Evaluation of Ambient Air Samplers for Biological and Radioactive Aerosol Monitoring

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Need for Radioactive and Biological Aerosol Sampling

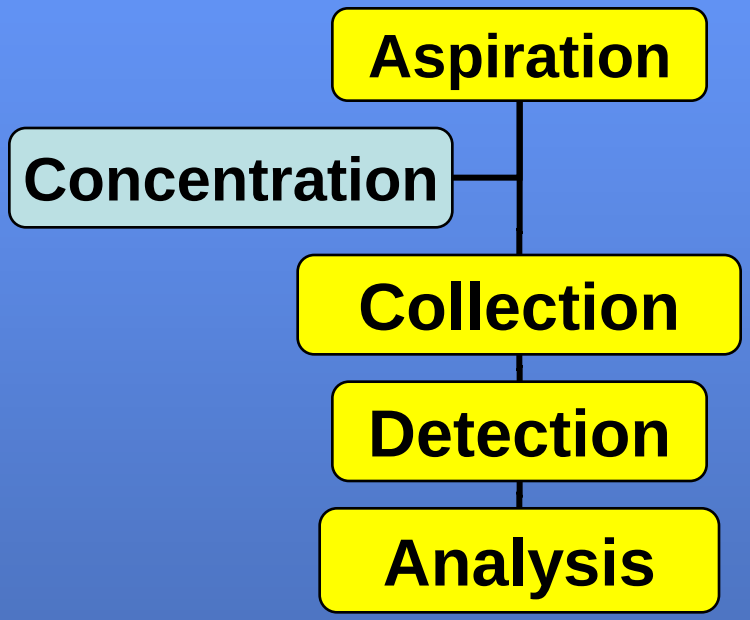
Radioactive

- Industrial Hygiene
- Detection of Nuclear Tests or Accidental Release
- Environmental Regulations
- And, now Homeland Security

Biological

- Industrial Hygiene
- Homeland Security

Steps to Airborne Radionuclide and Biological Agent Detection



Ideal Sampler

- Sample only Particles of Desired Size (e.g.,0.5 μm -10 μm)
- Provide Representative Sample
- Performance Independent of
  - wind speed,
  - turbulence scale and intensity and
  - extraneous air borne matter (rain, snow, insects, debris, etc.)

(Cont'd)

Ideal Sampler (cont'd)

- **Zero False Alarm**
- **Real Time Results**
- **And much more (light weight, low power consumption, portable, etc.)**

