

Applications of permeation passive sampling in environmental analysis.

Tadeusz Górecki, Faten Salim, Oana Goli and Suresh Seethapathy

Department of Chemistry, University of Waterloo, 200 University Avenue West, Waterloo, Ontario, N2L 3G1, Canada

Passive sampling is based on free flow of analyte molecules from the sampled medium to a collecting medium due to a difference in chemical potential of the analyte between the two media. It has many advantages compared to active sampling, including simplicity, low cost and no need for trained personnel. A new permeation-type passive sampler has been developed at the University of Waterloo and is available commercially under the name “Waterloo Membrane Sampler” (WMS). It uses mostly off-the-shelf components, which makes it simple and inexpensive. In WMS, a polydimethylsiloxane membrane separates the sampled medium from the sorbent. Analyte uptake rate is determined by the permeability of the membrane to a given analyte.

The sampler was originally developed for quantitative analysis of volatile organic compounds (VOCs) in air. It has been tested in numerous applications including analysis of indoor and outdoor air, as well as soil gas. Recently, new application areas of the WMS have been explored. The suitability of the WMS for compound-specific isotope analysis (CSIA) was examined. It was found that the sampler introduced small isotopic fractionation, but its extent was independent of analyte concentration, sampling time and temperature. The sampler was also tested for VOC preconcentration from water. Linear responses were observed with sub-ppb limits of detection. Finally, the sampler was tested for the extraction of VOCs from bulk soil samples. Near-quantitative extraction was possible under optimized conditions for a variety of soil types. Most recently, a mathematical model has been developed allowing detailed predictions about the sampler’s performance. Since the WMS can be used to sample all major compartments of the environment (air, water and soil), it is a unique and versatile tool for environmental analysis.