

## 1、 Corrosion and Protection of Oil & Gas and New Energy Materials

### Study on the Synergistic Corrosion Inhibition Performance of H<sub>2</sub>S Corrosion Inhibitor and Desulfurizer Composite System on X65 Steel

Sa XIAO, Haonan LIN, Xing ZHAO, Xuefei PENG, Haitao LIU

*China Oilfield Services Limited, CNOOC, Tianjin 300459, China*

*lotsoxiao@126.com*

**Abstract** The corrosion of oilfield gathering and transportation systems, as well as wellbores, by hydrogen sulfide significantly impacts the normal production of oilfields and can even lead to serious safety incidents. This type of pipeline corrosion adversely affects the economic viability of oilfields. To investigate the corrosion behavior of gathering and transportation pipelines exposed to hydrogen sulfide, a high-temperature and high-pressure dynamic corrosion reaction kettle was utilized in a controlled indoor environment. Additionally, the study examined the corrosion inhibition performance of a combination of hydrogen sulfide corrosion inhibitors and desulfurizers. The research results indicate that as the partial pressure of hydrogen sulfide increases, the corrosion rate of X65 steel gradually rises. Similarly, an increase in watercut correlates with a gradual increase in the corrosion rate of X65 steel. Furthermore, as the corrosion temperature increases, the corrosion rate of X65 steel initially rises before subsequently decreasing. When employing the H<sub>2</sub>S corrosion inhibitor composite desulfurizer system, a synergistic corrosion inhibition effect is observed. This approach demonstrates superior hydrogen sulfide corrosion inhibition compared to the use of a single corrosion inhibitor, with the corrosion inhibition rate of X65 steel potentially increasing by 2 to 10 percentage points.

**Keywords** Hydrogen sulfide corrosion; Corrosion inhibitor; Hydrogen sulfide scavenger; Micromorphology; Corrosion and protection

#### Reference

[1] Lizhi Zhang, Sansartuya Dorjpalam, Guojun Ji, Jingsi Peng.(2020). Corrosion of stainless steel coated with a ZrO<sub>2</sub> film in a hydrogen sulfide gas environment. *SN Applied Sciences*, Vol.2 (T159), pp.351-360. <https://doi.org/10.1007/s42452-020-2718-z>

- [2] M. S. Khoma, V. R. Ivashkiv, S. A. Halaichak, M. R. Chuchman, Kh. B. Vasyliv. (2019). Influence of the Structure of Carbon Steels on the Corrosion, Hydrogenation, and Corrosion Cracking in Hydrogen-Sulfide Media. *Materials Science*, Vol.55 (5), pp.266-270. <https://doi.org/10.1007/s11003-019-00299-8>
- [3] Mehdiyeva G. M. (2023). 8-Allyl-1,3-benzoxazines as Hydrogen Sulfide Corrosion Inhibitors and Biocides in Crude Oil Extraction. *Petroleum Chemistry*, Vol. 63(4), pp. 394-402. <https://doi.org/10.1134/S0965544123030039>
- [4] Suleymanova S.S. (2017). Anticorrosive properties of inhibitors synthesized on the basis of triglycerides of olive oil in case of a hydrogen sulfide and carbon dioxide media. *Neftyanoe khozyaystvo - Oil Industry*. Volume 2017, Issue 5. pp. 62-63. <https://doi.org/10.24887/0028-2448-2017-5-62-63>
- [5] G. M. Mekhtieva, A. M. Magerramov, M. R. Bairamov. (2015). Alkenylphenol-based pyridinium salts as hydrogen sulfide corrosion inhibitors and agents for inhibiting the growth of sulfate-reducing bacteria in oil production. *Petroleum Chemistry*. Vol. 55(3), pp. 247-251. <https://doi.org/10.1134/S0965544115030081>
- [6] Secco Carolinne, Fuziki Maria Eduarda Kounaris, Tusset Angelo Marcelo. (2023). Reactive Processes for H<sub>2</sub>S Removal. *Energies*. Vol. 16(4), pp. 1759-1759. <https://doi.org/10.3390/EN16041759>
- [7] Jeon Jiwon, Ahmed Ramadan, Elgaddafi Rida. (2022). Hydrogen embrittlement of high-strength API carbon steels in H<sub>2</sub>S and CO<sub>2</sub> containing environments. *Journal of Natural Gas Science and Engineering*. Vol. 104. <https://doi.org/10.1016/J.JNGSE.2022.104676>
- [8] Hongyu Sun, Liguang Zhong, Yu Zhu, Jianjian Zhu, Zhuo Li, Zhilong Zhang, Yangyang Zhou. (2024). Assessing sulfate-reducing bacteria influence on oilfield safety: Hydrogen sulfide emission and pipeline corrosion failure. *Engineering Failure Analysis*. Vol. 164, pp. 108646-108646. <https://doi.org/10.1016/J.ENGFAILANAL.2024.108646>
- [9] Pokhmurskii V. I., Khoma M. S., Chuchman M. R., Vasyliv Kh. B., Ratska N. B. (2024). Effect of Temperature and Pressure on Corrosion and Hydrogenation of Steel in Chloride-Acetate Environment with Different Concentrations of Hydrogen Sulfide and Carbon Dioxide. *Materials Science*. Vol. 59 (5). pp. 519-523. <https://doi.org/10.1007/S11003-024-00806-6>
- [10] Murtaza Mobeen, Alarifi Sulaiman A, Abozuhairah Ali, Mahmoud Mohamed, Onaizi Sagheer A, AlAjmi Mohammed. (2021). Optimum Selection of H<sub>2</sub>S Scavenger in Light-Weight and Heavy-Weight Water-Based Drilling Fluids. *ACS omega*. Vol. 6 (38). pp. 24919-24930. <https://doi.org/10.1021/ACSOMEGA.1C03792>