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Water quality — Sampling —

Part 23:

Guidance on passive sampling in surface waters

Qualité de l'eau — Échantillonnage —

Partie 23: Lignes directrices pour l'échantillonnage passif dans les eaux de surface



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 5667-23 was prepared by Technical Committee ISO/TC 147, *Water quality*, Subcommittee 6, *Sampling (general methods)*.

ISO 5667 consists of the following parts, under the general title *Water quality — Sampling*:

- *Part 1: Guidance on the design of sampling programmes and sampling techniques*
- *Part 3: Preservation and handling of water samples*
- *Part 4: Guidance on sampling from lakes, natural and man-made*
- *Part 5: Guidance on sampling of drinking water from treatment works and piped distribution systems*
- *Part 6: Guidance on sampling of rivers and streams*
- *Part 7: Guidance on sampling of water and steam in boiler plants*
- *Part 8: Guidance on the sampling of wet deposition*
- *Part 9: Guidance on sampling from marine waters*
- *Part 10: Guidance on sampling of waste waters*
- *Part 11: Guidance on sampling of groundwaters*
- *Part 12: Guidance on sampling of bottom sediments*
- *Part 13: Guidance on sampling of sludges*
- *Part 14: Guidance on quality assurance of environmental water sampling and handling*
- *Part 15: Guidance on the preservation and handling of sludge and sediment samples*
- *Part 16: Guidance on biotesting of samples*

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- *Part 17: Guidance on sampling of bulk suspended solids*
- *Part 19: Guidance on sampling of marine sediments*
- *Part 20: Guidance on the use of sampling data for decision making — Compliance with thresholds and classification systems*
- *Part 21: Guidance on sampling of drinking water distributed by tankers or means other than distribution pipes*
- *Part 22: Guidance on the design and installation of groundwater monitoring points*
- *Part 23: Guidance on passive sampling in surface waters*

Introduction

Passive sampling devices can be used for monitoring concentrations of a wide range of analytes, including metals, inorganic anions, polar organic compounds (e.g. polar pesticides and pharmaceutical compounds), non-polar organic compounds (e.g. non-polar pesticides), and industrial chemicals (e.g. polyaromatic hydrocarbons and polychlorinated biphenyls) in aquatic environments.

Pollutant levels in surface water have traditionally been monitored by spot sampling (also known as bottle or grab sampling). Such sampling gives a snapshot of pollutant levels at a particular time. Pollutant levels in surface water have a tendency to fluctuate over time and so it may be more desirable to monitor pollutants over an extended period in order to obtain a more representative measure of the chemical quality of a water body. This can be achieved by repeated spot sampling, continuous monitoring, biomonitoring or passive sampling.

Passive sampling involves the deployment of a passive sampling device that uses a diffusion gradient to collect pollutants over a period of days to weeks. This process is followed by extraction and analysis of the pollutants in a laboratory.

Passive sampling devices can be used in kinetic or equilibrium modes. In equilibrium mode, the passive sampling device reaches equilibrium with the sampled medium, and provides a measure of the concentration at the time of retrieval from the environment. In the kinetic mode, the passive sampling device samples in an integrative way, and provides a measure of the time-weighted average concentration of a pollutant in the water over the exposure period. Where uptake into the receiving phase is under membrane control, then passive sampling devices operate as integrative samplers between the time of deployment and an exposure period of up to the time to half maximum accumulation in the receiving phase. Membrane control means that the transport resistance of the membrane is larger than that of the water boundary layer. In stagnant water, uptake is generally controlled by the water boundary layer. Under highly turbulent conditions, uptake is membrane controlled. Where uptake is controlled by the water boundary layer, then the passive samplers behave in a manner similar to those where uptake is under membrane control, but the sampling rate depends on flow conditions. Where flow conditions vary over time, uptake can be under water boundary control when turbulence is low, but change to membrane control when turbulence increases.

Diffusion into the receiving phase is driven by the free dissolved concentration of pollutant, and not that bound to particulate matter and to large molecular mass organic compounds (e.g. humic and fulvic acids). This technique provides a measure of the time-weighted average concentration of the free dissolved fraction of pollutant to which the passive sampling device has been exposed. For some passive sampling devices for metals, the concentration of analyte measured includes both the free dissolved fraction and that fraction of the analyte bound to small molecular mass inorganic and organic compounds that can diffuse into and dissociate in the permeation layer. Pollutant bound to large molecular mass compounds diffuses only very slowly into the diffusion layer. The concentration measured by a passive sampling device can be different from that measured in a spot (bottle) sample. In a spot sample, the fraction of pollutant measured is determined by a combination of factors such as the proportion of pollutant bound to particulate matter and to large organic compounds, and the treatment (e.g. filtration at 0,45 µm or ultrafiltration) applied prior to analysis. Passive sampling devices used in surface water typically consist of a receiving phase (typically a solvent, polymer or sorbent) that has a high affinity for pollutants of interest and so collects them. This receiving phase can be retained behind, or surrounded by, a membrane through which the target analytes can permeate. A schematic representation of such a passive sampling device is shown in Figure 1. In its simplest form, a passive sampling device is comprised solely of a naked membrane, fibre or bulk sorbent which acts as a receiving phase. In such passive sampling devices, the polymer acts as both receiving phase and permeation membrane. The polymers used in these passive sampling devices usually have a high permeation, and uptake is controlled by the water boundary layer. Uptake comes under membrane control only at very high flow rates. Different combinations of permeation layer and receiving phase are used for the different classes of pollutant (non-polar organic, polar organic, and inorganic). Passive sampling devices are designed for use with one of these main classes of pollutant.

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Passive sampling devices can be used in a number of modes including qualitative or semi-quantitative which can be applied in the detection of sources of pollution, for example. When appropriate calibration data are available, passive sampling devices can also be used quantitatively for measuring the concentration of the free dissolved species of a pollutant.