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INULA VISCOSA EXTRACT AS A GREEN INHIBITOR FOR CORROSION OF CARBONE STEEL IN HYDROCHLORIC ACID SOLUTION

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INTRODUCTION

Carbon steel is one of the most used metallic materials in many industrial facilities. However, the major drawback of this versatile material is its relatively high corrodibility when exhibited to aggressive environments, particularly the acidic media [1]. The employment of inhibitors is one of the most effective methods for protection of metals against corrosion. Although most of the synthetic corrosion inhibitors are highly efficient in acidic environments but they are expensive and provide health and ecological risks. Therefore, due to the hazardous environmental effects of synthetic inhibitors the researchers' attention has been drawn towards finding cheaper and non-toxic inhibitors.

The extracts of plant have had a growing interest in corrosion inhibition over the last two decades Besides, a rigorous selection of the candidate plant is usually applied, based on its availability and the abundance of its extract content in phytochemical molecules [2-3].

The inhibiting action of Viscous Inula plant extract (IVE) was examined against the corrosion of X70 carbon steel in 1M HCl.
Weight loss, potentiodynamique polarization, and electrochemical impedance spectroscopy (EIS) measurements were used to assess the corrosion inhibition efficiency. Characterization of the steel surface was performed using scanning electron microscopy (SEM/EDS).

RESULTS AND DISCUSSION

1- Weight loss measurements

As can be seen, IVE exhibited a good inhibitive performance, by increasing the IVE concentration. The inhibition efficiency increased to nearly 93%. This observed corrosion inhibition of X70 CS can be attributed to the effective adsorption of the IVE molecules, reducing the surface area and blocking the active sites [4].

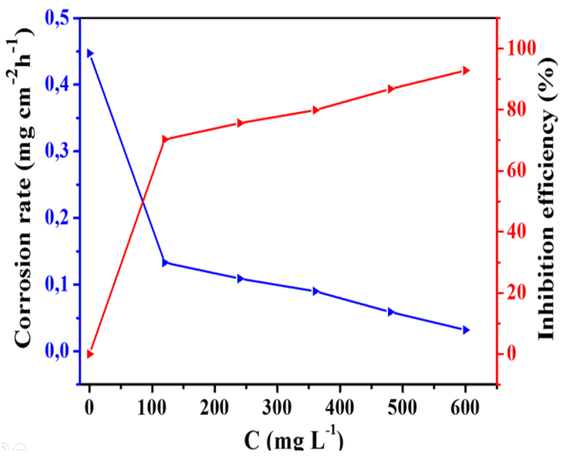

Figure 1. Variation of corrosion rate of X70CS and inhibition efficiency as a function of concentration of IVE in 1 M HCl after 6h of immersion time at 298 K.

2-Electrochemical impedance spectroscopy (EIS)

All the Nyquist plots presented single depressed semi-circles, having similar profiles both in the absence and presence of inhibitor, which indicate that adsorption of IVE did not change the corrosion mechanism, and the corrosion of X70CS could be consequently considered as controlled chiefly by a charge transfer process. [5] Moreover, the inhibition efficiency, η_{EIS}, increased with increasing IVE concentration up to 600 mg L^{-1} where a maximum of 92.4% was achieved.

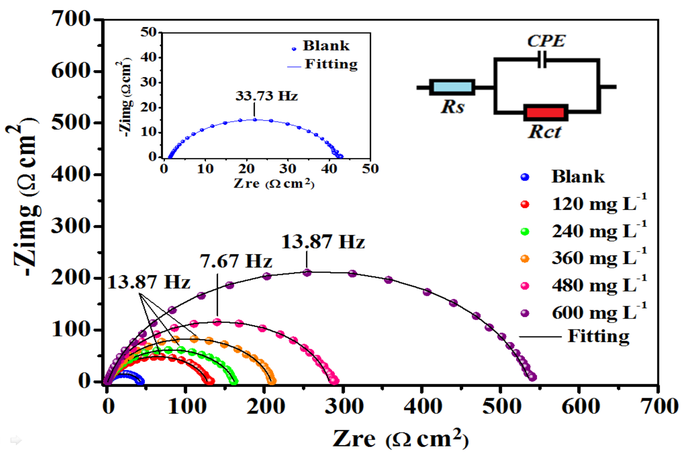

Figure 2. Nyquist plots for X70CS in 1 M HCl without and with different concentrations of IVE at 298 K.

