Mitigation of biocorrosion by a shale microbiome biofilm using biocide enhancer of D-amino acids

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Abstract

Microbiologically influenced corrosion (MIC) in shale gas field is a major threat with the hydraulic fracturing fluid injected into the subsurface. In this study, the microbiome collected from a shale gas produced water sample was extracted and cultivated in ATCC 1249 medium modified with 10 g/L NaCl anaerobically at 30 °C. D-amino acids, which were reported as biocide enhancers, were found to enhance 2,2-dibromo-3-nitrilopropionamide (DBNPA) biocide on the mitigation of shale microbiome MIC on X80 carbon steel. The combination of 50 ppm (w/w) D-leucine + 50 ppm D-alanine + 1 ppm D-tyrosine had the best enhancement effect on 50 ppm DBNPA with 84% less weight loss, and 67% lower corrosion current density (icorr) compared to 50 ppm DBNPA alone. The corrosion data were consistent with the enhanced biofilm inhibition observation. The experimental data also indicated that D-tyrosine used alone at a low dosage of 1 ppm enhanced DBNPA considerably, with 44% less weight loss and 47% less icorr. The electrochemical results showed the positive response of shale gas microbiome biofilm to the injected magnetite nanoparticles indicating the extracellular electron transfer might be a main mechanism for its corrosion.

Keywords *Microbiologically influenced corrosion; Shale gas; Carbon steel; Biocide enhancer; D-amino acid; Biofilm*