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Anti-Corrosion Activities of Apen-Class Inhibitive Drug on Aluminium Alloy in Simulated Chloride Environment

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Abstract. In this study, aluminium material normally used in the underlie ship was immersed in simulated sodium chloride environment and its degradation properties was evaluated. Investigation of corrosion rate and mass weight loss through gravimetric tests measurements showed that less mass loss was recorded for tests in sodium chloride with 3-(2'-chloro-6' fluorophenyl) and lowest corrosion rate values were found at 10%. On the other hand, the mass loss deteriorated in all 3-(2'-chloro-6' fluorophenyl) with less uniform corrosion. The existence of chloride dissolved the interfacial surface layer resulting into pit initiation and growth. It is found that corrosion degradation of aluminum is dependent on chloride and inhibitive concentration.

Key Words: Corrosion Degradation, Inhibitor. Aluminium

INTRODUCTION

In order to solve the problem of corrosion degradation in service, chemical inhibitors are being used as an alternative to challenge of materials selection [1-3]. Chemical inhibitor plays an important role in the protection and retarding of corrosion initiation. These inhibitors range from organic compounds to inorganic and presently a trend toward eco friendly corrosion compounds. Organic compounds are often seen as effective inhibitor especially those with heteroatom's such as O, N, and P [4-7]. The inorganic compounds like chromate (Zn, K, Na) and dichromate in their respective class are also be used and tested as good inhibitor. The detrimental effect of this compound in service has been a challenge to health and environmental consequence [8].

In view of this, development of new existence non toxic eco friendly compound has been look into lately ranging from the use of green compounds such as green tea and green extract to fluids inform of silicon, Avogadro and species vibrant particulates like TiO_2, ZnO. The research in to the progress in eco-friendly inhibitors are found across special trend toward pharmaceutical investigation with the discovery of molecules with related to biological activities [8, 9]. It was found that the substructure of drugs and corrosion inhibitors share so many similarities especially with heterocyclic and cyclic system [9, 10].

In view of the above, this study was undertaken to assess the corrosion behavior of aluminum alloy in 3.5 molar chloride environment in the presence 3-(2'-chloro-6' fluorophenyl) . In the investigation, weight loss and corrosion rates

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from immersion tests of aluminium in the chloride environments of interest were evaluated with respect to a reference test.

EXPERIMENTAL SECTION

Materials and Environment Test

The aluminium metal samples used for this study were machined and sectioned into coupon plate. The chemical composition of this steel is shown in Table 1. To make the corrosive solution, the specified NaCl and water concentrations respectively, NaCl was first dissolved in water, and then obtained at 40 mL. The properties of the inhibitive compound used are described in Table 2. All reagents used were of analytical grade. The corrosion tests were carried out at room temperature of 27°C.

Table 1. Chemical composition of micro-alloyed steel in as-received condition

Element	%Content	Element	%Content	Element	%Content
C	0.0012	Na	0.001	Ti	0.0046
Si	0.157	Ni	0.004	Zn	0.01
Mn	0.025	Cu	0.01	Zr	0.010
P	0.01	Al	99.01	B	0.004
Sr	0.0001	Co	0.004	Ag	0.004
Cr	0.01	Mg	0.5	Fe	0.281

Table 2. Properties of Inhibitive Compound used.

Floxapen Molar mass	Floxapen Molecular Formula
453.87 g/mol	$c_{19}h_{17}clfn_3o_5s$

Immersion Tests

Flat coupons of dimensions 20 x 20 mm from 22mm thick micro-alloyed steel plates were machined for long-term immersion tests. All specimens were dry-abraded up to 800, 100 grit, degreased with acetone, dried and used immediately for testing. The area and weight of each specimen were measured before exposure to the test environments for the purpose of post-analysis. Duplicate samples for each test condition were suspended with nylon thread in solution for a period of 21 days. After the immersion period, samples were removed, dried and cleaned in accordance with ASTM Standard G1-03 [11] for preparing, cleaning and evaluating corrosion test specimens. In addition, corrosion rate was calculated in milliliters per year using equation (1) obtained from ASTM G1-03:

$$Corrosionrate = (K \times W)/(A \times T \times D) \quad (1)$$

K is a constant (534), T is the exposure time in hours, A is the area in square inches, W is the mass loss in miligrams, D is the density in g/cm^3.

RESULTS AND DISCUSSION

Corrosion Rates Determination from Immersion Tests

Figure 1 shows the weight –time trend of result after immersion in 21 days. The susceptibility of the sample to pitting corrosion in the absence of inhibitive compound has cause drastic mass loss from the unset of the experiment. It is in no doubt that the likely factors influencing pitting of ferrous and non ferrous metal are water and chloride concentrations which were noticed to participate in the degradation process. Floxapen compound was found to work effectively in all medium there by retarding the penetration Cl^- within the lattice surface [4]. The influence of Cl ion on pitting of aluminium is mainly due to weak covalent bonds formed by floxapen at the latter end of the experiments [5].

