RESEARCH ON RESPIRATORY PROTECTION

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BRIEF HISTORY

- Funding from NIOSH and other agencies/industries since early 1980s
- Evaluation of newly developed and existing respiratory protection devices
- Development of methods and techniques for testing the performance of respirators and facemasks challenged with inert and biological particles
  - filter media
  - manikin-based experiments
  - experiments with human subjects
- Development and evaluation of User Seal check procedures and fit test methods

IMPACT

- 58 peer-reviewed publications on respiratory protection since 1975
- Development of CNC-based quantitative fit testing method (Willeke 1981)
- Evaluation of dozens newly-developed and commercially available respirators and facemasks – data generated for federal agencies and manufacturers
- Committee work (ANSI Z88, Z88.6, Z88.7, Z88.10; AIHA Respiratory Protection Committee, etc.)
- Training of graduate students:
  - 25 MS students; 6 PhD students
  - 10 Postdoctoral fellows

IMPACT
(continued)

- Continuing education courses on Quantitative Fit Testing and Worker Training (>10 courses/year) :
  - In-house (clinic) and on-site
  - Provided to Local & Regional Companies

LABORATORY STUDIES

RECENT EXAMPLES:

- Penetration of biological vs. non-biological particles through respirator filters
- Penetration of viruses and nanoparticles through respirator filters
- Simulated workplace protection factor study for N95 filtering facepiece vs. surgical mask (0.3 -1 µm particles)
- Evaluation and use of a novel Breathing Recording and Simulation System (BRSS):
  - Particle penetration pathways (filter vs. faceseal)
  - Realistic breathing patterns
- Development of novel respirators with specific properties
- Evaluation of user seal checks

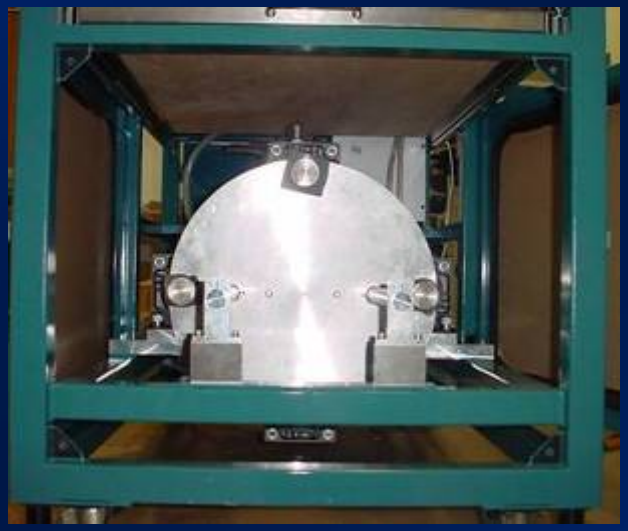
SMALL TEST CHAMBERS
Fit inside Biosafety Cabinet, BL-2

2.75 m^3 CHAMBERS

WALK-IN CHAMBER (24.3 m^3)

BREATHING SIMULATOR (Koken Ltd, Japan)

