Passive Monitoring Techniques - Feasibility Study

R&D Technical Summary E1-086/TS

Passive monitoring techniques are a recently developed range of tools for the detection and measurement of contaminants in, primarily, water and air. Under certain circumstances, they can also provide information about pollutant concentrations in soil and sediment.

Traditional monitoring techniques are often based on taking infrequent spot/grab samples. This is unsuitable for sampling pollutants that are intermittent or require large sample volumes in order to provide sufficient analyte for measurement. Changing priorities and emerging legislation such as the Water Framework Directive will require the Environment Agency (the Agency) to monitor trace organics and metals at environmental concentrations unobtainable with the current analytical techniques applied to spot water samples. Passive samplers are cheap, simple and effective and can be deployed in the environment for months. They concentrate dissolved, bioavailable pollutants from the surrounding medium and, when the absorbed chemicals are quantified, will provide time-weighted average concentrations over the deployment period. They are powerful tools when used in conjunction with other techniques. For instance, the toxicological significance of the accumulated chemicals can be assessed using biomarker/bioindicator tests.

Two types of device were initially assessed for field application and analytical accreditation within the National Laboratory Service.

Between 1999 & 2001, Agency scientists assessed the Diffusive Gradient in Thin Film (DGT) and the Semipermeable Membrane Device (SPMD) techniques. DGT was developed initially under an Her Majesty's Inspectorate of Pollution (HMIP, a predecessor of the Agency) research contract at Lancaster University for the detection of dissolved metals in water. SPMD was exclusively developed by the Biological Resources Division of the U.S. Geological Survey for the detection of polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs), and polychlorinated dibenzodioxins (PCDs).

The two sampler systems were deployed in rivers and effluent outfall channels in a series of staged experiments. The objective of the work was to assess:

- Device durability in adverse and turbid conditions.
- Analytical reproducibility between the devices.
- Estimated water concentrations of certain chemical classes at the selected survey sites.
- The impact of biogenic fouling on the efficiency and accuracy of the techniques.
- Ease of use by monitoring staff
- Ease of analysis by the National Laboratory Service

Both techniques proved to be very successful and provided invaluable information on environmental pollutants. The trials demonstrated that the DGT device can be damaged in high flows and requires a robust protective deployment apparatus. The technique also requires experienced laboratory handling for accurate analysis. Once these issues had been addressed, results from the DGT trials were generally satisfactory. The SPMD system also performed well, although the limitations of biogenic fouling are yet to be fully evaluated. The materials used to construct SPMDs are also sensitive to extreme environmental conditions.

SPMDs will not sample polar organic compounds with octanol/ water partition coefficients less than 3000; work from Project E1-086 has been taken up into Project E1-111 with the aim of addressing polar organic compounds not absorbed by SPMD.

A third technique developed by the United States Geological Survey under a research partnership agreement, is called the Polar Organic Chemical Integrative Sampler (POCIS). It will provide the Environment Agency with an effective tool for monitoring many polar compounds including endocrine disrupting chemicals and pharmaceuticals.

This R&D Technical Summary relates to information from R&D Project E1-086.

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