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Inhibition Effect of Eco-Friendly Extract of *Andrographis Paniculata* on Dissolution of Aluminium in Hydrochloric Acid Medium

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ABSTRACT

In the other side, hydrochloric acid, which is commonly used for picking, washing, descaling and etching metals, often leads to metal surface corrosion. In violent acid medium, metals suffer from extreme corrosion. Around 90 per cent of beating issues can be overcome by adding a suitable beating inhibitor into the medium. The plant extract of Andrographis paniculata have been selected to study anticorrosion on aluminum in acidic medium. The influence of the addition extract of Andrographis paniculata on the corrosion of Aluminum in 1M HCL was studied by weight loss measurement. The inhibition efficiency increases with extract concentration. The inhibitor showed maximum efficiency of 83.86% in acid at an optimum concentration of 50 ppm. The impact of the studied temperature reveals that the inhibition efficiency has decreased with rising temperature.

***Key Words**: Aluminum, Andrographis Paniculate, Plant Extract, Corrosion Inhibitor, Hydrochloric Acid*

1. INTRODUCTION

Aluminum and its alloy find extensive applications in industries where they are used in a variety of aggressive and corrosive service environments [1,2,3]. Aluminium, a light weight metal and is used in fabricating various reaction vessels, reaction tanks and pipes etc. for industrial uses because of their abundance and their low cost. However, in aggressive media, the unprotected metal surface sites get dissolved causing severe loss and malfunctioning of industrial equipment. Therefore, it is necessary to protect from getting corrode and the best method is employing inhibitors. The inhibitory impact of organic compounds is commonly related to its adsorption on the metal/solution interface. Recent and growing trends have shown that plant extracts are efficient inhibitors of corrosion [4-12] because of their biodegradability and ecological friendliness. Nowadays chemical or inorganic inhibitors creating an environmental hazard must be minimised and substituted with green inhibitors owing to environmental legislation. In present study, Andrographis paniculata extract has been used to inhibit the acid corrosion of Aluminium.

Green Chireta or Andrographis paniculata is a tropical and subtropical herb noted for their bitter flavor. It is spread in Asia, Australia, India, Laos and North-East India. It is commonly used as a medicinal herb. Is planned to explain and analyse their corrosion inhibition ability for aluminium in solutions of HCl (using gravimetric methods) in the chemical structures of ethanol extract Andrographis paniculata. Other industrial potential plants may also be investigated from known chemical components or structures that are inherent in the ethanol extract of Andrographis paniculata. Hence the extracts of Andrographis paniculata is used to study the corrosion inhibition effect on aluminum in hydrochloric acid medium.

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2. MATERIALS AND METHOD

1. Preparation of *Andrographis paniculata* extract

Andrographis paniculata were grinded and powdered. The finely powdered dry substance has been taken in a 500ml circular flask and ample volume of ethyl alcohol was consumed. Until the soaking time was over, the ethanol solution was purified to concentrate the inhibitory compounds and eventually filtered to extract suspended impurities. The mass of plant extract was dried.

2. Preparation of specimen

Aluminium sheets (3 mm thick) with normal composition 0.8% Si, 0.7% Fe, 0.4% Cu, 1.2% Mg, 0.35% Cr, 0.25% Zn, 0.15% Ti and the rest aluminum was taken for experiments. The sheet was cut into 1.0×4.0×0.2 cm rectangular coupons. The surface of the freshly cut was thoroughly polished with emery paper, from the lower grade - 150 to water, wraps in folds of philter paper.

3. Weight loss method

Weight loss tests were done with immersion in 200 ml solution beakers at 303-333 K held in a water tank. Aluminum coupons is weighted and suspended by rod and hook in the beaker. The coupons were retrieved at different inhibitor concentration at 303 K, washed thoroughly with distilled water, wrapped within fold of filter paper and desiccated overnight. The final weights of the coupons are measured. The weight loss of grains was taken as a variation in the weight of the aluminum coupons in various test solutions calculated using the automated balance mg before and after immersion. Then the test was repeated at different temperature. To ensure strong reproducibility, triple experiments were performed.

The weight loss was calculated using the equation:

$$\Delta W = W_1 - W_2 \quad (1)$$

Where

W_1= Initial weight of coupons before immersion

W_2= Final weight of coupons after immersion

ΔW= Weight loss of coupons.

The percentage inhibition efficiency (%IE) was than calculated from the resulting weight loss data as follows:

$$\text{“\%I.E.} = [1 - WL_i/WL_b] \times 100 \quad (2)$$

WL_i= Weight loss of coupons in inhibited solution.

WL_b= Weight loss of coupons in blank/uninhibited solution.

3. RESULT AND DISCUSSION

3.1 Effect of inhibitor concentration

The inhibition efficiency (%IE) and the corrosion penetration rate calculated from the weight loss measurement of hydrochloric acid. Figure 1 represents the effect of Andrographis paniculata extract concentration on weight loss in 1M HCl. The weight and corrosion rate fell with a rise of the inhibitor concentration up to its optimum, during which further increase in the inhibitor concentration did not improve the inhibitory activity and the corrosion rate significantly. The overall efficacy of the inhibitor was 83.86 percent in HCl at an optimal amount of 50ppm. Further increase of the concentration of extract did not alter the potency of the inhibition substantially. The percentage performance values for corrosion obtained from the weight loss process at various plant extract concentrations at 303 K are shown in Figure 1.

