# Turning Up for Air Quality:

## Particulate
## And
## Aerosol Emissions
## Control for
## Turning and Machining

# Meet Your Speaker

**Mike Meyer**

**Senior Application Engineer, RoboVent**

Mike Meyer has more than 30+ years of experience in the design and installation of non-standard air and other complex industrial ventilation systems and has designed over 1,000 industrial ventilation and air pollution control systems.

Mike currently serves as a Senior Application Engineer for RoboVent. Previously, he was Executive Vice President for Solution Sales and Technical Services.

He is an instructor for the Michigan Industrial Ventilation Conference, sponsored by the Michigan Occupational Safety and Health Administration (MI-OSHA).

# Are emissions from turning and machining operations putting workers at risk?

# Agenda

Particulate and Aerosol Emissions Control for Turning and Machining

Worker Health and Safety

Aerosol (Mists) Collection & Filtration

System Design Considerations

Q & A

# Turning and Machining Emissions: Health and Safety Considerations

# Worker Health & Safety: Turning and Machining

- Respiratory Irritation
- Eye, Nose, Throat & Skin Irritation
- Unpleasant Odors
- Allergic Reactions
- Neurological Damage
- Cancer
- Slip & Fall Hazards
- Possible Combustion and Flammability Risk

# Metalworking Fluid Risks

- Hypersensitivity pneumonitis
- Lipoid pneumonia
- Occupational asthma
- Chronic bronchitis
- Contact dermatitis
- Bacterial infections
- Skin allergies and rashes

# Inhalation Risks Depend On…

- Material Composition
- Particle Size (Thoracic, vs Inhalable vs Respirable - submicron)
- Presence of Additional Particulates, Aerosols, and Vapors (e.g., MWFs)
- Duration and Frequency of Exposure
- Pre-Existing Health Conditions

# Understanding Exposure Limits

- **OSHA**
  - General Industry: 29 CFR 1910 Subpart Z
  - Legally binding Permissible Exposure Limits (PEL's)
- **NIOSH**
  - Non-binding Recommended Exposure Limit (RELs)
- **ACGIH**
  - Non-binding Threshold Value Limits (TLVs)

**Only OSHA PELs are legally binding**

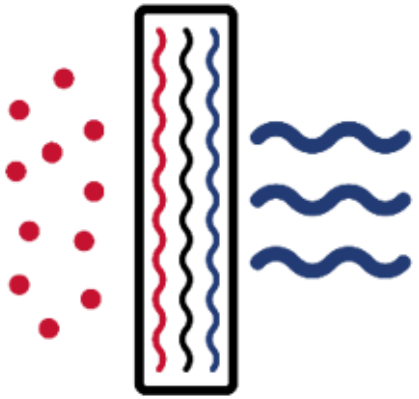
**NIOSH and ACGIH may recommend lower exposure limits based on scientific evidence of health impacts.**

| | OSHA PEL | NIOSH REL | ACGIH TLV |
|---|---|---|---|
| Oil mist (mineral) | 5 mg/m³ | 5 mg/m³ | 5 mg/m³ |
| Hexavalent chromium | 5 µg/m³ [2.5 µg/m³ AL] | 0.0002 mg/m³ | 0.0002 mg/m³ |
| Beryllium | 0.2 µg/m³ [0.1 µg/m³ AL] | | 0.00005 mg/m³ |
| Lead | 0.05 mg/m³ [0.03 mg/m³ AL] | 0.05 mg/m³ | 0.05 mg/m³ |
| Copper | 1 mg/m³ (dusts & mists) | 1 mg/m³ (except fume) | 1 mg/m³ (dusts and mists |

**Know what is in your particulate! Exposures will drive your control system**

OSHA PEL tables: https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1000TABLEZ1

# Protecting Workers from Turning and Machining Emissions



# Signs of a Particulate Problem

- Visible haze in the air
- Halos around lights
- Aerosols/Particulate accumulation on surfaces
- Particulate inside control panels and electronics
- Unpleasant odors to breathe
- Slippery floors


# What Causes the “Haze”

Small particles become airborne…
and stay airborne!

