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CORROSIVE BEHAVIOR OF IRON ALLOY IN ACIDIC MEDIUM PRESENCE OF INHIBITOR

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ABSTRACT

Amoxicillin is a corrosive inhibitor of metal alloys in acid medium was studied by Non electrochemical techniques (weight loss method) and electrochemical techniques by polarization techniques, Polarization studies showed that the amoxicillin compound is mixed type of corrosive inhibitor, these amoxicillin were adsorbed on metal alloys surface follow Langmuir adsorption isotherm. The effect of oxygenation on the corrosion behavior of metal alloys in acidic medium in presence of definite concentration of the amoxicillin.

Keywords: *Metal corrosion, weight loss method, Potentiodynamic polarization.*

I. INTRODUCTION

Corrosion monitoring techniques can be classified into two major categories viz non electrochemical techniques and electrochemical techniques. Traditionally the non-electrochemical techniques are widely used through the industry due to their simplicity[1-2], robustness and reliability. However, the drawback of these techniques is that they do not reveal any details about corrosion mechanisms[3-5]. On the other hand the electrochemical measurements provide a great deal more with regard to the corrosion mechanism. Corrosion is an electrochemical process[6-8], therefore electrochemical methods were designed as a preliminary investigation into the applicability of each technique for more detailed research into metal corrosion[9-12]. Laboratory studies using electrochemical techniques such as corrosion current measurements and linear polarization resistance tests have been used in static and flowing conditions with and without inhibitor to identify the corrosion rates of each region of the metal[13-15]. The main advantages of the electrochemical methods are short measuring times, high measurement accuracy and the possibility of continuous corrosion monitoring[16-18].

Corrosion is defined as the destruction or deterioration of a material due to a chemical or an electrochemical reaction with its environment[19-21], Corrosion behavior of a material is mainly determined by its structure and composition there are several ways of classifying corrosion, One method divides corrosion into low temperature and high temperature corrosion, Electrochemical corrosion reactions are conveniently divided into Dry corrosion which is mainly concerned with the oxidation of a dry metal surface and Wet corrosion in which the reactions occur in an environment under normal conditions[22-24], corrosion behavior of a material is quantitatively expressed in terms of corrosion rates corrosion rates have been expressed in a variety of ways in the literature[25-30], such as percent weight loss, grams per square inch per hour and milligrams per square decimeter per day (mdd).

Materials: Material having compositions of 0·08% Phosphorus, 0·27% Silicon, 0·01% Aluminum, 0·04% Manganese, 0·15% C, 0·04% Sulphar and the remaining Iron were used for the electrochemical polarizations and impedance measurements. The samples of 1×1 cm area were ground with different emery papers of grades 120, 320, 400, 800, 1000 and 2000; they were degreased with AR grade ethanol, acetone and dried at room temperature and then stored in desiccators before use. The acid solutions were made from analytical grade 34% HCl by diluting with double-distilled water.

Solutions: All the chemicals used in the present investigation, for the preparation of solutions were of analytical grade. Glass doubly distilled water was for the preparation of all the solutions.

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II. EXPERIMENTAL METHOD:

Weight loss method: The weight loss measurements enable us to illustrate the importance of the environment in the process of rusting, weight loss method is Non-electrochemically, the rate of corrosion is determined by the conventional weight loss technique Using this technique, the loss of a metal due to corrosion is measured by exposing the metal specimen of known area to the corrosive environment for a particular period and finding the difference in weight before and after exposure The expression 'mils per year' (mpy) is the most widely used way of expressing the corrosion rate, Corrosion rate is calculated using the formula,

Corrosion Rate (mpy) = 534 W
DAT

Where,

W = Weight loss in mg.
D = Density of the specimen in g/cm.
A = Area of the specimen in sq.
T = Exposure time in hr.

The weight loss measurements were carried out by weighing the prepared material before and after immersion for 24, 48, 72, 96, 120 hours in 50 ml various concentration of inorganic acidic solutions (HCI, H_2SO_4, HNO_3) in the presence and absence of various concentrations of Amoxicillin and variable concentration of oxygenation. From the weight loss data, the percentage inhibition efficiency (IE %) was calculated at different concentrations at 30 ^oC. using following equation.

$$\mathbf{IE\% = (100\times -W_{corr})/W_0}$$

Where,

IE%: Inhibition efficiency.
W_{corr} :Corrosion rates of iron with inhibitor.
W_0 : Corrosion rates of iron without inhibitor.

Electrochemical method: This technique uses data obtained from cathodic and anodic polarization measurements. Cathodic data are preferred, since these are easier to measure experimentally. The total anodic and cathodic polarization curves corresponding to hydrogen evolution and metal dissolution are superimposed as lines. It can be seen that at relatively high applied current densities the applied current density and that corresponding to hydrogen evolution have become virtually identical. To determine the corrosion rate from such polarization measurements. At the corrosion potential, the rate of hydrogen evolution is equal to the rate of metal dissolution in inorganic acidic medium (HCI, H_2SO_4, HNO_3), and this point corresponds to the corrosion rate of the system expressed in terms of current density. Polarization curve must be calculated from both the anodic and cathodic portions of the polarization curve. The units of the polarization curve are V/decade. A decade of current is one order of magnitude. A polarization curve calculation is illustrated in Figure. These measurements may be complicated by interfering phenomena of concentration polarization. Concentration polarization occurs when the reaction rate is so high that the electro active species cannot reach the electrode surface at a sufficient rapid rate and the reaction rate becomes diffusion controlled.

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III. RESULT AND DISCUSSION

Weight loss method

Acid	O_2 fully Satu-rated	O_2 Satur-ated	O_2 Abs-ent	O_2- fully Satu-rated (Inhi-bitor)	O_2 Satur-ated (Inhib-itor)	O_2 Absent (Inhi-bitor)
HCI	0.32	0.31	0.32	0.30	0.29	0.28
H_2SO_4	0.80	0.78	0.75	0.74	0.76	0.74
HNO_3	0.28	0.27	0.24	0.26	0.25	0.22

From above table observation weight loss of metal alloy in inorganic acidic medium are decreases in presence of organic inhibitor (Amoxicillin). Weight loss of metal alloy is maximum in fully saturated oxygenation as comparative to saturated oxygenation and absence of oxygenation in absence of organic inhibitor Amoxicillin.

Potentiodynamic polarization method:

H_2SO_4 Acid	Corrosion Current I_{corr} (μ A cm^{-2})	Corrosion Potential E_{corr} (V_{SCE})	Inhibition Efficiency IE (%)
Blank	660	-0.54	0
0.10 gm	22.1	-0.56	96.6
0.20 gm	21.3	-0.58	96.7
0.30 gm	20.4	-0.60	96.9

From the above table observation in Potentiodynamic polarization study of metal alloy corrosion in inorganic acidic solution, potential increases progressively by increasing the concentration of inhibitor Amoxicillin in inorganic acidic solution, and corrosion current decreases progressively by increasing the concentration of inhibitor Amoxicillin in inorganic acidic solution. By using the inhibitor Amoxicillin control the corrosion of metal and metal alloys in inorganic acidic medium.

IV. CONCLUSIONS

The results obtain form weight loss measurement, Potentiodynamic polarization method explained that the inhibition efficiency of amoxicillin increased with the increasing the concentration in acidic medium (HCI, H_2SO_4, HNO_3), which indicated that amoxicillin maintained stable passivity even in the presence of the acidic medium (HCI, H_2SO_4, HNO_3). Amoxicillin act as good inhibitor in presence of acidic medium.

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