Time- and area integrated filtration of natural waters for the analysis of hydrophobic organic contaminants - the design of two new samplers.

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When filtering natural water for the subsequent analysis of hydrophobic organic contaminants (HOCs), there are several problems that have to be considered. For instance, if background water levels are to be studied, the filtered water volume must be large enough to obtain detectable amounts of HOCs occurring in very low concentrations. The variations over time and area of the water particle content can also affect the HOC content in the water. To be able to obtain a quantitatively large and over time representative sample, many samples have to be collected separately over a long period of time, or the filtration has to be pursued for a long period of time. To obtain a representative sample from a large area, many samples have to be collected from many different places, or the filtration has to be pursued while moving.

An approach to solve the problems with samling over a long period of time is presented in method 1 and a method to obtain a sample from a large area is presented in method 2.

Method 1. A filtration equipment was constructed (Fig. 1), with the objectives of being able to filtrate up to 1 m^3 of water during up to 1 month without any supervision. Because of the long time the filtration will last, the inside of the cover of the filter- and adsorbent unit will be coated with an anti-fouling agent to minimise microbial growth.

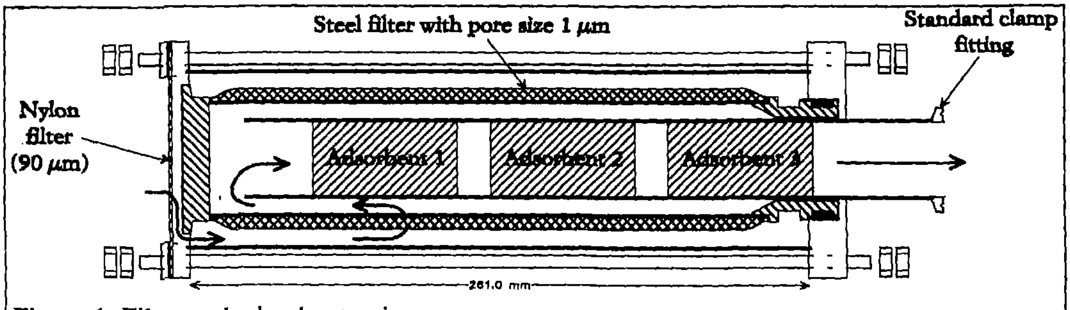

Figure 1. Filter and adsorbent unit.

First, the water flows through a nylon prefilter with a pore size of 90 µm. For the collection of particles in the size range between 1 µm and 90 µm, a filter cartridge made of stainless steel is used, which makes it possible to re-use the filter cartridge after extraction and cleaning.

Another advantage with a steel filter cartridge, is that it is possible to extract the cartridge in acids or a strong solvent such as toluene after use, as well as pre-clean the cartridge in acids or a strong solvent before it is used.

To sample the HOCs that passes through a filter, i.e. most often denoted the dissolved fraction, a solid adsorbent of some sort is often used. Some frequently used adsorbents are polyurethane foam (PUF), C-18 adsorbents, Amberlite™ XAD or activated carbon. In the filtration unit discussed here, solid adsorbents are assembled in line with the filters, and additional adsorbent can be placed between the filter-unit and the hose leading to the pump.

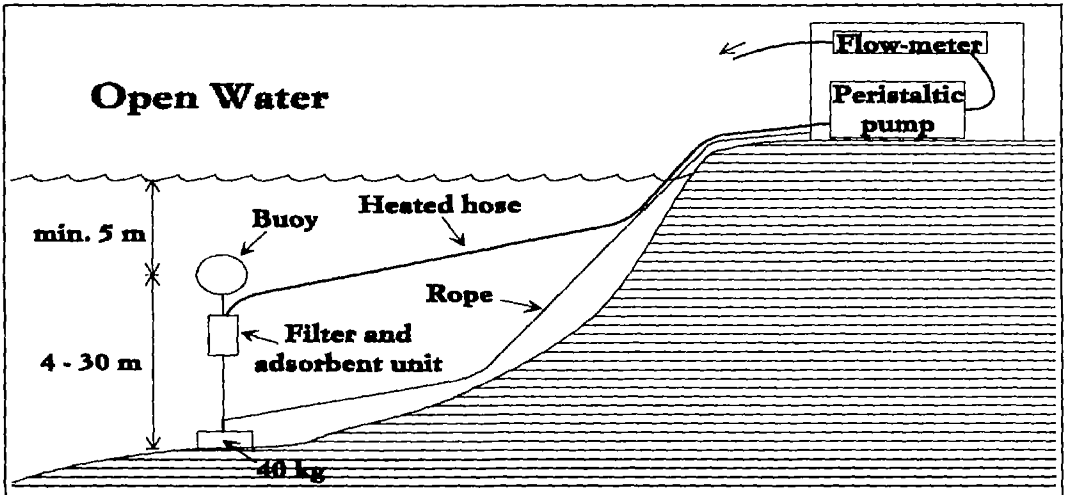

Figure 2. Filtration equipment *in situ.*

The filter- and adsorbent unit is placed in the water mass with a hose leading up to a peristaltic pump which is placed on the shore (Fig. 2). When placing the pump (and the hose connected to it) after the filtration equipment, there are no problems with adsorption inside the hose, which could be the case if the filters were placed on the shore and the water had to pass through a hose before reaching the filters and adsorbents. Another advantage is that this lowers the demands on the hose and the pump used.