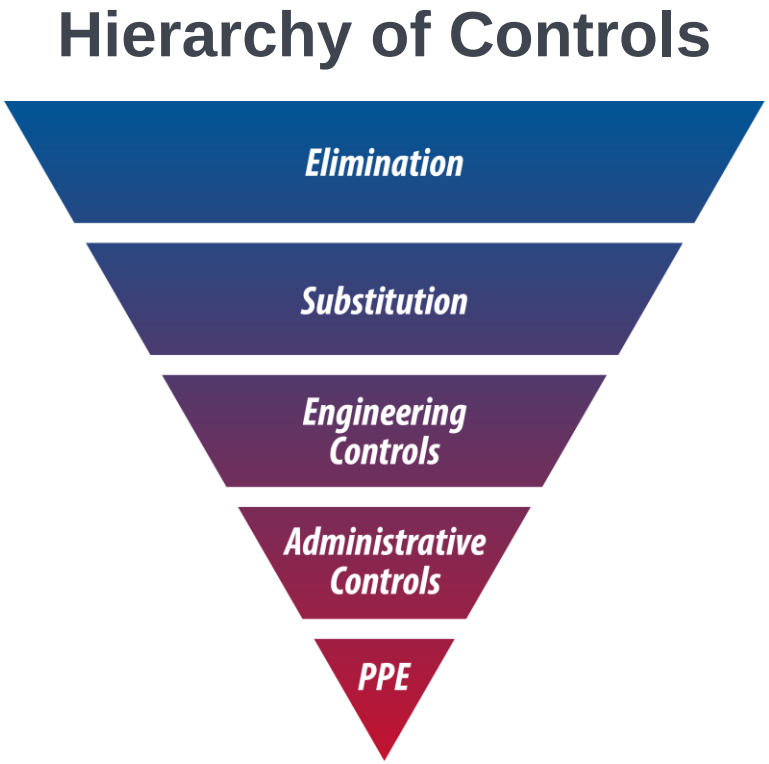
## Settling Velocities in Still Air

| Particle Size (μm) | Settling Velocity |
|---|---|
| 100 | 59.2 feet per minute |
| 50 | 14.8 feet per minute |
| 10 | 7.1 inches per minute |
| 5 | 2.5 inches per minute |
| 1 | 5.1 inches per hour |
| 0.5 | 1.4 inches per hour |
| 0.1 | 1.13 inches per day |

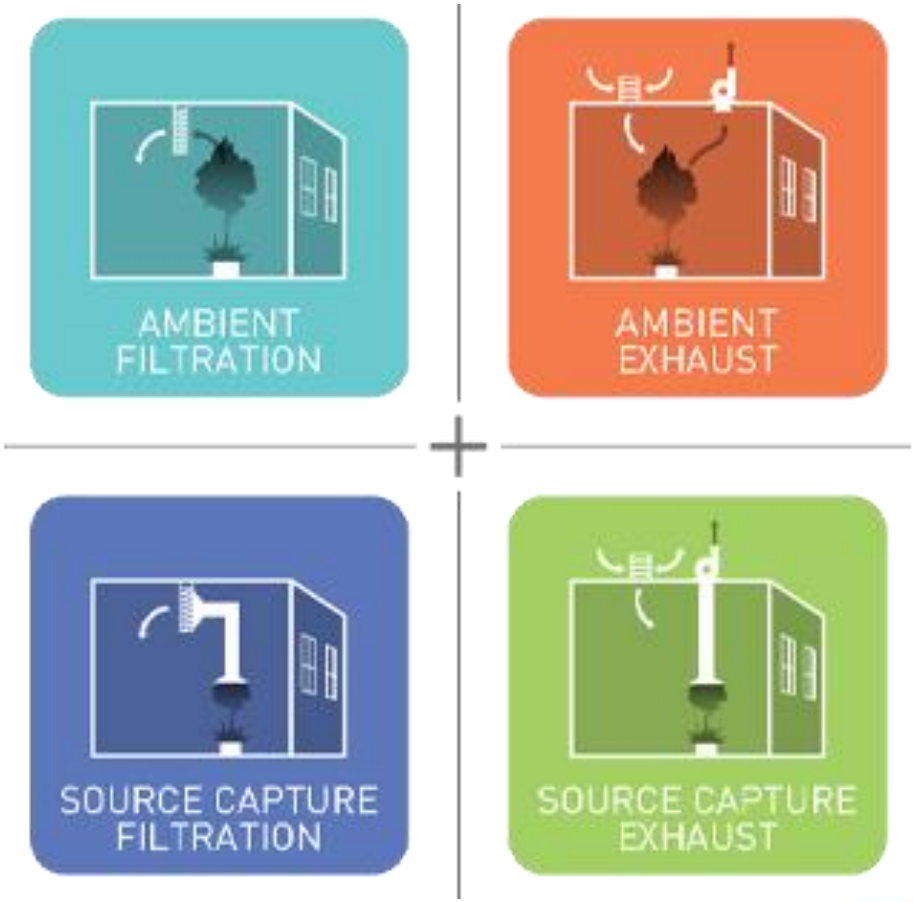
# Can’t I Just Use PPE?

No!

Engineering controls is the Best Practice to mitigate occupational exposure before relying on PPE.



