

427m Mass Transfer Effects on the Biofilms Due to Desulfovibrio Desulfuricans

Jie Wen, Kaili Zhao, Tingyue Gu, and Srdjan Nesic

Microbiologically influenced corrosion (MIC), or biocorrosion, is a major problem in the oil and gas industry as well as many other industries such as nuclear power and water utility. Nearly 20% of all corrosion damages were said to be attributed to MIC. Sulfate-Reducing Bacteria (SRB) are the most frequently implicated microorganisms among many other types of microorganisms. MIC damages cost hundreds of millions of US dollars in the United States every year in the oil and gas industry due to SRB alone. Mass transfer is a very important parameter in biochemical engineering studies of fermentation. In MIC, mass transfer was linked to nutrient distribution in the medium and the transport of corrosive species and corrosion products. It was also reported in the literature that biocides were not as effective against sessile organisms within biofilms as against a planktonic population since it was difficult for biocides to penetrate the biofilms. In this work, mass transfer effects on the MIC due to SRB were investigated. The ATCC 7757 strain of *Desulfovibrio desulfuricans* was used in this work. Laboratory experiments were carried out in 100 ml anaerobic vials and a 2-L electrochemical glass cell bioreactor. The bioreactor was equipped with a Gamry (www.gamry.com) potentiostat and electrodes to perform linear polarization sweeps for corrosion rate measurement in addition to weight loss. A rotating shaft fitted with a cylindrical C1018 coupon was placed in the center of the bioreactor vessel. Coin shaped C1018 coupons were used in the 100 ml vials. Results in the 100 ml vials and in the bioreactor both indicated that mild agitation promoted planktonic and sessile SRB growth as well as pitting corrosion compared to results with stagnant culture media. It was reasoned that agitation enhanced the mass transfer of corrosive species from the bulk of the solution to the metal surface and the distribution of nutrients in the culture media. Further experiments using a very high rate of agitation hinted that SRB cell growth and metal corrosion were both hindered. It was possible that high shear inhibited cell growth and biofilm formation. This points to a potential mitigation method using shear to control MIC. More experiments are underway to quantify the shear needed.