3-Potentiodynamic polarization

Increasing the IVE extract concentration led to a decrease of i_{corr} and an increase of η_{PDP}; for a concentration of 600 mg L^{-1} and at 298 K, they were measured to be 31.5 μA cm^{-2} and 92.18%, respectively

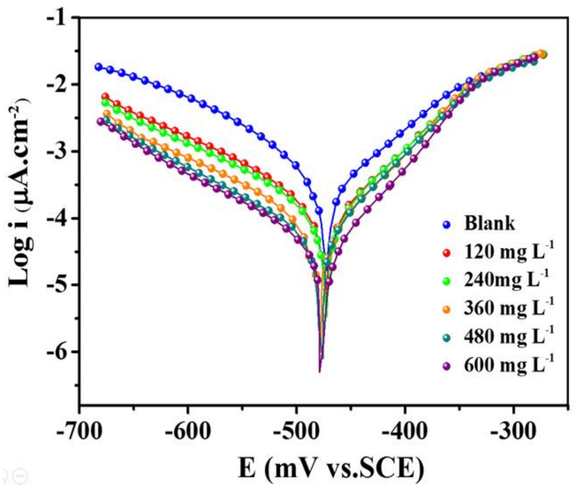

Figure 3. Potentiodynamic polarization curves of X70CS in 1 M HCl solution without and with various concentrations of IVE at 298 K.

4-Surface characterization

After being immersed in neat 1 M HCl, the surface became greatly scratched and corroded with apparent pits, cracks, and cavities. This surface damage was significantly reduced after immersion in the acid solution containing 600 mg L-1 of IVE, and a smoother surface was clearly noticed. This observation could be attributed to the adsorption of IVE molecules, forming a compact protective film on the steel surface, which constituted a barrier between the X70CS surface and the aggressive medium.

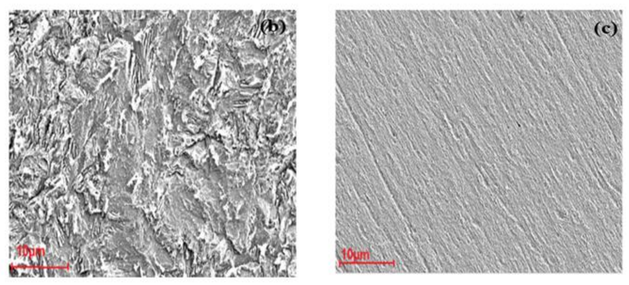

Figure 4. SEM micrographs and EDS spectra of the X70CS specimens , before immersion; (b), immersed in neat 1 M HCl solution for 24 h

CONCLUSION

This study has disclosed that Inula Viscosa leaves extract (IVE) is an excellent green corrosion inhibitor for the protection of X70 carbon steel in 1 M HCl. It was found that the measurements of inhibition efficiency by different methods were in a good agreement. The inhibition efficiency increases with the IVE concentration increasing; the optimal concentration is 600 mg L-1, giving ~ 93% inhibition at 25 °C. The inhibition effect of IVE is mostly ascribed to an effective adsorption of its main constituting molecules onto the X70CS surface, being able to form a protective barrier film. Mechanistically, the IVE adsorption process onto the X70CS surface involves both physisorption and chemisorption. IVE reduces significantly the corrosion current, acts as a mixed type inhibitor, and affects mainly the cathodic reaction by controlling the rate of hydrogen evolution reaction on the surface of the steel.

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