Silica and Silicosis

Presented by
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Where is Silica Found

- Sand
- Quartz
- Granite
- Products comprised of these.
  - Cement
  - Asphalt
  - Paints
  - Etc.

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A functional form of silica, Glass

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Silica Forms

- Crystalline Silica
  - Exists in 3 major forms (7 polymorph forms)
    - Quartz
    - Crystobalite
    - Tridymite
- Microcrystalline Silica
  - Crystalline silica bonded with amorphous silica.
    - Flint and chert
- Amorphous silica
  - Diatoms

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Amorphous silica (diatoms)

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What is Crystalline Silica?

- SiO_2
- A naturally occurring compound used in almost all aspects of life.
- It is generally harmless.
- Only when it is “respirable” does it become a hazard to your health.
- Respirable particles <10 microns (25,400 microns/inch)

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Silicon Dioxide

Silica Crystals

Silica Sand

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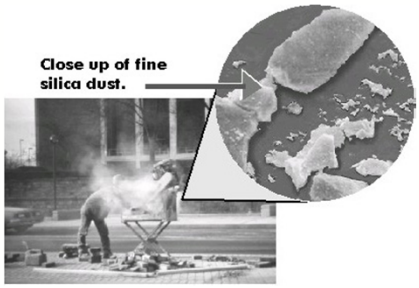

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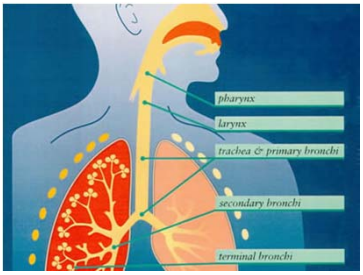

"Larger" (>10 microns) particles get caught before they reach the alveoli.

Particles are removed through mucous excretions and ciliary movement.

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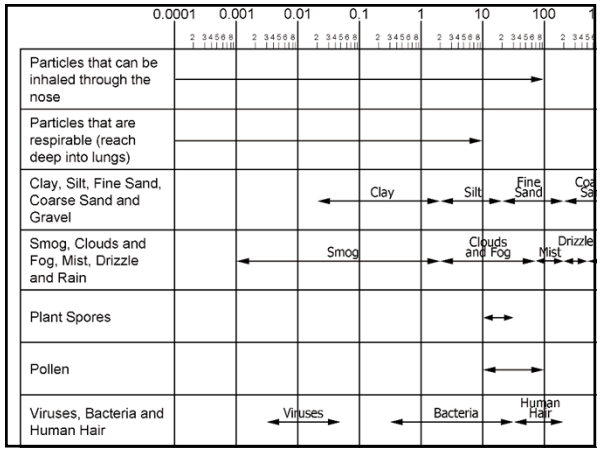
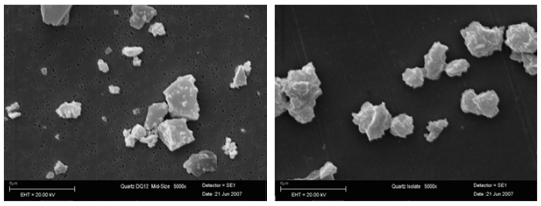


Respirable Quartz Crystals



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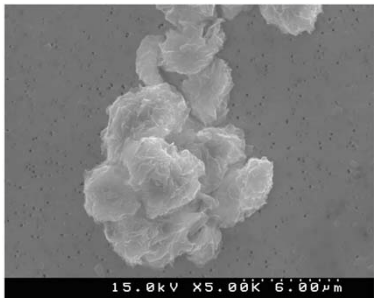
Respired Quartz from Rat Lung



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Shoveling

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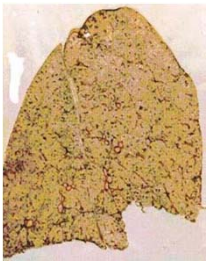
Lungs

Healthy Lung



Lung with Silicosis

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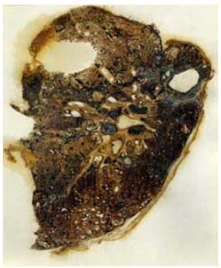
Advanced Silicosis

Silica crystals lodge in the lungs, then as the body tries to remove them, an inflammatory reaction occurs ultimately causing growth of scar tissue which limits air passage and gas exchange.



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Hawkes Nest Tunnel

- Gauley Bridge, West Virginia 1927
- 3 mile tunnel under Gauley Mountain
- No respirators (Management used them).
- 109 admitted deaths
- 472 fatalities according to a congressional hearing.
- Some estimates range from 700-1000 due to transient workers never accounted for.
  - The company sent them packing when they got sick.

