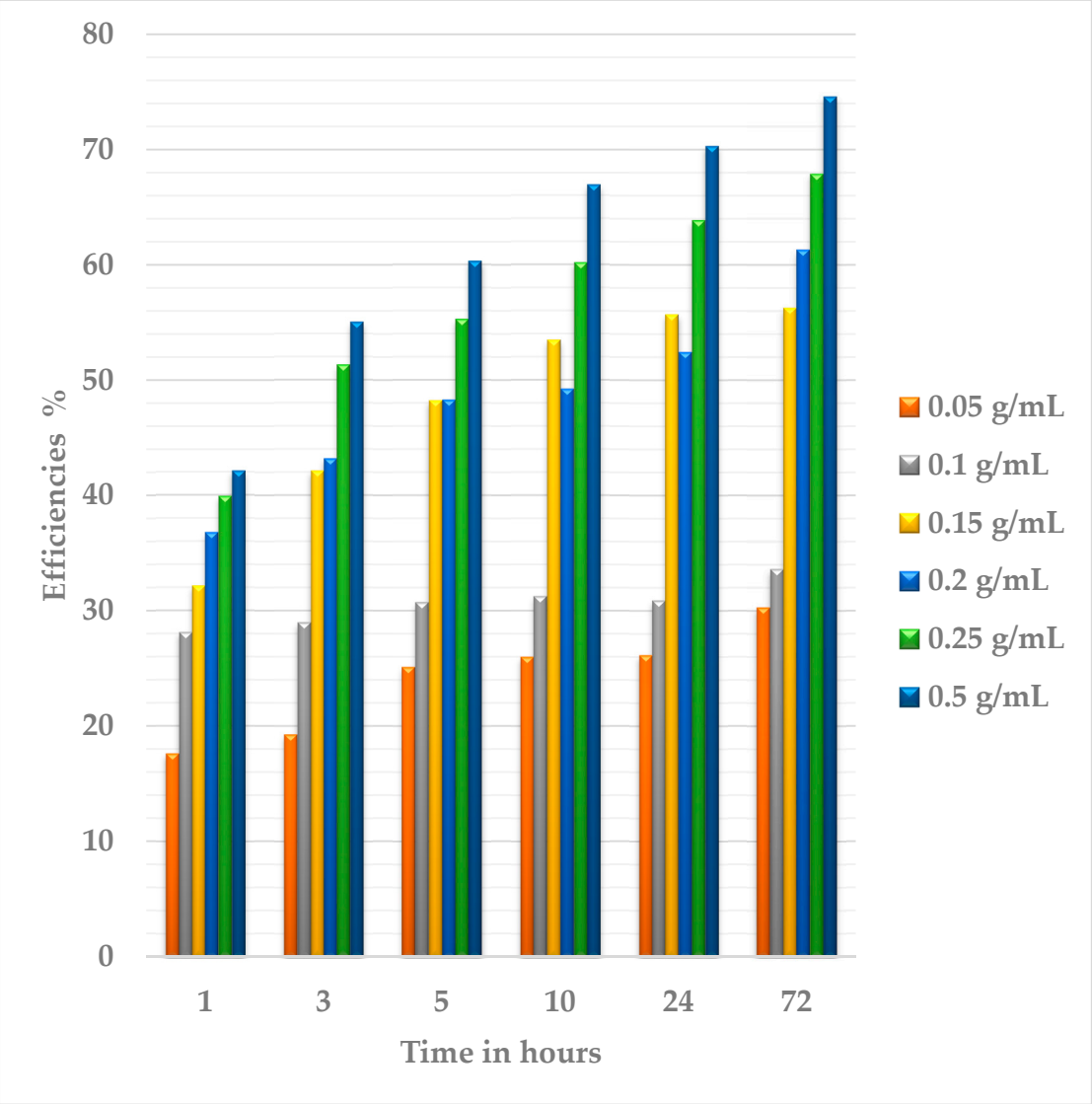
Figure 1. Function of time at concentrations of 3-((2-chlorobenzylidene)amino)coumarin.



4. Conclusions

3-((2-Chlorobenzylidene)amino)coumarin as new inhibitor for surface of mild steel was prepared coumarin-3amine and the structure of it molecule was identified based on NMR and FT-IR spectroscopy moreover the elemental analyses was also used for characterization. Inhibition activity of 3-((2-chlorobenzylidene)amino)coumarin as inhibitor in corrosive solution of 1M of hydrochloric acid for mild steel has been investigated. 3-((2-chlorobenzylidene)amino)coumarin , displayed a an excellent performance as inhibitor and with maximum efficiency 74.6% at the maximum studied concentration of 3-((2-chlorobenzylidene)amino).

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