

Aerosol Collector Efficiency  
Characterizations at the  
Edgewood Chemical Biological  
Center

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# Report Documentation Page

*Form Approved  
OMB No. 0704-0188*

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1. REPORT DATE <b>19 NOV 2003</b>	2. REPORT TYPE <b>N/A</b>	3. DATES COVERED <b>-</b>	
4. TITLE AND SUBTITLE <b>Aerosol Collector Efficiency Characterizations at the Edgewood Chemical Biological Center</b>		5a. CONTRACT NUMBER	
		5b. GRANT NUMBER	
		5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)		5d. PROJECT NUMBER	
		5e. TASK NUMBER	
		5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>U.S. Army Edgewood Chemical Biological Center, Maryland</b>		8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)	
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release, distribution unlimited</b>			
13. SUPPLEMENTARY NOTES <b>See also ADM001851, Proceedings of the 2003 Joint Service Scientific Conference on Chemical &amp; Biological Defense Research, 17-20 November 2003. , The original document contains color images.</b>			
14. ABSTRACT			
15. SUBJECT TERMS			
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>	<b>UU</b>
			18. NUMBER OF PAGES <b>30</b>
			19a. NAME OF RESPONSIBLE PERSON

# Introduction

- Harmful Aerosols
  - BW agents are aerosols
  - Workplace aerosols (toxic and high concentration)
  - Environmental aerosols
- Different samplers for different purposes
  - High volume samplers – to collect maximum # of particles from air
  - Representative sampler – unbiased sample – proportional to distribution in air

- Aerosol collector is a critical component of the CB Point Detection System
- A high volume sampler extracts and concentrates aerosol samples from the surrounding environment
- Characterizing performance of a sampler is important to assess system effectiveness and to choose an appropriate sampler for the situation
- Ideal sampler
  - High sampling efficiency and Concentration Factor
  - Low weight
  - Low power consumption
  - Collection media compatible with detection schemes

- Sampler components
  - Inlet (omni and uni directional)
  - Transport tube – precollectors, concentrators, tubes, bends
  - Collection site (filter, cyclone, impaction surface)
- Overall sampling efficiency = Ratio of particles collected to particles in the environment
- Overall sampling efficiency is the product of the efficiency of each component
- Individual component efficiency will indicate where design problems exist and where improvements can be made

- Testing for efficiencies

- Wind tunnel testing – inlet aspiration efficiencies

- Chamber testing – sampler at calm air condition

- Flow through cell testing – sampler component testing

(example: ducts)

# Aerosol Chamber

- 70 m<sup>3</sup> environmentally controlled stainless steel chamber
- Temperature and humidity are controlled in the chamber
- Air entering and exiting the chamber are filtered by HEPA filters
- Wash down capability
- UV lights to kill biological materials
- Computer controlled power receptors
- Mini chambers are placed inside for special tests