① Table Top



③ Front View

② Control Panel

④ View from Back

Photographs courtesy of Mr. Haruta

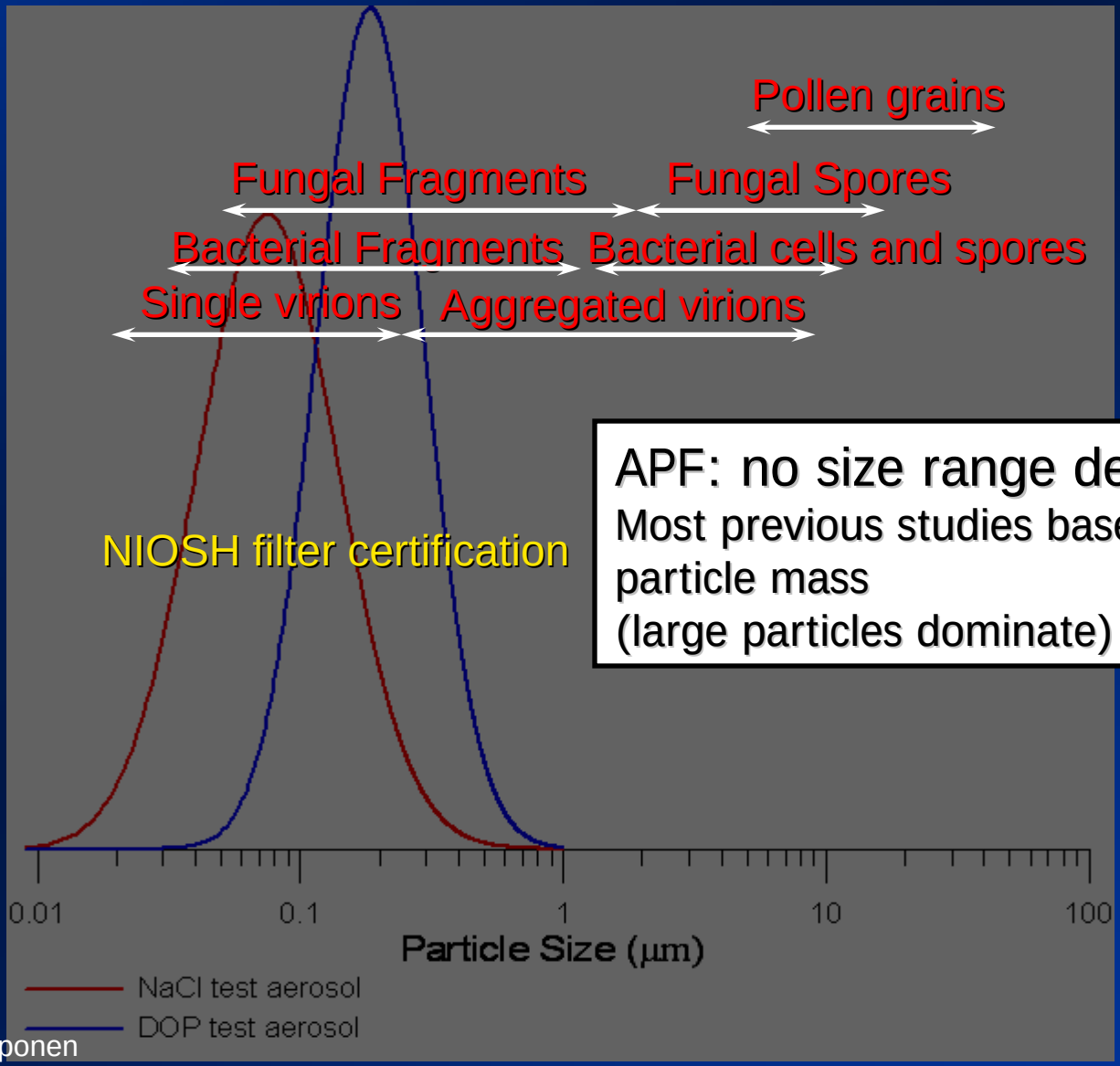
EFFICIENCY OF RESPIRATORS AGAINST BIOAEROSOLS IN AGRICULTURAL WORKPLACES

NIOSH RO1-OH-04085

BACKGROUND

- Farmers are exposed to high levels of bioaerosols
- No general guidelines for respiratory protection against bioaerosols in agricultural workplaces
- N95 filtering facepiece respirators are commonly used
- No previous data on WPF (workplace protection factors) against bioaerosols

