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Transformation and accumulation of PAH and bound residues in soil under extreme conditions – a risk assessment approach

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The degradation of PAH in contaminated soil does not proceed completely in the majority of cases. However microorganisms which are able to degrade PAH are present in PAH-contaminated soils normally. A total degradation of PAH in contaminated soils is often limited by a lack of bioavailability, which results from a lack of mass transfer. The analytical depletion of contaminants in soil is not only based on degradation processes but also on a fixation or immobilization of the xenobiotic substances as stronger adsorbed to or bound residues in the soil matrix. These bound residues were verified by using 14C-labelled PAH in different soil samples. To evaluate the long term fate of theses PAH-residues the stability and transformation of 14C-labelled non-extractable PAH-residues was investigated in detail under different extreme ecological and climate conditions such as biological stress, freezing and thawing cycles, and chemical worst case conditions. The transformation and remobilization of non-extractable PAH-residues was observed in long-time experiments and was very limited in general (Eschenbach et al. 2001). Only small amounts of non extractable residues were transformed and converted to CO2 and thereby detoxified. However the treatment with a complexing agent led to an increase of extractable 14C-activity.

In a further set of experiments the long term risk of a groundwater contamination was assessed. Therefore the elution rate of 14C-PAH was investigated by a routinely usable column test system. It was found that the PAH elution was not solely controlled by desorption processes. The extractable PAH concentrations and elution rates were affected by the mineralization and formation of bound residues as well. For the assessment of the maximum PAH release rate the soil material was treated by extreme and worst case conditions as well. The impact of the elution of bidestillated water, of repeated freeze-thaw cycles and a simulation of acidic rain was investigated. The application of environmental stress treatments led in some tests to an increase of PAH elution rates in comparison to the control.

Though the simulation of worst-case conditions in laboratory experiments can never imitate exactly real outdoor situations and changing climate conditions they are useful to evaluate the impact of extreme conditions on contaminants in soils samples to assess a possible risk.

References:

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