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Abstract

Corrosion inhibition of copper alloy in 0.3 M HNO and KOH at room temperature using Mangiferaindica leaf extract in different concentrations was studied. A Gravimetric technique was employed. The result obtained showed that Mangiferaindica leaf extract is a good inhibitor for 0.3 M HNO3 and KOH solution. The weight loss, corrosion rate, and inhibition efficiency were deduced. The inhibition efficiency showed a good percentage result with the optimum value of 85.60

Index terms— corrosion, copper alloy, mangiferaindica, gravimetric, HNo3, KOH.

1 Introduction

orrosion is the disintegration of engineering and industrial materials into its constituent atoms due to chemical reactions with its surroundings. Furthermore, corrosion is the wearing away of metals due to a chemical reaction (Fontana, 1986).

Aluminum is a durable, soft, lightweight, malleable metal with appearance ranging from silvery to dull grey. Aluminum is a very reactive metal with a high affinity for oxygen; the metal is highly resistant to most environments and a great variety of chemical agents. The resistance is due to the inert and protective character of aluminum oxide film which forms on the metal surface. In most environments, the rate of corrosion of aluminum decreases rapidly with time. In only a few cases, e.g. caustic soda does the corrosion rate approximate to linear (David and James, 2000). The oxide film is stable in aqueous media when the pH is between about 4.0 and 8.5 the oxide film is naturally self-renewing, and accidental abrasion or other mechanical damage of the surface film is rapidly repaired. The acidity or alkalinity of the environment significantly affects the corrosion behavior of the aluminum alloys. At lower and higher pH of 4 and 8.5, aluminum is more likely to corrode. Below and above theses values, acid dissolution yields Al +3 ions and the alkaline dissolution lead to the formation of AlO 2 ions (Pourbaix, 1974).

To be realistic, corrosion can only be reduced significantly or delayed to a reasonable extent.

Controlling of the pH or ion concentration of the solution or controlling the metal solution interface had some of ways to achieve the reduction in the rate of corrosion over the years. The above is achieved through the addition of small quantity of chemicals called inhibitors, that either encourage film formation or form a barrier like a layer on the metal surface and by so doing stop or slow down the rate of metal decomposition (Obot et al., 2011).Corrosion inhibitors are chemicals either synthetic or natural which when added in small quantity to an environment decrease the rate of attack by the environment on metals (Lebrini et al., 2011).Therefore, the present study aims at investigating the corrosion inhibition effect and adsorption properties of Mangifera indicaleaves extract on Al alloy corrosion in 0.3 M and 0.8 M nitric acid using gravimetric techniques.Mangifera indica was considered for the study due to its medicinal value and phytochemical composition. Mangifera indica leaf contains steroids, flavonoid, reducing sugar and cardiac glycosides in the hexane extract; anthraquinone, tannin and reducing sugar in the ethyl acetate extracts and saponin, steroids, tannin, flavonoid, reducing sugars and cardiac glycosides in the methanolic extracts (Aiyeluagbe and Paul, 2009).

2 II.

3 Materials and Method b) Preparation of Mangiferaindica leaf Extract

The extract was prepared according to (Oka for et al., 2008). Mangiferaindica leaves was collected from University of Port Harcourt, River State, Nigeria. They were washed with plenty of water, dried and ground to powder form. The extraction was done in reflux setup for 3 h at a constant temperature of 75°C using 10 g of air dried Mangiferaindica leaf in 300 ml of 0.3 M and 0.8 M HNO 3 solution. The solution was cooled. The filtrate measured. Different concentrations of the inhibitor were prepared from the filtrate and the corrosive environment in the range 0.1, 0.2, 0.3, and 0.4 g/L.

4 a) Coupon Preparation

The aluminum alloy used for the study was obtained from Steel Village in Port Harcourt Rivers State, Nigeria. It consist the following element (in % Composition):

Al(99.84), Fe(0.144), Co(0.001), Mn(0.000), Zn(0.008), Cr(0.000), Ni(0.001), Mo(0.000) Cu(0.000). The metal sheet was cut in to samples of dimension 40 x 20 x 2 mm and used for corrosion studies.

5 c) Gravimetric technique

The gravimetric technique used was according to the description by (ASTM G1-72, 1990). All reagents used were BDH grade. Before measurement, each coupon was degreased in ethanol, the surface smoothened using sic emery paper (of grades 400, 600, 800 and 1000) and then double washed with distilled water and air dried after dipping in acetone. The coupons were weighed using FA2104A analytical electronic digital weighing balance (sensitivity of 0.0001). The specimen were immersed in 250 ml beaker containing 240 ml of 0.3 M and 0.8 M HNO 3 solutions of different concentrations (0.1, 0.2, 0.3, and 0.4 g/L) of the prepared inhibitor at room temperature (303°K). The set up was exposed for seven (7) days after which the specimen was taken out, washed, dried and weighed accurately.

III.

6 Results and Discussion

7 a) Weight loss

The variation of weight loss against (7) days exposure time of Al alloy in different concentrations of the investigated inhibitors and without the inhibitor in 0.3 M and 0.8M HNO 3 at room temperature.

Figures one and two below depict the weight losses of Al alloy in different concentrations of the inhibitor and without inhibitor in 0.3 M and 0.8 M HNO 3 respectively. The result shows that weight loss is higher in the blank system than the inhibited and also increases as the exposure time increases and reduces as the concentration of the inhibitor increases in both 0.3 M and 0.8 M HNO 3 . Figure **??** had higher weight loss than figure **??** which may be due to the increase in the concentration of the corrosive environment (HNO 3).

8 b) Corrosion rate

The corrosion rates of Al alloy were calculated using eq.1.

Where Î?"W is the weight lost (in grams), 87.6 is a constant; A is the surface area of the coupon (in cm 2), ? is the density (in g/cm 3), t is the period of exposure (in days). The calculated corrosion rate fits into the range (less than 0.50 mm/yr.) at which the application is acceptable **??**William, 2007).

Corrosion rate decreases with increase in exposure time and increase in inhibitor concentration which indicates that the presence of the additive reduces the corrosion rate of Al alloy in 0.3 M and 0.8 M in HNO 3 as shown in figures 3 and 4. Figure **??** showed higher corrosion rate than figure **??**, which maybe as a result of increase in nitric acid concentration.

9 c) Corrosion Inhibition Efficiency

Where W blank = weight loss in the control corrosion. W inh = weight loss in the inhibited environment The plots of Figure 5 and 6 depict that inhibition efficiency increases as the inhibitor concentrations increases. It is also observed that the inhibition efficiency increased as the corrosion rate decreases. Mangiferaindica leaf extract could be considered as an inhibitor of Al alloy in 0.3 M HNO 3 having a maximum value of inhibition efficiency 79.59% while in 0.8 M HNO 3 recorded optimum value of 69.55%.

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