



## Transport of selected wastewater contaminants in tropical soil

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The objective of this study was to investigate the leaching behavior of selected wastewater contaminants in a variable charge tropical soil. Miscible displacement experiments were conducted to obtain breakthrough curve (BTC) for a conservative tracer and a mixture of seven wastewater contaminants. Selected chemicals include: lindane and atrazine, estrogen compounds 17- $\beta$ estradiol, estrone, product of water chlorination N-nitrosodimethylamine (NDMA) and two phenols (octyphenol and nonyphenol). Experiments were performed on topsoil Oxisol (Rhodic Eutrustox, Wahiawa series) and subsurface soil (saprolite) to characterize the effect of organic carbon content on the sorption of the above compounds. The column hydraulic properties were determined by one-step infiltration method. Retention curves were also developed independently. The leaching study using artificial groundwater was done on three soil columns. Near-saturated steady state flow of water was adjusted by proper settings of the inflow rate and a small suction pressure head applied at the bottom of the soil core. The chemical compounds were mixed into background water and a long concentration pulse was applied at the surface of soil column. The effluent was collected in a fraction collector and analyzed to develop BTC for each compound. Diverse chemical properties and low concentration of compounds required two pre-concentrating methods to be employed. Liquid-liquid extraction was used for lindane and phenols. Samples of effluent were concentrated by freeze-drying for analysis of estrone and 17- $\beta$ estradiol. Lindane and atrazine were analyzed by gas chromatography using an electron capture detector. Detection of NDMA was performed by HPLC. Estrogen and 17- $\beta$ estradiol were analyzed by HPLC-MS. The flow interruption technique was used to test the rate-limited processes of above compounds while undergoing competitive

sorption. The influence of sorption on the transport of compounds through the column was evaluated based on the observed breakthrough curves.

For topsoil ( $\sim 1\%$  of organic carbon content), the breakthrough of estrone and estradiol, was very low even after the infiltration of 30 and more pore volumes. In saprolite the peak value of BTC was several orders higher. Concentrations of atrazine and lindane in effluent reached the level of the input concentration after leaching approximately 10 pore volumes in the saprolite and 50 pore volumes in the topsoil. For saprolite the full breakthrough concentration appeared one order earlier in time. NDMA was the chemical with fastest breakthrough. Its BTC was practically identical for topsoil and saprolite. The results will be used as the input for a larger scale modeling of treated wastewater reuse in tropical environment.