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## Occupational Safety & Health Administration **We Can Help**

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### Chapter 1: Dust and Its Control

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#### What Is Dust?

Dust consists of tiny solid particles carried by air currents. These articles are formed by a disintegration or fracture process, such as grinding, crushing, or impact. The Mine Safety and Health Administration (MSHA) defines dust as finely divided solids that may become airborne from the original state without any chemical or physical change other than fracture.

A wide range of particle size is produced during a dust generating process. Particles that are too large to remain airborne settle while others remain in the air indefinitely.

Dust is generally measured in micrometers (commonly known as microns). Some common objects and their size in microns are listed below.

	$\mu\text{m}$
Red blood corpuscles	8
Human hair	50-75
Cotton fiber	15-30



#### How Is Dust Generated?

Dust is generated by a wide range of manufacturing, domestic, and industrial activities. Construction, agriculture, and mining are among the industries the most to atmospheric dust levels.

In minerals processing operations, dust is emitted-

- When ore is broken by impact, abrasion, crushing, grinding, etc.
- Through release of previously generated dust during operations such as loading, dumping, and transferring
- Through recirculation of previously generated dust by wind or by the movement of workers and machinery

The amount of dust emitted by these activities depends on the physical characteristics of the material and the way in which the material is handled.



Photo of Respirable Dust

#### Types Of Dust

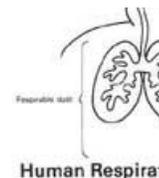
Fibrogenic dust, such as free crystalline silica (FCS) or asbestos, is biologically toxic and, if retained in the lungs, can form scar tissue and impair the lungs' ability to function properly.

Nuisance dust, or inert dust, can be defined as dust that contains less than 1% quartz. Because of its low content of silicates, nuisance



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dust has a long history of having little adverse effect on the lungs. Any reaction that may occur from nuisance dust is potentially reversible. However, excessive concentrations of nuisance dust in the workplace may reduce visibility (e.g., iron oxide), may cause unpleasant deposits in eyes, ears, and nasal passages (e.g., portland cement dust), and may cause injury to the skin or mucous membranes by chemical or mechanical action.



From an occupational health point of view, dust is classified by size into three primary categories:

- Respirable Dust
- Inhalable Dust
- Total Dust

## Respirable Dust

Respirable dust refers to those dust particles that are small enough to penetrate the nose and upper respiratory system and deep into the lungs. Particles penetrate deep into the respiratory system are generally beyond the body's natural clearance mechanisms of cilia and mucous and are more likely to be re

MSHA defines respirable dust as the fraction of airborne dust that passes a size-selecting device, having the following characteristics:

Aerodynamic diameter $\mu\text{m}$ (unit density spheres)	Percent passing selector
2.0	90
2.5	75
3.5	50
5.0	25
10.0	0

## Inhalable Dust

The EPA describes inhalable dust as that size fraction of dust which enters the body, but is trapped in the nose, throat, and upper respiratory tract. The median aerodynamic diameter of this dust is about  $10\ \mu\text{m}$ .



## Total Dust

Total dust includes all airborne particles, regardless of their size or composition.

## Why Is Dust Control Necessary?

Although unavoidable in many minerals processing operations, the escape of dust particles into the workplace atmosphere is undesirable. Excessive dust e cause both health and industrial problems:

- Health hazards
  - Occupational respiratory diseases
  - Irritation to eyes, ears, nose and throat
  - Irritation to skin
- Risk of dust explosions and fire
- Damage to equipment
- Impaired visibility
- Unpleasant odors
- Problems in community relations

Of greatest concern is the health hazard to workers who are excessively exposed to harmful dusts. In order to evaluate the severity of health hazard in a the American Conference of Governmental Industrial Hygienists (ACGIH) has adopted a number of standards, commonly known as threshold limit values ( values are used as guides in the evaluation of health hazards. TLVs are time-weighted concentrations to which nearly all workers may be exposed 8 hours extended periods of time without adverse effects. MSHA uses these TLVs for health hazard evaluation and enforcement.

