CASE STUDY

rawwater

Long-Term Microbial Evaluation for Souring Management

Long-Term Microbial Souring: Evaluating VFA and Nitrate Utilisation from High-Pressure, Hydrocarbon-Degrading Systems

CHALLENGE

Microbial souring, driven by hydrogen sulfide (H_2S) production, is a persistent and costly issue in oilfields, particularly in mature reservoirs undergoing produced water reinjection (PWRI). Traditional mitigation methods often lack insight into microbial behaviour under true reservoir conditions, especially during shut-in periods. Understanding how microbial communities respond to changes in nutrient availability and pressure is essential for developing robust souring control strategies and improving long-term reservoir management.

SOLUTION

High-Pressure Bioreactor Simulation Study

To replicate realistic reservoir conditions, Rawwater employed long-term, high-pressure bioreactors - oil-saturated, sand-packed columns operating at 1,000 psig and 30°C. These unique systems were operated for over a decade, enabling detailed observation of microbial sulfide production rates under oil-degrading conditions. The study originally focused on how varying shut-in durations affected H_2S generation, with results showing reduced souring activity under extended shut-in periods, likely due to factors including nutrient limitation and sulfide product inhibition.

To build on these findings, Rawwater and The University of Manchester investigated whether microbial communities from the high-pressure bioreactor effluents could metabolise volatile fatty acids (VFAs) and nitrate under atmospheric-pressure incubation conditions. The experiments revealed rapid VFA oxidation and nitrate reduction, with a shift toward Marinobacter dominance, indicating the potential for VFAs to stimulate sulfide production when reinjected.

Together, these results provide vital insight for developing field-relevant souring forecasts and refining chemical treatment strategies in late-life, oil-washed reservoirs.

BENEFITS

Improved souring control through field-relevant microbial understanding

- Shut-in duration reduces rate of microbial H_2S generation
- Planktonic communities rapidly oxidised VFAs and reduced nitrate
- Marinobacter dominance indicated potential risk of sulfide generation via reinjected VFAs