Generic geochemical modelling approach to the environmental impact assessment of urban contaminated materials

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Geochemical modelling is increasingly being used in the characterization and environmental risk assessment of contaminated materials that are produced and/or applied in urban areas. While geochemical models are mostly developed and tested for specific types of materials, their performance is strongly determined by the specific modelling approach and methods to estimate the required model parameters. This presentation will give an overview of the development of a generic multi-reactive surface geochemical model. The generic character refers to its development and application to a wide range of materials, as well as to the (sorption) parameters used. The approach is being developed to describe the speciation and solid/liquid partitioning (leaching) of major and trace elements in contaminated (waste) materials and soils, based on the notion that the reactive organic and mineral surfaces in the model play a generic and determining role in element speciation and leaching from these materials.

The multi-surface model relies on individual adsorption models for which generic binding parameters have been developed and published for a wide range of elements. It includes reactions for aqueous speciation and solubility of selected minerals, in combination with sorption to organic matter (NICA-Donnan model), Fe/Al-(hydr)oxides (Generalized Two-Layer Model) and clay (Donnan model). Model parameters are obtained with standard methods for the estimation of the potentially available/reactive fraction of the elements of interest, and the available amount of the above reactive surfaces. Examples will be presented of model applications to different secondary (waste) materials that are being used in construction, to urban atmosferic dust and contaminated soils, including measurements and model predictions of the solid/liquid partitioning and speciation of a wide range of elements. Finally, an outlook will be given towards recent model developments and applications in environmental risk assessment of contaminated materials.