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A novel multiple batch extraction test to assess contaminant mobilization from porous waste materials

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Contaminated porous materials, like soils, dredged sediments or waste materials must be tested before they can be used as filling materials in order to minimize the risk of groundwater pollution. We applied a multiple batch extraction test at varying liquid-to-solid (L/S) ratios to a demolition waste material and a municipal waste incineration product and investigated the release of chloride, sulphate, sodium, copper, chromium and dissolved organic carbon from both waste materials. The liquid phase test concentrations were used to estimate parameters of a relatively simple mass balance model accounting for equilibrium partitioning. The model parameters were estimated within a Bayesian framework by applying an efficient MCMC sampler and the uncertainties of the model parameters and model predictions were quantified. We tested isotherms of the linear, Freundlich and Langmuir type and selected the optimal isotherm model by use of the Deviance Information Criterion (DIC). Both the excellent fit to the experimental data and a comparison between the model-predicted and independently measured concentrations at the L/S ratios of 0.25 and 0.5 L/kg demonstrate the applicability of the model for almost all studied substances and both waste materials. We conclude that batch extraction tests at varying L/S ratios provide, at moderate experimental cost, a powerful complement to established test designs like column leaching or single batch extraction tests. The method constitutes an important tool in risk assessments, because concentrations at soil water contents representative for the field situation can be predicted from easier-to-obtain test concentrations at larger L/S ratios. This helps to circumvent the experimental difficulties of the soil saturation extract and eliminates the need to apply statistical approaches to predict such representative concentrations which have been shown to suffer dramatically from poor correlations.