- 40 CFR 53 – Testing of Samplers for Air Quality Monitoring

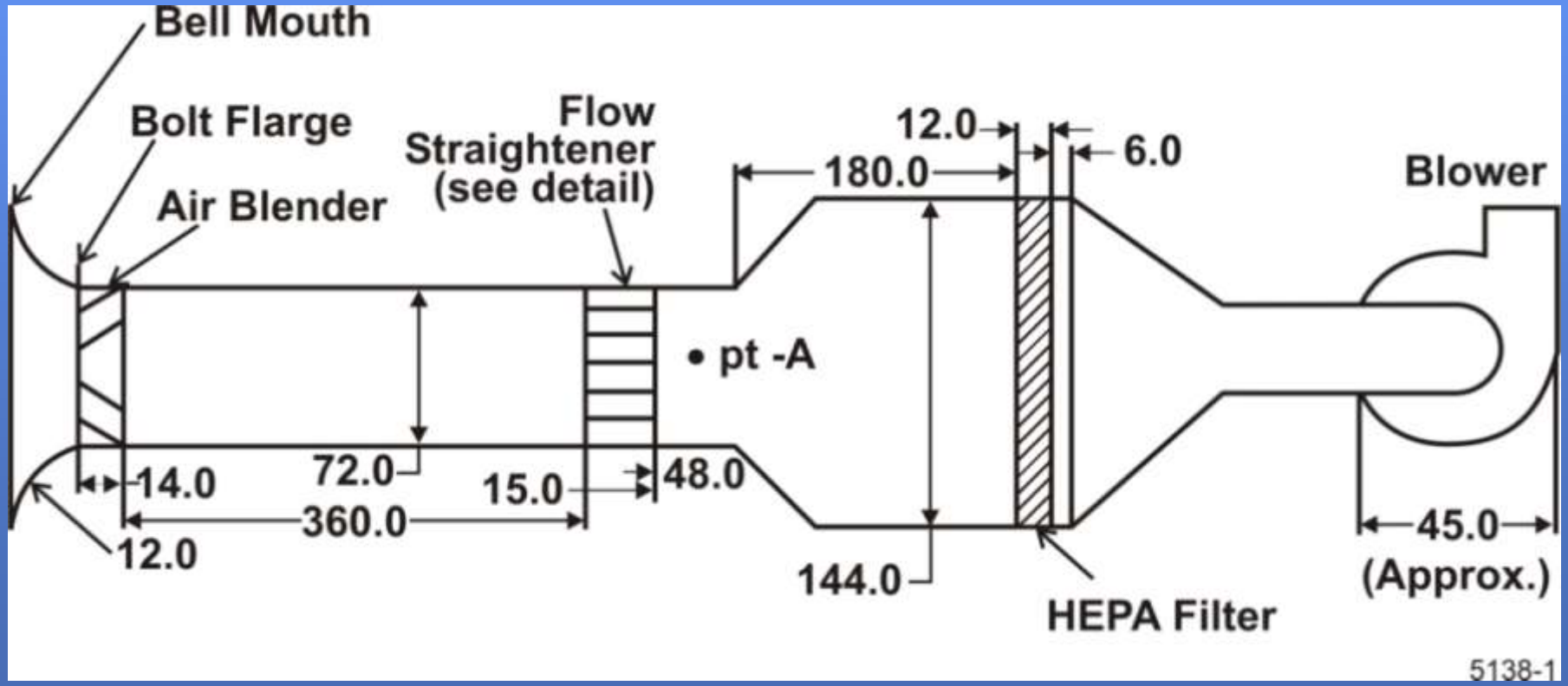
Wind Tunnel Evaluation

1. Determine their Collection Efficiency as a Function of Wind Speed and the Particle Size using Liquid/solid test aerosol
2. Identify the areas with particle losses
3. Determine the Aspiration Efficiency of the sampler
4. Determine Collection Efficiency using Simulants for Bioaerosol Samplers (e.g., Bacillus Subtilus (BG))

LRRI Wind Tunnel Facilities

	North Facility	South Facility
Wind Speed	0.5 m/s-7m/s	0.5-m/s - 24m/s
Test Section	12’ x 12’	2.5’ x 2.5’ (1’ dia.- higher wind speed)
Mixing Device	Air Blender	Stairmand Disc
Test Aerosol Used	Liquid/Solid Particles	Liquid/ Solid Biological Agent

