

A Compact, Rapid Concentrator for Increased Sensitivity of Commercially Available Protein Detection Kits

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(1) InnovaPrep, (2) AlburtyLab Inc.



InnovaPrep LLC

- Technical expertise:
 - Biological sample concentration
 - Biological sample preparation

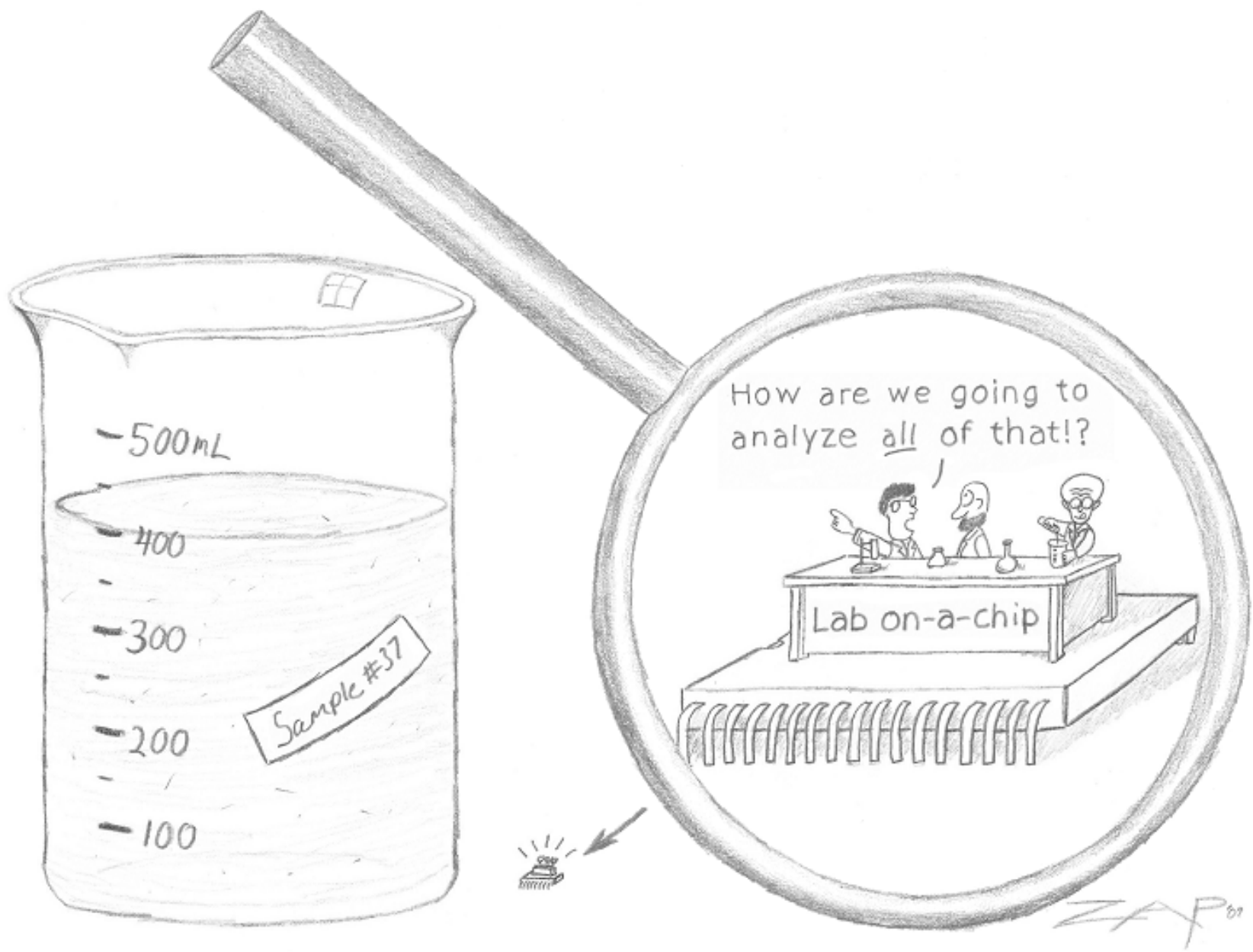
AlburtyLab, Inc.

