Laboratory Evaluation of a Commercial Spot Sampler

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1. The S$^3$ uses moderate temperatures for water-based condensational growth
2. Collection efficiency is >95% for airborne particles down to 10 nm
3. The concentrated nature of the dry samples allows short collection times
4. It runs uninterrupted and unattended for several weeks at a time, with sample intervals selected by the user
5. Sample extraction and chemical analysis is fully automated using a PAL autosampler
In 2014 we presented the prototype of the “Liquid Spot Sampler”

1. The collection in water or cell culture medium is highly efficient (>95%) 
2. The system collects both soluble and insoluble particles 
3. The small volume of liquid increases sample concentration 
4. The liquid suspension does not require any extraction and pre-concentration steps prior to chemical or toxicological characterization
• In 2015 we present the *commercial system* from Aerosol Devices Inc. (AD)
1. SEQUENTIAL SPOT SAMPLER

• Collection of up to 32 concentrated samples (1-mm “spot”)
• Collection flow rate can be adjusted from 0.6 lpm to 1.5 lpm (internal pump)
• Automated water injection and extraction prevents flooding
• User-selected sampling intervals from 1 min to 24 hrs
• Sample plate may be made from a variety of solid materials, can be cleaned and reused
• Interface with a PAL3 autosampler for automated extraction and chemical analysis
• Small volume of solvent used for extraction (70 µL)
2. LIQUID SPOT SAMPLER

• Direct gentle particle deposition into liquid
• No particle bounce or re-aerosolization
• Captures soluble and insoluble particles
• Particles are concentrated in a 0.5mL of liquid (water, broth, cell culture medium)
• Collection vial of polycarbonate (can be customized)
• The liquid vial can be user configured for on-line extraction and analysis
LABORATORY CHARACTERIZATION

Atomizer

(NH₄)₂SO₄ + NH₄NO₃

Sebacic Acid

Neutralizer (soft X-ray)

HFDMA

or

nanoDMA (TSI)

(15 lpm)

OPC

3783 WCPC @ 0.6 lpm

S³

3787 WCPC @ 1.5 lpm

(NH₄)₂SO₄ + NH₄NO₃

Sebacic Acid

OPC

3783 WCPC @ 0.6 lpm

S³

3787 WCPC @ 1.5 lpm
1. Physical Collection Efficiency

**Dry Collection**

- Collection efficiency >95% for hydrophilic particles down to 6 nm for dry and liquid collection configuration.

**Liquid Collection**

- Collection efficiency >90% for hydrophobic particles as small as 15 nm when collection dry samples, and 20 nm for liquid collection.
2. Chemical Collection Efficiency

- Good agreement between collected and estimated mass for sulfate and nitrate
- Nitrate/Sulfate ratio consistent over time and collections
3. Bioaerosol Collection Efficiency

1. **H1N1 INFLUENZA virus**: physical collection efficiency and viability

   Stop by poster **8BA.9** (Thursday @ 12:15)
   
   “Highly Efficient Collection of Viable Influenza Virus A/Mexico/4108/2009 (pdmH1N1)” MAOIHUA PAN

2. **MS2 virus**: physical collection efficiency and viability

   Attend platform **12BA.5** (Friday @ 12:15)
   
   “A Novel Sampler for Viral Aerosols through Water-based Condensation Particle Growth” MAOIHUA PAN
1. The Sequential Spot Sampler and the Liquid Spot sampler are a novel tool for the efficient collection (>95%) of airborne particles both as dry spots or as liquid suspensions

2. The concentrated nature of the samples allows for short-time collections required for better characterizing changes in the physical, chemical and toxicological properties of the particles

3. Samples are ‘ready to analyze’ and the automated extraction and analysis by the autosampler eliminates the need for time-consuming, and expensive prep steps

4. Liquid collection in small volumes (<0.5 mL) enables faster and more direct characterization of the toxicological properties, as well as detecting the presence of bioaerosols (see 8BA.9 and 12BA.5)

5. The Spot sampler is portable and does not require personnel in the field, which makes the Spot sampler an ideal collector for long field campaigns and time-resolved sample collections

These systems combine the simplicity of filter sampling with the data completeness of real time instruments