

Short Note

# Coumarin-3-amine as new corrosion inhibitor

Ahmed A. Al-Amiery

Energy and Renewable Energies Technology Centre, University of Technology, Baghdad, Iraq

\* Correspondence 100173@uotechnology.edu.iq.

**Abstract:** Corrosion inhibitors are the natural or synthetic compounds that have the ability to inhibit the average of corrosion and reduce the damage of the mild steel. Enormous organic inhibitors nowadays employed in the corrosion domain but excluded due to costly. Comparatively cheap, and stable organic compound, namely 3-((4-nitrobenzylidene)amino)coumarin, have been utilized as an excellent corrosion inhibitor in hydrochloric acid for mild steel. The inhibition efficiency has been figured regarding to weight loss method. The corrosion inhibitor was identified according to spectroscopic techniques namely Fourier transform infrared and nuclear magnetic resonance in addition to micro-elemental analysis. Inhibition efficiency for the studied inhibitor was 71.4% that, at the highest studied concentration.

**Keywords:** corrosion inhibitor; coumarin; resonance

## 1. Introduction

Organic inhibitors enhanced the resistance mild steel and become more reluctant toward acidic or basic solutions through adsorbed the inhibitor molecules on the surface of mild steel [1-7] and produce barrier which block active sites of the surface of mild steel [8-10]. Molecules of the corrosion inhibitors adsorbs on the surface of the mild steel which affected by several agents such as mild steel natures also electrolyte types in addition to the structure of inhibitors molecules [11,12]. The inhibitor molecules may have bonded with the atoms of metal on the surface of mild steel and produce metal complex which blocks the mild steel surface against corrosive solutions [13]. To extend our previous investigations about synthesis of new applicable molecules [14-28], the organic compound derived from coumarin-3-amine namely 3-((4-nitrobenzylidene)amino) has been synthesized and characterized by carbon-hydrogen-nitrogen (CHN) elemental analysis technique in addition to Nuclear magnetic resonance (NMR) and Fourier transform infrared FTIR spectroscopies. The action inhibitor molecules in acidic solutions to inhibits the corrosions of mild steel corrosion has been investigated based on weight loss method.

## 2. Materials and Methods

*Materials:* Solvents and needed chemicals has been purchased and utilized without further purifications. FT-IR spectrum has been performed by Shimadzu FTIR-8300 spectrometer. Elemental analyses have been done utilizing Carlo Erba 5500. NMR spectrum has been obtained by Bruker instrument at 300MHz Ultra/Shield magnets with solvent and internal standard namely dimethylsulfoxied-d6 in addition to TMS, respectively.

*Synthesis of corrosion Inhibitor:* A condensation reaction for 8 hours [29] of 2-acetamidoacetic acid, 2-hydroxybenzaldehyde and acetic anhydride at molar concentrations (0.05, 0.076 and 0.053 mol) respectively. After 15 min piperidine in few drops was added to the refluxed solution. Cooling to room temperature and separate out than wash with absolute ether many times. After drying recrystallized from ethyl alcohol. The product has been refluxed for four hours in ethyl alcohol with 2 mL of hydrochloric acid. The coumarin-3-amine left to cool and poured on ice then neutralize by  $\text{NaHCO}_3$ . The coumarin-3-amine has filtered and dry. Ethyl alcohol was utilized to recrystallized coumarin-3-amine to produce yellow powder with melting point equal to 129 °C. An ethanolic

solution of coumarin-3-amine (0.005 mol) and 4-nitrobenzaldehyde (0.005 mol) and a few drops of piperidine have been reacted for eight hours. Cool the reaction mixture followed by filtration and recrystallized from hot ethanol to produce the target compound namely 3-((4-nitrobenzylidene)amino)coumarin as the corrosion inhibitor with melting point 221 °C. FTIR: 3082 (aromatic C-H), 1703 (C=O), 1613.0 (C=N). <sup>1</sup>H NMR: 7.16-8.26 (m, 1H, Ar-H), 9.18 (d, 1H, H-C=N). Elemental analysis (CHN): C 65.94% (65.31%), H 3.58% (3.43%), N 10.11 (9.52).

Corrosion tests: Specimens of mild steel which have employed in this investigation as electrodes were purchase through company of the metal samples. The iron portion was 99.21%, carbon portion was 0.21%, silicon portion was 0.38%, phosphorous portion was 0.09%, sulfur portion was 0.05%, manganese portion was 0.05% and aluminum portion was 0.01%. The active studied surface of mild steel was 4.5 cm<sup>2</sup> as area, and cleaned regarding to references [30]. In a typical technique, duplicate suspended samples of mild steel in 200 mL of hydrochloric acid solution with concentration of one molar without 3-((4-nitrobenzylidene)amino)coumarin as inhibitor and also in presence of 3-((4-nitrobenzylidene)amino)coumarin at various investigated concentrations 0.001, 0.05, 0.10, 0.15, 0.2.0, 0.25 and 0.50 g/L for (1, 2, 3, 4, 5, 10, 24, 48 and 72 h). The inhibition efficiency has been estimated regarding to equation 1:

