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MASTER THESIS PROJECT

Fate of Emerging Organic Compounds In Horizontal Subsurface Flow Constructed Wetlands Operated Under Pulse Loading

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ABSTRACT

This study monitored and evaluated the fate of emerging organic compounds (diclofenac, acesulfame, sucralose, and caffeine) in synthetic grey water, using horizontal subsurface flow constructed wetland (HSSF-CW) models, operated under pulse loading. Constructed wetlands with mixed matrix (MM1, MM2) and gravel matrix (GM) were investigated. The emerging organic compounds in the constructed wetland models were quantified using the LC-MS/MS, and analysed on a spatial and temporal scale. Alongside these compounds, standard wastewater quality measures including total nitrogen (TN), NH^{+}_{4}-N, NO_3^{-}-N, S^{2-}-S, SO_4^{2}-S, and dissolved organic carbon (DOC) were also analysed spatially and over a period of five weeks. The physicochemical parameters of the pore water including dissolved oxygen (DO), pH, oxidation-reduction potential (ORP), conductivity, and temperature were also measured. The DO concentrations and ORP measured in all three wetlands were typical of those found in reduced environments like HSSF-CW. Spatial variations were observed for the measured physicochemical parameters. While all the CWs removed DOC and TN efficiently, sulfate concentrations remained high inside the CWs, with the highest sulfate reduction observed in MM2. Sulfide concentrations were highest also in MM2. The three CW models efficiently removed caffeine with 99 % – 100 % of the inflow load. MM1 and MM2 removed diclofenac load with 70 % and 73 % efficiencies respectively, and GM had 60 % efficiency. MM2 however had the highest sucralose and acesulfame load removal efficiencies (68 % and 66% respectively). Strong positive correlations were observed between wastewater quality measures and some emerging compounds. Our results further buttresses the significance of appropriate matrix selection in constructed wetland operations. The spatial and temporal removal dynamics from our study provide relevant insights into the design and use of constructed wetlands.

Keywords: Emerging compounds treatment; constructed wetlands; wastewater treatment; pharmaceuticals; artificial sweeteners.