MONTANA STATE UNIVERSITY
NORM ASBJORNSON College of ENGINEERING

Biocorrosion of Copper *Oleidesulfovibrio alaskensis* G20 Biofilms in Static and Dynamic Environments

Masters Thesis Defense

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Plant Biosciences Building, 108 and via Webex

This study presents a detailed examination of the intricate relationships between Oleidesulfovibrio alaskensis G20 and copper (101), emphasizing three interconnected perspectives: the kinetics of copper toxicity in three distinct media, the impact of surface finishing on microbiologically influenced corrosion (MIC), and the interaction of G20 biofilms and copper in CDC biofilm reactors. Initially, the study concentrates on the kinetic effects of copper toxicity on the growth of G20. The research meticulously quantifies the detrimental impact of different copper (II) concentrations (6, 12, 16, and 24 µM) on bacterial growth kinetics in three media: LS4D balanced (BAL), electron acceptor-limited (EAL), and electron donor-limited (EDL). Using a non-competitive inhibition model, I50 (concentrations of copper causing 50% inhibition of bacterial growth) values were calculated to be 13.1, 13.87, and 11.31 µM for LS4D BAL, EAL, and EDL media, respectively.

The second part of the study shifts its focus to the effect of surface finishing on MIC of copper 101 by G20. The biofilm and corrosion pit depths were measured through a series of sophisticated analyses employing 3D optical profilometry, Scanning Electron Microscopy (SEM), Energy Dispersive X-Ray (EDX), and X-ray Diffraction Analysis (XRD). The research investigates how different levels of surface roughness, applied through metallographic grinding and polishing, influence corrosion. The findings demonstrate a clear pattern of both uniform and pitting corrosion across all surface finishes. Notably, a statistically significant decrease in corrosion rates was observed when the surface roughness of copper was altered from approximately 13µm to about 0.06µm.

Finally, the study explores the interaction between G-20 biofilms and copper (101) into CDC reactors to understand biofilm development on copper surfaces and its subsequent impact on copper corrosion in a dynamic environment over periods of 7, 9, and 14 days. The results showed robust biofilm formation through hexose and protein analyses and SEM images displaying progressive increases in SRB cell accumulation over time. Localized pit depths were measured and compared to static conditions, and pits showed only a 20% increase in a dynamic environment. These findings offer an improved understanding of the complex interactions between G-20 and MIC of copper.

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