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# Corrosion Inhibitive Analysis of metal

**D. K. Gupta* and Jinendra Singh****

**Department of Chemistry, Govt. M. V. M. College, Bhopal (M.P.), India*
*** Sagar Institute of Research and Technology Bhopal (M.P.), India*

## Abstract

The natural products in acidic media were tested for corrosion inhibition of Cu in 0.5N HCl acid solution at 30 to 40 $^0$C temperature range by Potentiometric technique, it reveals that Natural Products shows anti-corrosive properties and zenthoxylum alatuma is best all of them to protect metallic layer by corrosion.

**Key words:** Natural Product, Inhibitors, HCl, Potentiommetric.

## Introduction

The electrochemical behavior of metals and alloys in aqueous solution is complex. This depends on the ionic composition of the medium, the crystal Orientation, thermal treatment and on the perturbation applied to metal / solution interface. Electrochemical behavior and its study confirm that the metal electrode involves the presence of adsorbed hydroxo-species [1].

The passivation of metal in acidic solutions containing high concentration of Chloride ions and metal ions was explained with the chemical reaction intermediates [2].

The behaviour of fresh metal electrode generated low potential, which shows that monolayer of solution, is formed. Passivation of metal at high potential is controlled by the component of the inhibitor and oxide film component [3].

The Cu is widely used in different appliances because of good properties. These valuable properties are caused by the passive films that are rapidly formed in the environment [4-6]. In the

environment there are so many components are present which destroy the metal surface, the corrosion resistance of Cu and metal alloys decreasing in that type of environment is reported [7-15]. Therefore, some studies have been made to controlling the corrosion by natural plant product in acidic media for the metal and alloys.

The interaction between the plant extract and metal was studied to the mechanism of inhibition of cathodic evolution of hydrogen. The previous studies state that the corrosion of metal and the alloys in 0.5 M of solution was not significantly affected by the presence of natural plant products.

This work intends to characterize the inhibitor ability of all used natural products on the electro oxidation reaction of metal electrode deaerated and aerated in acidic solution. There are three different methods were used: (1) Potentiometry (2) Potentiodynamic (3) Partial Polarization curves . Some experiments were made in darkness in order to observe the influence of incidence of polychromatic light on the electrochemical behavior of the metal in the absence and presence of inhibitor.

*Technique and process of method*

**Electrode materials:**

The experiments were carried out with the sample of Cu. Cylindrical samples of each specimen, approximately 1 cm in length, were cut from section of stock rod. In order to supply an electrical connection, a suitable length of copper wire was then spot welded to one end.

The cross-section surface area of each specimen metal depended, of course, on the diameter of the stock road. For the metal this amounted to 0.506 $cm^2$. However, the aluminum was smaller diameter and the cross- section area in this case was 0.47$cm^2$. The surfaces of both the cut ends and body of metal slightly polished to remove trace of contamination and achieve a fairly surface at both the cut edges, then the cut samples were degreased in alcohol. This was carried out to improve the adhesion of the epoxy mounting resin to the so as to reduce the tendency of the metal experiencing crevice corrosion at the edge of the mounting resin.

The cut section of rod was then embedded in epoxy mounting resin, with the connecting wire protected by rigid plastic tube. The resin mixture was prepared by blending araldite with hardener in the ratio of 5:2. After hardening leaving the specimens overnight, then after metal polished.

Polishing of the specimens was done using SiC paper. The specimens were ground on successively smaller grades of SiC paper from P220 grit, using water as lubricant on grinding wheels. After polishing, the samples were washed in deionisd water dried. Then they were kept dry.

**Chemical used in the Experiments:**

The two solutions were used in these tests. The first was potassium chloride of 0.5 M which was used as it was used as an electrolyte. This solution will encourage the pitting of substrates, due to the chloride ions. The second electrolyte was 0.5 M of potassium sulphate solution. This was used due to the replacement of chloride by sulphate here shold discourage pitting corrosion.

**Electrochemical Experiments:**
Potentiodynamic polarization was carried out using an ACM potentiostat controlled by a PC and for the current and resistance analysis ANOVA instruments are used. A silver/ silver Chloride electrode was used as a reference electrode, which was connected to the electrolytic cell using a salt bridge and a Luggin capillaries, which was placed approximately 1mm away from the working electrode. The auxiliary electrode was made of platinum and consisted of a flag shape with an area of 1 $cm^2$.

Sample ware immersed for the 1min of time at the free corrosion potential prior to the establishment of polarisation. Also, since the potentiostat controlled the voltage from the cathodic and anodic direction, the potential was held at the initial cathodic value for 1 min. before the sweep.

All the measurements were performed at least twice. The temperature of the assembly was at ambident and it was open to air and not stirred. As mentioned above, the basic testing electrolyte solution used was 0.5M KCl and Sodium sulphate. Potentiodynamic polarization curves were produced using ACM Auto Tafel software at a sweep of 50-60 mV/s. the working electrode potential was measured with respect to the reference electrode and was plotted against current in external circuit. Thus giving the anodic and cathodic current curves according to the variation of the working electrode potential. As mentioned above, in order to minimize Ohamic resistance and maintain consistency. The capillary and auxiliary electrode was placed close to the working electrode and allowing formation of uniform and electric field during the anodic and cathodic polarization.

**Result and Discussion**

**Copper in KCl solution:**
The corrosion potential of copper is about -188mV with the Ag/AgCl Electrode when immersed in KCl solution. The anodic current increases rapidly when the potential moves to a more positive direction. This behavior is likely due to the rapid dissolution attack by the chloride ions on copper surface. The cathodic current shows limiting current behavior at the value of -48 $\mu Acm^{-2}$ at a potential of -1125mV and below, hydrogen evolution is observed.

The addition of Zenthoxylum Alatum is mix with the solution the corrosion potential shifted to more negative value about -180 mV. In the cathodic current, the limiting current decreases significantly to less than $12\mu Acm^{-2}$. The anodic current is inhibited significantly. Nyctanthin extract move the corrosion potential to a negative direction at -250 mV. It also induced a region of passivity before the pitting potential. The cathodic current region shows increases in the limiting current reaching the value of $-30\mu Acm^{-2}$. This is still less than in the KCl solution showing some cathodic inhibition.

**Copper in $K_2SO_4$ solution:**
Cooper polarized in uninhibited potassium solution shows corrosion potential of -210mV with the Ag and AgCl electrode. The anodic current rises at a moderate rate prior to its increases once the potential become positive. The current (cathodic) shows limiting characteristics of about 10

$\mu Acm^{-2}$. The current moves toward the hydrogen evolution region as the potential become more negative around -1100mV.

The addition of Zenthoxylum Alatum causes the corrosion potential which shifted to negative direction, giving corrosion potential of about -298mV. A significant reduction in the anodic current is occurs, this current rising again as the potential became more positive. In the cathodic direction, the current increases and then moves back to the value of that of the inhibition solution when the potential is -600mV and below. With the Nyctanthin extract induce a less reduction in anodic current. The anodic current also rises rapidly when the potential to -5mV. The corrosion potential is -270mV. This inhibitor dose not has any effect on the cathodic corrosion.

## Conclusion

The inhibitive effect of the both used inhibitors in this method shows the good efficiency against the corrosion inhibition over the all metals and alloys. In this case Echitamine shows some inhibition but in chloride and sulphate solution Nyctanthin given a high efficiency against the corrosion of all used metals.

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