Passive sampling in groundwater monitoring on contaminated sites

BIO1. Risk Based Remediation of Contaminated Environment Heidi Ahkola Finnish Environment Institute SYKE 13.09.2021



Chemicals in water





Grab sample: solid bound fraction + dissolved fraction

Passive sampler: dissolved fraction

Active- and passive sampling

Representative Sampling Volume



From: Introduction to mass flux, Goedele Verreydt, Founder& Technical Director iFLUX

Project "PASSIIVI"





Project "PASSIIVI"

Passive samplers

- SorbiCell
- iFlux
- VOC-compounds (tetrachloroethene PCE)
- Two study sites
- The aim was to deploy passive samplers before and after remediation













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SorbiCell-sampler

- Groundwater, surface water
- Contains sorbent material and inert salt
- Sampler is clicked onto groundwater sampler system (GWS Sorbisystem)
- The sampled water volume is known via two ways
 - Removal of inert salt from the sampler
 - Measured from GWS Sorbisystem
- Gives time weighted average concentration of contaminant (µg/L)
- VOC-, PAH- and PFAS-compounds, pesticides, metals, hydrocarbons and inorganic parameters (ammonium-N, nitrit+nitrat, orthophosphat-P)
- Deployment time days to weeks
 - 8-13 days
- Delivery and analysis performed by EuroFins Scientific



iFlux-sampler

- Fits exactly to the groundwater well, no loose space
- Gives contaminant mass flux (mg/m²/day)
- VOC, nutrient-, metal- and water flux sampler
- Deployment time depends on the concentration and groundwater flow rate
 - 8 and 6 weeks
- More pre-information needed
- Delivery and analysis performed by iFlux
- https://www.ifluxsampling.com/









Field trials





Sampling

- Passive samplers were deployed at two depths, near surface and near bottom
- Traditional groundwater sample was taken
 - Water pumped before sample was taken
- Water sample from the passive sampler deployment depth near surface and near bottom
 - Certain sampling depth is closed and water sample is taken in between (Pöyry Finland Oy)



Pohjankorpi, Kouvola



- Near dry cleaner
- Contaminated water intake plant
- 6 monitoring wells
- 2 deployment depths
- SorbiCell sampler,
 3 deployments
- Remediation conducted by injection between 1st and 2nd deployment

SorbiCell results

 Concentrations in SorbiCell samplers decreased after remediation

- Not observed in water samples in 2nd trial
- SorbiCell sampler and water sample taken from the same depth during 3rd trial were lower than before remediation



Nikro, Ylöjärvi



- Polluted by industrial activities
- Contaminated water intake plant
- 6 monitoring wells
- 2 deployment depths
- iFlux samplers, 3 deployments
- Deployment time 8 and 6 weeks
- No remediation



iFlux, Nikro





- RHP20: located at the emission area, higher concentrations in the surface sampler
- RHP16 and RHP11: hydraulic conductivity is higher in lower soil layer
 - Chemicals spread better in soil layers having high hydraulic conductivity
- RHP2: near protective pumping which causes mixing and shifts high concentrations from bottom to the surface

iFlux results

- Not much difference in iFlux sampler results
 - No remediation

- High concentrations in surface water samples taken from RHP20
 - Not seen in traditional water samples
 - Leaks from the emission area



iFlux, SorbiCell and own sampler, Nikrog Ylöjärvi



SorbiCell vs. iFlux

RHP11

 Samplers gave similar concentration trends

RHP2

- Samplers gave differing trends
 - Protective pumping
 - iFlux was deployed for 6 and 8 weeks and own/SorbiCell 8 or 13 days

Pros and cons of passive samplers

- Typical groundwater samples represent a "snapshot" value, while concentrations may vary strongly over time
 - The sampling process occurs over a longer time period averaging out short time fluctuations
- No well purging required when deploying samplers
 - No need for external energy
 - The sampling process does not disturb the natural flow of groundwater
 - Possible contamination between monitoring wells can be avoided
- Quick installation of the samplers
- No need to handle water bottles \rightarrow samplers need less space
- Samplers collect only dissolved chemical fraction, traditional water sample also particle bound fraction
 - -> Measure different things





Passiivinäytteenotto pilaantuneiden pohjavesialueiden tutkimisessa ja seurannassa PASSIIVI-hankkeen -loppuraportti





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Elinkeino-, liikenne- ja ympäristökeskus

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