- Technical expertise:
 - Aerosol Research
 - R&D, testing, validation of biodefense detection systems
 - Biodefense consulting and test support

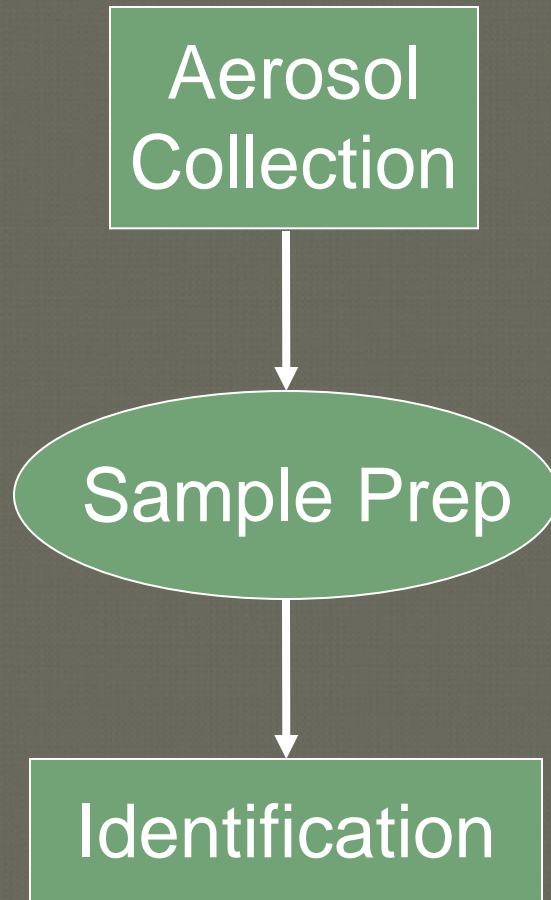


AlburtyLab, Inc.





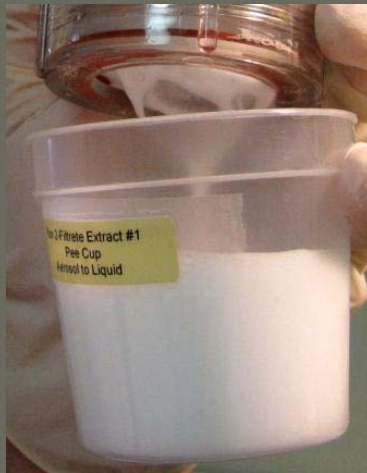
InnovaPrep - Motivation



- Sample collection into 2 - 15 mL
- Identifiers accept 5 - 200 μL

From 90% to 99.97% of the sample is not analyzed!

InnovaPrep - Technologies



Wet Foam Elution



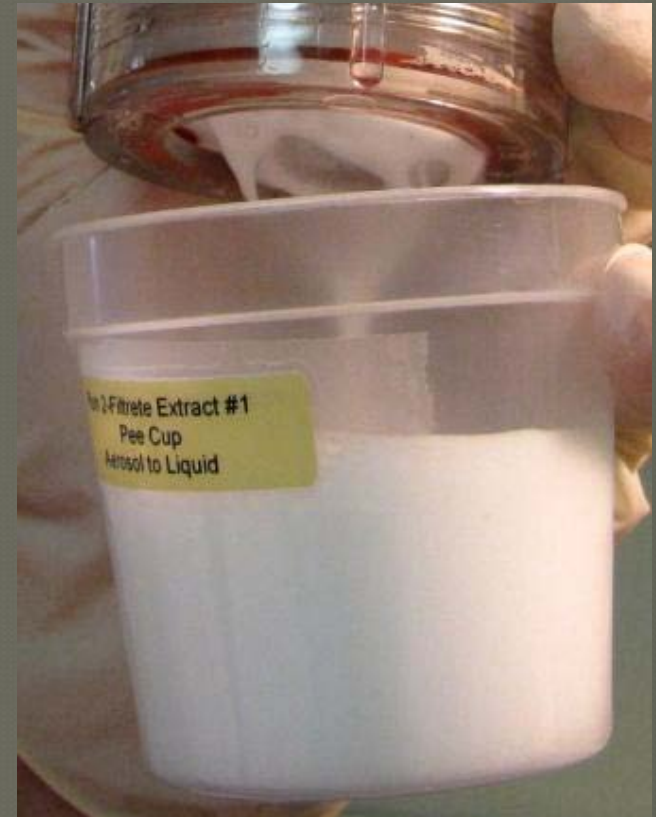
Liquid-to-Liquid Concentration & Sample Preparation



