A Spot Sampler for Concentrated Collection of Airborne Particles

Susanne Hering
Arantza Eiguren Fernandez and Gregory Lewis
Aerosol Dynamics Inc.
with A. Hecobian and Jeffrey Collett
Colorado State University

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How concentrated “spot” collection is done

Condensational growth \rightarrow \text{droplet impaction}

Condensational growth requires supersaturation

Equilibrium RH above 5 nm water droplet is 150%

\[ P_{\text{droplet}} = P_{\text{flat-surface}} \exp\left(\frac{4\sigma v}{kT \rho D}\right) \]

Surface tension
First systems:
mix steam into airstream, then cool
   Maze Collector (Simon and Dasgupta)
   Steam-jet Collector (Khlystov et al)
   Particle in Liquid sampler (Weber et al)

*These methods subject the sample to high temperatures*

Our Approach: Moderated Growth Tube

cool | warm | cool

5°C | 35°C | 10°C
Moderated approach

output temperature <18°C

output dew point <20°C

Droplet Size > 2 μm

Hering et al, 2014
Collection into Liquid, or as Dry Spot

1-mm spots
Collection Efficiency

![Graph showing collection efficiency for different particle diameters.]

- **NaNO₃ + Na₂SO₄**
- **Arizona Road Dust**

**Dry Spot Sampler**

Into Liquid

*Eiguren Fernandez et al, 2014*
“Dry Spot” as a sequential sampler for monitoring

Field: sequential collection onto well plate

Lab: place well plate on autosampler, as it came from the field.

Results: time-resolved sulfate, nitrate concentrations.

autosampler adds internal standard, eluent, handles extraction and injection onto liquid chromatograph
Precision Testing

Figuren Fernandez et al, 2014
Colorado State Field Study in Southern California

Sulfate:
Comparison to 12-hr URG Filters

A. Hecobian et al, in preparation
Nitrate: Comparison to 12-hr URG Filters

A. Hecobian et al, in preparation
Summary

• Collection efficiency into liquid or as dry spot on solid surface

• Efficiency > 99% for a broad range of particle sizes

• Reproducibility & precision generally ~ 3% - 5%

• Anion Field Comparison: within 10% of filters

• PAH Field Comparison: → 15% for individual PAHs

available commercially from Aerosol Devices Inc.
AerosolDevices.com