

The Value of Air Monitoring

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Executive Summary

Air pollution must be managed for health and environmental reasons. Along with negative health effects, air pollution can also negatively impact many different aspects of the Earth's environment. Fortunately, Ambient Ion Monitor samplers automatically collect and prepare air samples for ion analysis. These Ambient Ion Monitors are configured with one or two Thermo Scientific™ Dionex™ Ion Chromatography (IC) systems to separate, identify and quantify various pollutants.



Keywords

Ambient Ion Monitor,
Particulate Matter,
Ion Chromatography,
Clean Air Act

Air Pollution and Where it Comes From

Air pollution is the term for a mixture of solid particles, gases and liquid droplets found in the air. These particles and gases can include dirt, soot, aerosols, dust, and exhaust. They are made up of many different chemicals, some of which can be identified as either inorganic (nitrate, sulfate, particle ammonium) or organic (carbon, semi-volatile) compounds.

Fine particle pollution, particles that are 2.5 μm and smaller in diameter (PM_{2.5}), are found in smoke and haze caused by the emissions from power plants, industrial processes and automobiles. These particles are so small that they can get into the lungs and bloodstream, potentially causing critical health issues. These issues include heart attacks, asthma, respiratory symptoms such as difficulty breathing and even premature death in people with heart or lung disease.

Why Air Sampling is Important

Air pollution, particulate matter especially, must be managed for health and environmental reasons. Along with the negative health effects mentioned above, particulate pollution can also negatively impact many different aspects of the Earth's environment. It can damage sensitive ecosystems by making lakes and streams acidic, change the nutrient balance in coastal waters and river basins, deplete nutrients in soil, and damage forests and farm crops. Particulate pollution also affects the energy balance of our planet by scattering solar radiation and reduces visibility through the formation of haze.

The U.S. EPA is required by the Clean Air Act to monitor air pollution and set air quality standards to protect public health and the environment. The National Ambient Air Quality Standards sets the standards for six common air pollutants that are considered especially harmful. These are: particulate matter (PM), ground level ozone, carbon monoxide, nitrogen oxides, sulfur dioxide and lead. These air pollutants (also known as 'Criteria Pollutants') are found all over the United States. The U.S. EPA calls these pollutants "criteria" air pollutants because it regulates them by developing human health-based and/or environmentally-based criteria (science-based guidelines) for setting permissible levels. The set of limits based on human health is called primary standards while another set of limits intended to prevent environmental and property damage is called secondary standards.

On December 14, 2012 the U.S. EPA strengthened the annual health National Ambient Air Quality Standards for fine particles (PM_{2.5}). This recent update to the primary standard reduces the acceptable amount of PM_{2.5} allowed in the air.

An Automated Air Sampling and Analysis System

The URG 9000 Series Ambient Ion Monitor (AIM) is an advanced air sampling instrument that simultaneously measures both fine particle composition (PM_{2.5}) and precursor gases. The AIM enables the analysis of not only the atmospheric chemistry leading to the formation of PM_{2.5}, but also physical transformation and subsequent particle/gas partitioning of its constituents. AIM samplers provide time-resolved direct measurements of anions (nitrate, sulfate, nitrite, phosphate and chloride) and cation particulates (ammonium, sodium, calcium, potassium and magnesium) in PM_{2.5}. Furthermore, the AIM provides time resolved direct measurements of anion (hydrogen chloride, nitric acid, nitrous acid and sulfur dioxide) and cation (ammonia) gases.

AIM samplers collect and prepare air samples. They are configured with one or two Dionex Ion Chromatography (IC) systems, as shown in Figure 1. The ion chromatographs separate, identify and quantify ionic pollutants such as ammonium, chloride, nitrate, nitrite and sulfate. These systems include dual-piston pumps, manually or electrolytically generated eluents and electrolytic suppression for ion chromatography. Table 1 describes individual parameters for the AIM samplers.



Figure 1. The URG 9000 Series Ambient Ion Monitor (AIM) with two Thermo Scientific Dionex Ion Chromatography Systems.

Table 1. Parameters for various AIM samplers.

Parameter	Ambient Ion Monitor (AIM)
Inlet	Customizable Teflon Coated Aluminum/Stainless Steel Sharp Cut Cyclone.
Flow Control Method	Volumetric Flow Control
Denuder	Parallel Plate Denuder with new synthetic polyamide membrane No Moving Parts Membrane replacement every 6 weeks 99.7% efficient Denuder can be changed without stopping the sampler
Collection Method	Steam Jet Aerosol Collector
Sample Time	60, 30, 15 minute
Software	Dionex Chromeleon IC Software, URG AIM Software
Unattended Operation	2 Weeks
Remote Access	Remote Access, Operation, and Data Transfer
Check Standards	Lithium Bromide with Every Sample* <i>*Optional</i>
Fluid Usage	15 Liters of fluids (absorbing solution, eluent, DI water) for a 7 day period (URG-9000D Model)
Size	36"(W) x 19.5" (D) x 36" (H) (URG-9000D Model)
Waste	Safe for Disposal

Who Should Consider the AIM?

The AIM is utilized by governmental agencies, universities, state agencies and numerous research groups around the world for both PM2.5 speciation monitoring and for research into the health and environmental impacts of PM2.5 pollution. The AIM is a powerful system for ensuring that the environment and human health are preserved and enhanced.

Benefits of the AIM

AIM samplers are scientifically advanced systems that have numerous advantages over manual sampling methods. The AIM uses an automatic “Real-Time” method for air sampling, providing time-resolved data on an hourly basis. Manual sampling methods usually take 24 hours for data resolution and days or weeks to get the final processed data. The AIM samplers collect and analyze samples automatically, eliminating the cost and common handling errors associated with the lab services that manual samplers require.

The AIM sampler needs as little as 4 hours of maintenance per week with a start-up time of less than an hour. The AIM and IC systems can be operated and monitored remotely and left unattended for up to 10 days. It can be installed in city centers, research and mobile sampling labs and can also be rack mounted with minimal space requirements.

Works Cited

- <http://www.dionex.com/en-us/markets/environmental/air-analysis/lp-79979.html>
- URG Particulate Matter & Air Sampling Presentation
- URG AIM Overview Presentation

www.thermofisher.com/dionex

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