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Transport of Sulfadiazine in Soil Columns

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Sulfadiazine is a widely used antibiotic pharmaceutical in intensive livestock production. 40 -90 % of the applied pharmaceutical are excreted mainly as active compound after administration. Antibiotics such as sulfadiazine reach agricultural soils directly through grazing livestock or indirectly through the spreading of manure or sewage sludge on the field. Knowledge about the fate of antibiotics in soil is crucial for assessing the environmental risk of those compounds including possible transport to groundwater. Transport of ^{14}C-labelled sulfadiazine was investigated in disturbed soil columns at constant flow rate near saturation. Sulfadiazine was applied in different concentrations (5.7 vs. 0.57 mg L^{-1}) for either a short or a long pulse duration (7 vs. 68 h). Breakthrough curves of sulfadiazine and the non-reactive tracer Cl^- were measured during 500 h. At the end of each experiment the soil concentration profile was determined. The breakthrough curves are characterised by an early arrival of sulfadiazine and a pronounced tailing. The peak maxima arrive at approximately the same time for all experimental conditions, but the maximal relative concentrations differ as well as the eluted mass fraction. Whereas for the experiments with the longer pulse duration the highest concentrations in the soil profile are near the surface, concentration distribution with depth is more constant for the short pulse experiment. To identify relevant sorption processes, breakthrough curves of sulfadiazine were fitted with a convective-dispersive transport model considering different sorption concepts. Kinetic sorption can describe both the extended tailing and the concentration profile. Best fits are achieved assuming first order reversible and irreversible sorption.