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Xanthium Strumarium leaves extracts as a friendly corrosion inhibitor of low carbon steel in hydrochloric acid: kinetics and mathematical studies

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Abstract

Corrosion inhibition of low carbon steel in 1M HCl was investigated in absence and presence of *Xanthium Strumarium leaves (XSL)* extracts as a friendly corrosion inhibitor. The effect of temperature and inhibitor concentration was studied using weight loss method. The result obtained shown that *Xanthium Strumarium leaves* extracts act as an inhibitor for low carbon steel in HCl and reduces the corrosion rate. The inhibition efficiency was found to increases with increase in inhibitor concentration and temperature. Higher inhibition efficiency was 94.82% at higher level of inhibitor concentration and temperature. The adsorption of *Xanthium Strumarium leaves* extracts was found to obey Langmuir adsorption isotherm model. The values of the free energy of adsorption was more than -20 kJ/mol, which is indicative of mixed mode of physical and chemical adsorption.

Keywords: Corrosion; green inhibitor; natural extracts; low carbon steel; acid; adsorption.

1. Introduction

Steel and its alloys are widely used in constructions of tanks, petroleum refineries equipment, pipes, etc. The main problem of using steel alloys is its aggressive reaction in acidic solutions. Acid solutions are commonly used for removal of unwanted scale and rust in many industrial processes. Among the commercially available acids, the most frequently used one is hydrochloric acid. Inhibitors are generally used in these processes to control iron and iron alloys dissolution as well as the consumption of acid (Ameer and Fekry, 2010; Musa *et al*, 2010). Inhibitor investigations cover a variety of activities, ranging from protection mechanisms through discover and synthesis of new compounds and the assessment of competitive commercial products to the monitoring of industrial systems in which inhibitors are being used (Khaled, 2011). Inhibitors can alter the consumption reaction rate of metals in acids, affecting the kinetics of the electrochemical reactions which organize the corrosion process. Inhibitors adsorbed on the metal surface and change the structure of the electrical double layer. The adsorption process depends to a great extent on the molecular structure. To this problem is devoted a number of investigations including organics and inorganics components (Khadom *et al*, 2010A; Bouayed et al, 1999; Quraishi and Sardar, 2002; Khadom and Yaro, 2011A; Khadom *et al*, 2009A). Many organic inhibitors contain in their structures N, S, and O atoms and can be used in acidic environments. The organic inhibitors form a protective layer on the steel surface while inorganic inhibitors act as anodic inhibitors (Musa *et al*, 2011A; Musa *et al*, 2011B; Musa *et al*,