Surface Extraction

Wet Foam Elution

- Improved Elution
 - “Expanded Liquid”
 - Increased Viscosity – reduced channeling (Yan et al., 2006)
 - Moves as rigid body with very narrow ($<10\ \mu\text{m}$) lubricating layer (Briceno and Joseph, 2003; Tisne et al., 2004)
 - Bursting bubbles
- Quickly Breaks Down into a Liquid



Liquid-to-Liquid Concentration & Sample Preparation

- Dead-end Hollow Fiber Membrane Filter
- Automated Process
- Wet Foam Elution of Captured Particles into Volumes as Small as 50 μL



Surface Extraction

- Wet Foam Elution
- Vacuum Pickup



Aerosol Collection

- Electret Filter
- Hollow Fiber
- Wet Foam Elution



**Patents Pending*

InnovaPrep JBTDs Solution

1. Dry Electret Filter Collector
2. Wet Foam Elution of Electret Filter
3. Liquid-to-Liquid Concentration



Capture, Concentration, and Detection of Biological Particles from Surfaces, Air, and Liquids

Application: First Responders

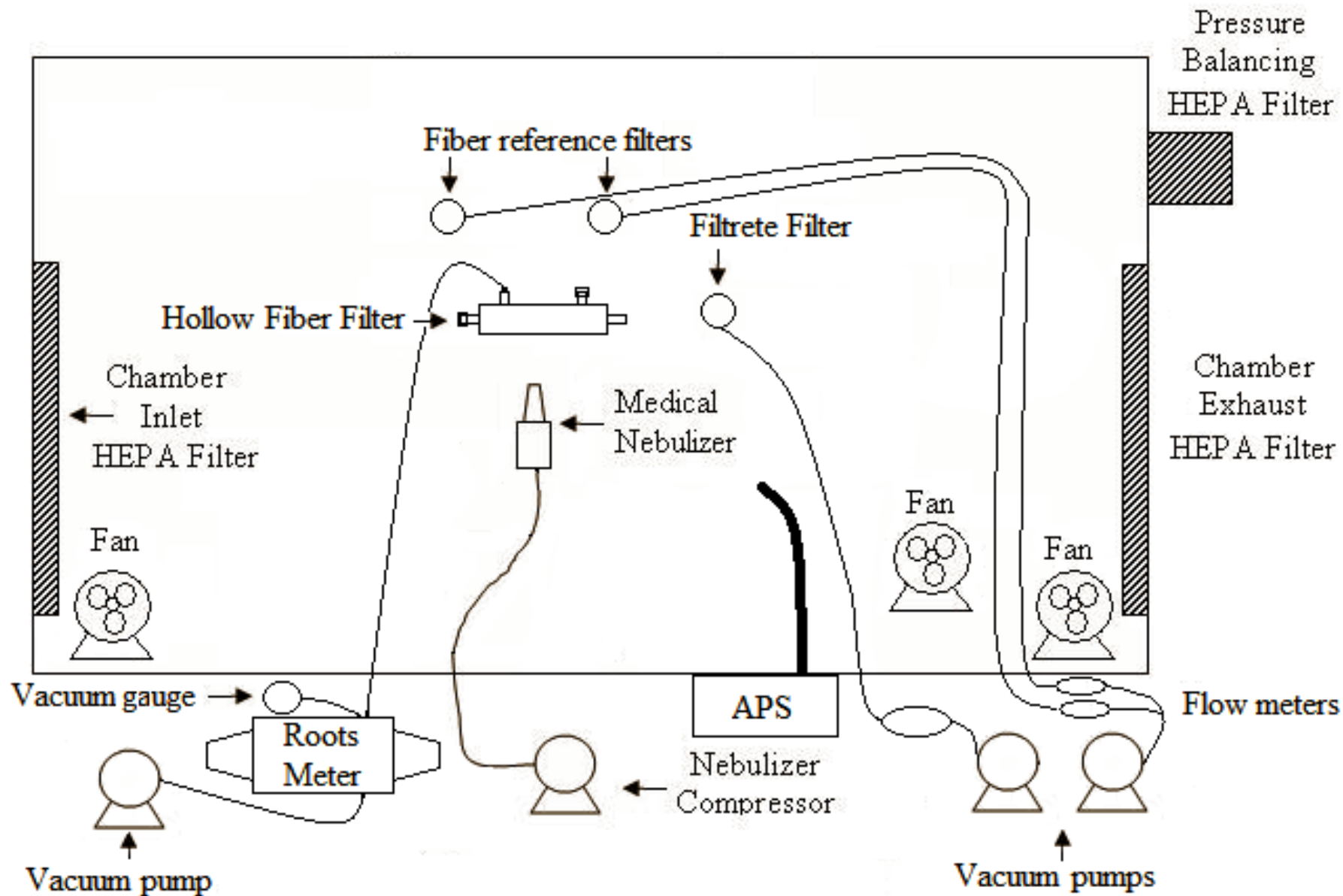
- Wet foam surface extractor
- Wet foam elution system for electret filters and hollow fiber membrane filters
- Liquid-to-Liquid concentration
- Detection by lateral flow immunoassay test strips or other rapid methods

