Development of analytical methods for the analysis of contaminants in sediment after electro-kinetic treatment

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Introduction

- Many organic pollutants such as PAHs and PCBs and metal contaminants are accumulated in the sediment
- Consequences:
  o Damaging aquatic ecosystems
  o Toxic for life including human-beings
- Aims of researches:
  o Develop extraction and analytical methods for these pollutants and their metabolites
  o Using electro-kinetic (EK) method for reducing their quantities in sediment

- Organic pollutants:
  o 16 polycyclic aromatic hydrocarbons (PAHs)
    - 2 rings
    - 3 rings
    - 5 rings
  o 7 Polychlorinated biphenyls (PCBs)
- Inorganics: metal contaminants

Materials & Methods

- Harbor dredged sediments
- Extraction methods
  - ICPE-AES for metals
  - GC-MS for PAHs and PCBs
  - HPLC-Fluor/UV for metabolites

Results and discussions

- GC-MS analysis of PAHs and PCBs
- Extraction of real sediment pollutants from Tancarville
- MSPD: matrix solid phase dispersive extraction

- Extraction of soil organic pollutants

- MAE (microwave) is more efficient and faster than the traditional Soxhlet method.
- Acetone/Toluene or CH2Cl2 = good extracting solvents for PAHs+PCBs

- Acenaphtalene, fluorene and anthracene > N1, other PAHs < N1.
- PCBs < N1.
- Metals < N1, but Cd > N2.

- Hexane/Acetone 50/50: more efficient
- Recovery of PAHs 60% (>71.4% with MAE) and PCBs 90% (>84.5 with MAE).
- Effect of solvent volume and combinations of dispersants = not significant
- MSPD: simpler and faster than MAE
- 4 PAH quinones are separated by C18 RP column.
- Resolution is good enough.
- Problem: UV detection not enough selective (pics may coincide with other substances)

Conclusion

- GC-MS and ICP-AES are adapted to detect different pollutant families in sediment.
- Extraction efficiency: MSPD > MAE > Soxlet.
- MSPD still needs optimization (necessary to introduce surrogate standards to correct results related to poor reproducibility of flow-rates).
- HPLC-UV not enough selective to analyse PAHs metabolites
- Coupling UV+fluorescence ? GC-MS after derivatization?

- Improving EK treatments using original additive mixtures: biosurfactants + citric acid
- Detect PAH metabolites (quinones + hydroxyl-) and reduced PCBs after EK treatment ⇝ link with sediment toxicity?
- Microcosms tests to monitor natural dissipation of contaminants in Tancarville sediment (comparison with EK treatment efficiency)

Perspectives