

BINGHAM RESEARCH CENTER · UTAH STATE UNIVERSITY

Dual-Channel Speciated Mercury System

Oxidized mercury sits at a few tens of picograms per cubic meter in ambient air, and the commercial KCl-denuder method behind most published measurements is now known to be biased low. Our dual-channel system measures elemental and oxidized mercury separately, every 10 minutes, with SI-traceable calibration.

6–12 pg m^{-3}	10 minutes	97–100%
OXIDIZED MERCURY DETECTION LIMIT	TIME RESOLUTION, BOTH SPECIES	RECOVERY OF INJECTED HG^0 AND $HGBR_2$

How it works

01 **Heated inlet:** ambient air is drawn at 9 L min^{-1} through a 110 °C inlet with an elutriator and impactor that removes particles larger than 2.5 µm. The sampling line is kept under 1 m to minimize loss of oxidized mercury.

02 **Two parallel channels:** air is sampled from the inlet at 1 L min^{-1} through two channels. One passes a 650 °C thermal converter that reduces all mercury to elemental; the other passes cation exchange membranes that retain oxidized mercury and let elemental through.

03 **One detector, alternating:** a cold vapor atomic fluorescence analyzer switches between channels every 5 minutes — total mercury from the thermal converter channel, elemental mercury from the membrane channel.

04 **Oxidized by difference:** oxidized mercury is the difference between the channels. Periodically routing converter output through the membranes quantifies channel bias and establishes the detection limit.

Excelling where other instruments fall short

No denuder bias

Cation exchange membranes collect a wide range of oxidized mercury compounds without the low bias of KCl-coated denuders. Against 16 co-located network sites, denuder data required upward correction factors of two to three.

Calibrated, not assumed

Most oxidized mercury measurements have never been calibrated. This system has been verified in field conditions against a permeation-tube calibrator with gravimetrically characterized, SI-traceable permeation rates.

Losses designed out

A short, hot inlet and an enclosure mounted at the sampling point keep reactive compounds from being lost on tubing walls before they reach the membranes.

Proven in the field

The system has operated in winter conditions at the 3,220 m mountaintop **Storm Peak Laboratory** in Colorado, through desert winter inversions in Utah's **Uinta Basin**, and in high-precision laboratory environments.

While sampling ambient air, it recovered 97 ± 4% of injected elemental mercury and 100 ± 8% of injected $HgBr_2$ — the first oxidized mercury measurements at low environmental concentrations verified against an SI-traceable calibration system in the field.

Interested in a system or collaboration?

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