

SILICA TOXICITY

Hillary M. Carpenter

Minnesota Department of Health

Silica Toxicity

- Crystalline silica is widely used in industry and has long been recognized as a major occupational hazard, causing disability and deaths in workers in several industries
 - Silica exists in two forms – amorphous and crystalline
 - When discussing the toxicity of silica the real concern is with respirable crystalline silica (PM₄)

Health Impacts of Silica

- Diseases associated with Crystalline silica include:
 - Silicosis – the hallmark disease – incurable, but preventable
 - Lung cancer
 - Chronic obstructive pulmonary disease (COPD)
 - Renal disease/kidney cancer
 - Several diseases of the immune system

Health Impacts of Silica

- Disease risk is related to both the levels and duration of silica exposure.
 - The onset of disease may occur long after the exposure has ceased
- Silica has a non-linear exposure response curve – risks of disease are greater at higher exposures

Workplace Exposure Limits for Silica

- The Occupational Safety and Health Administration (OSHA) permissible exposure limit for crystalline silica is 0.100 ppm ($100 \mu\text{g}/\text{m}^3$) for an 8-hour time-weighted average exposure
 - Adjusted to $24 \mu\text{g}/\text{m}^3$ for a 24 hour, 7 day a week exposure

Workplace Exposure Limits for Silica

- The National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit is 0.05 ppm ($50 \mu\text{g}/\text{m}^3$) for a 10-hour time-weighted exposure
 - Adjusted to $12 \mu\text{g}/\text{m}^3$ for a 24 hour, 7 day a week exposure.

Health Impacts of Silica

- Occupational silicosis is underdiagnosed
 - There is significant risk to workers chronically exposed to silica concentrations lower than the OELs
 - Silicosis has been diagnosed at autopsy in workers exposed to occupational levels of 50-100 $\mu\text{g}/\text{m}^3$

Ambient Silica Toxicity

- There appears to be a low level risk of contracting silica related disease from background levels of exposure
- However, ambient crystalline silica levels can be significantly elevated downwind of peak sources of silica such as mine or quarry operations
 - Silicosis has been reported in highly exposed, non-occupational cohorts

Silica Ambient Exposure Limit

- California's EPA has developed a chronic exposure limit for silica in ambient air of $3 \mu\text{g}/\text{m}^3$
 - This value is 8 times less than the time-adjusted OSHA limit and 4 times less than the time-adjusted NIOSH recommendation.
 - The differences between acceptable risk levels for occupation settings and those for the general population are typically much greater than 4-8 fold.