

The inhibition effect and mechanism of 1827 cationic surfactant for cold rolled steel in HCl solution

Chengjie Shi, Shuduan Deng, Xianghong Li*

*College of Materials and Chemical Engineering, Southwest Forestry University,
Kunming 650224, P.R. China*

e-mail address: xianghong-li@163.com

Abstract: Benzyltrimethylstearylammonium chloride (1827) exhibits widespread and potent bactericidal efficacy. However, as a quaternary ammonium salt cationic surfactant with excellent potential for metal corrosion inhibition has not been revealed. Its inhibitory performance and mechanism on cold rolled steel (CRS) in HCl medium was investigated by comprehensive methods. The results show that 1827, serves as a mixed inhibitor, exhibits remarkable surface activity in HCl, efficiently suppressing both cathodic and anodic reactions by occupying active sites, achieving an inhibition efficiency of up to 98.49%. The Langmuir isotherm precisely describes the adsorption behavior of 1827 on the CRS surface. XPS, SEM, and AFM analyses indicate that 1827 effectively adsorbs onto the CRS surface, demonstrating significant inhibitory performance. Theoretical calculations reveal strong interactions between the active moieties of 1827 and the CRS surface, leading to the formation of a protective film through physisorption and chemisorption, effectively impeding the aggressive action of corrosive media. This work provides the basis and theoretical foundation for the application of 1827 in the field of metal corrosion protection.

Keywords: Corrosion inhibition; Benzyltrimethylstearylammonium chloride; HCl; Cold rolled steel

Reference

- [1] Y. Zhu, M.L. Free, R. Woollam, W. Durnie, A review of surfactants as corrosion inhibitors and associated modeling, *Prog. Mater. Sci.* 90 (2017) 159-223.
- [2] C. Verma, C.M. Hussain, M.A. Quraishi, A. Alfantazi, Green surfactants for corrosion control: Design, performance and applications, *Adv. Colloid Interface Sci.* 311 (2023) 102822-102833.
- [3] A.H. Tantawy, K.A. Soliman, H.M. Abd El-Lateef, Novel synthesized cationic surfactants based on natural piper nigrum as sustainable-green inhibitors for steel

pipeline corrosion in CO₂-3.5% NaCl: DFT, Monte Carlo simulations and experimental approaches, *J. Clean Prod.* 250 (2020) 119510-119529.

[4] Q.H. Zhang, Z.N. Jiang, Y.Y. Li, X. Wang, W. Xiong, H.F. Liu, G.A. Zhang, In-depth insight into the inhibition mechanism of the modified and combined amino acids corrosion inhibitors: “intramolecular synergism” vs. “intermolecular synergism”, *Chem. Eng. J.* 437 (2022) 135439-135457.

[5] A. Singh, K.R. Ansari, D.S. Chauhan, M.A. Quraishi, H. Lgaz, I.M. Chung, Comprehensive investigation of steel corrosion inhibition at macro/micro level by ecofriendly green corrosion inhibitor in 15% HCl medium, *J. Colloid Interface Sci.* 560 (2020) 225-236.

Acknowledgements

Funding support from National Natural Science Foundation of China (52161016), and Joint Key Project of Agricultural Fundamental Research in Yunnan Province (202101BD070001-017) are acknowledged.