Xanthan Gum and Gum Acacia as corrosion inhibitor for mild steel in 15 % HCl medium

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Corrosion is a very natural phenomenon. The simplest and efficient way to protect metals and alloys from corrosive environment is the application of inhibitors. Currently efforts are being made to find cheap and eco-friendly compound which is used as corrosion inhibitors in acidic medium. The natural polysaccharides Xanthan Gum (XG) and Gum Acacia (GA) were tested as corrosion inhibitors for mild steel in 15 % hydrochloric acid medium. Gravimetric analysis, potentiodynamic polarization and electrochemical impedance spectroscopy (EIS) methods were employed for investigating the effectiveness of both inhibitors. The inhibition efficiency ($\eta\%$) and surface coverage (θ) increased with increasing inhibitor concentration. The maximum efficiency obtained for XG and GA are 90.2 %, and 70.2 % respectively at 0.4 g/L as shown in Figure 1. The weight loss study was also carried out at different temperature (303-333 K) in a thermostated water bath to calculate the kinetic and thermodynamic parameters.

Figure 1: Variation of efficiency of inhibitors XG and GA with concentration

Adsorption of these inhibitors is found to be effective and follow Langmuir adsorption isotherm. The electrochemical study (polarization study) indicates that the inhibitors are of mixed type. The nature of polarization curves (Shown in Figure 2) indicates that the inhibitors influence both the anodic and cathodic reactions resulting in retardation of anodic dissolution of metal and cathodic hydrogen evolution reaction through blocking the active reaction sites on metal surface.

Figure 2: Polarisation curves for mild steel in 15% HCl solution with and without various concentrations of XG and GA at 298 ± 1 K.

Surface was characterized by the Scanning Electronic Microscope (SEM). The SEM study also confirmed the protection of mild steel surface with the XG and GA. The surface morphology of the mild steel sample in 15% HCl solution in the absence and presence of inhibitors of optimum concentration (0.3 g/L) is shown in Figure 3.

Figure 3: SEM images of mild steel in 15% HCl solution at 298 ± 1 K : (1) Before immersion (Polished); (2) in the absence of inhibitors (Blank); (3) presence of inhibitor XG and (4) GA at 0.3 g/L after 6 h of immersion.

Reference

1. A. Biswas, S. Pal, G. Udayabhanu, Appl. Surf. Sci. 353 (2015) 173–183.