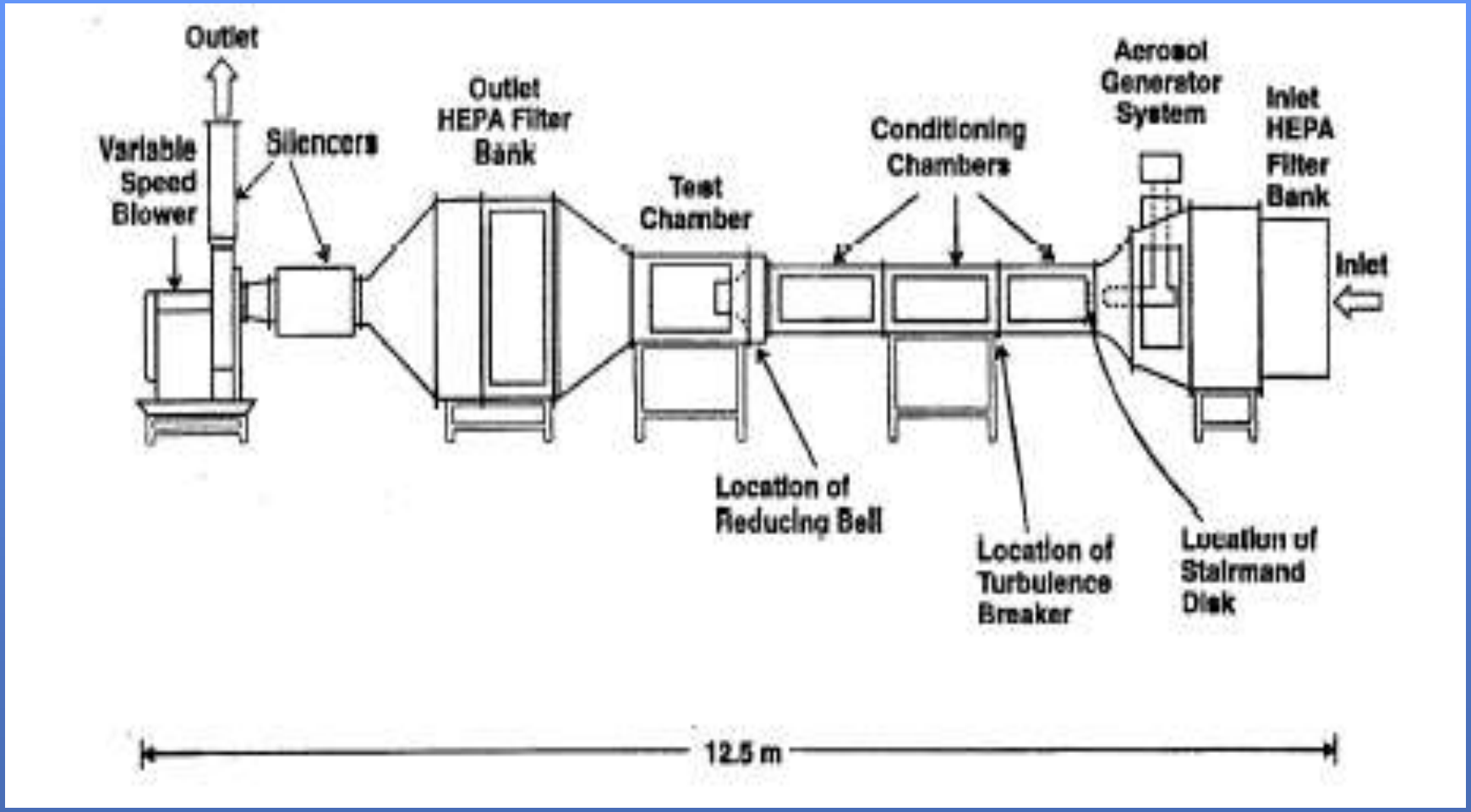
Wind Tunnel- North



Aerosol Wind Tunnel - North

Test Section- Wind Tunnel North

Wind Tunnel- South



Radionuclide Samplers Tested at LRRI

RASA- PNL

Snow White

Lab Impex CMS 2000

RADOS CAM-03

MGP Alpha CAM

Eberline Alpha 7L

Eberline Alpha CAM

PERFORMANCE EVALUATION

- Sampling Efficiency:
  - ≥ 50%
- Homogeneity of Particle Collection
- Response Time
  - Pu aerosol challenge
- False Alarm Rate
  - Radon background
- Air In-Leakage
  - <10%

