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Flaxseed mucilage as an eco-friendly inhibitor for ASTM A335 P11 steel in HCl

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Statement of the Problem: The high efficiency of corrosion inhibition of synthetic organic inhibitors in the industries of chemical cleaning, acid etching, acidification of oil wells and acid desalination is well recognized. However, most of these inhibitors are toxic to the environment and human health. This has forced to look for more secure corrosion inhibitors called "green corrosion inhibitors" due to its non-toxicity, biodegradability and low cost. In recent years, the use of natural polysaccharides as an environmentally safe corrosion inhibitor has received special attention. For this reason, the present study, evaluates the mucilage of Linum usitatissimum, which contains a high content of polysaccharides, as a corrosion inhibitor of ASTM A335 grade P11 steel in HCl -1.0 M.

Methodology & Theoretical Orientation: All the corrosion tests were carried out at least in triplicate to evaluate the reproducibility of the same, by means of the techniques of: weight loss tests, Tafel extrapolation, resistance to linear polarization, electrochemical impedance spectroscopy and electrochemical frequency modulation. For the electrochemical tests the Gamry Reference 3000 potentiostat was used. Figure 1 shows part of the tests carried out at 65°C.

Findings: Considering the five techniques, it was observed that the average inhibition efficiencies for a dosage of 0.5g/L of mucilage were 77.3%, 81.2% and 88.6% at temperatures of 25°C, 45°C and 65°C, respectively. Higher dosages only generated a slight increase in inhibition efficiency. Additionally, it was also found that an increase in temperature produced an increase in the adsorption constant and a decrease in the standard free energy of adsorption. The standard enthalpy of adsorption was positive and the apparent activation energy decreased with increasing mucilage concentration.

Conclusion & Significance: From the results, we conclude that the Linum mucilage acts as a good corrosion inhibitor of P11 steel in HCl-1.0 M. Its efficiency increased with the increase in temperature. Likewise, it was determined that the adsorption of mucilage on steel P11 occurs through a chemical adsorption, acting as a mixed type inhibitor.

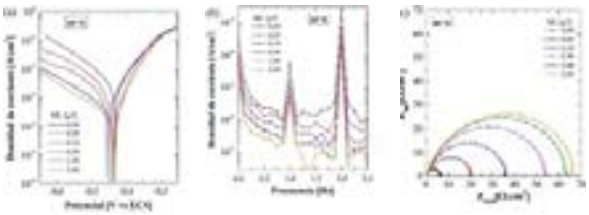

Figure 1:
Corrosion tests of P11 steel in HCl-1.0 M containing different concentrations of Linum mucilage (g/L) at 65°C.
(a) Potentiodynamic polarization curves,
(b) Intermodulation spectra and (c) Nyquist diagram

Recent Publications:

1. Finšgar, M., Jackson, J. (2014) Application of corrosion inhibitors for steels in acidic media for the oil and gas industry: A review. Corrosion Science, v. 86:17–41.
2. Sharma, S.K., Sharma, A. (2011) Green corrosion inhibitors: status in developing countries. In: Sharma S.K. (ed.) Green corrosion chemistry and engineering, Wiley–VCH, Weinheim, p. 157-180.
3. Peter, A., Obot, I.B., Sharma, S.K. (2015). Use of natural gums as green corrosion inhibitors: an overview. International Journal of Industrial Chemistry, 6:53-164.

4. Bentrah H, Rahali Y, Chala A. (2014) Gum Arabic as an eco-friendly inhibitor for API 5L X42 pipeline steel in HCl medium. Corr. Sci. 82: 426-431.
5. Roy P, Karfa P, Adhikari U, Sukul D. (2014) Corrosion inhibition of mild steel in acidic medium by polyacrylamide grafted Guar gum with various grafting percentage: Effect of intramolecular synergism. Corr. Sci. 88: 246-253.

Biography

Luis M. Angelats Silva has experience in electrochemical corrosion of metallic materials. Within its diverse research in materials science and technology, it is currently looking for alternatives to improve corrosion resistance by using natural polysaccharides as non-toxic inhibitors for human health and the environment. His experience in electrochemical studies has allowed him to develop diverse methods and/or techniques that allow him to evaluate, through accelerated corrosion tests, the efficiency of inhibition of these polysaccharides in alloy steels widely used in high temperature pipes.

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