Experiences with a higher tier test design simulating environmental fate and effect of medical products after the use phase

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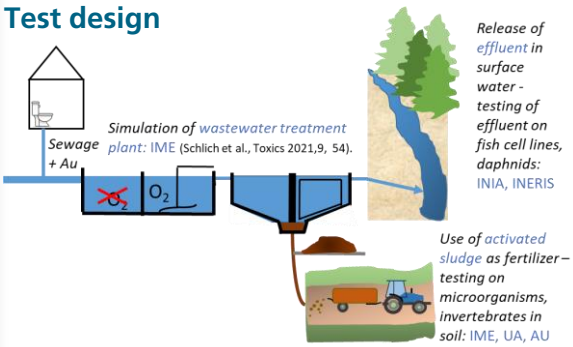
Introduction

Nanomedicine is of growing interest, as the nanoscale materials exhibit new possibilities. Excretion of materials (e.g. nanocarrier drug delivery systems) cannot be excluded. This pathway is not considered in the current risk assessment. We simulated fate and effect of biomedical products after excretion. AuNPs designed for medical applications and its dispersant were added to the influent for model WWTP (OECD 303A). The effluent (synthetic sewage → non-treated effluent = control; synthetic sewage + Au → treated effluent) was used for aquatic studies. For the terrestrial studies activated sludge (AS) was mixed with soil.

Test design



Results / Conclusion – Test design

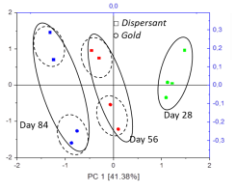
- Limited amount AS; test systems requiring small amounts of soils have to be prioritized. Sufficient amount of effluent for extensive testing. In the risk evaluation assessment factors are considered (max 1,000).
- *Soil microbial population*: combination of structural and functional approaches provide additional information; approaches to assess changes in microbial community structure in the scope of regulation are required.
- *Invertebrates*: sludge impact → control treatments with uncontaminated AS; *E. crypticus, F. candida* - extended test (56 d) provides additional impact; *E. fetida*: exposure via food due to limited amount of AS; food chain data by accumulation test.
- *Daphnids*: can be exposed directly to the effluent
- *Fish cells lines*: the effluent should be dried and resuspended in the cell culture to avoid a decrease in the culture medium nutrients.

Materials and Methods

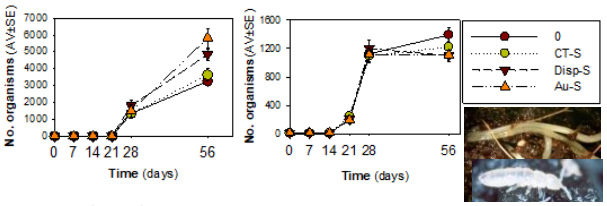
- AuNPs: aqueous suspension containing PVP (Colorobbia Consulting)
- Amount of sludge mixed with soil following agricultural practice.

Results / Conclusion – Toxicity of Au

- High adsorption of AuNPs to sludge; concentration exceeded PEC value for medical applications by a factor of 10,000. Very low concentration in effluent (0.1mg/L).
- *Soil microbial population:* Functional microbial diversity: no effect; Structural microbial diversity: significant effect of Au, increases over time.



- *Invertebrates:* *E. crypticus* increase performance, as opposed to *F. candida*, where a (minor) decrease was observed.



- *Daphnids:* EC50 AuNP 100 mg/L

  No toxicity was observed after a short and a long-term exposure to effluents (OECD TG 202, 211)
- *Fish cell lines: Au NPs toxicity*

  Short-term: EC50 AuNP>100 mg/L
  Long-term for 100 mg/L, 50% mortality after 30 d
- *Fish cell lines: effluents toxicity*

  Treated effluent containing Au produced a higher toxicity than non-treated effluent before 1 day exposure in RTS-11 and 19 days in RTLW-1

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