

**Stress corrosion cracking failure of X80 carbon steel U-bend caused by
Desulfovibrio vulgaris biocorrosion**

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Abstract: Sulfate reducing bacteria (SRB) are widely present in oil and gas industry, causing pitting corrosion on pipeline steel. Stress corrosion cracking (SCC) often occurs in the presence of mechanical stress before pitting perforation failure, leading to economic losses and even catastrophic accidents. In this study, stress distribution simulation using the finite element method (FEM), corrosion analysis techniques and electrochemical corrosion measurements were employed to investigate the SCC mechanism of X80 pipeline steel caused by *Desulfovibrio vulgaris*, which is a common SRB strain used in microbiologically influenced corrosion (MIC) studies. It was found that *D. vulgaris* MIC caused sharp microcracks on an X80 U-bend coupon after only 2 weeks of immersion at 37 °C in the deoxygenated ATCC 1249 culture medium inoculated with *D. vulgaris*. The X80 U-bend coupon's weight loss-based uniform corrosion rate for the 12 cm² surface was 60% of that for the unstressed flat square coupon (2.3 mg cm⁻² vs. 3.8 mg cm⁻²). This was likely because the square coupon had wide MIC pits, providing a larger effective surface area for more sessile cells (4.2×10⁸ cells cm⁻² on square coupon vs. 2.4×10⁸ cells cm⁻² on U-bend coupon) to attach and harvest more electrons. An SCC failure occurred on an X80 U-bend pre-cracked at the outer bottom after a 6-week immersion in the *D. vulgaris* broth. Apart from MIC damage, this could also be because *D. vulgaris* metabolism increased the availability hydrogen atoms on the steel surface, and promoted the diffusion of hydrogen atoms into the metal lattice, thus increasing the brittleness of the steel.

Keywords: stress corrosion cracking, microbiologically influenced corrosion, sulfate reducing bacteria, X80 U-bend steel, tensile stress