Figure 2 shows the corrosion rates for aluminium after immersion in 3.5% NaCl environments. For specimens immersed in flaxopen, there was no massive mass loss for the test duration. A close look at the results profile reveals that there was highest corrosion rate with as-received control sample. The margin of increase in corrosion rate from 3.002E-02 mpy in Floxapen to 6.03E-02 mpy in control sample is quite significant. Therefore, it can be concluded that increasing floxapen concentration up to 10% resulted in decrease in corrosion rate for aluminium.

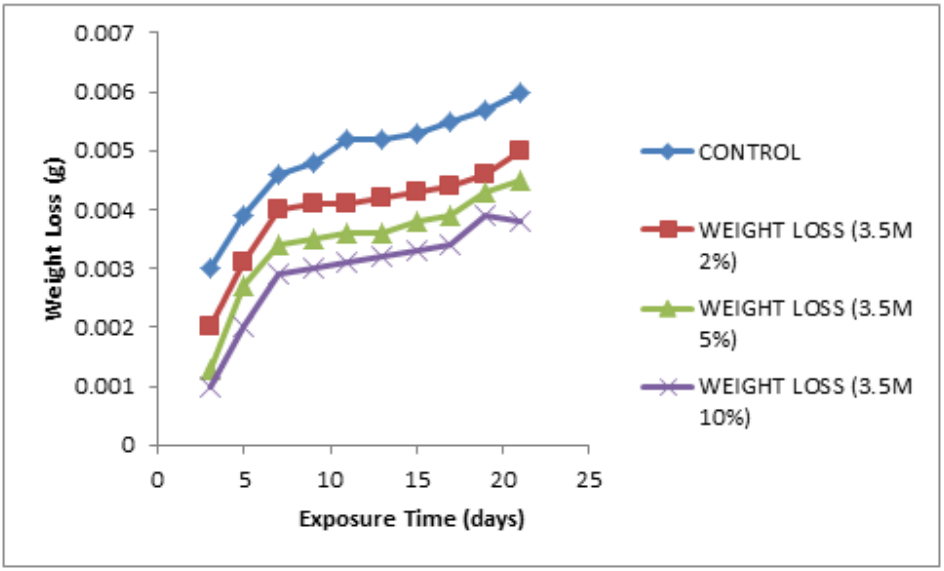

Figure 1. Weight loss of aluminium alloy against time at varying inhibitive concentration

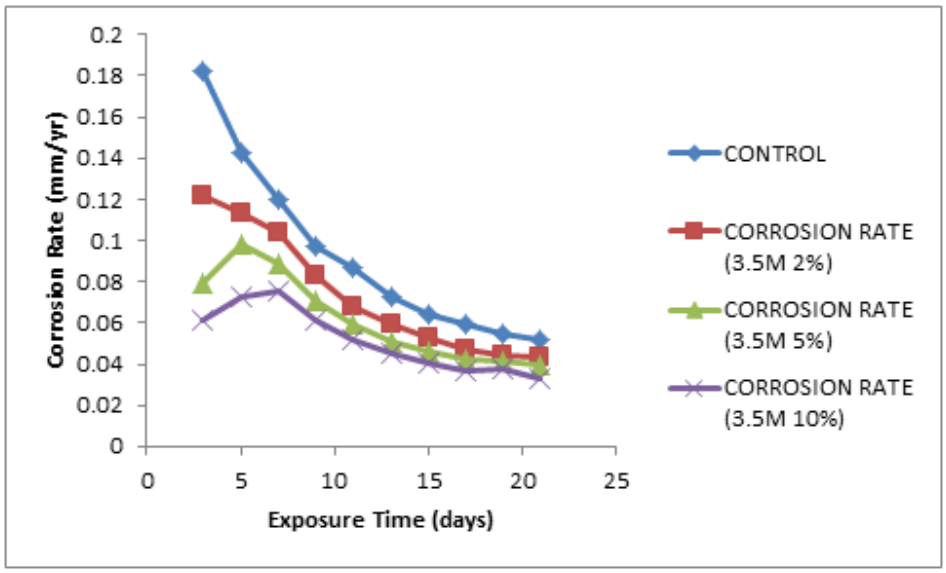

Figure 2. Corrosion rate of aluminium alloy against time at varying inhibitive concentration

CONCLUSIONS

The degradation process of aluminium in simulated sodium chloride has been systematically studied with variations in floxapen compound concentration. The precise conclusions arrived at are as follows:

- Corrosion rate decreased with increasing percentage concentration of inhibitor
- The massive weight loss of the aluminium sample was as a result absence of surface active protective compound.
- The interfacial surface observation shows degradation by uniform corrosion with week covalent bond repulsion during the latter part of the experiment.

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