

The combination of HEDP and D-phenylalanine inhibits methanogens-mediated corrosion

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Abstract Methanogens are one of the main species that cause metal corrosion in pipelines via forming biofilm, which greatly reduce the role of corrosion inhibitors and thus increase their dosages. D-amino acids can inhibit the formation of biofilm, which might be an effective means to improve the conventional corrosion inhibitors. However, little literature reported the synergistic effects of corrosion inhibitors and D-amino acids on methanogens-mediated corrosion. Therefore, 1-hydroxyethane-1,1-diphosphonic acid (HEDP) was chosen as a typical corrosion inhibitor and D-Phenylalanine (D-Phe) as a D-amino acid to evaluate their roles in corrosion caused by *Methanosarcina barkeri* (*M. barkeri*). D-Phe and HEDP can synergistically inhibit microbiologically influenced corrosion, reducing corrosion rate by 89.66% and effectively mitigating corrosion on carbon steel surfaces. Electrochemical tests showed that HEDP and D-Phe can retard the cathodic reaction and reduce the corrosion rate, and CLSM analysis showed that HEDP and D-Phe can reduce the protein content in biofilm, which was only 2.44% of that in the blank group. Transcriptome analysis further revealed the molecular mechanism by which HEDP and D-Phe alleviated corrosion. The addition of HEDP and D-Phe resulted in the down-regulation of the genes *MSBRM_RS06090*, *MSBRM_RS13790*, and *MSBRM_RS13820*, which are related to extracellular protein secretion and biofilm formation, thus making it difficult for *M. barkeri* to aggregate and form biofilms. This study provides a new approach to enhance conventional corrosion inhibitors, mitigate microbiologically influenced corrosion and alleviate eutrophication of water bodies.

Keywords Microbiologically influenced corrosion; Corrosion inhibition; Methanogens; D-amino acid; HEDP

Reference

[1] H. Li, Z. Kang, K. Zhang, et al., Enhanced inhibition of HEDP on SRB-mediated corrosion with D-phenylalanine. *Environmental Research* 227, 115754 (2023).

[2] E. Li, J. Wu, D. Zhang, et al., Electron donor dependent inhibition mechanisms of D-phenylalanine on corrosion of Q235 carbon steel caused by *Desulfovibrio* sp. Huiquan2017. *Corrosion Science* 188, 109493 (2021).