Bio-Samplers Tested at LRRI

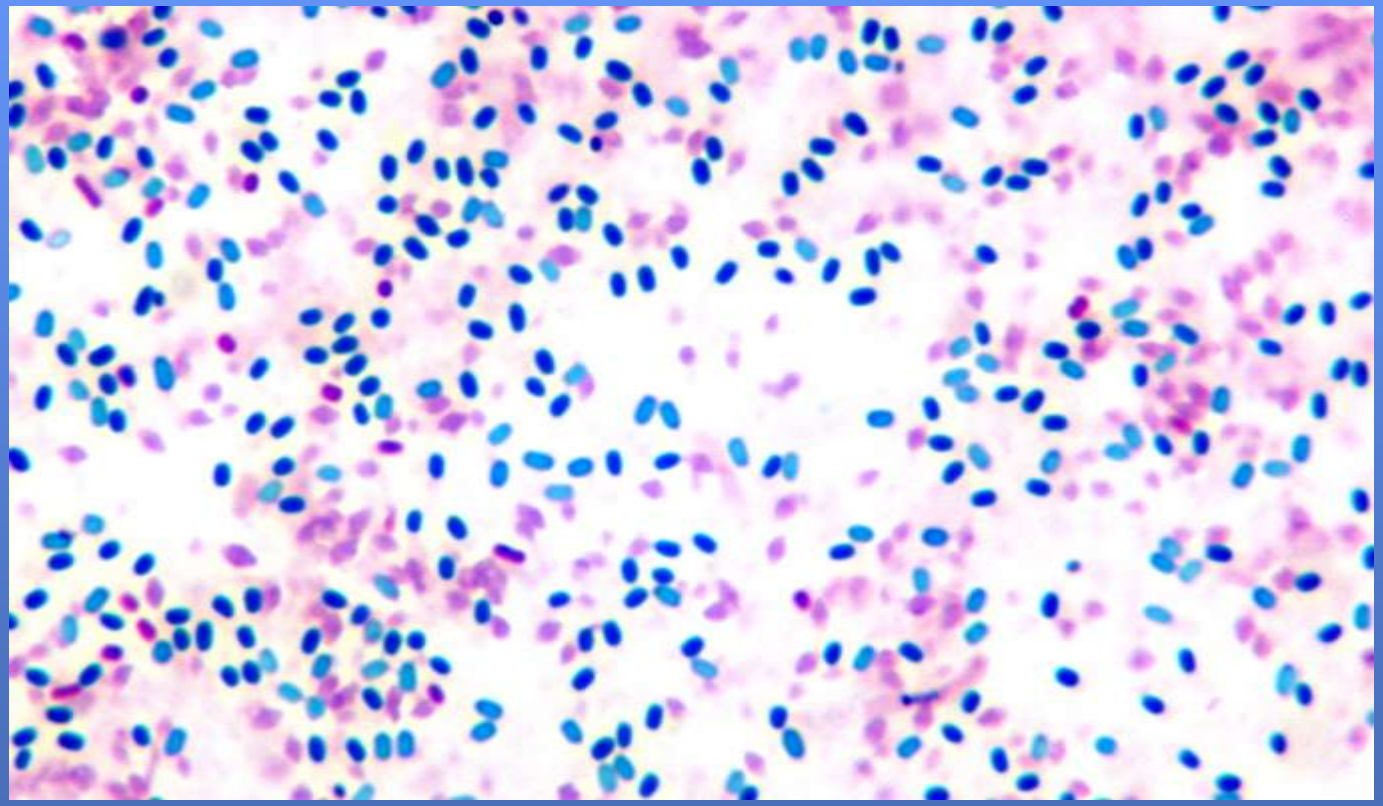
XMX