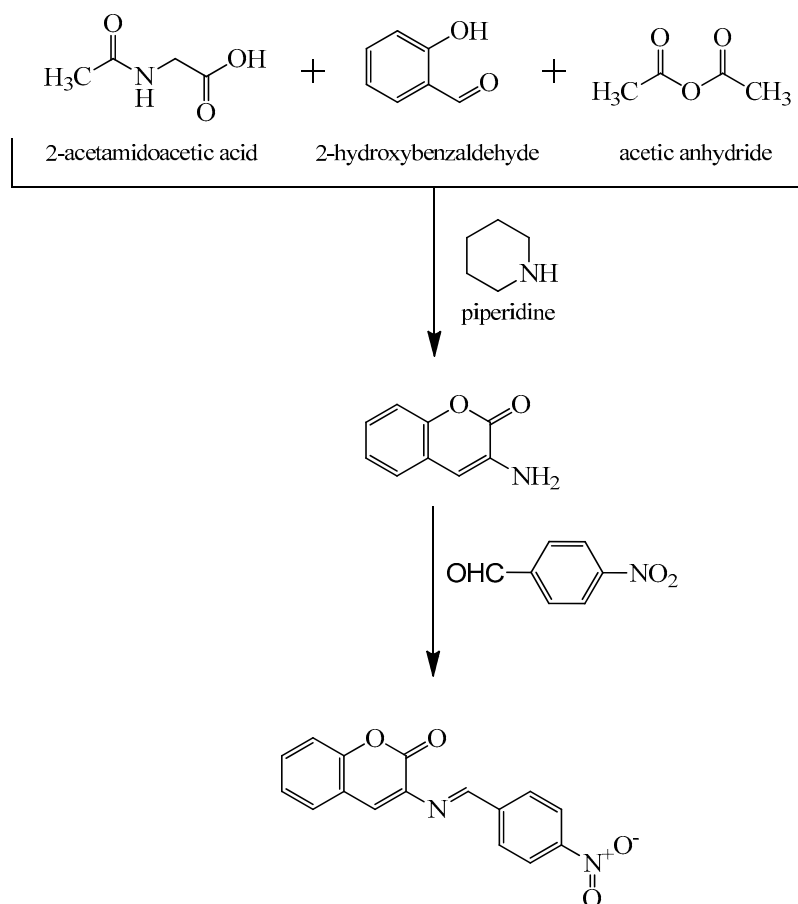
$$IE(\%) = \left(1 - \frac{W_2}{W_1}\right) \times 100 \quad 1$$

where W<sub>1</sub> and W<sub>2</sub> referring to weight specimens in the absence and presence of 3-((4-nitrobenzylidene)amino)coumarin respectively.

### 3. Results and discussion

Synthesis: The inhibitor 3-((4-nitrobenzylidene)amino)coumarin has been synthesized in good yield through condensation reaction of equal molar ratio of refluxing coumarin-3-amine with 4-nitrobenzaldehyde. The molecular weight of 3-((4-nitrobenzylidene)amino)coumarin has been obtained from the chemical formula (C<sub>16</sub>H<sub>10</sub>N<sub>2</sub>O<sub>4</sub>) which has been approved by CHN microelemntal analysis. No amino absorption band has been shown for 3-((4-nitrobenzylidene)amino)coumarin in the infrared spectrum. The Nuclear magnetic resonance spectrum demonstrated doublet at δ 9.18 ppm, due to the H-C=N) proton. The target inhibitor 3-((4-nitrobenzylidene)amino)coumarin has been synthesize from coumarin-3-amineregarding to the Scheme 1.