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Silicosis Today

- NIOSH estimates 250 die annually (work related).
- Hundreds are incapacitated.
- All cases are preventable.
- Serious threat to 2 million in US labor force.

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"Are YOU breathing silica dust?

- If YOU do one of the following jobs, you ARE at risk for breathing silica dust:
- Removal of paint and rust with powertools;
- Abrasive blasting of bridges, pipes, tanks, and other painted surfaces especially while using silica sand;
- Grinding mortar;
- Abrasive blasting of concrete (many bridges and buildings are made of concrete);
- Crushing, loading, hauling, chipping, hammering, drilling, and dumping of rock or concrete;
- Chipping, hammering, drilling, sawing, and grinding concrete or masonry;
- Demolition of concrete and masonry structures;
- Dry sweeping or pressurized air-blowing of concrete or dust; or
- Jackhammering on various materials."
  - Source: CDC.gov

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Symptoms

- Early phases are unnoticed.
- Exercise and shortness of breath.
- Possible fever and bluing of ear lobes and lips.
- Silicosis patients are more prone to other lung infections.
- Advanced silicosis
  - Shortness of breath, fatigue, lost appetite, respiratory failure, chest pains, death

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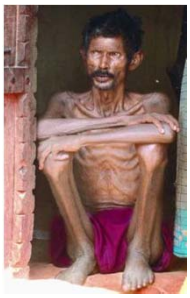
Silicosis Victim

NIOSH (branch of CDC) regards silica as a carcinogen.



Acute Silicosis: months-2 years
Accelerated Silicosis: 5-10 years
Chronic (classic) Silicosis: 15-20 years

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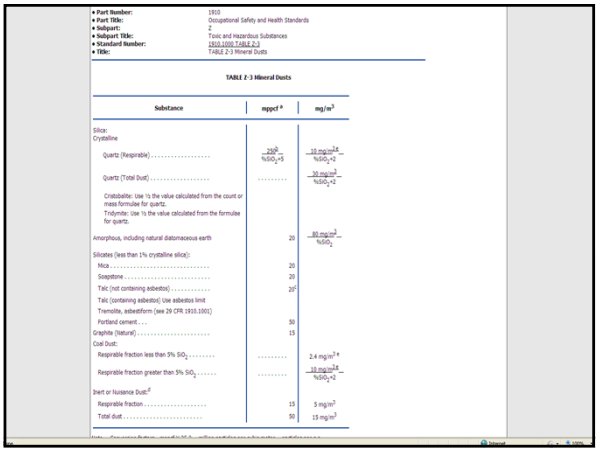

- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** Z
- **Subpart Title:** Toxic and Hazardous Substances
- **Standard Number:** 1910.1000 TABLE Z-3
- **Title:** TABLE Z-3 Mineral Dusts

TABLE Z-3 Mineral Dusts

Substance	mppcf [a]	mg/m³
Silica: Crystalline		
Quartz (Respirable)	250 / %SiO₂+5	10 mg/m³ / %SiO₂+2
Quartz (Total Dust)		30 mg/m³ / %SiO₂+2
Cristobalite: Use ½ the value calculated from the count or mass formulae for quartz. Tridymite: Use ½ the value calculated from the formulae for quartz.		
Amorphous, including natural diatomaceous earth	20	80 mg/m³ / %SiO₂
Silicates (less than 1% crystalline silica):		
Mica	20	
Soapstone	20	
Talc (not containing asbestos)	20[c]	
Talc (containing asbestos): Use asbestos limit		
Tremolite, asbestiform (see 29 CFR 1910.1001)		
Portland cement	50	
Graphite (Natural)	15	
Coal Dust:		
Respirable fraction less than 5% SiO_2		2.4 mg/m³ [e]
Respirable fraction greater than 5% SiO_2		10 mg/m³ / %SiO₂+2
Inert or Nuisance Dust:[d]		
Respirable fraction	15	5 mg/m³
Total dust	50	15 mg/m³

Testing for Silica

- The PEL for respirable dust varies since you are dealing with different concentrations of silica in every scenario.
- Samples are taken using an air pump fitted with a filter and cyclone.
- NIOSH recommends
  - .05 mg/m^3 for 10 hr shift

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Sources

- National Institute of Environmental Health Sciences
- www.OSHA.gov
- Toxicity of a Quartz with Occluded Surfaces in a 90-Day Intratracheal Instillation Study in Rats. Authors: O. Creutzenberg [a]; T. Hansen [a]; H. Ernst [a]; H. Muhle [a]; G. Oberdrster [b];R. Hamilton
- www.CDC.gov/niosh
- www.sy-klone.com
- Silent Victims of Silicosis, Frontline; Author, ANNIE ZAIDI *in Shankargarh, Uttar Pradesh*

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