Chapter 13

Corrosion Inhibition Studies of Synthesized Oleic Sources-Based Green Inhibitors From Agro-Industrial Waste

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ABSTRACT

Now, the use of corrosion inhibitors is an effective method to mitigate the corrosion in hydrocarbon extraction and transportation pipelines. Crude oil has several corrosive species, which includes chloride, carbon dioxide, and hydrogen sulphide. Organic type corrosion inhibitors are frequently used to prevent the metallic surface's corrosion due to the mechanism of adsorption related to the displacement of water molecules and the formation a monomolecular hydrophobic layer. With the aim of increasing the inhibition efficiency and obtaining a sustainable corrosion inhibitor, vegetables oils are extracted from agro-industrial waste such as rice, coffee, palm, avocado, etc., and have been used to synthesize a new generation of inhibitors, namely, green corrosion inhibitors, which are cheaper and environmentally friendly. Hence, the purpose of this chapter is to explain the concepts and fundaments about corrosion inhibitors based on imidazoline derivates of natural oils and include information on synthesis and electrochemical performance of a green corrosion inhibitor.

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INTRODUCTION

Principles of Corrosion Using Inhibitors

Corrosion processes are surface phenomena that occur when metals and alloys interact with the environment that surrounds them. These seek to achieve their more stable thermodynamics form by means of a chemical reaction. Corrosion processes are responsible for several issues within the petrochemical, food, marine, aeronautical, etc., industries. Corrosion of metal and alloy parts can not only represent an economical issue due to the time and expenses required for maintenance of corroded parts, but also it can be a security risk because of possible failures of structures that can cause injuries to users due to unexpected malfunction (Angst, 2018). In this manner, one of the best strategies adopted in the industry against corrosion of metal and alloys is its prevention, saving costs and lives (Tamalmani & Husin, 2020).

Different approaches are reported in the literature to prevent the corrosion of metals and alloys, such as the use of physical barriers between the alloy and the aggressive media; these barriers can be thick and thin coatings or film-forming chemicals (Montemor, 2014). Another approach is the use of a method for compensating the loss of electrons related to the corrosion reaction; one can mention the cathodic protection and the use of sacrificial anodes (Von Baeckmann et al., 1997). Among the different methods for corrosion prevention, one can also find out the use of corrosion inhibitors; in particular, this method has excellent acceptance in the industry because of its versatility and low cost (Dariva & Galio, 2014).

Corrosion inhibitors include organic and inorganic compounds that can be adsorbed on the metallic alloy surface in order to isolate it from the surrounding environment and leads to prevent the electrochemical redox reaction. For instance, organic inhibitors can promote inhibition on metal surfaces by adsorption of their molecules to form a protective molecular layer, isolating the metal surface from the electrolyte. Alternatively, inorganic inhibitors can act through their metallic atoms, which are enclosed in the metal surface to improve corrosion resistance (Kadhim et al., 2021).

Scientific investigations about corrosion inhibitors have been conducted mainly for applications in large areas such as long petrochemical pipelines and metallic structures in construction (Finšgar & Jackson, 2014) (Venkatesh et al., 2019). Corrosion inhibitors have had great acceptance in petrochemical and construction industries due to excellent anti-corrosive properties. However, one of the issues that havehindered some of these compounds is their toxicity and damage to the environment. Much research in the last decade has been conducted to find out new corrosion inhibitor formulations with environmentally friendly signature (Verma et al., 2021).

Corrosion inhibitors have become a crucial part of anti-corrosive systems in the industry. Among various inhibitor formulations, these compounds can be classified according to their role in the electrochemical process and the manner in which they inhibit the corrosion as follows: 1) anodic, 2) cathodic, and 3) mixed. They can also be classified as a function of their nature as follows: 1) organic and 2) inorganic. In addition, they can be classified according to the effect on the environment, namely, 1) acid, 2) neutral, alkaline, and vapor-phase inhibitors. Finally, inhibitors can also be classified according to their source as 1) synthetic and 2) natural (derived from natural products) (Kadhim et al., 2021).

Cathodic inhibitors are those compounds that decrease the corrosion potential of the system, avoiding the reactions that take place at the cathode, such as oxygen reduction and hydrogen evolution. Alternatively, anodic inhibitors increase the corrosion potential of the system, by passivating the active sites. Mixed-type corrosion inhibitors cannot be only classified as cathodic and anodic-type. Substituted aromatic rings,