

**FATE OF PHARMACEUTICALS AND PERSONAL CARE PRODUCTS  
FOLLOWING LAND APPLICATION OF LIQUID MUNICIPAL BIOSOLIDS**

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**ABSTRACT:** Liquid municipal biosolids (LMB) are a source of nutrients for crop production. The application of this material to soil must be managed to minimize the risk of contamination of adjacent water resources with chemical or microbial agents that are of public or environmental health concern. In this field study, we applied LMB at a commercial rate using the recommended practices of either subsurface injection, or broadcast application followed by incorporation. Precipitation was simulated at 1, 3, 7, 22, 36 and 266 days post-application on 2 m<sup>2</sup> microplots to evaluate surface runoff of model pharmaceuticals (i.e. atenolol, carbamazepine, cotinine, gemfibrozil, naproxen, ibuprofen, acetaminophen, sulfamethoxazole and triclosan). In runoff from the injected plots, concentrations of the model pharmaceuticals were generally below the Limits of Quantitation. In contrast, in the broadcast application treatment, the concentrations of atenolol, carbamazepine, cotinine, gemfibrozil, naproxen, sulfamethoxazole and triclosan on the day following application ranged from 70-1,477 ng l<sup>-1</sup> in runoff and generally declined thereafter with first order kinetics. The total mass of pharmaceutically active compounds (PhAC) mobilized in surface runoff ranged from 626 ng m<sup>2</sup> for atenolol to 21,095 ng m<sup>2</sup> for ibuprofen. Ibuprofen and acetaminophen concentrations first decreased and then increased, suggesting that portions of these drugs were initially chemically or physically sequestered in the LMB, and subsequently released in the soil. Carbamazepine and triclosan were detected in a runoff event 266 days after broadcast application. Overall, the concentrations of PhACs in surface runoff following broadcast incorporation of biosolids were generally low (i.e. ng l<sup>-1</sup>), and could be effectively eliminated by injecting LMB below the soil surface. Estimates of the total mass of the model PhACs potentially released into the aquatic environment from runoff from agricultural fields amended with biosolids in the province of Ontario were orders of magnitude lower than the total mass of these compounds estimated to be released in the effluent of Ontario wastewater treatment plants.

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