SCCWRP #1200

Crushed recycled glass as a substrate for constructed wetland wastewater treatment: a case study of its potential to facilitate pharmaceutical removal

Luis G. Chaves-Barquero^{1,2}, Braedon W. Humeniuk¹, Kim H. Luong³, Nazim Cicek⁴, Charles S. Wong^{1,2,3,5}, Mark L. Hanson¹

¹Department of Environment and Geography, University of Manitoba, Winnipeg, Canada ²Escuela de Química, Instituto Tecnológico de Costa Rica, Costa Rica ³Richardson College for the Environment, The University of Winnipeg, Winnipeg, Canada ⁴Department of Biosystems Engineering, University of Manitoba, Winnipeg, Canada ⁵Southern California CoastalWater Research Project Authority, Costa Mesa, CA

Abstract

The use of recycled glass as a substrate for constructed wetlands was assessed through two studies. The first study examined the dissipation of atenolol, carbamazepine, and sulfamethoxazole in mesocosm-modeled wetlands using glass or limestone gravel as substrates, with or without cattails (Typha spp.). Following pseudo-first-order kinetics, atenolol dissipated the fastest from the water surface of the mesocosms (t1/2~1 day), followed by sulfamethoxazole (t1/2~14 days), and carbamazepine (t1/2~48 days), with no significant differences across treatments. Increased half-lives were observed at greater depth, likely due to light screening. A Monte Carlo sensitivity analysis diagnosed sunlight absorption rates and second-order hydroxyl-mediated indirect photolysis rates to be the main sources of uncertainty in our dissipation rate estimates, compared to our observed rates. The second study examined in situ pharmaceutical removal in tertiary pilot-scale subsurface filters made of crushed recycled glass or sand in a wastewater treatment facility in Manitoba, Canada. Glass and sand showed no significant differences for pharmaceutical removals; atenolol and metoprolol were removed below limits of detection, while carbamazepine and sulfamethoxazole persisted over a retention time of 24 h. Overall, recycled glass performed similarly to traditional substrates for wetland-based wastewater treatment.

Due to distribution restrictions, the full-text version of this article is available by request only. Please contact pubrequest@sccwrp.org to request a copy.