SCCWRP #1125

In situ kinetics of human pharmaceutical conjugates and the impact of transformation, deconjugation, and sorption on persistence in wastewater batch bioreactors

Alistair K. Brown[1], Joe Ackerman[2], Nazim Cicek[2], Charles S. Wong[1,3,4]

[1]*University of Manitoba, Department of Chemistry, Winnipeg, MB, R3T 2N2, Canada*
[2]*University of Manitoba, Department of Biosystems Engineering, Winnipeg, MB, R3T 2N2, Canada*
[3]*Southern California Coastal Water Research Project Authority, Costa Mesa, CA, 92626, USA*
[4]*School of Environment, Jinan University, Guangzhou, 510632, China*

ABSTRACT

The fate of selected common pharmaceuticals and four of their major conjugates in wastewater batch bioreactors was evaluated to determine how treatment plant parameters such as addition of air, and the presence of waste activated sludge (WAS) could influence the removal of parent compounds and conjugates. Under a realistic hydraulic residence time (HRT) for each treatment sub-process of approximately 2 h, acetaminophen and its sulfate metabolite were both rapidly degraded (>99%). Propranolol was sulfated and concurrently removed. Deconjugation of N-acetylsulfamethoxazole and sulfamethoxazole-glucuronide contributed to increases of the parent sulfamethoxazole. Thyroxine was resistant to degradation, while thyroxine-glucuronide was rapidly deconjugated (>90% in <2 h). In the absence of WAS, sorption to suspended solids was another major removal mechanism for acetaminophen, propranolol, sulfamethoxazole, and thyroxine. However, withWAS, concentrations associated with suspended solids decreased for all analytes within 24 h. These results indicate that both conjugation and back-transformation are compound-specific and dependent on parameters such as HRT, addition of microbial content, and suspended solids levels. Therefore, conjugation-deconjugation processes may strongly influence the speciation of pharmaceuticals and their fate in wastewater treatment plant effluents.