Chapter 18
Corrosion Inhibition on Carbon Steel in Hydrochloride Acid Using Some Bolaamphiphile Surfactants

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ABSTRACT

Novel Bolaamphiphile surfactants: 1,n-bis(4-amino-3-methyl-1,2,4-triazole-thioyl)alkane (DTCn, n=10,12) have been synthesized and characterized in the author's laboratory. The corrosion inhibition effect of carbon steel in molar hydrochloric acid was investigated using electrochemical methods, scanning electron microscope with energy dispersive x-ray analysis and theoretical tools such as density function theory calculation. This investigation shows that all compounds studied are good corrosion inhibitors for carbon steel in molar HCl. The inhibition efficiency increased with increasing inhibitor concentration, and reached 91.57% and 96.63% respectively for DTC10 and DTC12. The obtained results lead to the selecting the DTC12 as the best inhibitor. The surface analysis using SEM coupled with EDX confirms an excellent protective effect due to the establishment of the covering inhibitor film on the carbon steel surface. The density functional theory calculations were reasonably achieved to get a more understanding of the adsorption mechanism for corrosion inhibitors studied on the metal surface.

INTRODUCTION

Corrosion inhibition using surfactant's compounds has been studied by some authors (Achouri, et al. 2001, Hajjaji, et al. 1993, Bastidas, et al. 2000). However, little work appears to have been done on the inhibiting of carbon steel in acidic media using bolaamphiphile surfactants (Chafiq, et al. 2020, D. Chebabe, et al. 2004). The use of the organic compounds as corrosion inhibitors is justified by their useful role in reducing the dissolution of metals in different corrosive environments (Rezaeivala, et al. 2022, Karimi, et al. 2022).

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In the present paper, some bolaamphiphile surfactants in the series of 1,n-bis(4-amino-3-methyl-1,2,4-triazole-thioyl)alkane (DTCn, n=10,12), referred as DTCn (n =10 and 12) (Figure 1) have been synthesized and characterized in aour Laboratory.

Following the previous work carried out in our laboratory concerning the use of conventional surfactants as inhibitors for iron corrosion (Chebabe, et al. 2003, Alaoui, et al. 2018, Ait haddou, et al. 2022).

MAIN FOCUS OF THE CHAPTER

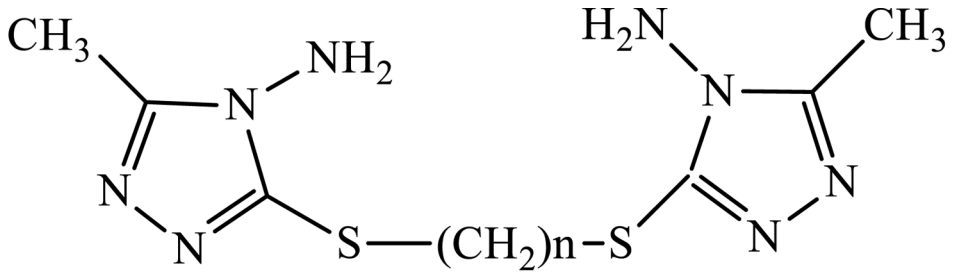
In this work, we study the effect of addition of 1,10-bis(4-amino-3-methyl-1,2,4-triazole-thioyl)decane (DTC10) and 1,12-bis(4-amino-3-methyl-1,2,4-triazole-thioyl)dodecane (DTC12) on the corrosion resistance of carbon steel in 1 M HCl. The electrochemical behaviour of the carbon steel/1 M HCl system both in the absence and presence of these surfactants is studied by potentiokinetic polarization methods and electrochemical impedance spectroscopy.

Potentiodynamic polarization results have sufficiently shown that the selective inhibitor studied acts as mixted inhibitor and its inhibition efficiency was assuredly found to be around 92 and 96% at 10^{-3}M respectively for DTC10 and DTC12.

The impedance diagrams show that the protective effect of the inhibitors studied is attributed to the formation of an inhibitor film on the steel surface. The scanning electron microscopy technique amply confirms the excellent protective effect of the DTC12.

The theoretical calculations are important technics enabling a comparison of the inhibition properties of organic compounds (Rezaeivala, et al. 2022). The DFT calculations shows the adsorption behaviour of the studied compounds on the steel surface and confirm that DTC12 is the best inhibitor.

Figure 1. Molecular structure of Bolaamphiphile surfactants



n=10 DTC10
n=12 DTC12

ISSUES, CONTROVERSIES, PROBLEMS

The use of the organic compounds as corrosion inhibitors is justified by their useful role in reducing the dissolution of metals in different corrosive environments. Corrosion inhibition using surfactant's