Analysis of Aerosols

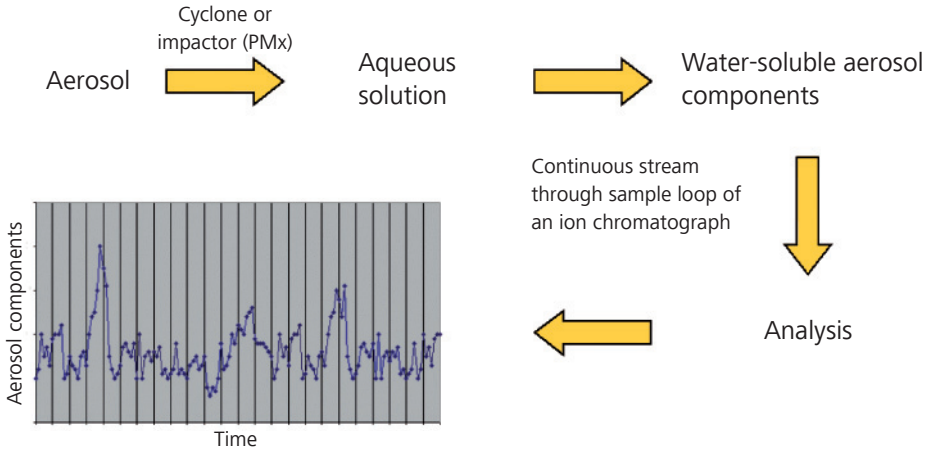
Particle-into-Liquid Sampler – Ion Chromatography
PILS – IC

Metrohm

The Particle-into-Liquid Sampler: a simple solution for the determination of ions in aerosols

02

The combustion of fossil fuels for energy production pollutes the environment with large quantities of harmful substances in the form of gases or aerosols. These emissions cause damage, not only at their source, but also far away from it. The chemical and physical properties of the emissions from anthropogenic as well as natural sources are highly relevant to the climate and the environment. The Particle-into-Liquid Sampler, or PILS[1] for short, samples aerosol particles from an airstream and transfers them to the aqueous phase. Subsequently, they are analyzed by ion chromatography. In order to analyze the complete gazeous phase we recommend a MARGA[2]-system as produced by Applikon Analytical.



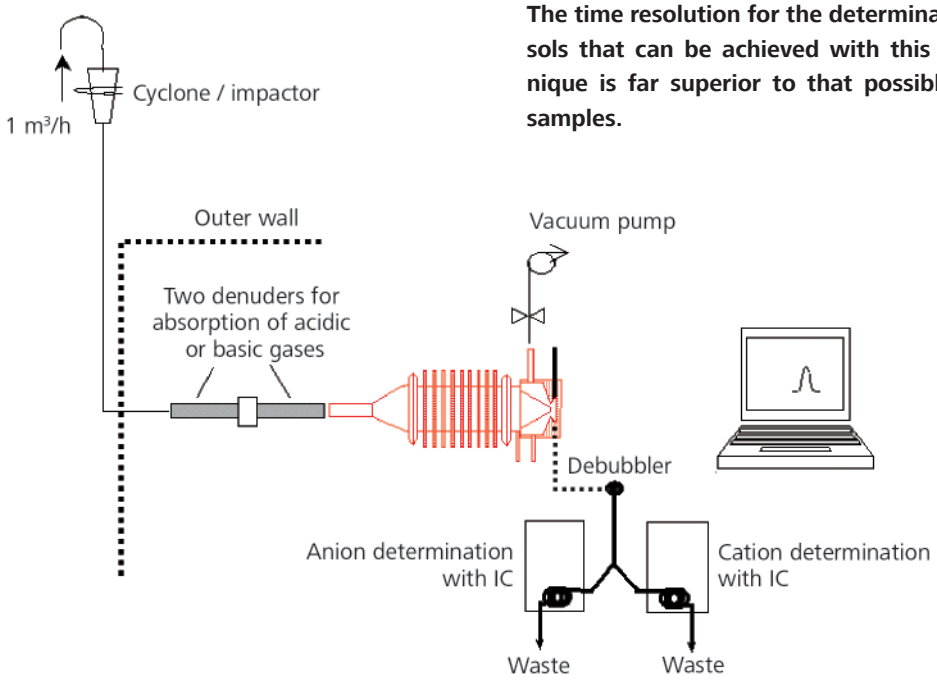
Flow diagram for Particle-into-Liquid Sampler (PILS)

Mode of operation

PILS puts aerosols into a supersaturated water vapor phase, where they quickly grow into droplets. These droplets are separated on the basis of their inertia and pumped on with a carrier fluid, which contains an internal standard to allow simple quantification. Air bubbles that are present are removed in a so-called debubbler, and the aqueous phase is transferred to an ion chromatograph for analysis.