# The Ventilation Matrix

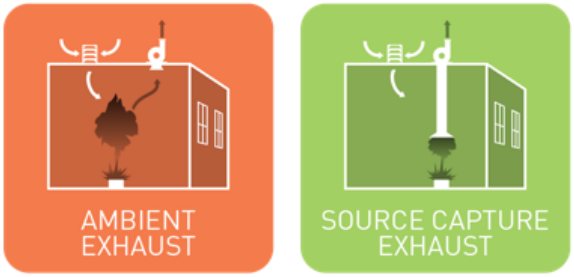



**The Solution may be a combination of approaches to meet air quality goals.**

# Dilution vs Filtration Ventilation

## Simple Exhaust Ventilation System

- Exhausts dirty air to outside
- Brings clean, fresh air in
- Works on DILUTION principle







## Air Filtration System

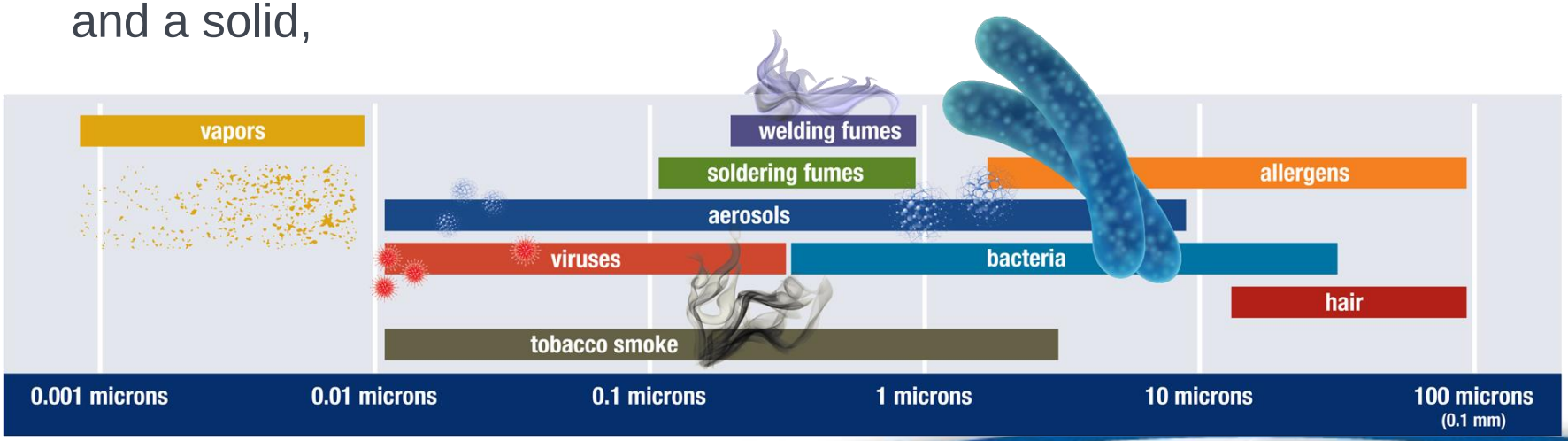
- Filters contaminants out of air
- Returns clean, filtered air to the facility


# Aerosol Control for Turning & Machining

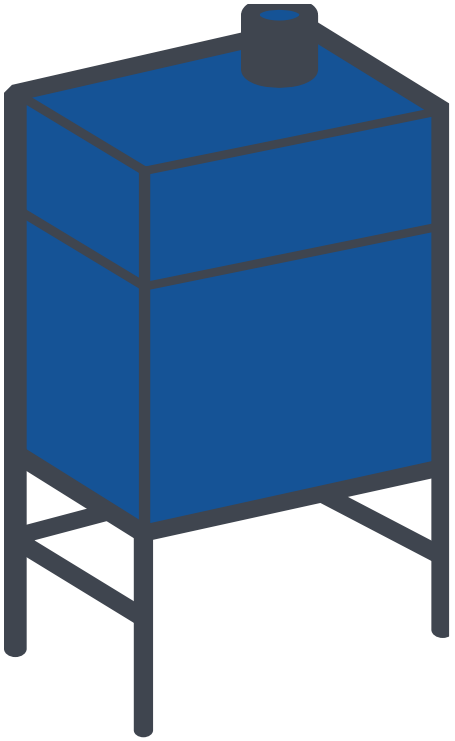
- Your first line of defense against turning and machining emissions is a well-designed, well-constructed, and well-maintained air quality control system.
- A **source capture filtration** solution is recommended
- Can use built-in machine enclosure or separate capture hood
- Filtration strategy must be matched to the particulate and/or aerosol type

# What Type of Particulate?

- Turning metals with MWFs produces a combination of aerosols, vapors and encapsulated solids
- Metalworking Fluids are typically a mixture of oils, water, emulsifiers, rust inhibitors, paraffins,  biocides, buffers, extreme pressure additives, and many others
- Particulates may be wet, sticky, static-y, combination of both liquid and a solid,



# Considerations in Particulate Control System Design



# Your control strategy depends on…

- The volume and composition of particulates generated
  - Types of materials used
  - Production volume
- Human exposures
  - Manual or robotic machining?
  - Humans in the room?

