Development and calibration of a passive sampler based on diffusive gels for monitoring of polar organic compounds in water

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Passive sampling is nowadays commonly used technique for monitoring of trace contaminants in all environmental matrices. In water, quantitative monitoring of polar compounds using adsorption-based passive samplers poses a challenge, since non-isotropic exchange kinetics prevents effective use of performance reference compounds (PRCs) commonly applied in partitioning-based samplers. Concentrations of polar organic compounds in waters acquired by currently mostly used passive samplers, such as POCIS, are semiquantitative, due to a strong dependence of uptake rates on the variable hydrodynamic conditions and/or sorption of analytes to the membrane material separating the sorbent from the aqueous phase. Sampling rates acquired by laboratory calibrations may therefore differ from the actual sampling rates in the field. Recently, a novel sampler based on DGT shows a great potential and has already been successfully used in sampling of different polar compounds in waters and soils (CHEN ET AL. 2012). In this so-called o-DGT sampler, the sorbent containing gel is covered with a hydrogel diffusion layer that behaves as an immobilized water layer. This layer may help to control the analyte uptake rate, eliminating the effect of hydrodynamic conditions.

In our work, the applicability of agarose hydrogel has been tested for its suitability as a diffusion medium for several pesticides, pharmaceuticals and perfluorinated compounds by measuring analyte diffusion coefficients and their possible sorption to hydrogels. Then, using the o-DGT design without a membrane, a laboratory uptake study has been conducted for broad spectrum of polar substances, such as perfluorinated compounds, currently used pesticides and pharmaceuticals. However, the sampling rates of a sampler design with an active surface area of 3.14 cm^2 turned out to be too low for practical usage, therefore a new design was used, with an increased surface area of 22,7 cm^2. A sorptive gel and diffusive gel layers strengthened by a nylon mesh netting are enclosed between two metal rings, creating two sided gel-gel sampler with more than seven times higher sampling area compared to o-DGT. This sampler design has been successfully tested on Svratka River close to Brno, Czech Republic, alongside composite water sampling. Results of the field testing prove that the novel design is suitable for monitoring of polar organic compounds in water.

References

Chen C.-E., Zhang H., and Jones K. C., A novel passive water sampler for in situ sampling of antibiotics., J. Environ. Monit., 2012, 14, 1523–30.

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