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Eucalyptus Extract as Eco-Friendly Inhibitor for the Corrosion of Steel

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ABSTRACT

The objective of this study was to evaluate the potential of Eucalyptus plant extract as a green inhibitor for carbon steel in 1M HCl acid medium. The leaves of the Eucalyptus plant were extracted and tested for their inhibitory effect on carbon steel using the mass loss method. The results showed that the maximum inhibitory efficiency of 92.79% was achieved with a concentration of 4.28 g/L of the Eucalyptus extract at room temperature. DRX characterization was conducted on steel electrodes before and after 24 hours of immersion in 1M HCl solution, both in the absence and presence of the Eucalyptus extract. This analysis aimed to examine any structural changes in the steel electrodes caused by corrosion and the presence of the green inhibitor.

Keywords: Eucalyptus, green inhibitor, corrosion, carbon steel.

1. Introduction

Corrosion is a phenomenon of material degradation. This phenomenon most often affects the industrial sector, particularly the construction sector, but also the aeronautical industry. Today, it can be noted that steel is the basis of mass production in many industrial sectors. This material is largely affected by corrosion, especially from aggressive solutions. However, the aggressive solutions such as acids are also widely used in the industrial sector for pickling, acid cleaning, removal of localized deposits, oil well stimulation . As a result, the aggressive nature of these acid solutions and their use in the presence of steels has led research to focus on the implementation of means of protecting steels in an acid environment. Among these means of protection, we find corrosion inhibitors. It should be noted that most of the inhibitors used in an acid environment are of the synthetic organic type [4-9]. However, the disadvantage of these types of inhibitors lies in their high toxicity as well as the harmful impacts they can have on the environment. In order to overcome these drawbacks, research has now turned to the use of natural substances.

2. Experimental

Extract preparation: The extract was prepared from green eucalyptus leaves by washing them with distilled water and drying them in the dark at room temperature for two weeks. The dried leaves were ground, then soaked in distilled water for 24 hours at a moderate temperature. The obtained solution was filtered and evaporated using a rotary evaporator for 24 hours at 35°C[1]. Samples preparation: The samples were polished using grit SiC papers. They were then cleaned by deionized water, and dried with cold air. Before immersion in HCl solution, samples were weighted using the analytical balance. After soaking for 24 h, samples were weighted again.

3. Results and Discussion

3.1 Gravimetric measurement:

Effect of concentration: Mass loss measurements were carried out in the concentration range of Eucalyptus extract from 0.85 to 6 g/L at 298 K for an immersion time of 24 hours in 1M HCl. The results obtained for the corrosion rate (Wcorr) and inhibition efficiency (Ew %) are recorded in Figure 1.

3.2 DRX characterization:

DRX characterization (Figure 2) was conducted on steel samples before and after 24 hours of immersion in 1M HCl solution, both in the absence and presence of the Eucalyptus extract.

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Figure 1 show a clear variation in the corrosion rate and inhibiting effectiveness of the extract as a function of its concentration. Indeed, the corrosion rate decreases while an increase in efficiency is observed. This can be explained by an increase in the surface area covered by the absorption of the extract components on the steel surface by increasing the protection of the steel surface against corrosive ions. This protection is achieved by blocking the active sites, thus creating a protective film at the steel/solution interface[2].
Figure 2 show structural changes in the steel samples caused by corrosion and the presence of the green inhibitor. The presence of iron oxide in (2) is due to the reaction between the surface of steel and the corrosive medium (HCl), while the high pic of iron and nearly absence of iron oxide pic is due to the creation of protective film which block the active sites[3].

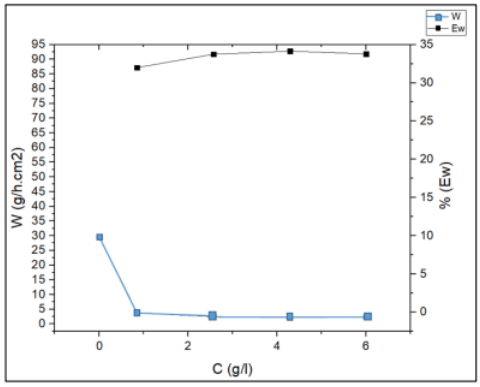

Figure 1: effect of concentration.

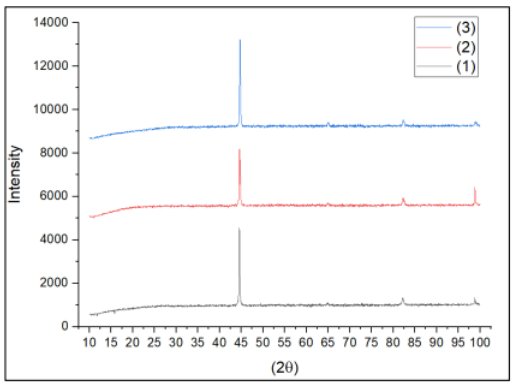

Figure 2: DRX caracterisation results.

4. Conclusions

Eucalyptus leaf extract can act as an eco-friendly novel corrosion inhibitor for carbon steel in HCl solution. Results of weight loss and electrochemical methods indicate that the maximum corrosion inhibition efficiency can reach 92.79 %. As shown from the results of XRD characterization, the adsorption film can effectively retard the invasion of aggressive ions and inhibit the corrosion of carbon steel.

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