-Simulant Testing

- “New” Dugway *Bacillus atrophaeus*
1 μm Polystyrene Microspheres
Ba Sterne

- Spiked into a liquid
- Aerosolized, collected, and transferred into a liquid
 - ECBC reference methods for Bg and PSL
- Spiked onto a flat surface and extracted into liquid
- In each case above, the resulting liquid samples were:
 - Concentrated by liquid to liquid concentrator
 - Analyzed by plating, LFIs, and qPCR

Aerosol Chamber Schematic



Aerosol Chamber



Wet Foam Elution of Hollow Fiber

1



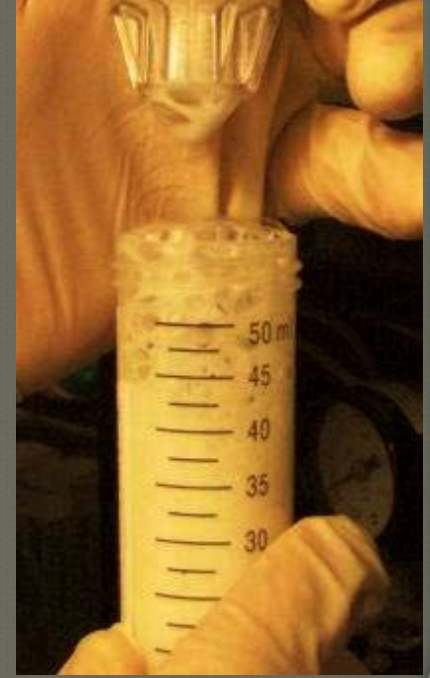
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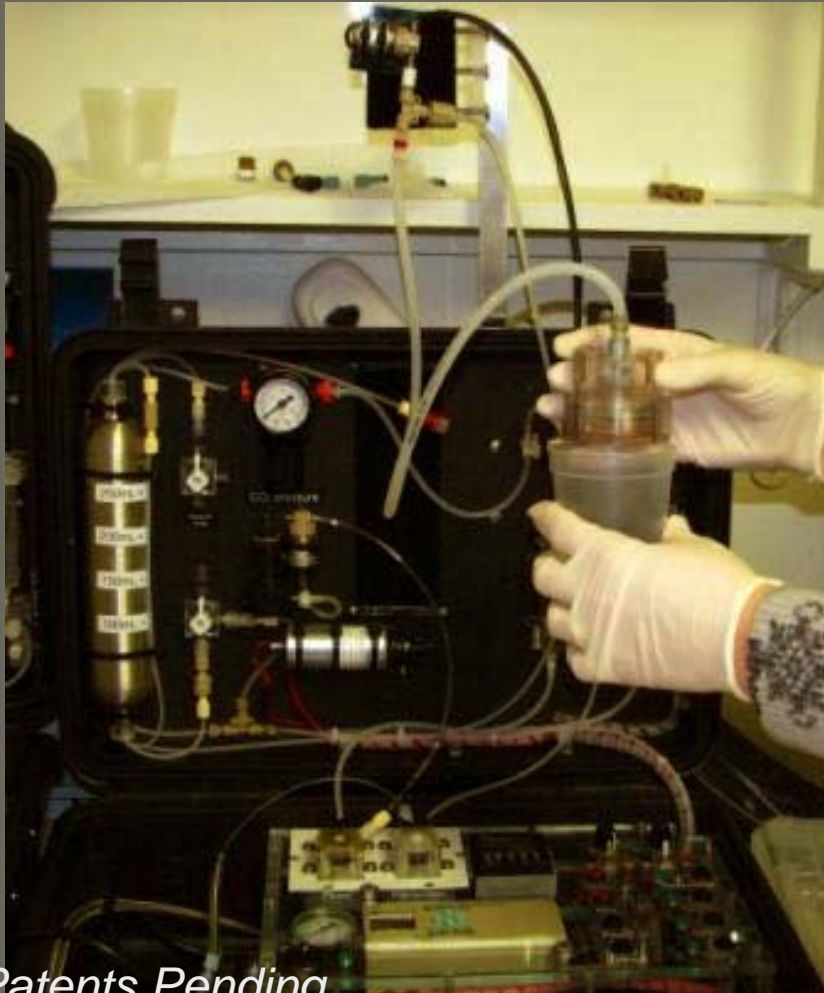
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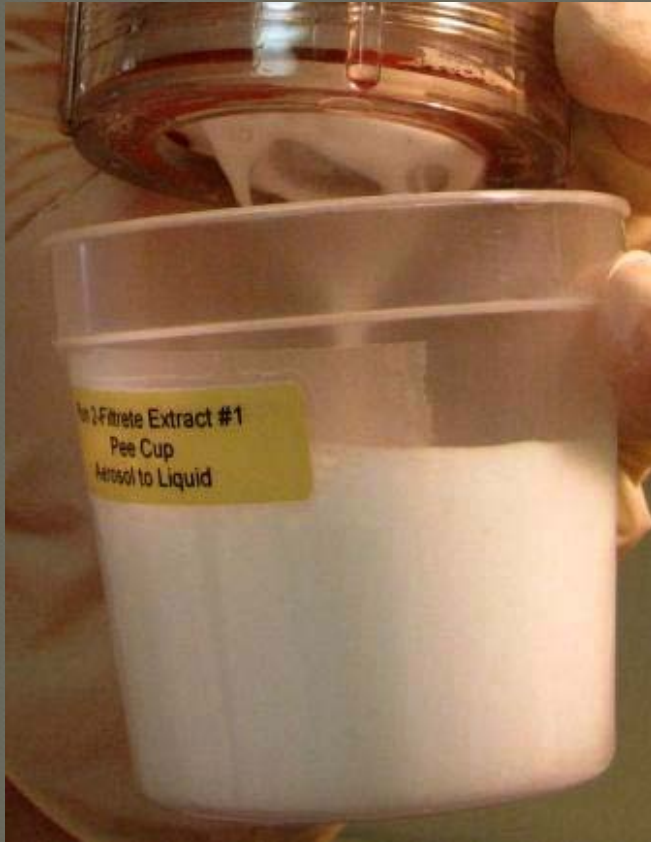


