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Articles

Comparative studies on the corrosion inhibition efficacy of ethanolic extracts of date palm leaves and seeds on carbon steel corrosion in 15% HCl solution

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Abstract

The work reports on the study carried out to comparatively assess the corrosion inhibition efficacy of crude ethanolic extracts of date palm leaves and seeds on X60 carbon steel corrosion in 15% HCl solution at 25–60 °C. The corrosion inhibition studies was carried out using weight loss and electrochemical (potentiodynamic polarization and linear polarization resistance) techniques. Preliminary phytochemical screening was performed in order to determine the phytoconstituents present in the crude extracts. The influence of extractive solvents on the corrosion inhibition performance of the extracts was also investigated. It is found that the crude extracts of both date palm leaves and seeds contain saponins, flavonoids, cardiac glycosides and reducing sugars. Tannins is only present in the leaves and absent in the seeds while anthraquinones is absent in both extracts. The crude ethanolic extracts inhibited the corrosion of X60 steel in the aggressive 15% HCl solution with the leaves extract showing superior performance. Inhibition efficiency increased with increase in concentration of the extracts and temperature. Potentiodynamic polarization results reveal that the extracts function as mixed type inhibitors. Corrosion inhibition occurs by virtue of adsorption of components of the extract on the steel surface and was found to follow Langmuir adsorption isotherm model. On the influence of the extractive solvents on the corrosion inhibition performance, the order of inhibition efficiency at 60 °C follows the trend DPLAE (73.6%) > DPLEE (62.5%) > DPSAE (59.9%) > DPSEE (55.9%) with the optimum extract concentration (2000 ppm) studied.

Keywords:

- Date palm
- carbon steel
- acid corrosion
- corrosion inhibition
- natural product

1. Introduction

Carbon and low alloy steels are materials of choice in comparison to corrosion resistance alloys (CRAs) in the construction of down hole tubulars, casings, flow lines and transmission pipelines in the petroleum industry [Citation1]. This is predicated on their cost effectiveness. However, low corrosion resistance of carbon and low alloy steels in corrosive environments is the major drawback against their use. One of the challenging corrosive environments encountered in oilfield operation is oil well acidization or stimulation. Here, concentrated hydrochloric acid (HCl) between 15 and 28% or hydrofluoric acid (HF) is pumped down a well to clean up wellbore damage, create fissures deep into the formation or simply remove scale from casing and tubing. In the absence of adequate protection, these acids will in no time destroy well tubulars. Corrosion inhibitors are therefore indispensable to prevent acid damaging well tubulars. Given that acids are aggressive environment for oil and gas well infrastructures, the effective way to control their corrosion attack on tubing and casing materials is to inject corrosion inhibitor which could be added to the acid solution in the course of the acidization process [Citation2,3]. Corrosion inhibitors function mostly by modifying the surface of the metal via adsorption of the inhibitor molecules resulting in the formation of a protecting layer.

Most of the well-known inhibitors that offer protection to metal surfaces in contact with aggressive environments are organic compounds containing heteroatoms such as nitrogen, sulphur, phosphorous and oxygen atoms [Citation4]. However, most of the synthetic organic compounds that are used as inhibitors are not cost-effective and are toxic to humans and the environment. Consequently, the use of less toxic and renewable products as corrosion inhibitors is at the forefront of current research interest. The use of natural products as corrosion inhibitors has been advocated

because they are renewable, readily available, ecologically acceptable, environmentally
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