SIZES OF BIOLOGICAL PARTICLES

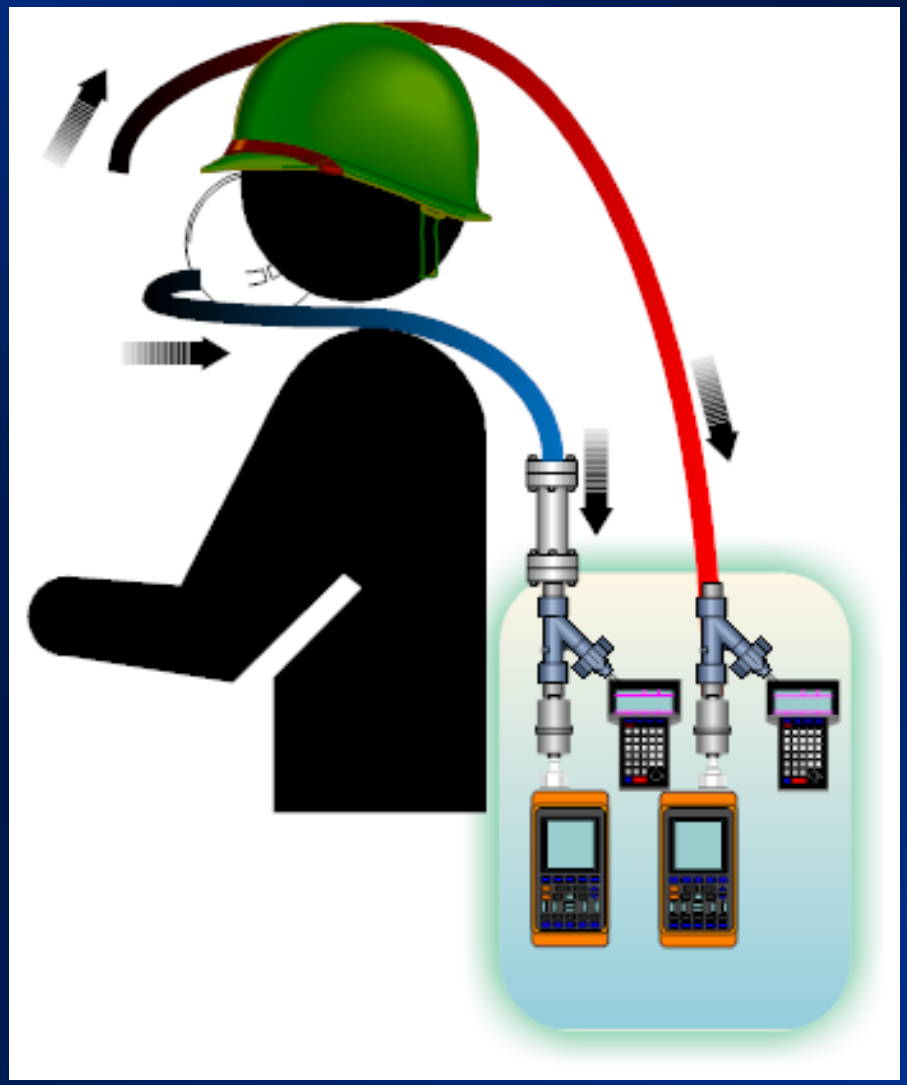


APF: no size range defined

Most previous studies based on particle mass

(large particles dominate)

