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AROMATIC QUINOXALINE AS CORROSION INHIBITOR FOR Zn-Al ALLOY IN 3% NaCl SOLUTION

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ABSTRACT

A new corrosion inhibitor, viz. 3-ethyl-6-méthyl-quinoxalin-2-one, 1-benzyl-6-methyl-quinoxalin-2-one, 2-benzyloxy-3,6-dimethyl-quinoxaline, 1-benzyl-3-methyl-quinoxalin-2-one, were synthesized in the laboratory. Their influence on the inhibition on corrosion of Zn-Al in aqueous chloride solution (3% NaCl) was studied by weight-loss measurements. The impact of temperature on the effectiveness of the substances mentioned above has been determined between 20^o and 40^oC. The results showed that the corrosion resistance was greatly enhanced in the presence of inhibitor and that the effectiveness depends on some physicochemical properties of the molecule, related to its functional groups[1]. These compounds act through the formation of a protective film on the surface of the alloy.

Key words: Quinoxaline, Corrosion inhibitor, Zn-Al alloy.

INTRODUCTION

Heterocyclic organic compounds containing nitrogen, sulphur or oxygen atoms are often used to protect Zn-Al alloy metals from corrosion. Among them, azoles compounds like triazoles, imidazoles and thiazoles have been intensively investigated as effective Zn-Al alloys corrosion inhibitors. Benzotriazole (BTA) is one of the most efficient inhibitor for Zn-Al and its alloys[2-4]. However, in line with environmental protection requirements, the use of BTA is now a days quite limited, as toxic inhibitors that are widely used in industrial processes should be replaced with new environmental inhibitors. The use of non-toxic imidazoles derivatives, oximes andquinolines have very good inhibiting properties for Zn-Al in NaCl media Zn-Al-based alloys containing alloying elements such as aluminum, nickel

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and iron offer a good combination of mechanical properties and corrosion resistance. Aluminum enhances the properties of castings, nickel improves corrosion resistance and iron increases tensile strength. Consequently, Zn-Al are widely used in a variety of marine applications such as pump casting, valves and heat exchanger[5-6].

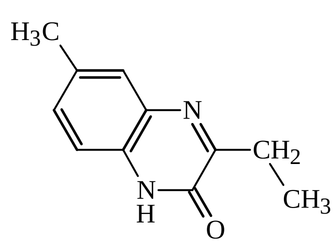
EXPERIMENTAL

3-Ethyl-6-methyl quinoxalin-2-one (P4), 1-benzyl 3,6-dimethyl quinoxalin-2-one(YA1), 2-benzyloxy-dimethyl-3,6-quinoxalin1-benzyl (YA2), 1-methyl quinoxalin-2-one(YA3) tested as inhibitors were prepared in the following steps: (I) A mixture of threonine (0.018 mol) and o-phenylene diamine (0.018 mol) in 40 mL of HCl 5.5 N, was refluxed for 72 h, then cooled to room temperature and washed with a saturated solution of Na_2CO_3. The precipitate was filtered off and recrystallized from ethyl alcohol and gave pure product (yield 65%). (II) Alkylation: To a solution prepared by dissolving 0.0057 mol of quinoxaline in 40 mL of DMF, was added 0.0069 moles of the alkylating reagent, potassium carbonate and tetra-n-butyl ammonium bromide. The solution was stirred for 4 hrs at room temperature. The mixture was then filtered off, and the solvent was removed under reduced pressure. The residue was washed with dichloromethane[7]. After performing a second filtration and evaporating the solvent, pure products were obtained after recrystallization from ethyl alcohol. The Zn-Al Specimen prepared as per ASTM standards and the specimen should added in the electrolyte and the weight loss tested for 48 hours in different temperature. Finally the % efficiency calculated by using the formula,

