Desalination and Water Treatment
www.deswater.com

doi: 10.1080/19443994.2014.981225

57 (2016) 3098–3106
February

Taylor & Francis
Taylor & Francis Group

Diazepam stability in wastewater and removal by advanced membrane technology, activated carbon, and micelle–clay complex

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Received 21 July 2014; Accepted 21 October 2014

ABSTRACT

Stability and removal of the anti-anxiety drug diazepam (valium) from spiked wastewater samples were studied. An advanced wastewater treatment plant (WWTP), utilizing ultrafiltration (UF), activated charcoal (AC), and reverse osmosis (RO) after the secondary biological treatment showed that UF and RO were relatively sufficient in removing spiked diazepam to a safe level. Kinetic studies in both pure water (abiotic degradation) and in sludge (biotic degradation) at room temperature were investigated. Diazepam showed high chemical stability toward degradation in pure water, and underwent faster biodegradation in sludge providing two main degradation products. The degradation reactions in sludge and pure water showed first-order kinetics with rate constant values of 2.6×10^{-7} s^{-1} and 9.08×10^{-8} s^{-1}, respectively (half-life = 31 and 88 d, respectively). Adsorption of diazepam by activated carbon and composite micelle–clay (octadecyltrimethylammonium montmorillonite) complex was studied using both Langmuir and Freundlich isotherms. Based on the determination coefficient, Langmuir isotherm was found to better fit the data, indicating the retention of diazepam monolayer on both adsorbents. Filtration of 100 mg L^{-1} solutions of diazepam by micelle–clay filter yielded almost complete removal at flow rates of 2 mL min^{-1}.

Keywords: Diazepam; Wastewater treatment; Stability in sludge; HF membranes; Activated carbon; Micelle–clay complex

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