ASAP-PM10

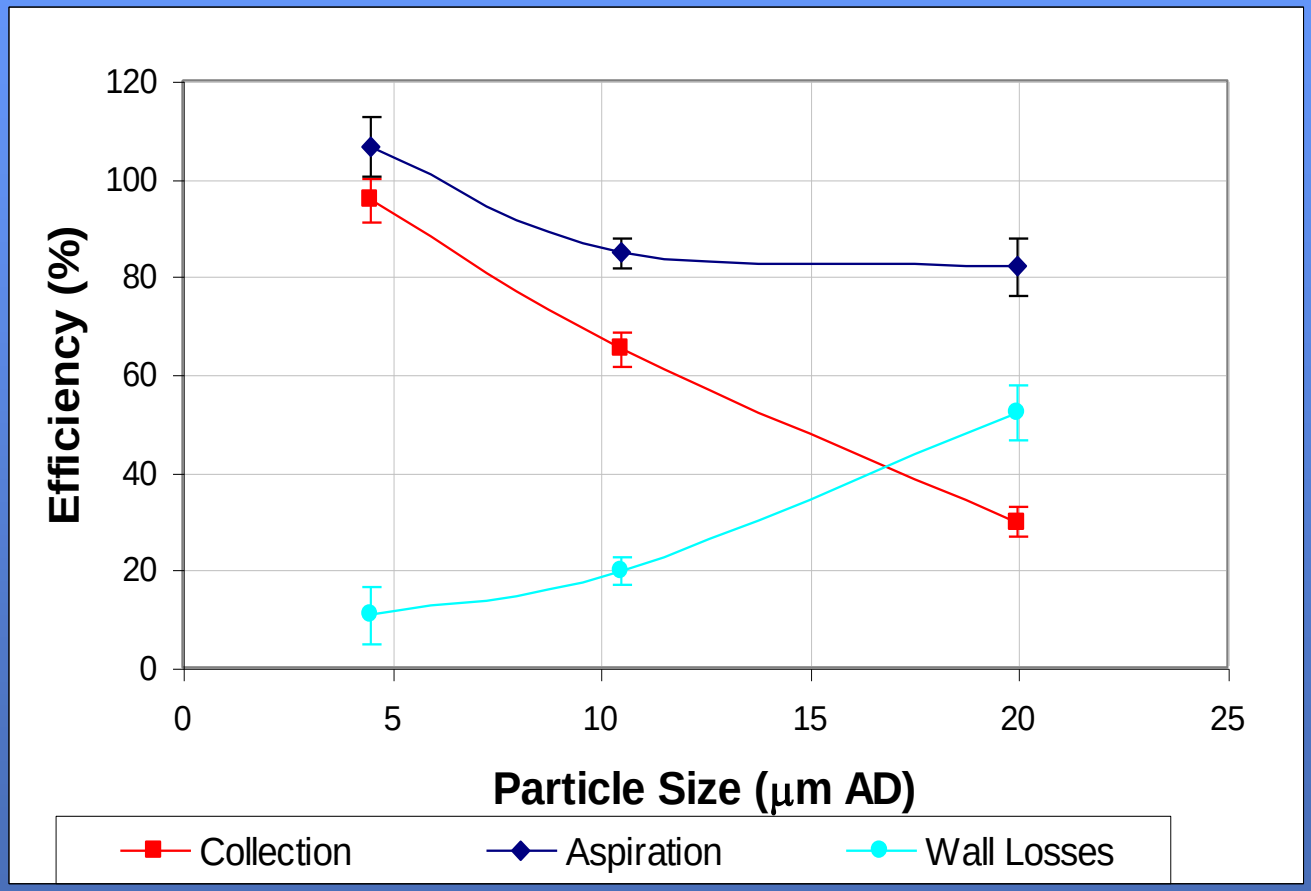
PSU-2

Bacillus Globigii (BG)