# Aerosol Chamber



# Aerosol Chamber



# Aerosol Chamber

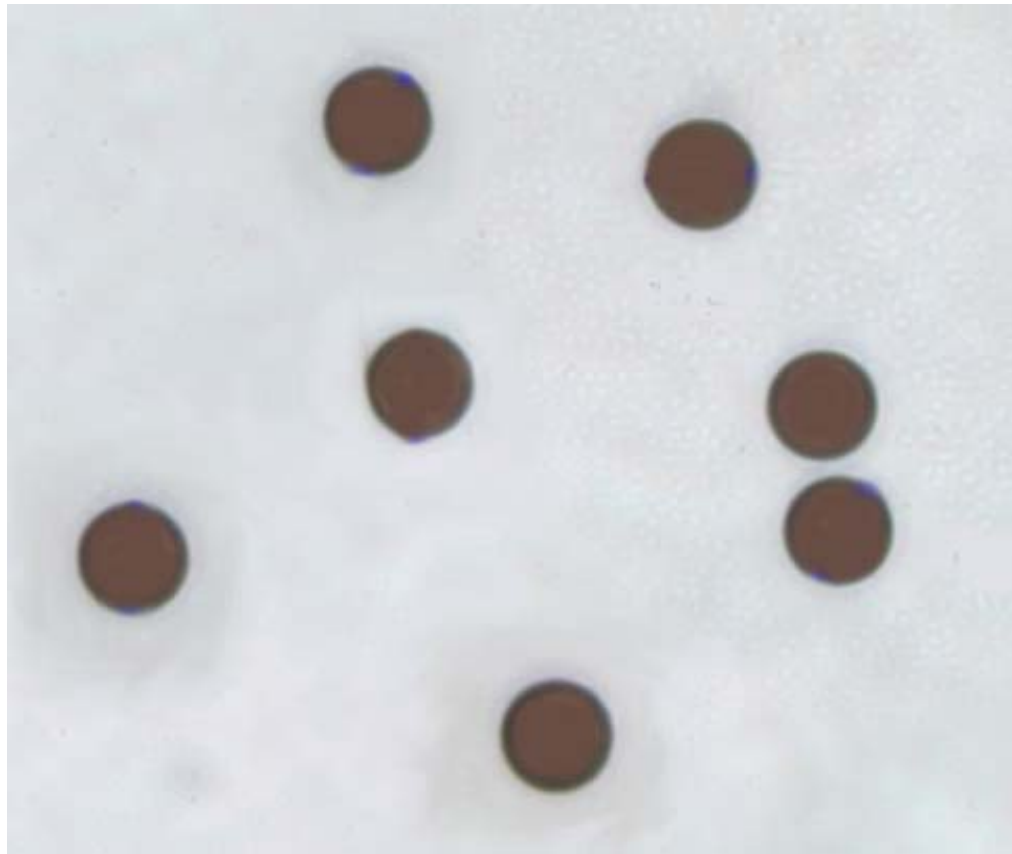


## Typical aerosol challenges used in ECBC chambers and wind tunnels

Aerosols	Generation Method	Size Distribution	Analysis Method	Comment
PSL	Nebulizers, Sonic nozzle, IJAG, puffers	Monodisperse	Microscopy, Fluorometry Coulter Counter	Expensive Membrane filters
Fluorescent oleic acid droplets	VOAG Spinning top Aerosol generator	Monodisperse	Fluorometry	
Test dust $Al_2O_3$	Sonic nozzle	Poly or narrowly dispersed	Gravimetric Coulter Counter	
Biosimulants	Nebulizers, IJAG, sonic nozzle, bubbler	Poly, mono or narrowly dispersed	Culturing Coulter Counter APS	Survivability of Biosimulants

- Liquid particles – monodisperse fluorescent Oleic acid aerosols
  - VOAG
  - Neutralized
  - Aerosol generation for 10 min, mixing in the chamber for 30-60 seconds, and sampling for 10 min
- Analysis using fluorometry
  - Suitable excitation and emission filters
  - pH between 8 – 10
  - All samples must be at the same temperature