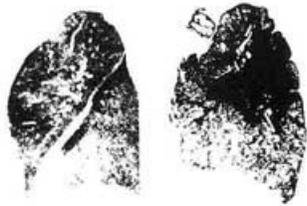
## Health Hazard Factors

Not all dusts product the same degree of health hazard; their harmfulness depends on the following factors:

- Dust composition
  - Chemical
  - Mineralogical
- Dust concentration

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- On a weight basis: milligrams of dust per cubic meter of air (mg/m<sup>3</sup>)
- On a quantity basis: million particles per cubic foot of air (mppcf)
- Particle size and shape
  - The particulate size distribution within the respirable range
  - Fibrous or spherical
- Exposure time



Healthy Lung    Contaminated Lung

Excessive or long-term exposure to harmful respirable dusts may result in a respiratory disease called pneumoconiosis. This disease is caused by the build up of metallic dust particles in the lungs and the tissue reaction to their presence. Pneumoconiosis is a general name for a number of dust-related lung diseases; types of pneumoconiosis are:

- **Silicosis** - Silicosis is a form of pneumoconiosis caused by the dust of quartz and other silicates. The condition of the lungs is marked by nodular fibrosis (scarring of the lung tissue), resulting in shortness of breath. Silicosis is an irreversible disease; advanced stages are progressive even if the individual is removed from the exposure.
- **Black Lung** - Black lung is a form of pneumoconiosis in which respirable coal dust particles accumulate in the lungs and darken the tissue. This disease is progressive. Although this disease is commonly known as black lung, its official name is coal worker's pneumoconiosis (CWP).
- **Asbestosis** - Asbestosis is a form of pneumoconiosis caused by asbestos fibers. This disease is also irreversible.

## How Is Dust Controlled?

Dust control is the science of reducing harmful dust emissions by applying sound engineering principles. Properly designed, maintained, and operated dust control systems can reduce dust emissions and, thus workers' exposure to harmful dusts. Dust control systems can also reduce equipment wear, maintenance, increase visibility; and boost employee morale and productivity.

Reducing employee exposure to dust can be accomplished by three major steps:

- Prevention
- Control Systems
- Dilution or Isolation

### Prevention

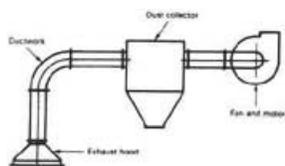
The saying "prevention is better than cure" can certainly be applied to the control of dust. Although total prevention of dust in the bulk material handling is an impossible task, properly designed bulk material handling components can play an important role in reducing dust generation, emission, and dispersion.

### Control Systems

After all the necessary preventive measures have been adopted, the dust still remaining in the workplace can be controlled by one or more of the following dust collection systems, wet dust suppression systems, and airborne dust capture through water sprays.

### Dust Collection Systems

Dust collection systems are industrial ventilation principles to capture airborne dust from the source. The captured dust is then transported to a dust collector which cleans the dusty air.

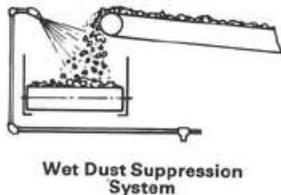


Dust Collection System

### Wet Dust Suppression Systems

Wet dust suppression systems use liquids (usually water) to wet the material so that it has a lower tendency to generate dust. Keeping the material damp reduces the dust, and very little material becomes airborne.

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### Airborne Dust Capture Through Water Sprays

This technique suppresses airborne dust by spraying fine droplets of water on the dust cloud. The water droplets and dust particles collide and form agglomerates. Once these agglomerates become too heavy to remain airborne, they settle from the air stream.

## Dilution-Isolation

### Dilution Ventilation

This technique reduces the dust concentration in the area by diluting the contaminated air with uncontaminated fresh air. In general, dilution ventilation is satisfactory for health hazard control or dust collecting systems; however, it may be applied in circumstances where the operation or process prohibits other control measures.

### Isolation

Isolation is another means to protect workers from exposure to harmful dust. In this technique, the worker is placed in an enclosed cab and supplied with filtered air.

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