The size of the aerosol particles to be determined is limited by a cyclone or an impactor at the intake. This makes it possible, for example, to analyze particles smaller than 1 µm, 2.5 µm, or 10 µm (PM_1, $PM_{2.5}$, PM_{10}), depending on requirements. To prevent interferences, the gases are absorbed by denuder systems. A vacuum pump produces an airstream in the system with a flow rate of 1 m³/h.

The time resolution for the determination of aerosols that can be achieved with this simple technique is far superior to that possible with filter samples.



[1] PILS is a coproduction of Applikon Analytical B. V. and Metrohm AG.

[2] Monitor for Aerosols & Gases in ambient Air.

Advantages of PILS at a glance

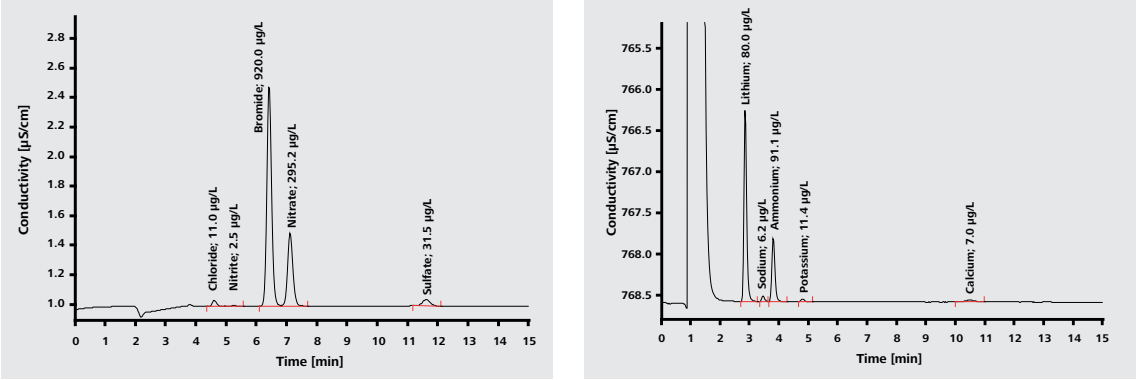
- **Determination of ions in aerosols with high temporal resolution**
- **Simple interfacing to an ion chromatography system**
- **High sampling rate**
- **Diurnal variation analysis with high time resolution**
- **Direct on-site sample analysis**
- **Contamination-free aerosol collection technique (Particles PM_1, $PM_{2.5}$, PM_{10})**
- **No sample storage required**
- **No sample preparation required**

Application areas

PILS can be directly coupled with various analysis techniques. With ion chromatography, water-soluble anions and cations can be determined simultaneously. PILS can also be used for offline sampling with an autosampler. Other examples are the determination of total organic carbon (TOC Analyzer) or coupling with ICP techniques.

Application areas for PILS – IC:

- Monitoring of pollutants inside buildings
- Emission control at the workplace for worker protection
- Monitoring of outside air
- Measurements of tunnel air
- Determination of stack emissions
- mobile use for example on aircraft



Anion and cation chromatogram for an outside air determination of aerosol particles smaller than 2.5 µm (PM2.5). Lithium bromide was used as an internal standard.

Please contact your Metrohm representative for any questions concerning your application.

Ordering information

Metrohm instruments

PILS

2.136.0400	Particle-into-Liquid Sampler ADI 2081
2.136.0500	Peristaltic pump, 8 channels with 6 rollers
6.5335.000	Liquid Handling Set for PILS

IC

2.850.3030	850 Professional IC AnCat – MCS
6.6059.112	MagIC Net™ 1.1 Professional
6.1825.290	250-µL sample loop made of PEEK

Columns

6.1006.510	Metrosep A Supp 5 – 100
6.1006.500	Metrosep A SUPP 4/5 Guard
6.1050.410	Metrosep C 4 – 100
6.1050.500	Metrosep C 4 Guard

Further application-specific equipment

For sample delivery it is possible to use a vacuum pump with a drying system made by KNF (vacuum pump N840.3ft.40p). The gas phase is separated with denuder systems (e.g., Multi Channel Annular Denuders made by URG, model no. URG-2000-30x242-4CSS). Intake systems such as the cyclones made by URG (e.g., PM 2.5 URG, model no. URG-2000-30EH) allow aerosols to be differentiated by particle size.

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