# Fluorescent Oleic Acid Droplets

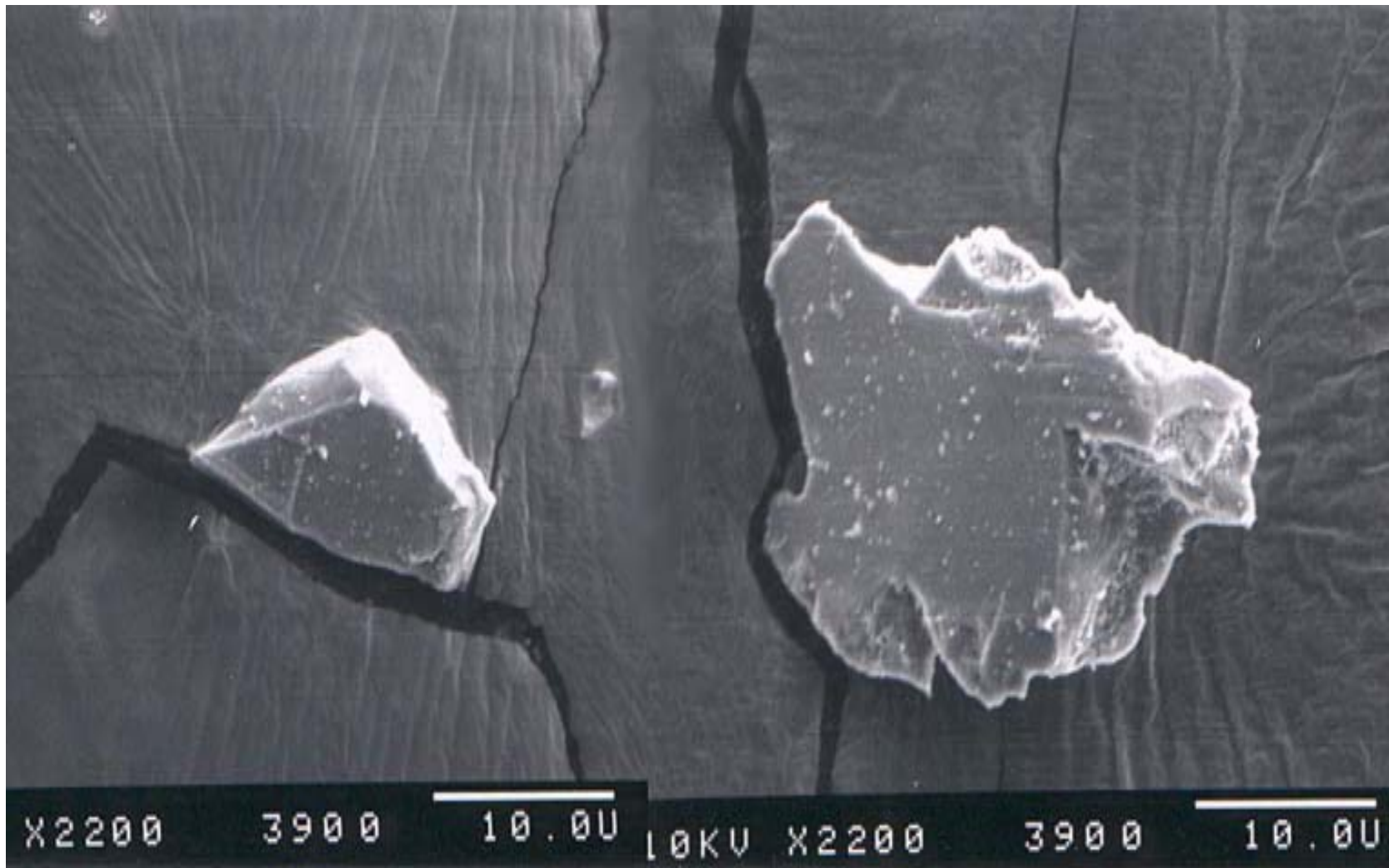


- Solid particles – polydisperse  $\text{Al}_2\text{O}_3$ 
  - Sonic nozzle
  - Not-neutralized
  - Aerosol generation in 15 – 30 sec, mixing in the chamber for 1 min, and sampling for 10 min
- Analysis is using Coulter counter
  - Solid
  - Particles must be insoluble

# Sonic Nozzle



# $\text{Al}_2\text{O}_3$ Particles



# Solid particles – PSL

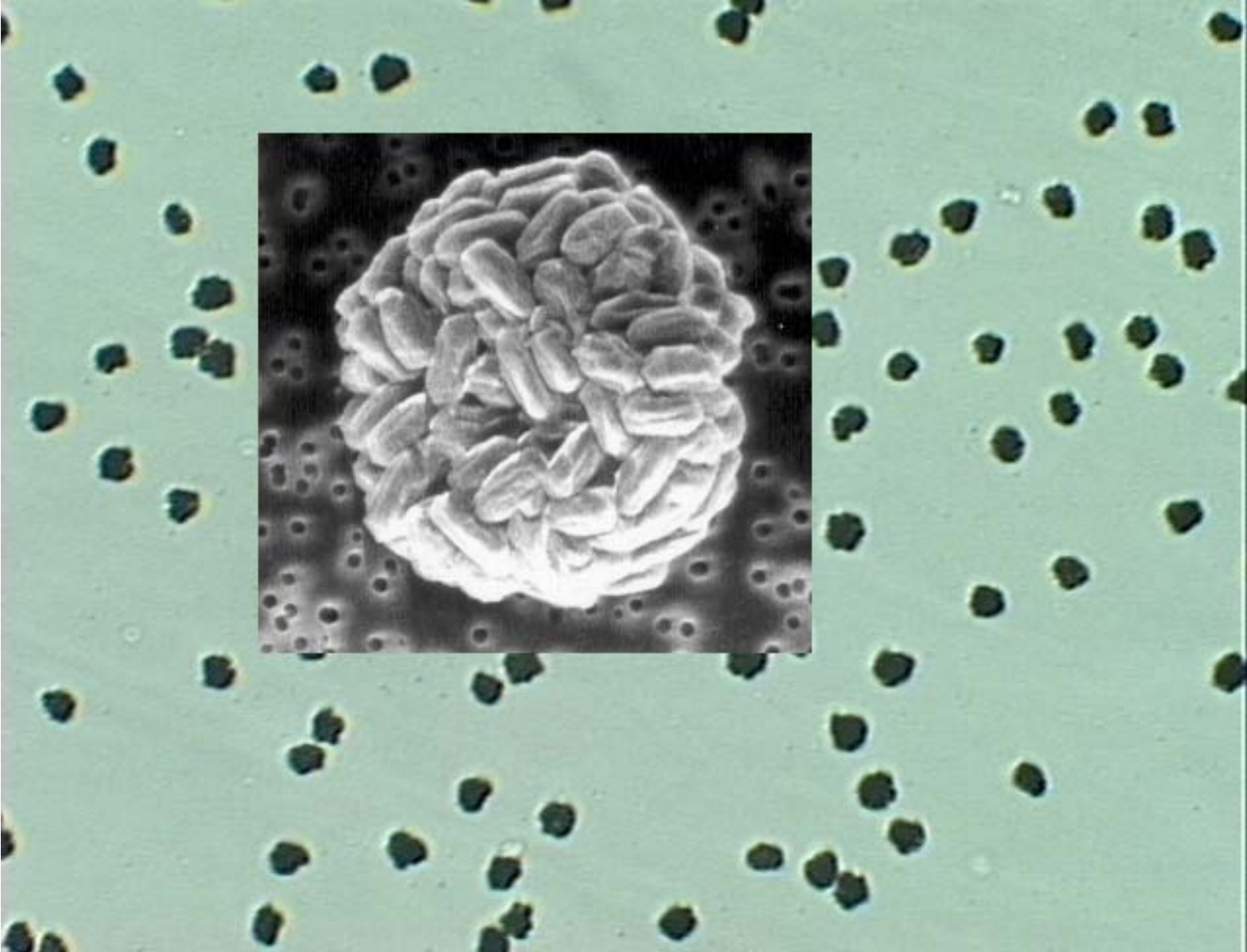
- Generation
  - Generated using 36 jet collision nebulizer and sonic nozzle
  - Neutralized
  - Generated 0.5, 1, 2, 5, and 6 micron blue or green fluorescent particles
- Analysis using a fluorometer
  - Use appropriate excitation and emission filters to detect blue or green
- Analysis using a Coulter counter
  - Install appropriate orifice tubes to measure small particles

