



ISSN: 2155-9589 Journal of Membrane Science & Technology

Experimental Investigation of Rate of Corrosion in the Reboilers in Refinery and Petrochemical Factories

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ABSTRACT

To prevent the rate of corrosion, as well as to maintain various devices, a series of materials are used as inhibitors. If these materials are used, the lifespan of tools and devices will be increased and economic costs will be reduced. In this study, a new inhibitor that can be used instead of hydrazine was used. This inhibitor is called levoxin-15 and can be used to prevent corrosion caused by oxygen in steam tanks. In addition, the results illustrate that with increasing the concentration of hydrazine from about 20 mg/l to 30 mg/l and also the concentration of levoxin-15 from about 78 g/m³ to about 88 g/m³, the operating time increases significantly. Also, results state that with increasing acidity from about 11 to 15, the relative corrosion rate will increase almost as a quadratic function to about 178 times. **Keywords:** Hydrazine; Levoxin-15; Cavity corrosion; Oxygen depletion; X-ray; Steel alloy

INTRODUCTION

The corrosion can be classified in different ways. The basis used in this manuscript is the appearance and shape of the metal [1]. In this way, the type of corrosion can be determined simply by observing the corroded metal. In most cases, the naked eye is sufficient to detect the type of corrosion. But, sometimes magnification (such as a magnifying glass or microscopes with low magnification) will be useful or valuable information to solve a corrosion problem is often obtained by carefully studying corroded test specimens or equipment or components that have been destroyed. It is necessary to study the eaten samples, especially before cleaning them. Among the types of corrosion, 8 unique types can be found. But, all of them are more or less similar. These 8 types are: (1) uniform or uniform corrosion, (2) bimetallic corrosion, (3) groove corrosion, (4) cavitation corrosion, (5) inter-granular corrosion, (6) selective separation, (7) abrasion corrosion, (8) stress corrosion. This classification is optional and may not be 100% complete. But, it covers almost all types of corrosion problems and damage. The above order does not indicate the importance of these types [2].

The price and corrosion resistance are the most important factors, although appearance is often the most important issue in architectural applications and productivity, which indicates the ease of forming welding and other mechanical operations, should also be considered. It is important and should be considered even when choosing corrosion resistance. In some highly corrosion resistant materials such as gold, platinum and some super alloys, the presence of these materials is often the determining factor. The thermodynamics and electrochemistry are very important for understanding and controlling corrosion. Thermodynamic studies and calculations indicate the direction of a reaction. In the case of corrosion, thermodynamic calculations can determine the theoretical possibility or impossibility of corrosion. The electrochemistry of the field and the kinetics of the electrodes will be discussed in detail. Often metallurgical factors have a great influence on corrosion resistance. There are many cases in which the control of the metallurgical structure of alloys can be used to reduce corrosion. The physical chemistry and its various fields are very useful in studying the mechanisms of corrosion reactions, surface conditions and some of the main properties of metals [3].

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Received: 02-Aug-2021, Manuscript No. JMST-24-12061; Editor assigned: 05-Aug-2021, PreQC No. JMST-24-12061 (PQ); Reviewed: 19-Aug-2021, QC No. JMST-24-12061; Revised: 16-Aug-2024, Manuscript No. JMST-24-12061 (R); Published: 13-Sep-2024, DOI: 10.35248/2155-9589.24.14.399

Citation: Darvishi A (2024) Experimental Investigation of Rate of Corrosion in the Reboilers in Refinery and Petrochemical Factories. J Membr Sci Technol. 14:399.

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DESCRIPTION

Laboratory equipment

It is a metal box that is located in the pipeline and is in contact with water and oxygen. This box measures the average corrosion rate. Its material is proportional to the material of the steam tank pipeline and its dimensions are proportional to the diameter of the pipeline. This device measures the amount of corrosion in millimeters per year, mills per year and inches per year according to the following equation. This device is shown in Figure 1 [4].

Average corrosion rate=weight of the sample box measured at the beginning of the work multiplied by the specific gravity at the time of contact at the contact surface

Contact level=Sum of 6 levels minus twice the area of the circle



As shown in the corrosion measuring device in Figure 1, this device is located in the flow path of the passing fluid (which in this study contains water and oxygen) and is eaten based on the coupons used in it and its weight decreases. Because the initial weight of the coupon was measured by a scale [5]. It can be reweighed over time. The difference between the two weights (at the beginning and at the end of the operation) will indicate the rate of corrosion in the defined time period. The Equations (1) and (2) are used to calculate and estimate the corrosion rate (Figure 2).



Figure 2: Investigation of the relationship between operating time, hydrazine and leucine (low concentration range).

As shown in the Figure 2, with increasing the concentration of hydrazine from about 20 to 30 mg/l and also the concentration of levoxin-15 from about 78 g/m³ to about 88 g/m³, the

operating time increases significantly [6]. In other words, laboratory results indicate that the concentration of hydrazine and levoxin-15 will have a positive effect on the operating time of the used system. This effect can be explained by the removal of oxygen ions by the nitrogen compounds hydrazine and levoxin-15. As can be seen in this diagram, its increasing slope is somewhat towards the vertical axis (effect of levoxin-15) and as a result, it can be said that the effect of levoxin-15 is somewhat greater than the effect of hydrazine in removing oxygen from corrosion (Figure 3) [7].



Figure 3: Investigation of the relationship between operating time, hydrazine and leucine (average concentration range).

The Figure 3 also shows the effect of increasing the concentration of hydrazine from about 50 mg/l to 100 mg/l. Also, the concentration of levoxin-15 in this experiment has increased from about 100 to 135 grams per cubic meter and has increased the operating time of steam tanks to about 480 hours. In other words, by increasing the concentration of hydrazine and levoxin-15, the life of steam tank tubes can be increased and the process can be more economically justifiable. This diagram also shows that the functional effect of levoxin-15 is somewhat better than that of hydrazine [8].

CONCLUSION

Based on laboratory results, it has been observed that levoxin-15 eliminates the corrosion process by reducing the amount of oxygen in the environment and minimizing the electrochemical reduction of oxygen in the cathode areas on the metal surface. Levoxin-15 acts as an inhibitor of operating steam tanks by setting the acidity between 11 and 12 and stops corrosion. This material also causes the acidity of standby tanks to be between 10 and 10.5 and in this case, stops corrosion for this group of steam tanks. Also, the compounds derived from this substance (levoxin-15) are not corrosive and increase the life of the equipment and reduce maintenance costs. Also, during 2 years of using this substance (levoxin-15) as well as its derivatives, no adverse effects on humans and animals have been reported so far.

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