Section (A)

Studying the Corrosion Inhibition of Carbon Steel in Sulfuric Acid by Some 5-Arylazothiazole Derivatives Using Chemical Technique

In this section, the effect of increasing concentrations of 5-arylazothiazole derivatives on the corrosion behavior of carbon steel in 0.5M sulfuric acid solution and also in presence of potassium iodide was studied.

It is generally accepted that the organic compounds inhibit the corrosion process by adsorbing at the metal / solution interface, the modes of adsorption are depends on:

i) Effect of molecular chemical structure on corrosion inhibition

ii) Chemical composition of the solution.

iii) Nature of the metal surface, and

iv) Electrochemical potential at the interface, one or a combination of more of the three principal types of adsorption: π bond, electrostatic and /or chemisorption (152). In addition, it is believed that the formation of a solid organic molecule complex with the metal atom has received considerable attention (153).

when designing inhibitors, all of the theories are in common agreement that adsorption phenomena involves either:-

1) Proton acceptor (cathodic site absorbers), material in this group accepts the hydrogen ions or proton and migrates to the cathode .

2) Electron acceptor (anodic site absorbers), inhibitor functions due to their ability to accept electrons.

3) Adsorb at anodic and cathodic sites.

It has been generally accepted that group contributions vary considerably from molecule to molecule. Utilization of these concepts permits the systematic construction of an increasing efficiency of organic molecule.

3.1- Effect of Inhibitor Concentrations

The inhibition behavior of 5-arylazothiazole derivatives for carbon steel corrosion in 0.5M sulfuric acid solutions was studied using weight loss method. This can be quantified by using the simple relationship:

$$W_o = W_B - W_A \tag{3.3}$$

where:

W_o = weight of metal loss in the corrosive solution.

W_B = weight of metal before exposure to the corrosive solution.

W_A = weight of metal after exposure to the corrosive solution.

The degree of dissolution, of course , dependent on the surface area of the metal exposed and the time of exposure; hence the amount of corrosion is given with respect to area and time. The resulting quantity, corrosion rate, is thus a fundamental measurement in corrosion science. Corrosion rates can be evaluated by measuring either the concentration of the dissolved metal in solution by chemical analysis or by measuring weight of specimen before and after exposure and applying equation (3.1). The later is most common method. The weight-loss method is usually preferred because the quantity measured is directly related to the extent of corrosion and does not rely on any assumptions about reactions occurring during corrosion.

Figures (3.1-3.5) show the weight loss-time curves for carbon steel in 0.5M H_2SO_4 in absence and presence of different concentrations of the selected organic compounds. As shown in these figures, by increasing the concentration of these compounds, the weight loss of carbon steel samples are decreased. This means that the presence of these compounds retards the corrosion of carbon steel in 0.5M H_2SO_4 or in other words, these compounds act as an inhibitor.

The linear variation of weight loss with time in uninhibited and inhibited 0.5M H_2SO_4 indicates the absence of insoluble surface films during corrosion. In the absence of any surface films, the inhibitors are first adsorbed onto the metal surface and thereafter impede corrosion either by merely blocking the reaction sites (anodic and cathodic) or by altering the mechanism of the anodic and cathodic partial processes.

The inhibition efficiency (%IE) of the selected organic compounds were determined by using the equation:

$$\%IE = (W - W') / W \times 100 \qquad (3.4)$$

where, W and W′ are the corrosion rates of carbon steel in the absence and presence of the selected organic compounds, respectively, at given time period and temperature.

Weight loss of carbon steel in mg cm^{-2} of the surface area was determined at various time intervals in absence and presence of 5-arylazothiazole derivatives. The obtained weight loss-time curves are represented in Figs. (3.1-3.5). The inhibition efficiency was found to be dependent on the inhibitor concentration, nature of substituents and their positions in phenyl ring.

The curves obtained in the presence of inhibitors fall significantly below that of free acid. In all cases, the increase in the inhibitor concentration was accompanied by a decrease in weight loss and an increase in the percentage inhibition efficiency. These results lead to the conclusion that, the compounds under investigation are efficient as inhibitors for carbon steel dissolution in sulfuric acid solution.