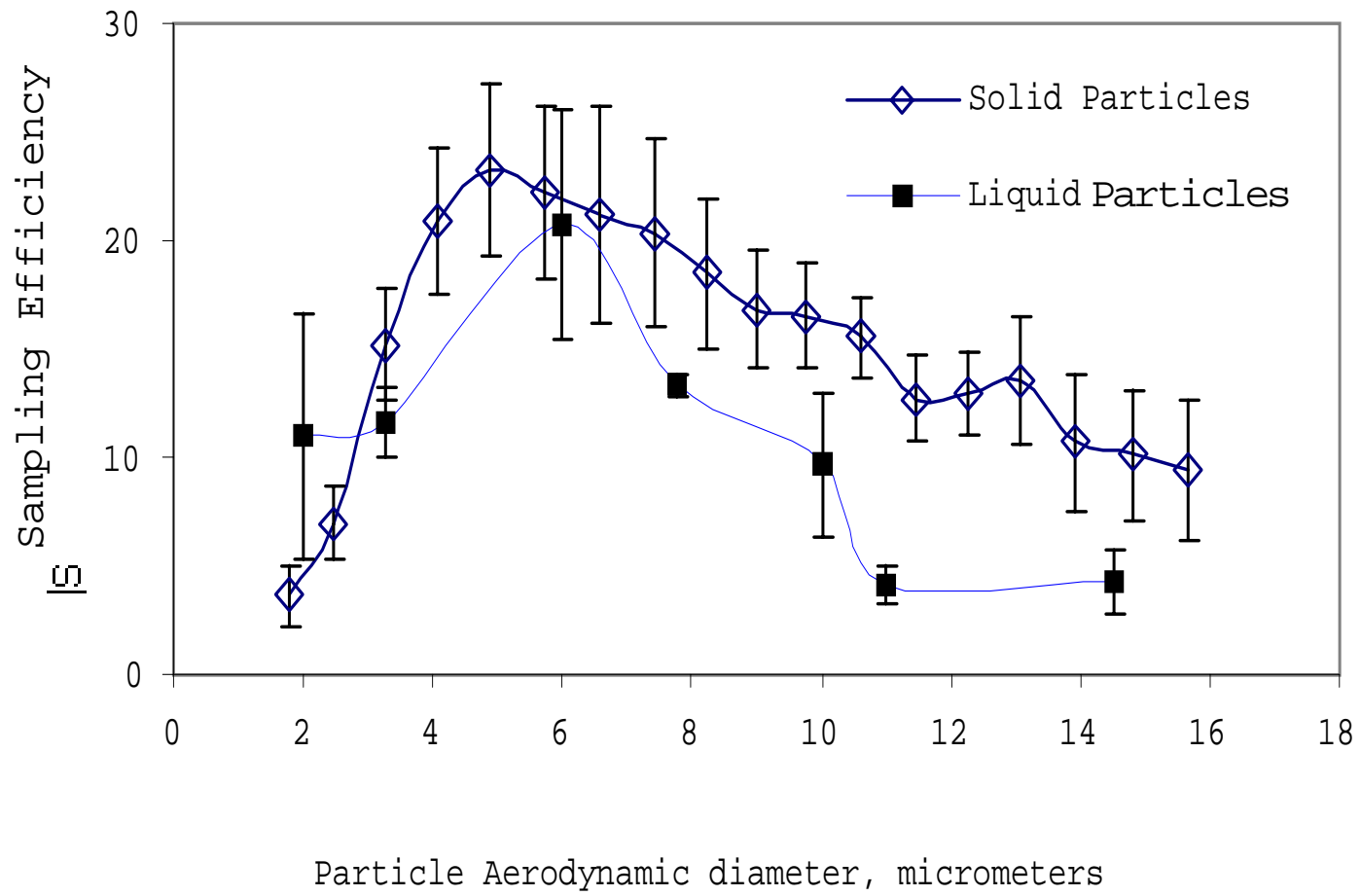
## Bg and Yeast extract

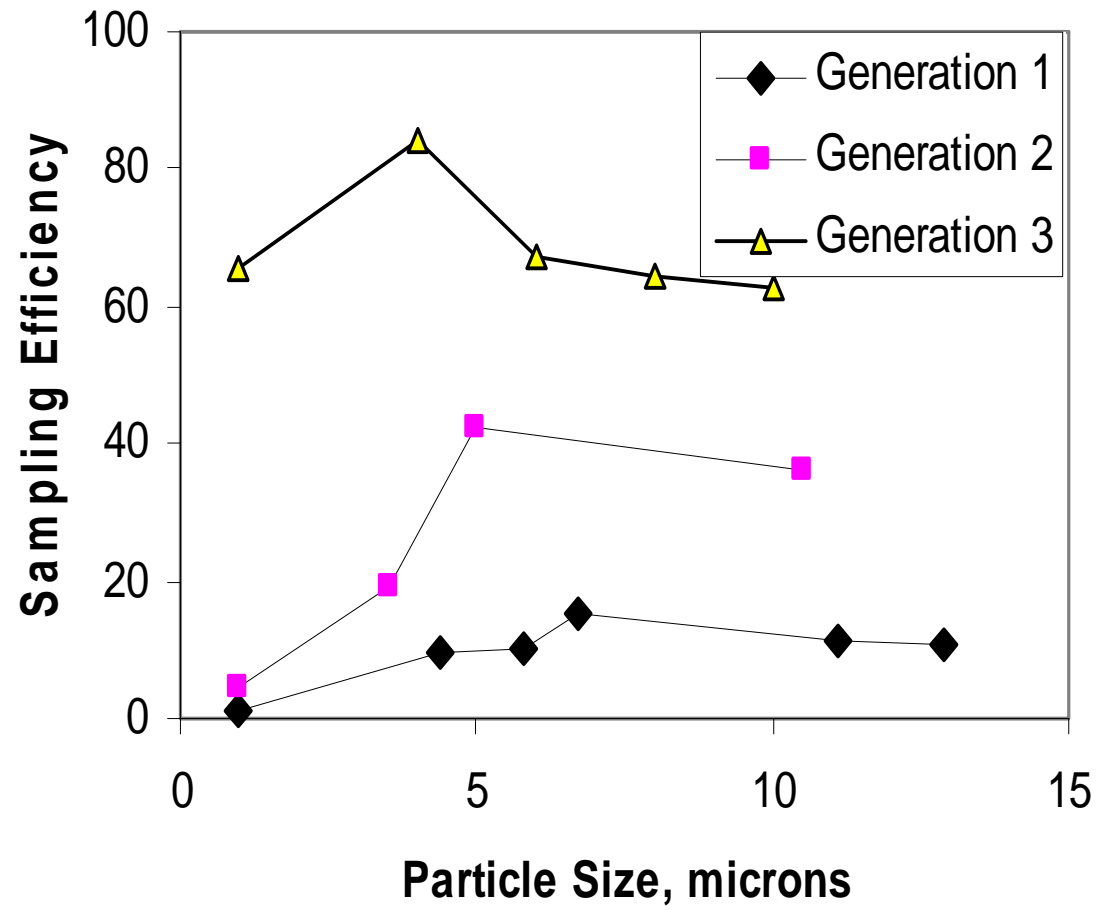
- Generated using puffers, bubblers, nebulizers, sonic nozzles and IJAG
- Analysis by APS, culturing, PCR, and Coulter counter method







