Geophysical Research Abstracts
Vol. 15, EGU2013-9166, 2013
EGU General Assembly 2013

Behaviour of five pharmaceuticals with high baseline toxicity in wastewater treatment

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Many pharmaceuticals enter the aquatic environment through sewer systems and are partially removed in wastewater treatment plants (WWTP) by sorption to sludge biomass or biodegradation. Biodegradation often does not lead to complete mineralization but to the formation of stable transformation products (TPs), which might still be harmful to the environment.
Recently, a study was undertaken to assess the risk of the top 100 pharmaceuticals from wastewater of a hospital in Switzerland. The predicted toxicity was linked to the predicted environmental concentration in order to assess overall risk potential.
In this study, biodegradation and sorption studies were carried out on the top five selected pharmaceuticals (amiodarone, atorvastatin, clotrimazole, meclozine and ritonavir). Potential TPs that are formed during activated sludge treatment were identified and concentrations of both the parent compounds and TPs were measured in the WWTP. With this data, the fate of these compounds was modeled in a WWTP system using a multi-reactor steady-state WWTP model.

This study showed that sorption was the most important loss process for amiodarone and meclozine. They had an elimination of more than 99%. Sorption was also the main loss process for clotrimazole, but it was combined with some biodegradation. For ritonavir, both biodegradation and sorption played a role in the loss of this compound. The most important removal process for atorvastatin was biodegradation. Four TPs, formed through β-oxidation and monohydroxilation, were identified in both the activated sludge batch reactors and the WWTP effluent.
In the WWTP effluent, only atorvastatin, clotrimazole and ritonavir were found. All identified TPs of atorvastatin were detected in the effluent. Risk quotients (RQ) of all five pharmaceuticals were estimated based on effluent concentration and baseline toxicity and ranged from zero to 2.14. Only ritonavir potentially poses an ecotoxicological risk for the aquatic environment.