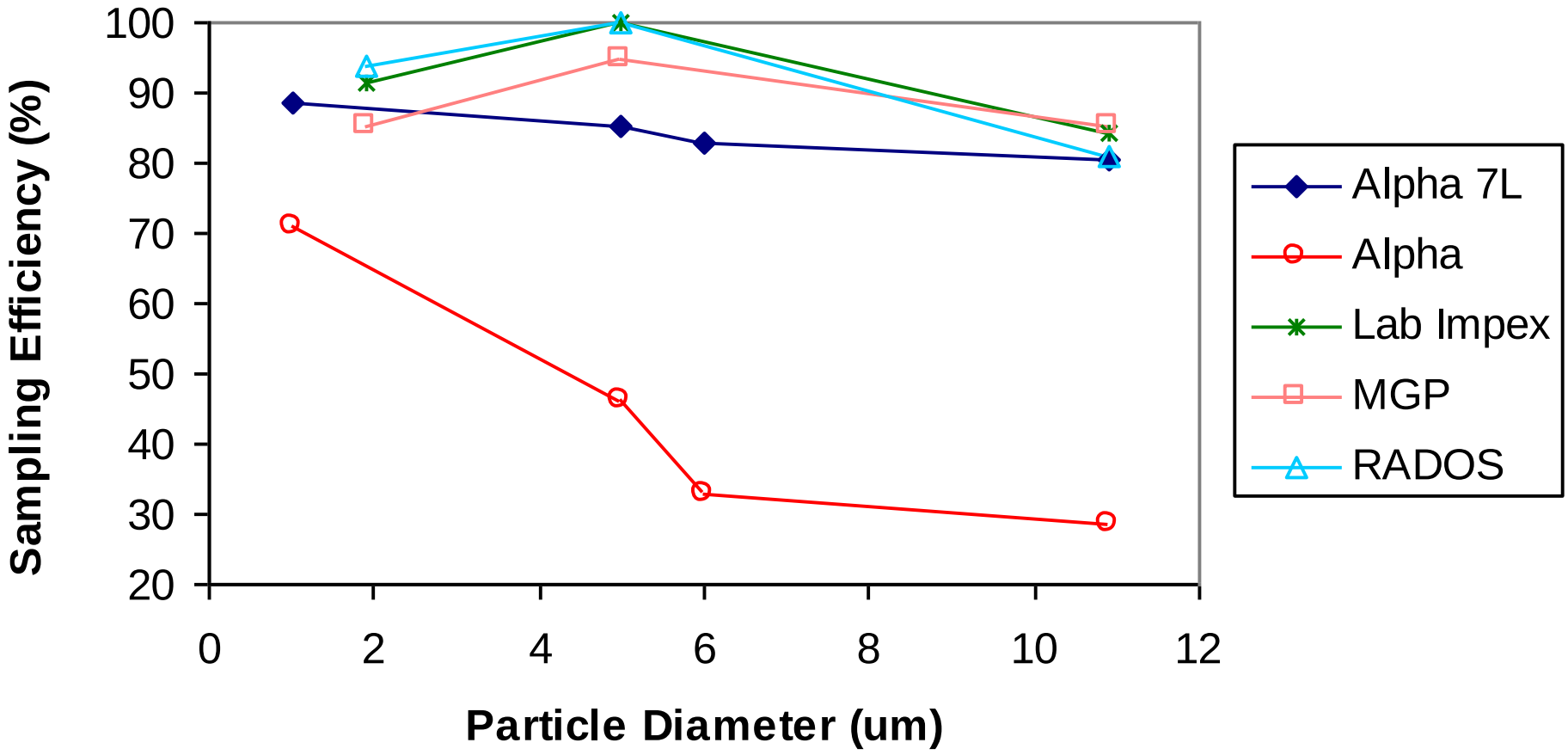
Bacillus Thurungenesis (BT)