Setup for Wet Foam Elution of Electret Filter

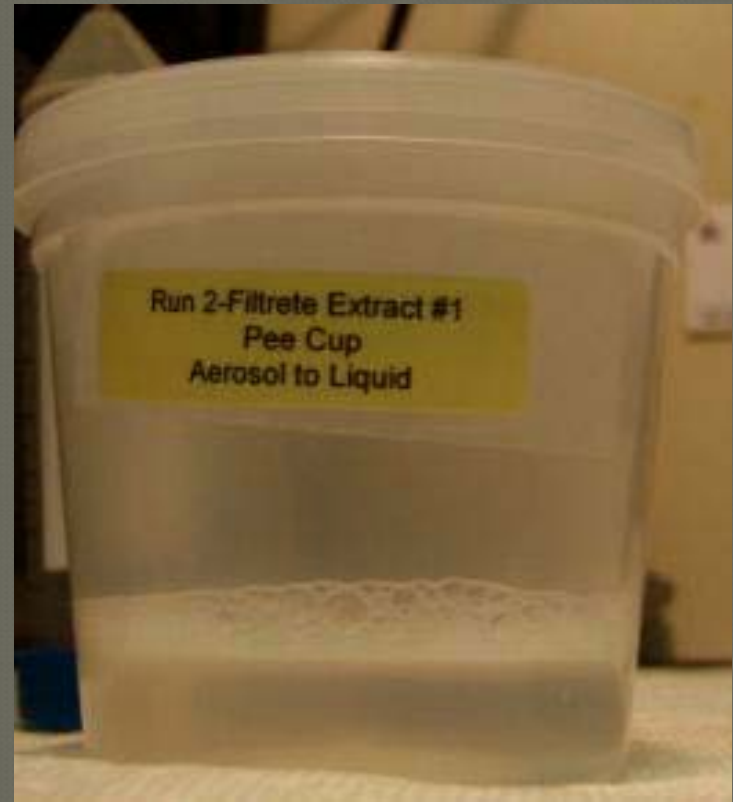


**Patents Pending*

Wet Foam Elution of Electret Filter



Elution ~ 5 seconds



Breakdown of foam ~ 25 seconds

Test Series One

Test Conditions

- Electret Filter Flow Rate: 20 Lpm
- Nominal Elution Volume: 35 mL
- Loose weave electret
- *Bacillus atrophaeus*
- **92.7% efficiency**

Test Series Two

Test Conditions

- Electret Filter Flow Rate: 140 Lpm
- Average Elution Volume: 5.3 mL
- Tight weave electret
- 1 μm polystyrene microspheres

Condition 1:

- 50% Humidity
- No Charge Neutralization
- 2 test runs
- **107.4% efficiency**
- **11.1% std. dev.**

Condition 2:

- 85% Humidity
- Charge Neutralization
- 3 test runs
- **100.1% efficiency**
- **0.9% std. dev.**

Test Series One



Test Series One

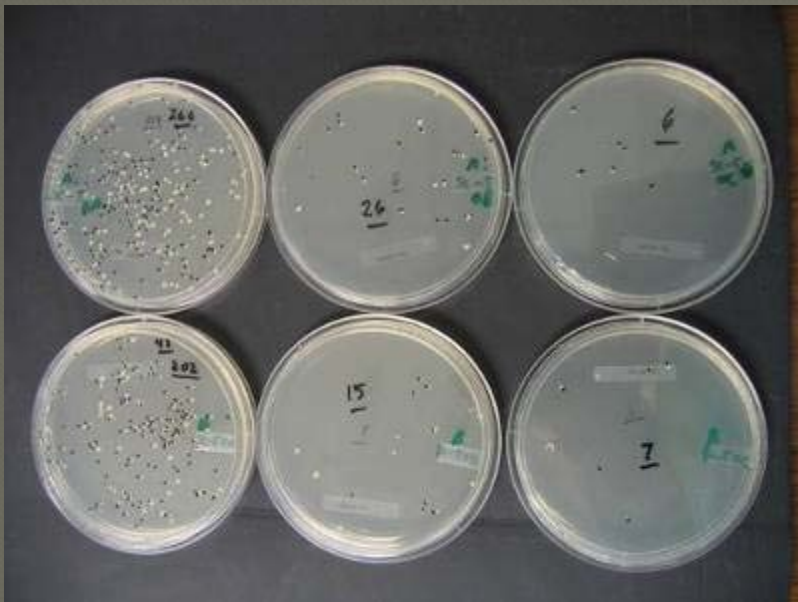


Test Series One



Surface to Liquid to Liquid

- Surface recovery efficiency 88-119%, average 99.6%
- Liquid to Liquid Concentration efficiency 88-105%, average 97.8%



*Patents Pending

Observations

- Demonstrated efficient aerosol capture and elution coupled with efficient liquid-to-liquid concentration
- LFI results do not necessarily match the improvement seen in culturing
- “New” Dugway Bg contains considerable amounts of free DNA and free antigens
 - Smaller hollow fiber pore sizes are needed for efficient concentration of free DNA and free antigens
 - Electret filters can capture free DNA and free antigens
- Wide dynamic range of LFIs makes quantitation of improvement difficult

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