In order to get a comparative view, the variation of the inhibition efficiencies of the fifth inhibitors with their molar concentrations at 303K were calculated according to equation (3.4); values obtained are summarized in Table (3.1).Inspection of these results showed that, at the same inhibitor concentration, the order inhibition efficiencies is decreased as follow:

5 > 4> 3 > 2> 1

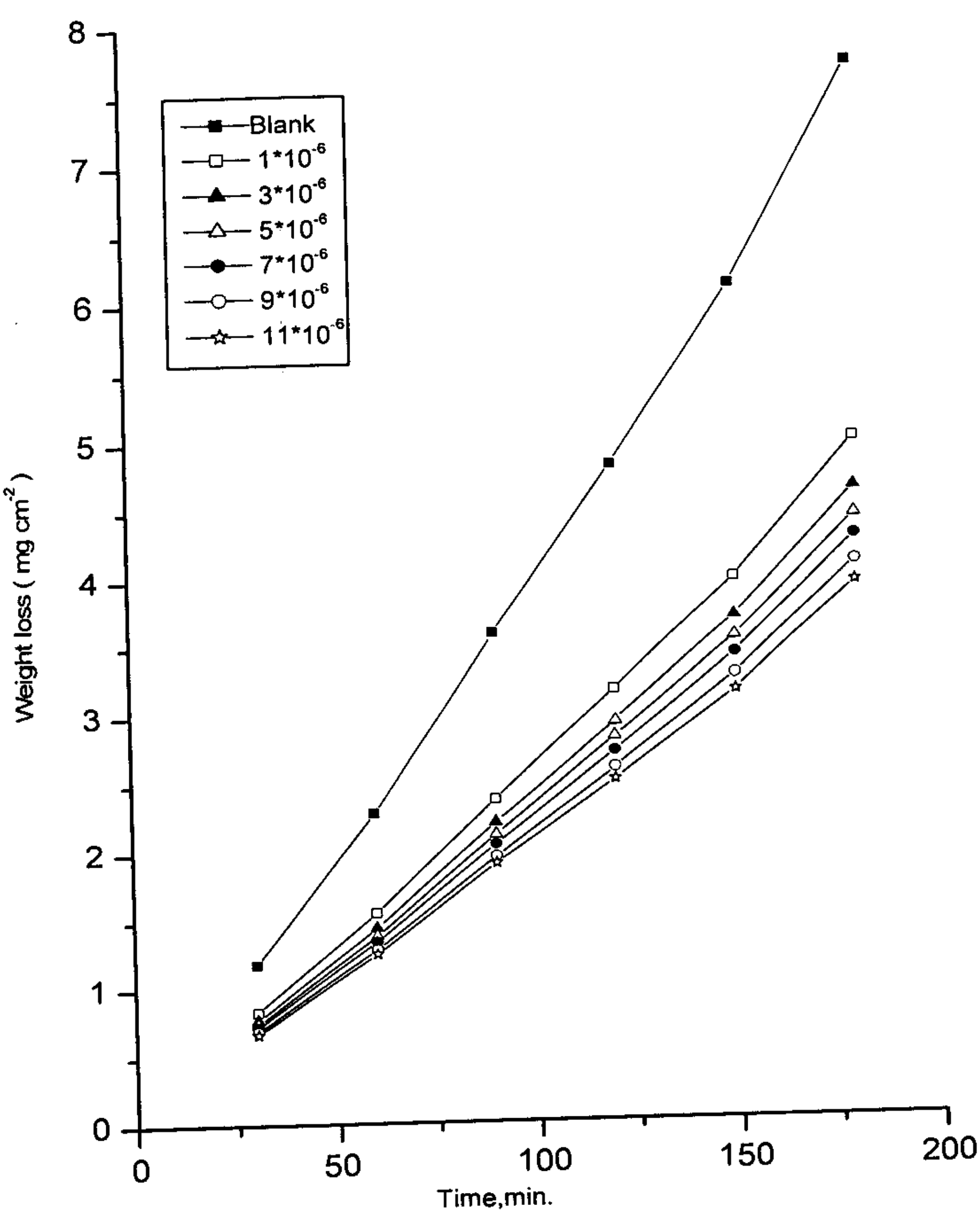

FIG. (3.1): Weight loss- time curves for carbon steel dissolution in 0.5M H_2SO_4 in absence and presence of different concentrations of compound (1) at 303K.