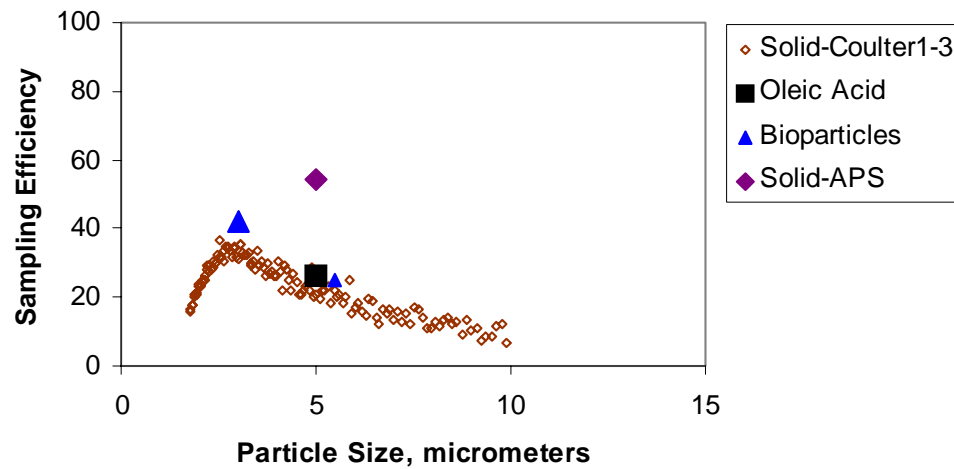




# XMx/2A



XMx/2A

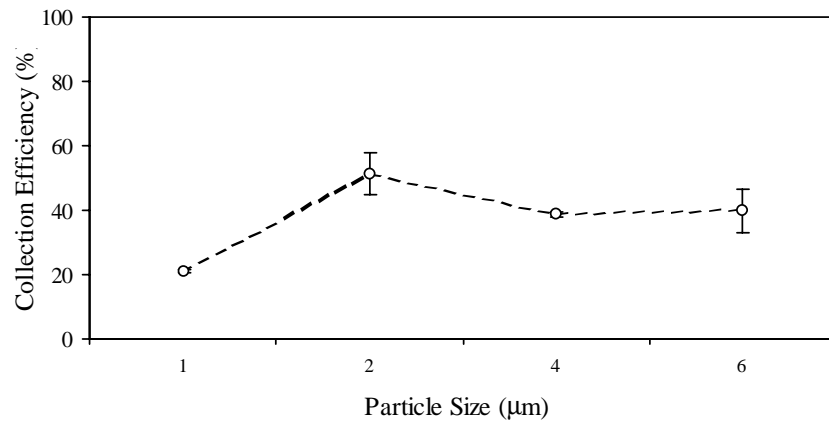


Characteristics	
Air sampling rate (L/min) Minor air flow (Inlet) (L/min)	742 0.4
Dimensions (inch) Size Length Width Height	8.5 18 18
Weight (lb, oz)	24, 12
Power, Watts Voltage, Volts Current, Amp	780 115.6 6.99

# BioGuardian<sup>®</sup> 1.02



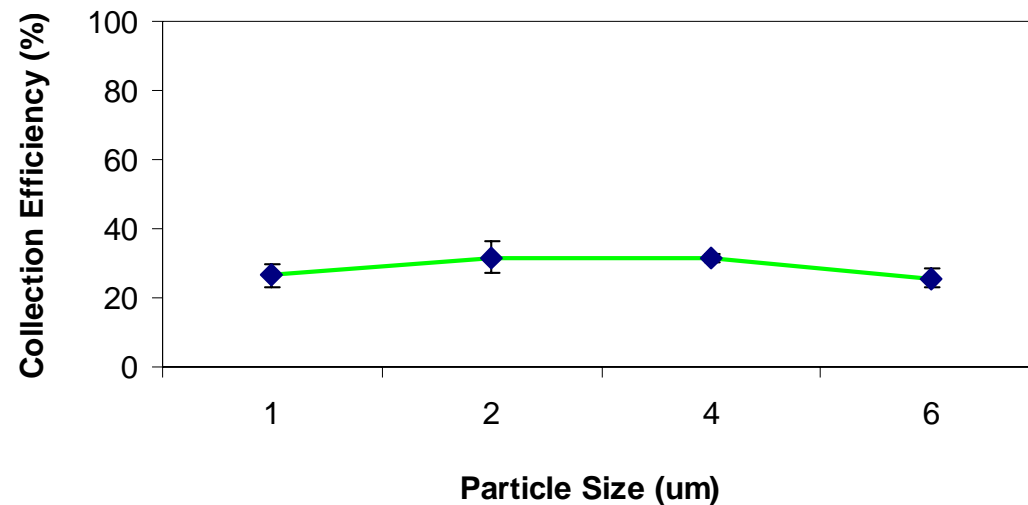
	BioGuardian <sup>®</sup> 1
Number of Cyclones	1
Designed air flow rate (L/min)	90
Measured air flow rate (L/min) (measured at ECBC)	88
Power, measured at (Watt) (measured at ECBC)	57.5
Weight (lbs)	17
Dimensions (inch)	Length = 11 ¾ Width = 11 . Height = 17 ¼
Sample Volume, (mL)	7.7 ± 0.5



