PASSIVE SAMPLERS AS TOOLS FOR BETTER UNDERSTANDING THE BEHAVIOR OF POLLUTANTS IN GROUNDWATERS

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Overview

Regulatory monitoring of groundwaters consist in the sampling of an "average water" along the strainers. However, in some cases, it could be interesting to go further in the chemical description of the water column by using alternative methods like sensors that offer the possibility to perform in situ measurements with a spatial resolution of ~ 10 cm or passive samplers for detecting and quantifying micro-pollutants as a function of depth. In this work, 4 different passive samplers have been investigated functioning either under equilibrium regime or kinetic regime.

Local context and study area



Cs

Sampler

Passive samplers

investigated

Kinetic

regime

Membrane

distance

 C_{w}

Water

The chalk aquifer located in the south of Lille is a strategic resource for the supply of drinking water to the metropolis of Lille (1.2 million inhabitants). Former industrial activities have left multi-contaminated soils, which have a very heterogeneous impact on the groundwater. In this context, it is becoming necessary to deploy passive samplers to better characterize groundwater quality as a function of depth and time. For this first attempt, 3 piezometers particularly impacted by chlorinated solvents have been selected. The monitoring period mainly took place during the year 2018.

Passive samplers features and validation

Dialysis Cell (DC)

• Cellulose acetate bag (MWCO:10 000 Da) filled with ultrapure water \circ Soluble species (Ca²⁺, Zn²⁺ and their complexes, NO₃⁻...)



- Volume sampled: around Ο 10-20 mL
- No accumulation inside the Ο sampler
- No chemical treatment \bigcirc before the analyses

Equilibrium achieved after approximately 24h of deployment. No visible biodegradation after 15 days of deployment

Diffusive Gradient in Thin films (DGT)

• Chelex resin : accumulation of cationic trace metals

Experiments including variation of the mass accumulated onto the resin as function of time and thickness of the gels allow the estimation of the Diffusive Bounding Layer (DBL) and diffusion coefficient. In static state, DBL ~ 1 mm.



Equilibrium achieved after approximately 15 days of deployment.

Polar Organic Compounds Integrative Samplers (POCIS)

• HLB resin: accumulation of polar organic compounds (pesticides, pharmaceuticals) • The diffusive layer is unknown and corrections must be done to achieve the concentration in the water

1. Calibration by comparing grab sampling and POCIS

Polyethylene Diffusive Bag (PDB)

- Volume sampled: up to 300 mL
- No accumulation inside
- Water samples are immediately transfered in a sealed bottle and analysed within 24 hours by HS-GC-MS/MS





3 thicknesses of diffusive gel were also deployed for 1 week in the PZ61. The uncertainties of the calculations do not permit to estimate accurately a DBL. We do suggest to not consider a DBL even in the groundwaters

2. Use of Performance Reference Compounds (PRC)

• PRC

Correction made with the DIA-d5



 $k_{e \ calib \ (DIA)} = 0.057 \ j^{-1}$

The correction factors found are close to those used in rivers





The concentrations measured using POCIS are around 10-30 times lower than those measured by grab sampling. Problem of Rs correction by using PRC?

Examples of advanced characterization of groundwater composition by using passive samplers







PZ 61, the use of PDB In the demonstrated that the groundwater is gradually contaminated by PCE. highest contamination takes The place in surface so that when the static level increases, the leaching of PCE in the soil is more important.

As the PZ 59 is close to the Deûle River, exchanges of water between the river and the aquifer is suspected. The use of **DC** clearly indicates that the chemical composition of the groundwater at low depth is close to that of the river.

The increase of conductivity and sodium from -18m and the good correlation between Na, K, Mg, B and Sr concentrations (estimated by **DC**) suggests that the mineralogy of the groundwater below -20 m evolves as a result of water-rock interactions favoured by a decrease in the rock permeability.

Acknowledgements : The authors would like to thank the Hauts-de-France Region, the Ministry of Higher Education and Research and the European Regional Development Fund. Mr. F. Hottin and Mr. C. Halkett (French Water Agency) are also thanked for their scientific exchanges.



10th International Groundwater Quality Conference - Liège, Belgium

09 - 12 September 2019