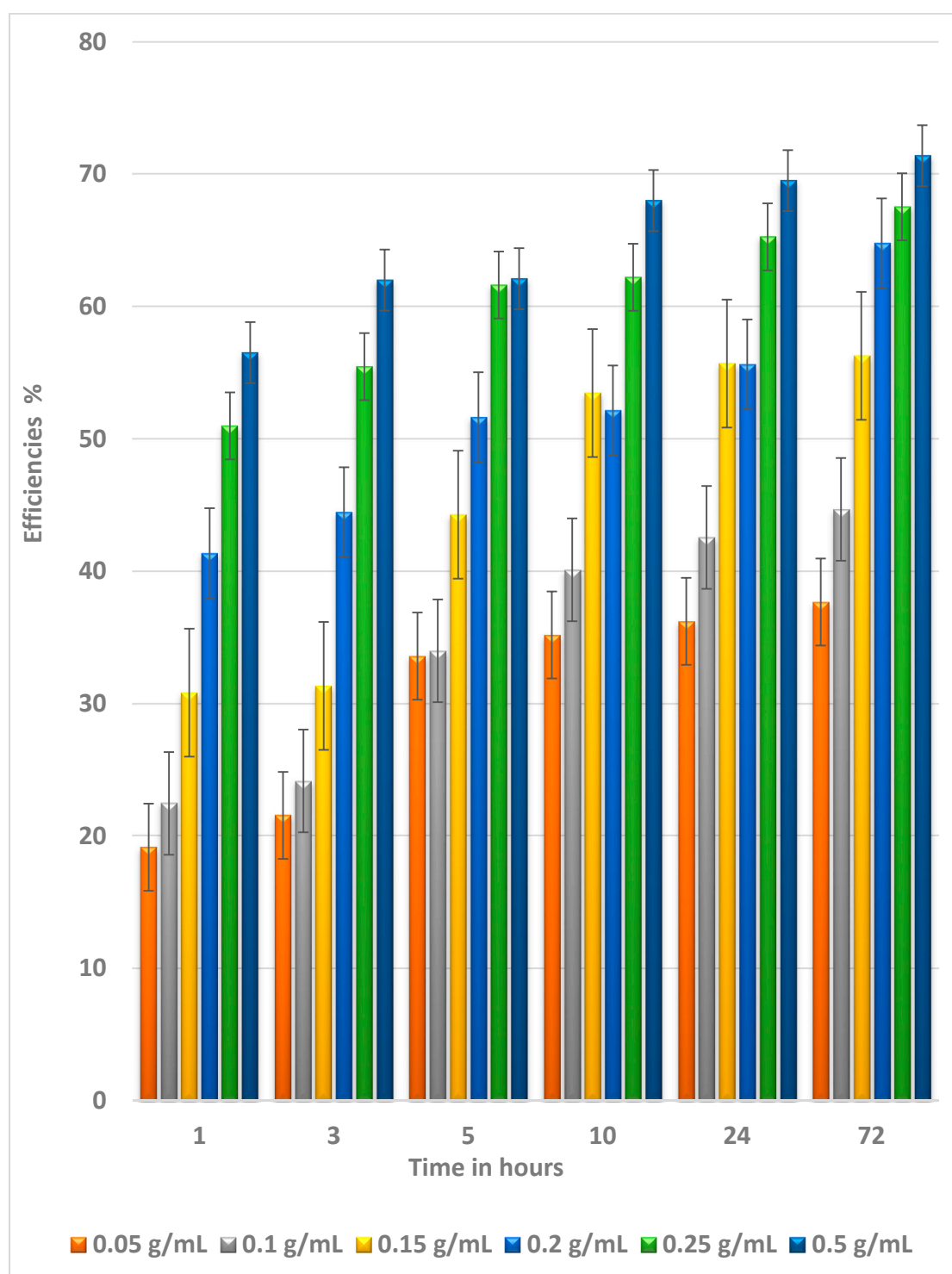
Scheme 1: 3-((4-nitrobenzylidene)amino)coumarin synthesis



Weight loss results: In manufacture, the utilization of corrosion inhibitors still the significant economic technique due to dynamically protection for the surface of mild steel versus corrosive solutions [31]. Organic corrosion inhibitors are the controlling tools utilized in oil and gas manufactures because they were become barriers to protect the surface of alloys and metals against acids or bases solutions. The majority of employed inhibitors were organic molecules with one or more nitrogen, oxygen and/or sulfur atoms, such as pyridines, imidazoles rings [32-34] in addition to polymers with heterocyclic rings [35].

Concentration impact: Weight loss technique has been utilize to figuration the inhibition efficiency of 3-((4-nitrobenzylidene)amino)coumarin with concentrations rang (0.05, 0.1, 0.15, 0.2, 0.25 and 0.5 g/L) for the period of time (1, 3, 5, 10, 24 and 72 h) and fixed temperature degree 303 K in one molar of solution of hydrochloric acid for mild steel surface. The 3-((4-nitrobenzylidene)amino)coumarin results, that was demonstrated in Figure 1, refer to the ability of 3-((4-nitrobenzylidene)amino)coumarin to reduced corrosion that was done by the corrosive solution of the surface of mild steel, and the highest inhibition efficiency that was 71.4% and done regarding to the maximum investigated concentration so the inhibition efficiency become the lowest with minimum concentration.

Figure 1. Function of time at various 3-((4-nitrobenzylidene)amino)coumarin concentrations.



#### 4. Conclusions

New corrosion inhibitor for the mild steel namely 3-((4-nitrobenzylidene)amino)coumarin has been synthesized from 2-acetamidoacetic acid, 2-hydroxybenzaldehyde and acetic anhydride and the chemical structure has been elucidated regarding to some spectroscopically techniques in addition to elemental analyses. The capability of 3-((4-nitrobenzylidene)amino)coumarin as inhibitor against corrosion of mild steel in solution of one molar of hydrochloric acid was studied. 3-((4-nitrobenzylidene)amino)coumarin, demonstrate a good inhibition performance and reach to the

maximum that was 71.4% at the addition of 0.5 g/L of 3-((4-nitrobenzylidene)amino)coumarin, so the inhibition efficiency become the lowest with minimum concentration.

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