Health and Environmental Impact of Particulate Matter - Overview
Fugitive Dust Workshop

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Dust dəst/noun

1. Dust are fine particles of matter. It generally consists of particles in the atmosphere that come from various sources such as soil, dust mechanically lifted or lifted by weather, volcanic eruptions, and pollution.

"the car sent up clouds of dust"
We Are All Familiar With This!
But There are Many Sources of Dust, Including...

- Burning
- Construction
- Roadwork
- Wind
Dust

1. **Indoor dust** is usually composed of carpet and clothing fragments, flakes of skin, use of aerosols, hygiene products, cooking smoke and smoke from cigarettes, candles, and wood burning.

2. **Outdoor dust** normally consists of agitated soils, industrial activity, wood burning, automotive activity and other air pollution sources, pollen, sea spray, and even volcanic activity.
Dust Propagates!

• Dust moves with air currents until the particle’s weight overcomes the wind’s ability to lift the particle.

• Strong winds keep particles aloft longer.
How Far can Dust Go?

- Large dust often travels short distances.
- But, smaller dust travels farther.
- Dust propelled higher from ground also travels farther.
Who Get Exposed?

- Workers
- People Passing Nearby
- Travelers
- People Living Nearby

Only a partial list.
Why is Dust a Problem?

- Dust can be very small.
- And can have variety of composition.
Dust is Small Enough to Get Deep Into Lungs

Particulate Matter in the Respiratory System

- > PM 5
- PM 1-5
- < PM 1

Scale
- 10 µm
- 1 µm
- 0.1 µm
- 0.01 µm
- 0.001 µm

Coarse → Fine → Ultrafine

PM definitions

- PM_{10}
- PM_{2.5}
- PM_{0.1}

Particle Origin

- Metal fumes
- Seasalt nuclei
- Coal dust
- Coal fly ash
- Tobacco smoke
- Diesel exhaust
- Manufactured NP
Health Impacts

- Respiratory disease
- Scar tissue development limits free breathing
- Blood flow to heart compromised
- Swallowing dust can lead to cancer of esophagus, stomach or intestines.

Construction Dust: THE SILENT KILLER

*23 NEW CASES OF WORK RELATED RESPIRATORY DISEASE DIAGNOSED EVERY DAY

Protect yourself before it’s too late

Dust or fibres enter the body through the nose and mouth (inhaling or drinking)

8,500 new cases of work-related respiratory disease per year

Lungs:
Scar tissue forms in the pleural membrane and the lungs are unable to expand and contract. Breathing can become painful or impossible

35,000 workers have reported breathing/lung problems caused or made worse by work

Oesophagus:
Cancer can develop from swallowing dust or fibres
Past occupational exposure to carcinogens currently accounts for 1 in 20 cancer deaths in Great Britain

Heart:
Blood flow to the lungs can be impaired and cause the heart to enlarge or fail

Stomach / Intestines:
Swallowed dust or fibres build up and may cause cancer
The construction industry has the largest burden of occupational cancer, attributing to 3,500 cancer deaths and 5,500 cancer registrations each year
Small Particles and Big Words

Pneumonoultramicroscopicsilicovolcanoconiosis

Huh???

A lung disease caused by breathing silica or quartz dust.

It’s also the longest word in most major dictionaries.

How about Pneumoconiosis?

A condition where dust accumulation in the lungs and the body reacts to its presence.
Different Dusts

- Sand and concrete dust inhalation can lead to Silicosis, an irreparable form of lung damage.
- Wood dust inhalation can lead to allergic reaction or even lung cancer.
- General dusts can lead to Chronic Obstructive Pulmonary Disease (COPD) [*Clogging of the lungs*].
Excess Exposure Risk

Symptoms
• Shortness of breath
• Fatigue
• Fever
• Bluish lips or ear lobes
• Loss of appetite
• Chest pain

At Risk Occupations
• Construction
• Sandblasting
• Mining
• Demolition
• Painting
• Masonry
• Industrial activities
Fewer Health Impacts with Lower PM$_{2.5}$ Air Pollution Concentrations

Figure 4.36: Health Statistical Relationship between PM$_{2.5}$ Exposure and Negative Health Symptoms

Source: NHDES, 2003
Wearing a Mask Protects Me

• True, it protects you, but often only to a degree.
  – Useful life of filter may get exceeded.
  – Sometimes doesn’t filter out the smallest particles.

• But not everybody is wearing a mask.
Breathing Protection

• Face Mask
  – Provides no meaningful filtration

• Dust Mask
  – Can provide protection but must fit snugly on face (no air gaps).
  – Minimal protection for PM$_{2.5}$.
  – Should be replaced after use for task.

• Filter Mask/Respirator
  – Good protection with proper fit and when filter correctly selected for task.
NHDES Monitors Particulate Matter

- Typically measure ambient air exposure in communities.
- Often wood smoke is the greatest concern.
- But have monitored at industrial locations where dust propagation presented public health and nuisance concerns.
National Ambient Air Quality Standard

**PM$_{10}$** 150µg/m$^3$ Average 24-hour exposure  
**PM$_{2.5}$** 35µg/m$^3$ Average 24-hour exposure  
**PM$_{2.5}$** 12µg/m$^3$ Annual exposure

New Hampshire currently meets particle air quality standards, but there are problem areas!

Even short term exposure to PM$_{2.5}$ has been shown to trigger asthma, worsen existing breathing difficulties and trigger heart attacks.
PM\textsubscript{10} Monitored Trends

New Hampshire Maximum 24-Hour PM\textsubscript{10} Averages

NAAQS = 150 ug/m\textsuperscript{3}
PM$_{2.5}$ Monitored Trends

New Hampshire Maximum 24-Hour Fine Particulate Matter Design Values

- NAAQS = 65 ug/m$^3$
- NAAQS = 35 ug/m$^3$
Environmental Effects

• Dust has been scientifically shown to impact crops, grasslands, heathlands, trees and woodlands, and lichen communities.

• Dust may affect photosynthesis, respiration, transpiration of plants and allow the penetration of phytotoxic gaseous pollutants.

• Visible injury symptoms may occur and generally there is decreased productivity.

A.M Farmer, Environmental Pollution, 1991
Environmental Effects

• A layer of dust on the leaves of plants will block sunlight and reduce the plant’s ability to photosynthesize.

• In order to protect the health of plants near dirt roads, construction sites and areas of loose dirt, plant leaves should be cleaned if coated.
Dust and Particles Also Impairs Visibility
(Regional Haze at Mt. Washington)

\[ \text{PM}_{2.5} \approx 5 \mu g/m^3 \quad \text{PM}_{2.5} \approx 22 \mu g/m^3 \]

Which view would a tourist find most rewarding? Would you come back after a bad view?
Questions?