

Enrichment and Determination of Drug Traces in Water using Liquid Membrane Systems and HPLC-MS

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Pharmaceuticals are released into the environment mostly through sewage. The concentrations of drugs and their metabolites found in sewage treatment plant's effluents or rivers are in the range of micrograms to nanograms per liter. As a consequence there is an urgent need to improve the purification of water and waste-water and to monitor the drug input of the waterways particularly of surface and groundwater.

For this purpose reliable and efficient sample separation and preconcentration methods using certain bulk liquid membranes and supported liquid membrane systems (SLM) were developed, to enable the reliable determination of trace amounts of various basic and acidic drugs of environmental concern from dilute aqueous solution. The target compounds were ibuprofen, diclofenac (anti-inflammatories), carbamazepin (antiepileptic) and sulfamethoxazol (human and veterinary antibiotic).

The SLM-system consisted of an aqueous feed solution containing the drugs, a supported liquid membrane (polypropylene layer impregnated with an organic solvent with and without a dissolved mobile carrier, filling the pores of the membrane and placed between the feed- and the strip-phase) and an aqueous stripping solution (e. g. mineral acids, salts or alkalies). Different solvents, admixed organic amines, acids or metal-complexing agents as well as a pH-gradient between feed and strip-phase and various parameters like stirring velocity, extraction-time and the cell-size have been used to optimize the efficiency and selectivity of the transport of drugs across the bulk membrane.

A method was developed to produce PP-bags as a support for liquid membranes. This bag-type SLM was used to enrich target drugs from surface waters and to determine them by means of HPLC-UV-MS. Very high enrichment factors (up to 1600) were attained for both acidic drugs ibuprofen and diclofenac. Recoveries were 97 % and 150 % for ibuprofen and diclofenac, respectively. The concentrations of the drugs in surface water were in the range between 170 and 280 ng/L.

For comparison, solid phase extraction (SPE) was also used to extract the target drugs from the same water sample. Much lower recoveries were achieved with SPE (34 % ibuprofen and 45 % diclofenac) compared to the SLM method. Hence, the novel SLM-bags offer advantages due to higher enrichment factors, efficient clean-up-effects, low consume of organic solvents and time.