Assessment of the biological and chemical availability of the freshly spiked and aged DDE in soil by various approaches

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Persistent organic pollutants (POP) residing in soils for long periods tend to form bound residues as a result of aging. The extent and progression of aging (i.e. formation of bound residues) drives the actual risks of the contaminated soil but also indicates the ability of the soil environment to eliminate the risks of a respective compound over time. Unfortunately, the extent of aging is difficult to assess since the contamination at the starting point (time 0) is usually not known. To have an idea how the formation of bound residues evolved for a respective soil, a surrogate laboratory soil contaminated to a similar level as the target soil may be used. Then, by applying of various approaches (exhaustive and non-exhaustive extractions, accumulation tests with soil organisms or passive samplers) the available and non-available (bound) pools of analytes can be indentified and compared between soils.

A historically (< 1974) and a laboratory contaminated soil were used to assess the variations between the rate and extent of availability of *p,p´*-DDE by various biological and chemical approaches. The uptake kinetics into earthworms and passive samplers (XAD resin, ß-cyclodextrine, and PDMS-fibers) was measured over a period of 30 days. Using the one compartment first-order kinetic model the uptake rate constants and equilibrium concentrations were determined. The tested soils were chosen intentionally to have similar properties especially those known to influence the aging process (e.g. the organic matter content and properties the particles size distribution etc.), spiked to have a similar level of contamination, and the biological and chemical tests ran in parallel to avoid any artifacts. As such, the differences observed between DDE-(bio)availability should be mostly related to the different aging periods. The uptake of aged DDE was faster than that of spiked DDE for all methods resulting in various equilibrium times in soils. The model-derived equilibrium concentrations were higher (SPME, earthworm, XAD) for spiked DDE or similar (HPCD) when compared to aged DDE. XAD was found to estimate the earthworm uptake more reliably than SPME probably because of the combined skin and gut exposure of earthworms to DDE often observed for compounds with log K_{ow} > 5. The bound residues, calculated as the fraction of DDE remaining in the historically contaminated soil after XAD or HPCD extraction, consisted 33% and 61% , respectively. If compared with the availability of DDE measured for the spiked soil by means of XAD and HPCD, the extent of aging reached 14% and 10%, respectively. This indicates that despite the reduced (bio)availability still a significant portion of available and potentially hazardous DDE remains in the historically contaminated soil after 30 years that should be considered from the respective of remediation.