

USE OF MODERN METHODS IN THE DEVELOPMENT OF CORROSION INHIBITORS

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Abstract. This review offers a summary of relevant literature that shows how scientists and researchers have reduced corrosion in a variety of alloy and metal-based equipment by using different types and procedures of corrosion inhibitors. Various chemical inhibitors were applied to different alloys to slow down the rate of corrosion. When exposed to varying molar concentrations in acidic conditions, the inhibition rates varied from 30 to 80%. In the second section of this article, the laser was employed as a tool to prevent certain alloys from corroding in a variety of circumstances, all without the need for chemical inhibitors to be utilized as a backup. The material becomes harder and more resistant to corrosion as a result of the laser pulses' action on it. We discovered that the inhibition rate approaches 80%.

Keywords: corrosion, Gravimetric investigation, Electrochemical investigation, Rp/Ec trend investigation.

Introduction. At the modern time the metallic material constitutes have the biggest role as a great part of construction material elements in the chemical industries oil and gas factories. In industries metal materials corrosion causes their environmental losses and contamination of environment.

The steel metal materials are commonly used in Uzbekistan's industries, as a result, it is mainly part of construction materials industries. Hydrochloric acid solutions are used in industrial processes during pickling and cleaning salts films of

metals; that causes significant metal loss. The inhibitors are added to the acid solution to minimize acid attack on metal. The corrosion inhibitors are the chemical compounds which at addition in corrosion system at a small concentrations adsorbed on the metal surface, connects with metal ions and decreases the corrosion rate. Inhibitors can react with a metallic surface or the environment, forming protection films which are metallic oxide, anodic film, thin film, chemical complex with metal ions, supramolecular substance or absorbs ion film on the metal surface.

Corrosion inhibitors are classified in depending on the metal construction and the environment type. They are divided on the environmental conditioners and interface inhibitors [1,2]. Liquid-phase inhibitors are classified as anodic, cathodic or mixed inhibitors depending on whether they inhibit the anodic, cathodic or both electrochemical reactions. This kind of inhibitors widely used in our republic factories.

Methods.

Gravimetric investigations were performed on mild steel specimens of the above mentioned composition with 3.0 cm × 3.0 cm × 0.1 cm exposed area. In all the gravimetric experiments, the specimens were in 250 mL of 10% HCl in the absence and presence of different concentrations of inhibitors. After 3 h immersion time, the mild steel specimens were taken out, cleaned with distilled water, dried and accurately weighed. Each experiment was performed in triplicate to ensure reproducibility, and the mean value was reported [3,4]. The inhibition efficiency ($\eta\%$) was calculated using the relation

$$\eta\% = \frac{w_0 - w_i}{w_0} \times 100$$

where w_0 and w_i are the weight loss (in mg) in the absence and presence of the cucurbiturils, respectively. From the calculated $\eta\%$, the surface coverage (θ) was derived using the equation

$$\theta = \frac{w_0 - w_i}{w_0}$$

The corrosion rate (CR), inhibition efficiency ($\eta\%$) and surface coverage (θ) was determined by following equations:

$$CR(\text{mmy}^{-1}) = \frac{8.76 \times 10^4 XW}{D \times A \times t}$$

where, W -weight loss (g), A -area of specimen (cm²) exposed in acidic solution, t - exposure time (h), and D - density of mild steel (g cm⁻³) [69; P. 17–24.].

Electrochemical investigation

We used the Gamry Potentiostat/Galvanostat (Model G-300) containing EIS software Gamry Instruments Inc., the USA containing Echem Analyst 6.22 software package in order to calculate electrochemical parameters. The instrument consists of a three-electrode glass assembly, in which pure platinum foil acts as the counter electrode, the saturated calomel acts as the reference electrode and rectangular steel specimen of the working electrode. The working electrode's immersed time is 30 min because during this time the state potential reached no changeable position before performing the electrochemical experiments [6].

All electrochemical studies were carried in electrochemical cell (fig. 2.1) contain reference electrode, CO₂ gas pipe for in and out, lugging capillary, platinum counter electrode, specimen holder, temperature probe, pH and working [7,8].

This electrode cell is universal and very comfortable, also it is possible to control temperature and pH medium, carbon dioxide or other kind of gas inter or go out, also platinum electrode is very sensible, very little error may be.

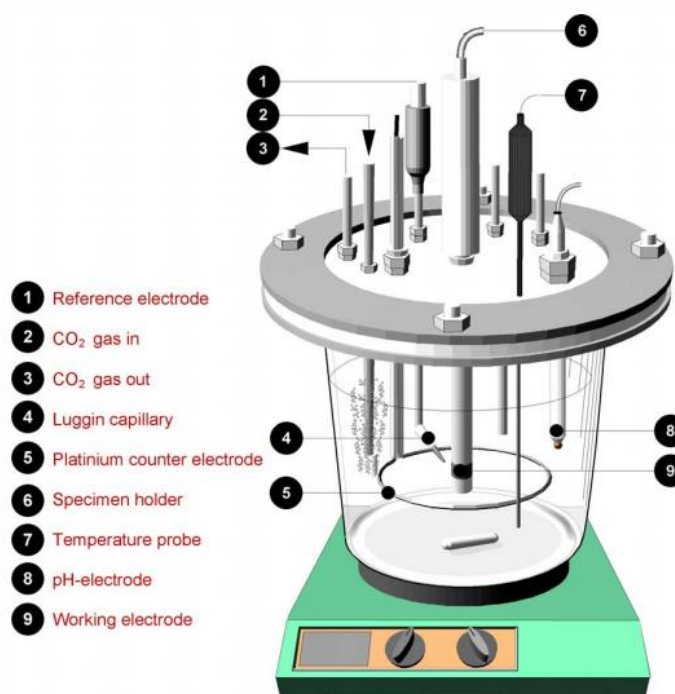


Figure 1. Electrochemical investigating cell

Polarization resistance investigation

The polarization resistance measurements were performed with following resistance parameters: resistance -0.02 to 0.02 mV, scan rate (mV/s) is 0.125, sample area is 1 cm², density g/cm³ is 7.87, equiv.Wt. is 27.92 and 0.12 (V/Dec)[9].

Potentiodynamic polarization investigation

The polarization study was obtained by changing the electrode potential from -0.25 V to +0.25 V vs. open circuit potential at 1.0 mV · s⁻¹ of scan rate. From the

Echem Analyst 6.22 software package installed in the instrument, polarization parameters such as corrosion potential (E_{corr}), corrosion current (i_{corr}) and anodic (β_a)/cathodic (β_c) Tafel slopes were derived by the extrapolation method. The $\eta\%$ was calculated from the values of i_{corr} using following relationship:

$$\eta\% = \frac{i_{\text{corr}}^o - i_{\text{corr}}^i}{i_{\text{corr}}^o} \times 100\%$$

where i_{corr}^o and i_{corr}^i are the corrosion current densities in the absence and presence of inhibitor, respectively [72; P. 961–981., 73; P. 83–90.].

Rp/Ec trend investigation

The Rp/Ec trend measurements were carried out -0.02 to 0.02 mV, sample area is 1 cm², Beta anodic and cathodic (V/Dec) is 0.12, total time is 0.3 hour by using the USA containing Echem Analyst 6.22 software package was used to carry out all electrochemical measurements[9,10].

Conclusions

At the modern time the metallic material constitutes have the biggest role as a great part of construction material elements in the chemical industries oil and gas factories. In industries metal materials corrosion causes their environmental losses and contamination of environment. Nowadays it is recommended to widely use the above methods in working with corrosion inhibitors

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