Bioremediation of Phenol Waste Using Activated Sludge in a Hybrid-Batch Reactor

Maxwell D.F. Goodacre[1], Erik J. Mead[2], and Nathan C. Wunder P.E.[3] Environmental Engineering Senior Design Students, Florida Gulf Coast University, 10501 FGCU Blvd South Fort Myers, FL 33965-6565; (email) [1] mdgoodacre5217@eagle.fgcu.edu, [2] ejmead@eagle.fgcu.edu, [3] ncwunder9742@eagle.fgcu.edu.

ABSTRACT

Phenol is a chemical in a multitude of products including plastics, disinfectants, and pharmaceuticals. It is carcinogenic, a listed hazardous waste, toxic, harmful to vegetation and animals (Canadian Council, 1999). Disposal is expensive when using chemical oxidation (Comninellis and Pulgarin, 1993), UV and ozone (Mahamuni and Adewuyi, 2010), or sent to a landfill (J. King, p.c., Feb., 2015). The team evaluated an economical approach to remove phenol waste on the FGCU campus and determine its potential in industry. Current bioreactors lack comprehensive data needed to determine potential benefits of implementing a bioreactor. A hybrid bioreactor (HBR) was designed and constructed to quantify that scientific gap with eight months of laboratory testing. An analysis of the microbial consortia within the HBR and a mass balance approach to determine the microbial degradation rate of phenol through batch testing was executed. The results showed a high phenol degradation rate of 1.106 hr^{-1} with the first trailing precedent at 0.691 hr^{-1}. The cost analysis demonstrated that phenol disposal through bioremediation exceeded at being 97% more economical than alternative methods. Overall, the novelty of an improved design and a formidable degradation rate data favors the implementation of an HBR for large scale phenol removal.