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The Inhibition and Adsorption Processes of L-Cysteine Against the Corrosion of XC 18 Carbon Steel in 2N H_2SO_4

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Abstract: The inhibition effect of L-cysteine as environmentally friendly corrosion inhibitor for XC 18 carbon steel in stirred 2 N sulphuric acid has been investigated by electrochemical techniques. The impedance measurements showed that the inhibition efficiency increased with the increase of inhibitor concentration to reach more than 84% at 500 mg L• [1] and indicated that the amino acid act as mixed type inhibitor, while the adsorption followed the Langmuir isotherm. Effect of temperature is also studied in the 30-60°C range. The values of adsorption free energy (• G^0_{ads}) and activation energies (E_a) reveal a physical adsorption of the inhibitor on the steel surface.

Key words: L-cysteine, ac impedance, corrosion inhibition, carbon steel, sulphuric acid

INTRODUCTION

The use of inhibitor is one of the most practical methods to protect metals from corrosion, especially in aggressive media, in particular, in the chemical, petrochemical and oil industries (Hackerman, 1987; Nestle, 1973). Most of the effective inhibitors are compounds containing, in their structures, nitrogen, phosphorus and/or sulphur. Heteroatoms such as nitrogen, oxygen and sulphur are capable of forming coordinate covalent bond with metal owing to their free electron pairs and thus, acting as inhibitor (Hackerman, 1987; Flick, 1993). The inhibiting effect of these molecules is excellent but they are highly toxic as well for the environment as for the man (Ismail, 2007). Their progressive substitution by substances in biological matter, not toxic, biodegradable and potentially inhibiting takes an interest growing and represents a very required objective.

Many researchers were interested in biochemical compounds based on amino acids, which exhibit excellent properties such as good water solubility and rapid biodegradability (Morreti *et al*., 2004; Ashassi *et al*., 2004). These inhibitors, used in protection against the acid corrosion of certain metals such as nickel, cobalt, copper as well as iron and steel (Aksut and Bilgic, 1992; Morreti and Guidi, 2002), gave much satisfaction.

The amino acids are the building block of proteins. All amino acids have a central or alpha carbon, to which are bonded four groups: hydrogen, an amino group, a carboxyl group and a unique side chain, also known as R-group (Aksut and Bilgic, 1992). These molecules differ in their unique side chain, which can be used to classify the molecules into functional types.

The original functional character of the amino acids is the simultaneous presence of two ionisable functions with an opposite chemical nature: the amine group with basic property and the carboxyl group with acid property. This amphoteric character enables them to form salts with the acids as with the bases. The ionized shapes of the amino acids are a function of the pH medium.

The inhibition of corrosion by organic compounds is primarily attributed to an adsorption process on the metal surface. This phenomenon is influenced by the nature and the surface charge of the metallic surface, the composition of the corrosive medium and the chemical structure of the inhibiting products. The physicochemical properties of the functional groups and the electron density at the donor atom play a significant part. The interactions of the • -orbital of the inhibitor with d-orbitals of the metallic surface atoms induce a strong adsorption of the inhibitor molecules onto the surface with the formation of a protecting film (Ali *et al*., 2003; Bentiss *et al*., 2000; Olivares *et al*., 2006).

The aim of this research, is to investigate the inhibitive effect and to determine the mode of adsorption of an amino acid such as L-cysteine, usually available and

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