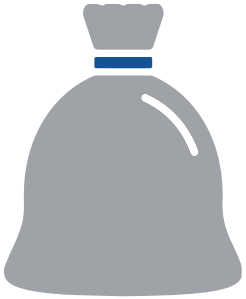
The goal: remove particulates and aerosols from the breathing zone and keep exposures within PELs

# System Design Considerations

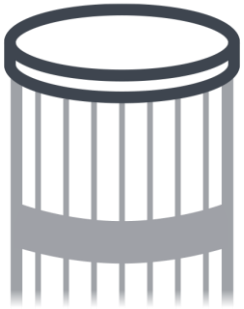
- Particulate Characteristics
- Type of Control Device (Collector)
- Capture/Containment Method (e.g., hood design, airflow, velocity)
- Ductwork Design
- Filter Selection
- Maintenance
- Fire & Explosion Safety
- Regulatory Compliance

# Types of Particulate Collectors

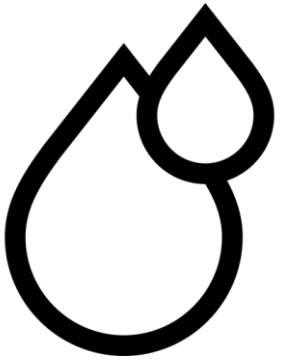
Cyclone



Baghouse



Cartridge



Mist Collector

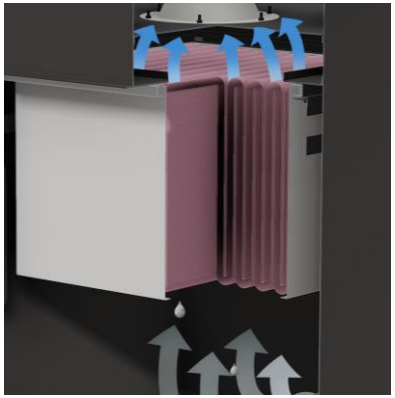
# Filtration Types

## Cartridge Filters

- For dry particulates (Solids)
- Various efficiencies available-MERV 11 to 16
- Various media types available

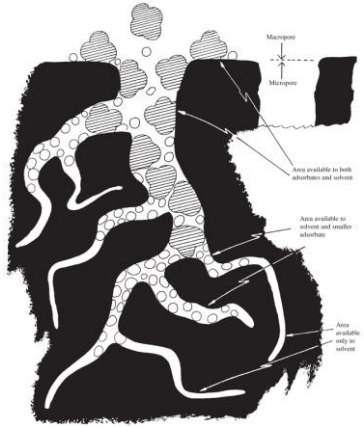
## Oil Mist Filters

- For metal working fluids (Liquids)
- Highly efficient coalescing medias to lofted fiberglass throw-away filters



## Molecular Filtration

- For odors and vapors (Gas-Phase emissions)
- Activated carbon and blended adsorbants



# Aerosol Particulate and Mist Collector

- Use coalescing filters to remove oil mists from air
- Best option for metal turning/machining when process uses MWFs
- May require a dual filtration strategy:
  - Pre-filter to remove solids and other non-soluble solids
  - Coalescing filter to remove oil

# Dry Particulate Cartridge Collector

- Use pleated cartridge filters to filter particulates from air
- Can be designed for a wide range of applications; coarse to ultrafine dusts
- Smaller space and high energy efficiency per CFM
- Best option for machining that generates dry particulates

# Types of Hoods for Source Capture Systems

## Enclosing Hood

Contain the contaminants. Do not let them escape into the manufacturing space!

## Receiving Hood

Take advantage of the motion of the emissions.
*Slinging off of wheel
*Thermal buoyancy

## Close Capture Hood

Locate hoods close. Closer the hood, less airflow required!

# Factors Affecting Air Quality within Manufacturing Space

- Number of Processes Generating Emissions
- Generation Rates of Particulates
- Size of the Manufacturing Space
- Make-Up Air, Exhaust, Supply Air, Spot Cooling systems
- Effectiveness of Current Air Quality Systems
- Chemical Make-up of MWF
- Particle Size of Contaminants

# Industry Guidelines and Regulatory Compliance

- Meet OSHA PEL-TWA's for exposure to hazardous emissions
- Comply with dust collector safety requirements outlined by **OSHA** and **NFPA**
- Designed in accordance with industry best practices including **ACGIH** and **ASHRAE**

**If you do not have in-house expertise in air filtration and ventilation system design, it is best to work with a qualified supplier / firm.**

# THANK YOU

## Questions?

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