Geophysical Research Abstracts
Vol. 18, EGU2016-2955-2, 2016
EGU General Assembly 2016

Competitive sorption of atenolol, trimetoprim, carbamazepine and sulfamethoxazole in three soil types

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Transport of human and veterinary pharmaceuticals in soils and consequent ground-water contamination are influenced by many factors, including compound sorption on soil particles and dissipation. Batch sorption experiment for 9 soils (3 soil types with 3 (Greyic Phaeozem on loess), 4 (Haplic Luvisol on loess) and 2 (Haplic Cambisol on gneiss) horizons) and mixture of 4 pharmaceuticals (atenolol, trimetoprim, carbamazepine and sulfamethoxazole) was performed to study competitive sorption of compounds in each soil sample. Sorption affinities and dissipation half-lives of all compounds in topsoils were previously studied by Kodešová et al. (2015 and 2016). Ten grams of dry soil was placed directly into the plastic centrifuge tubes and 20 ml of solution of a known pharmaceutical concentration was added. The same concentrations (0.5, 1, 2.5, 5 and 10 mg/l) were used for all compounds. Three replicates of each concentration were applied for each soil. Tube was shaken for 24 h using the shaking apparatus at 20 C. After shaking, the analyzed soil suspension was centrifuged for 10 min at 6,000 rotations per minute. The actual initial and final equilibrium pharmaceutical concentrations were measured using two-dimensional liquid chromatography-tandem mass spectrometry LC/LC-MS/MS using isotope dilution and internal standard methods. The pharmaceutical concentration adsorbed on soil particles was calculated using the initial and final (i.e. after incubation) pharmaceutical concentrations. The Freundlich equations were used to fit data points of the measured adsorption isotherms. In the case of carbamazepine (neutral form) and sulfamethoxazole (partly negatively charged) sorption affinity of compounds decrease with soil depth. On the other hand in the case of atenolol and trimethoprim (both positively charged) compound sorption affinity was not depth dependent. Data obtained for top soils were compared with sorption affinities for single compounds published by (Kodešová et al., 2015). While sorption affinities of atenolol, trimethoprim and carbamazepine due to compound competition decrease, sorption affinity of sulfamethoxazole increased. Pearson product moment correlation coefficient and p-value were used to evaluate relationships between sorption coefficients and soil properties.

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