Method 2. To filtrate water from a moving boat, an active seston trap (AST) have been constructed (Fig. 3)[1]. The AST is constructed to be toed with a wire after the boat, and works in speeds up to a maximum of 20 knots (10 m/s). In the very front of the AST there is a water inlet, where water flows in with a speed of 7 l/min (if boat speed = 20 knots). The filters and adsorbents which are used to filtrate the incoming water, can be placed either in the body of the AST, or on the boat. In the side of the ASTs body, there is a pressure gauge to measure at what depth the AST is working at.

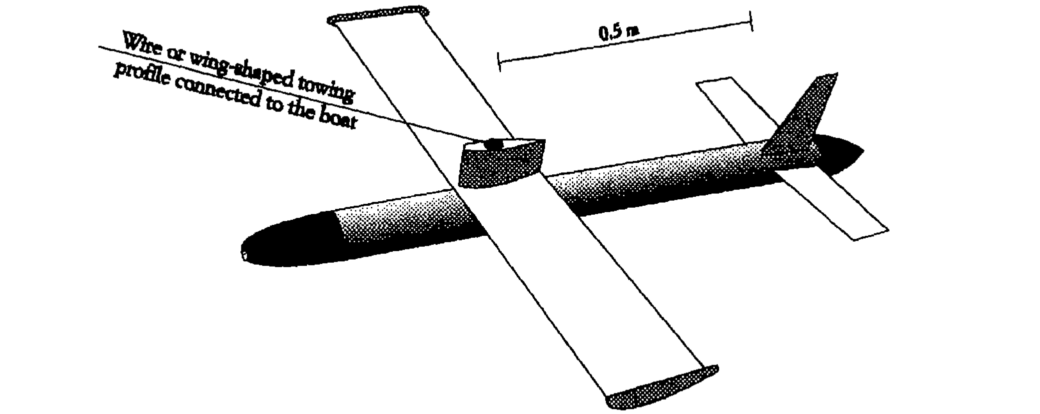

Figure 3. Active seston trap (AST).

If the filters are placed inside the AST, one has to use filter cartridges that maximises the filter area and minimises the weight, in order not to alter the balance of the AST. If the filters are placed on the boat, a hose is needed to bring the water from the AST to the boat.

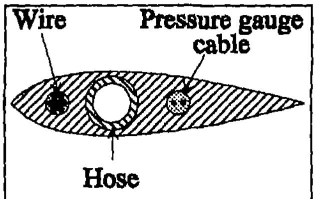

Figure 4. Wing-shaped towing profile.

The wire, hose and pressure gauge cable has to be enclosed in a wing-shaped profile to lower the water resistance (Fig. 4).

An advantage with filters and adsorbents on the boat, is that the filters and adsorbents can be changed without stopping the boat. One can also use planar filters instead of cartridges, and a number of space-consuming techniques for collection of the dissolved phase can be used, such as continuos liquid-liquid extraction[2] and/or gas-sparging[3].

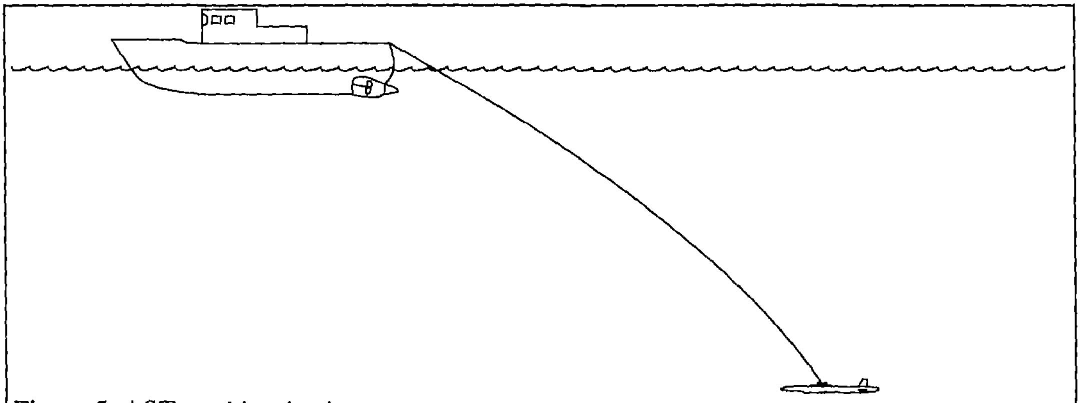

Figure 5. AST working *in situ*.

1 Weman M. Konstruktion, tillverkning och utprovning av aktiv sedimentfälla. *Ex.paper, Department of Hydromechanics, Royal Institute of Technology, Stockholm, Sweden* 1991 (In Swedish).
2 Anhoff M. Extraction of lipophilic substances and determination of chlorinated compounds from natural waters. *PhD Thesis, Department of Analytical Chemistry Chalmers Tekniska Högskola, Göteborg, Sweden* 1976.
3 Sproule JW, Shiu WY, Mackay D, Schroeder WH, Russell RW, Gobas FAPC. Direct in situ sensing of the fugacity of hydrophobic chemicals in natural waters. *Environ Toxicol Chem* 1991;10:9-20.