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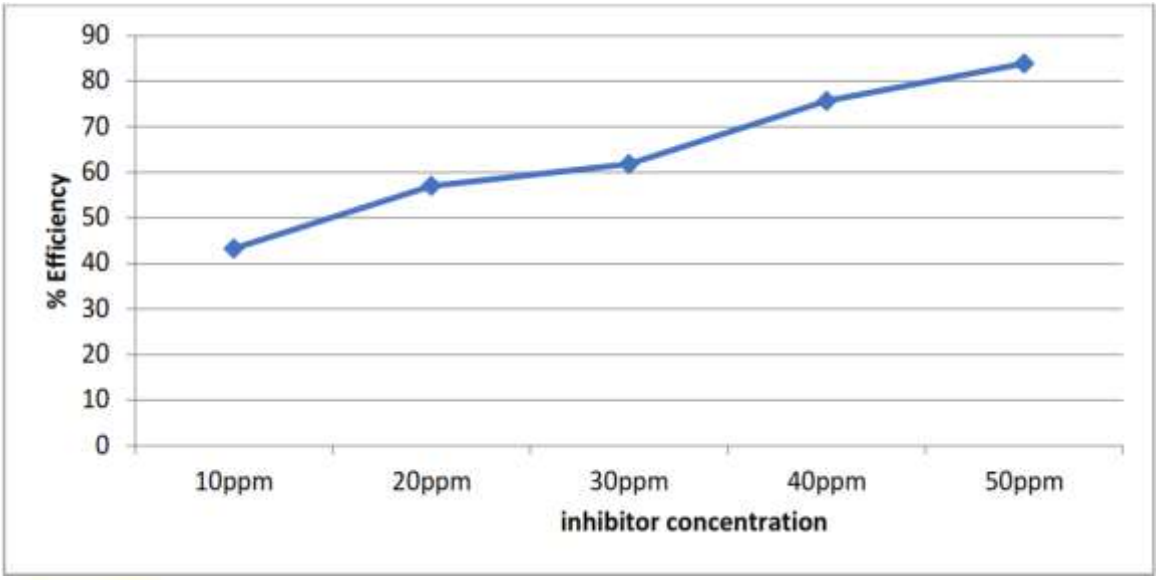
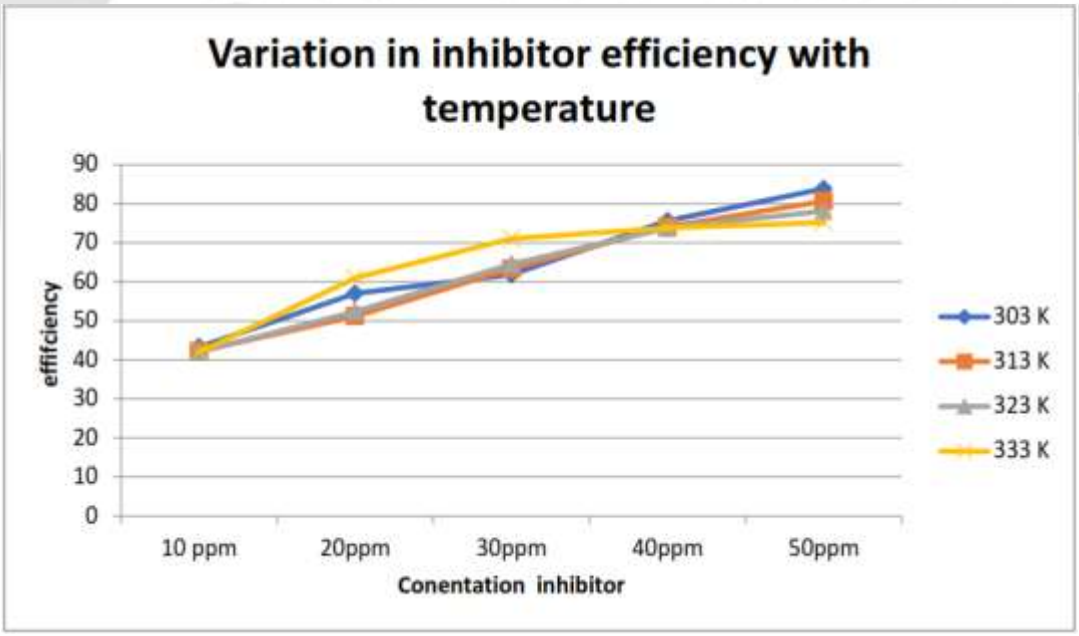


3.2. Effect of temperature

In the absence and existence of Andrographis paniculata extract in an acceptable concentration of 3 h immersion duration weight loss tests have been carried out in the temperature range 303-333 K. Figure 2 displays the findings thus obtained. This figure 2 indicates that inhibition performance reduces as the temperature rises. This is attributed to an elevated rate of aluminum dissolution and partial desorption of the metal surface inhibitor at temperature. The effect of increase in temperature on the inhibition log (Wi- ΔW) against time (min) at 303 K and other temperatures studied, showed that the maximum efficiency is showed at 50ppm and at 303 K.



CONCLUSIONS

From the result of this study, following conclusions can be drawn-

1. Plant extract of Andrographis paniculata was found to be an effective inhibitor for the corrosion of aluminium in 1M HCl at 303-333 K temperature.

2. Gravimetric measurements revealed that the inhibition efficiency reached 83.86% at a concentration as low as

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50ppm of the extract.

3. The inhibition efficiency increased with increased concentration of extract to an optimum concentration of inhibitor.

4. The inhibition performance decreased with elevated temperature.

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