



Phosphorus from wastewater in agriculture – a risk assessment

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Background

In recent years several processes of recovering phosphorous by struvite precipitation or ash processing have been developed. Depending on the technology used the recovered products vary significantly concerning the concentrations of heavy metals and organic residues. Within the boundaries of available data quality a comparative risk assessment has been conducted for ...

- ... 11 substances/ hazards (PCDD/Fs, PCBs, PAHs, As, Cd, Cr, Cu, Hg, Ni, Pb and Zn)
- ... 13 products (several types of sludge, raw ash, struvites from WWTP, ash based P-products and conventional fertilizers)
- ... 3 most important pathways and endpoints (soil organisms, humans by plant consumption, groundwater)

Exposure assessment

Regional exposure assessment was done for all substances accounting for both fertilizer application and average atmospheric deposition. An annual product application equivalent to 60 kg P₂O₅/ ha × year is assumed. Accumulation was modelled for a time span of 100 years. The used models are...

- ... the kinetic model of the European Union's Technical Guidance Document for all hazards
- ... a solute transport model and a precipitation model for refinement in case hazards are of concern (Cd and Zn)

Selected diagrams for accumulation in topsoil and leachate prognoses are shown in Fig. 1-3:

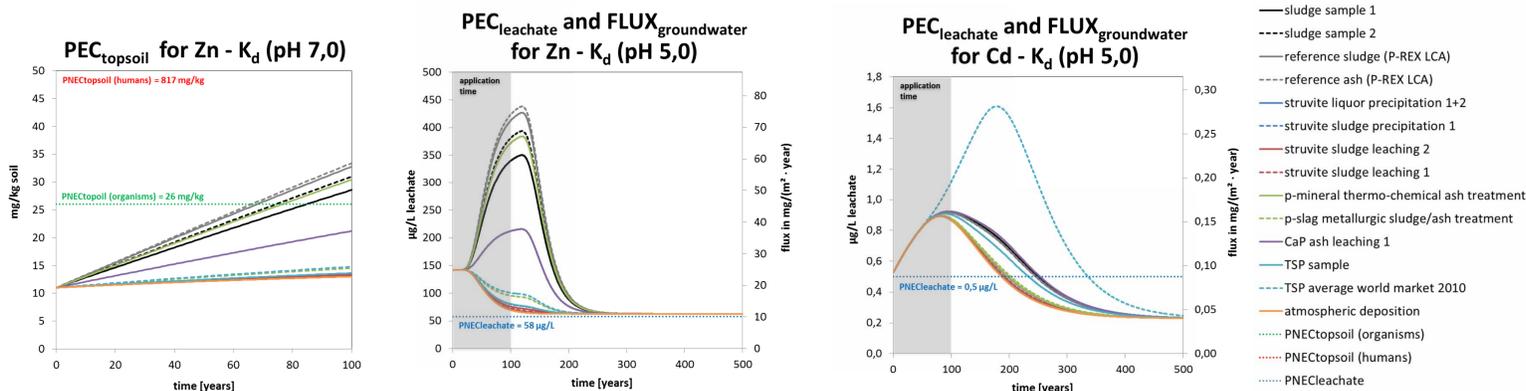


Fig. 1: Zn accumulation in topsoil as result of product application for a soil-pH of 7.0 and PNECs for topsoil and Zn

Fig. 2: leachate prognoses for Zn as result of product application for a soil-pH 5.0 and PNEC for leachate and Zn

Fig. 3: leachate prognoses for Cd as result of product application for a soil-pH of 5.0 and PNEC for leachate and Cd

Results and Conclusions

The results indicate that out of the selected 11 (groups of) chemicals only Cd and Zn are of concern:

- Elevated Zn concentrations in 5 products led to concerns regarding the endpoint soil organisms in case the soil-pH is above 6.0 (see Fig. 1 e.g. and 4)
- For the endpoint groundwater Cd and Zn are of concern in case the soil-pH is beneath 6.0 (see Fig. 2-3 e.g. and 4)
- No risk is expected regarding human health (see Fig. 4)
 - Struvites have shown the lowest phosphorus-specific heavy metal contents (see Fig. 5). In comparison to sludge or TSP, struvite application reduces risks regarding the selected hazards significantly
 - Considering products of ash processing an improvement regarding particular heavy metal depletion (especially Zn) is advisable (see Fig. 1-2 e.g. and 4-5)

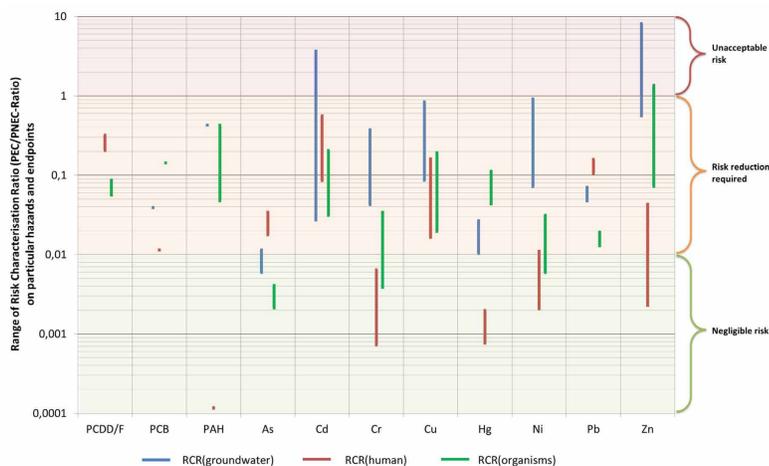


Fig. 4: Range of Risk Characterization Ratios (PEC/PNEC-Ratios) on particular hazards and endpoints

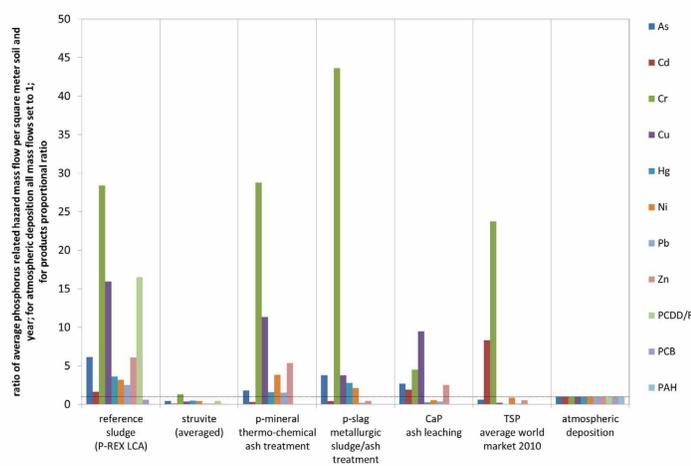


Fig. 5: hazards-ratio on soil by use of product as P-fertilizers proportional to atmospheric deposition

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