# BioGuardian<sup>®</sup> 12.02



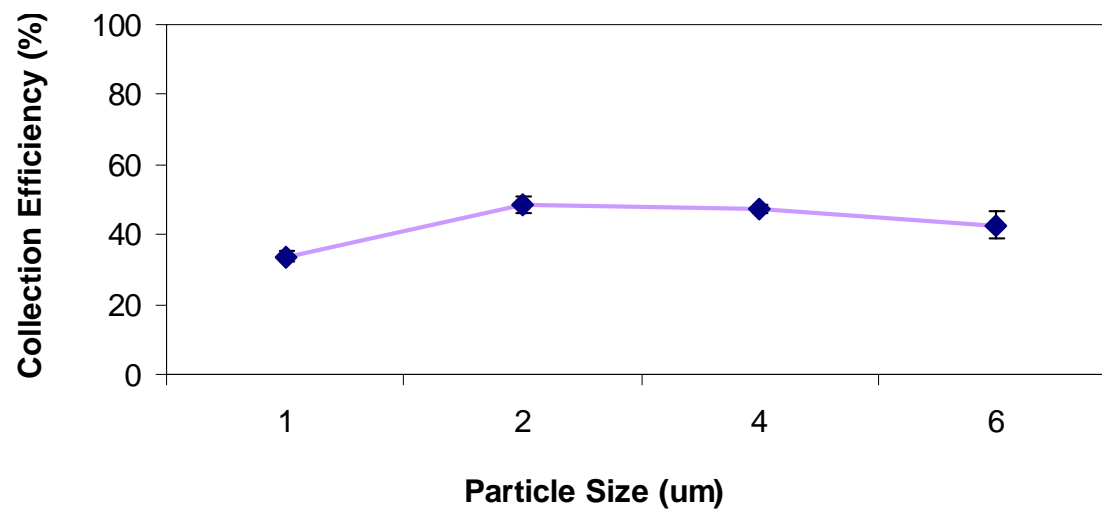
	BioGuardian <sup>®</sup> 12
Number of Cyclones	12
Designed air flow rate (L/min)	1100
Measured air flow rate (L/min) (measured at InnovaTex)	1000
Power, measured at (Watt) (measured at ECBC)	421
Weight (lbs)	>75
Dimensions (inch)	Height = 25 Diameter = 14.5
Sample Volume in 10 min, (mL)	12.6 ± 2.3



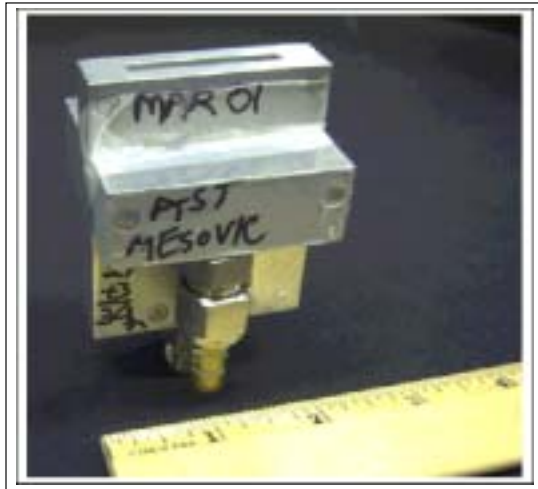
# BioGuardian<sup>®</sup> 4.02



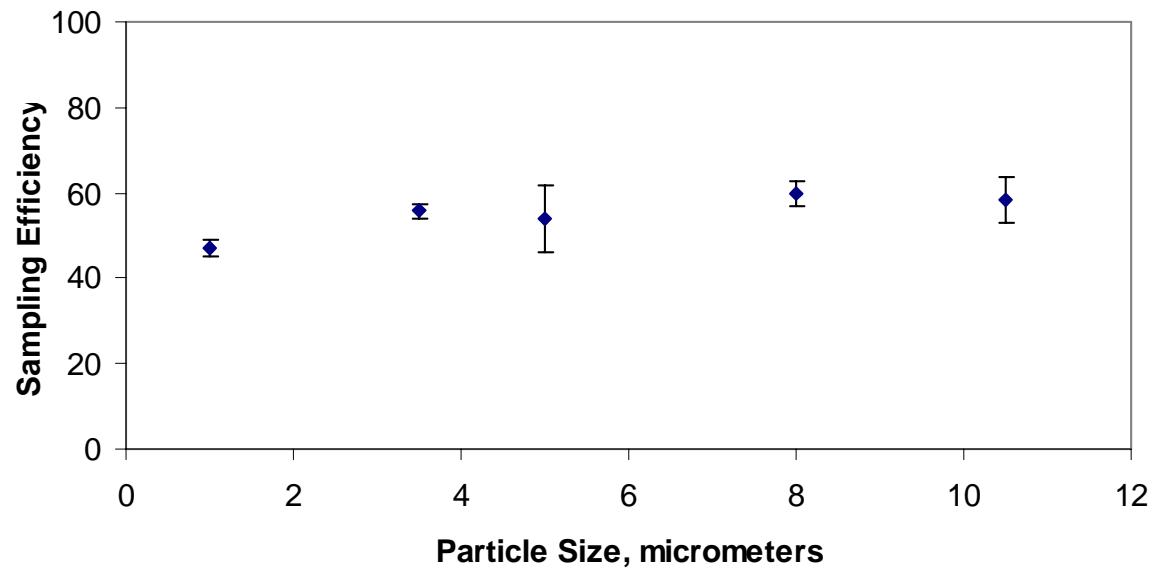
	BioGuardian <sup>®</sup> 4
Number of Cyclones	4
Designed air flow rate (L/min)	350
Measured air flow rate (L/min) (measured at ECBC)	350.9
Power, measured at (Watt) (measured at ECBC)	137
Weight (lbs)	32.5
Dimensions (inch)	Length = 12 Width = 10 Height = 18
Sample Volume in 10 min, (mL)	11.6 ± 1.3