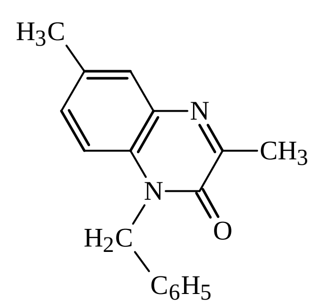
Calculation of Percentage of Efficiency

$$\% E = (1 - w/w_0) \times 100$$

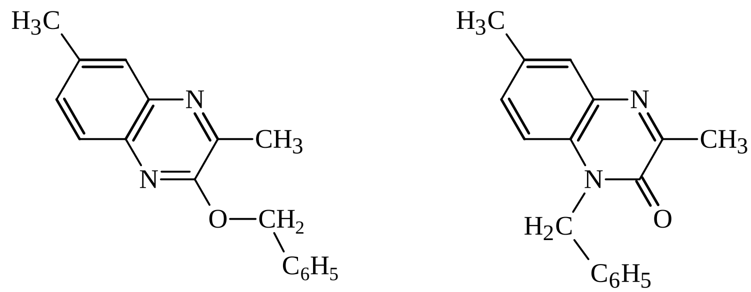
Where w and w_0 are rate of corrosion (g cm^{-2} h^{-1}) with and without inhibitor, respectively. The data obtained are given in Table 1, for an immersion period of 48 h.



p4



YA1



YA2 **YA3**

Fig. 1: Structure of aromatic quinoxaline (P4, YA1, YA2, YA3)

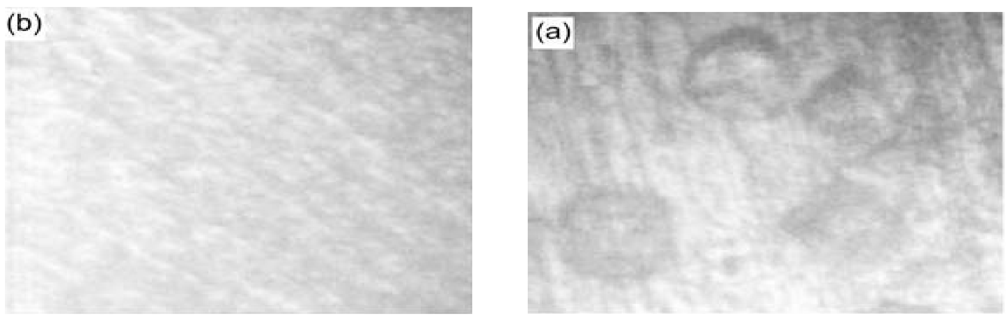


Fig. 2: Optical micrographs of Zn-Al alloy specimens before and after corrosion test in 3% NaCl solution

Table 1: Weight loss parameters of Zn-Al alloy in 3% NaCl added compounds at 5×10^{-3} M at different temperatures

Temperature	Electrolyte	% Efficiency
20°C NaCl 3%	NaCl 3% + YA2	88.0%
	NaCl 3% + P4	87.6%
	NaCl 3% + YA3	84.4%
	NaCl 3% + YA1	84.0%
30°C NaCl 3%	NaCl 3% + YA2	87.5%
	NaCl 3% + P4	86.6%
	NaCl 3% + YA3	84.0%
	NaCl 3% + YA1	83%

Cont…

Temperature	Electrolyte	% Efficiency
40°C NaCl 3%	NaCl 3% + YA2	85.0%
	NaCl 3% + P4	84.0%
	NaCl 3% + YA3	82.0%
	NaCl 3% + YA1	80.0%

CONCLUSION

(**I**) Weight loss measurements showed that all of the quinoxalines compounds (P4, YA1, YA2 and YA3) acted as efficient corrosion inhibitors of Zn-Al in 3% NaCl solution. (**II**) The maximum inhibition efficiency reached for many of them exceeded 80%. (**III**) The observed protecting effect of these inhibitors was affected by the nature of the functional group: maximum inhibitor efficiency of about 88% was obtained for 2-benzyloxy-dimethyl3,6-quinoxalin1-benzyl (compound with ester functional group). (**IV**) The inhibition efficiency did not change significantly with increase in temperature. (**V**) The inhibitors tested act by chemical adsorption leading to the formation of inhibitory films. Nevertheless, this protective film must be studied using techniques for surface analysis[8].

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