Typical Results for a Radionuclide Sampler

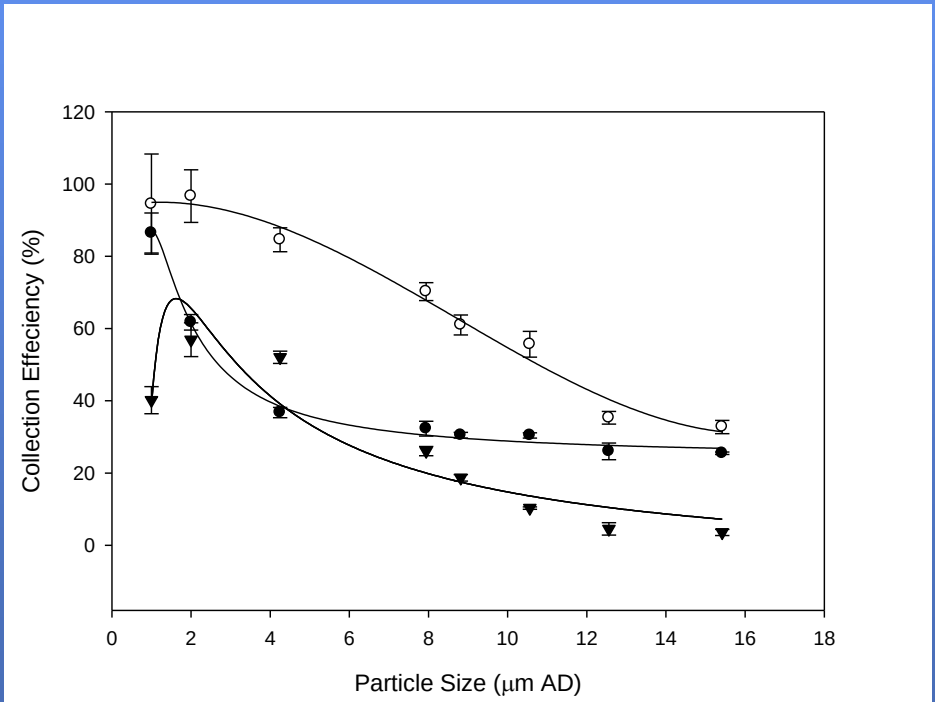


SAMPLING EFFICIENCY

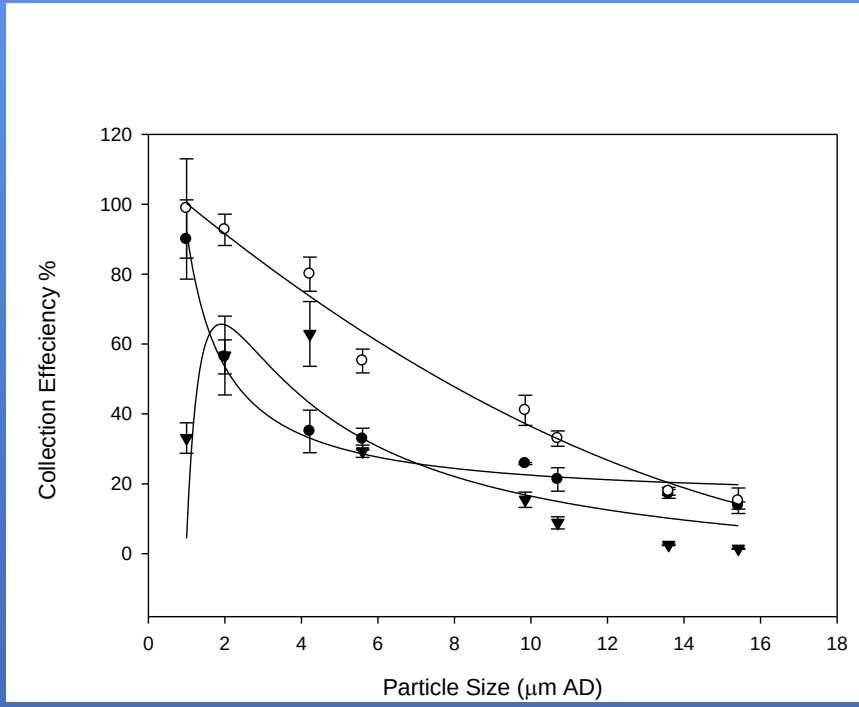


Typical Results of Bioaerosol Samplers

2 km/hr



8 km/hr



Particle Sizing and Aerosol Concentration

- Two TSI Aerodynamic Particle Sizers
- API Aerosizer
- TSI DustTrak
- Microscopes for Particle Sizing
- Andersen Impactors
- Insitec PCSV (Particle Counter Sizer Velocity Meter)

Analysis

- Gravimetric Analysis
- Fluorometric Analysis
- PCR
- ELISA
- Growth Media Culture
- Epifluorocsent Microscopy

Summary

- Performance Evaluation is an important step for Radioactive and Bioaerosol Samplers
- LRRI has complete facilities and expertise for the wind tunnel testing of Biological Agent Samplers.
- Two aerosol wind tunnels can accommodate different size and multiple aerosol samplers