NEW SET-UP FOR MEASURING WPF AGAINST BIOAEROSOLS



Lee et al. Aerosol Air Quality Res. 4:55-72, 2004

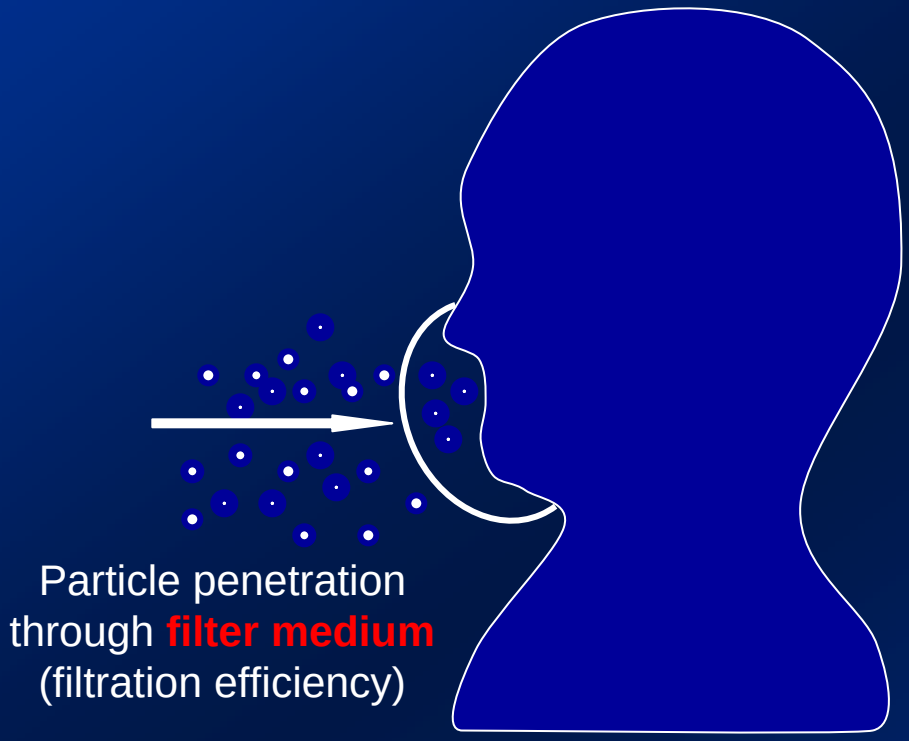
MAIN FINDINGS FROM FIRST PHASE

- WPF decreases with decreasing particle size
- WPF smaller for biological particles than for dust particles
- Exposure reduction for bioaerosols may be smaller than expected from the APF

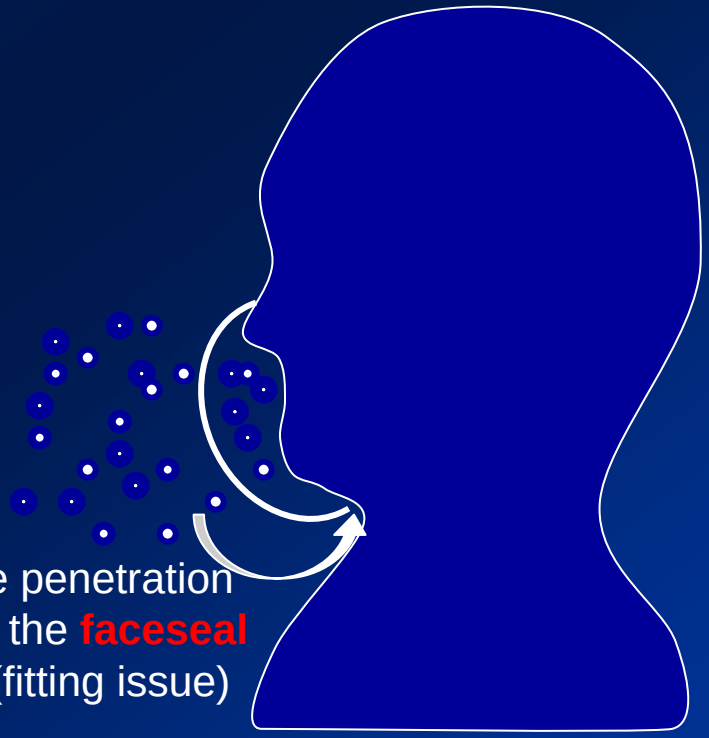
CURRENT FOCUS

- Compare filter and faceseal penetration of biological vs. non-biological particles
- Continue collecting WPF data in the field – including microbial fragments

Performance evaluation: Filter versus Faceseal



Particle penetration through **filter medium** (filtration efficiency)



Particle penetration through the **faceseal leaks** (fitting issue)

How are filter and faceseal penetrations affected by particle characteristics ?

How findings can be used to improve workplace safety and health

- Give information on performance of respirators against biological particles
- Justify the need for developing better fitting respirators.
- Suggest revisions to respirator testing protocols to better evaluate performance
  - against different types of particles
  - under realistic working conditions

Our research supports following PPT Program Strategic Goals:

Goal 1: Reduce exposure to inhalation hazards.

- **Intermediate Objective 1.2:** Develop CBRN respirator standards to reduce exposure to CBRN threats
- **Intermediate Objective 1.4:** Improve reliability and level of protection by developing criteria that influence PPE designs to better fit the range of facial dimensions of respirator users in the U.S. workforce
- **Intermediate Objective 1.5:** Quantify the impacts of various PPE on viral transmission
- **Intermediate Objective 1.6:** Evaluate the nanofiber-based fabrics and NIOSH-certified respirators for respiratory protection against nanoparticles