Science.

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Environmental Health Sciences Group

The PNNL Chemical Testing Chamber

There are many unknowns associated with how chemicals react in the environment. The PNNL Chemical Testing Chamber (PCTC)—also called the Atmospheric Reaction Chamber—aids in understanding and characterizing suspected source emissions and chemical mixtures released into the environment. By understanding transport phenomena and chemical reactions in the atmosphere, key chemical effluents and potential degradation signatures can be understood, modeled, and matched to the proper sensing technique.

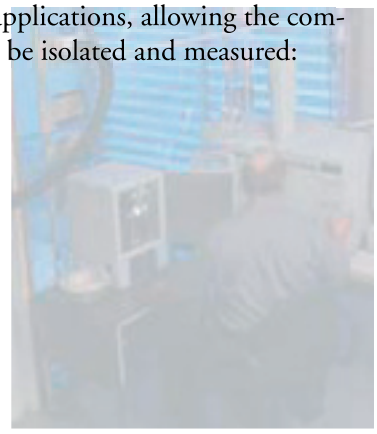
Unique Capabilities

Whereas other chambers have been designed primarily for gas-phase analyses, the PNNL Chamber is unique because it is:

- Configured to work with and sample both volatile and semi-volatile chemicals. Its semi-volatile capabilities make the Chamber unique.
- Contents injected through heated, fused-silica lines directly into a GC column. Other chambers require samples to be pulled and then injected separately to a GC or other analyzer.
- State-of-the-art sample pre-concentrator provides detection levels down to part per trillion levels.
- State-of-the-art GC-MS with flame photometric and nitrogen-phosphorous detectors and mass spectromter.
- Chemicals detected down to ppt levels and lower.

Diverse Applications

The Chamber can be used in a wide variety of applications, allowing the components of complex environmental problems to be isolated and measured:



- Air emission measurements
- Chemical transformations
- Continuous monitoring
- Hazardous waste treatment
- Measurements of biological organisms in air
- Worker safety and health
- National security and protection.

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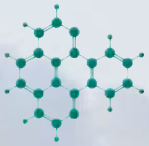
Specifications

The dual-chamber system is designed to simulate the chemistry involved with real-life releases and off-gassing (from environmental media) of chemicals and mixtures observed at ambient levels and down to ppt levels for both the (volatile) gas-phase and the sticky semi-volatile species.

Chamber objectives	Determine where chemicals go in the environment (air, soil,, water, biota). Identify degradation products for volatile and semi-volatile chemicals. Study kinetics and mechanisms.
Unique capabilities	Large-volume preconcentrator allows injecting and detecting semi-volatile compounds up to ~24 carbon atoms using heated, fused silica lines and valves. Computer-controlled direct sampling will occur from each chamber.
Wall materials	Inert DuPont 200A FEP Teflon, 0.002-inches thick.
Volume-surface area	Chamber volumes range from ~10 to ~20 m^3.
Operational concentrations	Detections of volatiles and semivolatiles are possible at ppt levels.
Input options	UV-A simulation of sunlight, O_3, ·OH (hydroxyl radical), NO, N_2O, Future: will provide selectable submicron particle generation
Analytical capabilities	GCMS (EI-CI), GC, long-path FTIR, UV Photolysis (O_3), Chemiluminescence (NOx), particle counting, acoustic gas analyzer
Environmental controls	Temperature and pressure are currently controlled at ambient levels. Relative humidity is selectable and daytime/night time simulations are options.
Chamber air	Clean air pack removes CO, O_3, all HCs (including CH_4), sulfur and nitrogen compounds (>1 ppb, except particles), particles (>0.02 µ)

Wide Variety of Research Possibilities

- Predictions of chemical signatures in the environment
- Kinetic, analytical methods for chemical detection
- Automotive and catalyst research
- Aerosol and atmospheric studies
- Indoor air studies (molds, allergens, dust-loading)
- Sensor testing (false alarms and calibrations)
- Studies of chemical and biological agents.



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