# Microvic™ Aerosol Concentrator



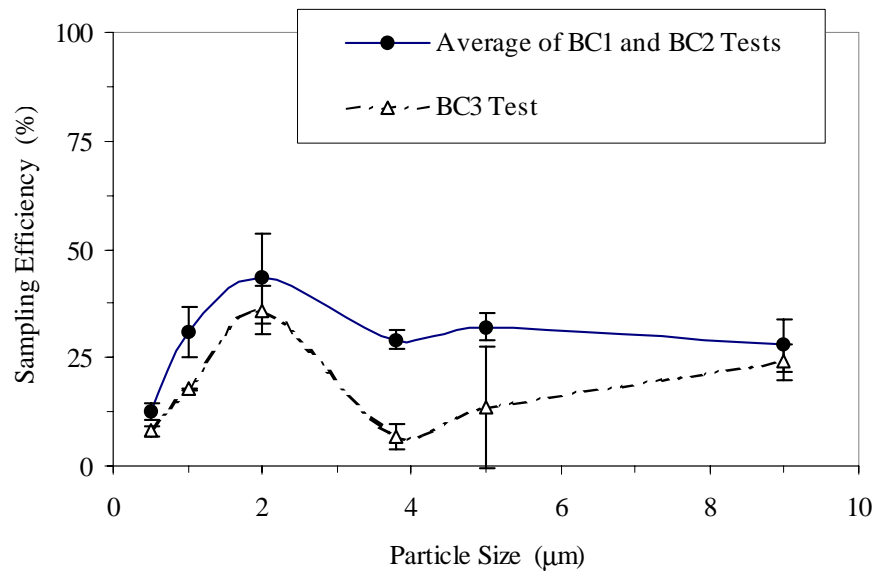
Air sampling rate: measured, L/min	30
Overall dimensions, inch	
Length, inch	2
Width, inch	2
Height, inch	2.5
Weight, lb	11/16
Power consumption	Lab pumps were used



# BioCapture™ BT-550 Aerosol Sampler



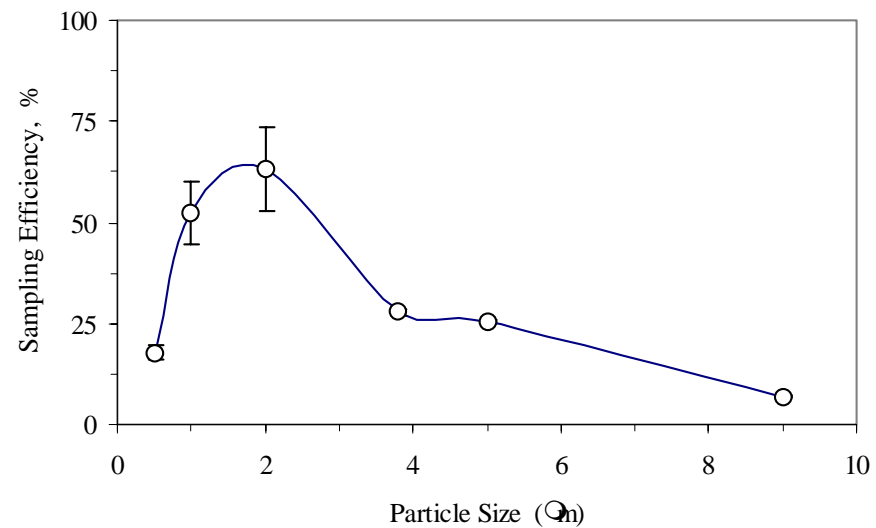
Measured air sampling rate, L/min	150
Overall dimensions, inch	12
Length	6
Width	8
Height	
Power, W	Battery operated
Weight, lb	10



# MicroVic® Aerosol Concentrator



Measured air sampling rate, L/min	423
Overall dimensions, inch	
Length	19
Width	9
Height	29.5
Power consumption, W	323
Weight, lb	24.7



# PHTLAAS Air Sampler



Air sampling rate, L/min	317
Sampling time, min	10
Liquid volume input, mL	50
Average liquid volume output ( $\pm$ std dev), mL	$35.3 \pm 3.5$
Power, Watts	85.3
Voltage, Volts	123.6
Current, Amps	1.1
<u>Particle Size (<math>\mu\text{m}</math>)</u>	<u>Sampling Efficiency (%)</u>
	$65.7 \pm 3.0$
1	$84.3 \pm 4.2$
4	$67.5 \pm 3.7$
6	$64.3 \pm 4.6$
8	$62.5 \pm 1.9$
10	

