Exposure to Refractory Ceramic Fibers in the Metal Industry

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Refractory Ceramic Fibers (RCF)

- A group of synthetic mineral fibers (MMVF), mainly aluminum silicates
- Used to replace asbestos in the thermal insulation applications (>350 °C)
- Carcinogenic (≤18 % alkali and alkali-earth oxides)
- Alkaline earth silicate (AES) fibers used as substitutes
Refractory ceramic fibers (500x magnification) and the elemental peak intensities of a fiber.
Glass wool fibers (500x magnification) and the elemental peak intensities of a fiber
Occupational exposure limits (OEL)

- **New Finnish OELs**
  - 0.2 f/cm³ for RCF
  - 1 f/cm³ for MMMF

- **ACGIH TLV** 0.2 f/cm³ for RCF

- **NIOSH REL for RCF** 0.5 f/cm³ (AL 0.25 f/cm³)

- **European OELs for MMMF** 0.5-1 f/cm³
Aims of the Study

• To elucidate the use of RCF and the dangerous tasks caused by it in the Finnish metal industry

• To examine the effectiveness of the exposure control methods and the spreading of fibers

• To investigate the usefulness of the nasal lavation method in exposure assessment (a separate presentation)
Materials

- Two steel plants
  - normal production
  - replacement of oven insulation

- Three foundries (an iron, a steel, and a copper foundry)
  - normal production

- A service company (repair of the insulation of rollers)

- 55 workers altogether
Methods

- **Airborne fibers**
  - optical microscopy
  - electron microscopy
  - energy dispersive X-ray analyzer

- **Inhalable dust**
  - IOM samplers

- **Cristobalite in used insulation**
  - X-ray diffraction
Sampling in workers' breathing zone
Mean fiber concentrations in the steel plants during normal production
Mean fiber concentrations in the steel plants during replacement of oven insulation

![Bar chart showing mean fiber concentrations in the steel plants during replacement of oven insulation. The chart compares breathing zone and stationary sampling sites for MMMF/OM, MMMF/EM, and RCF/EM, with sample sizes indicated for each category.]
Distribution of fiber diameters in steel plants samples

![Distribution of fiber diameters](chart.png)
Mean fiber concentrations in the foundries (normal production)

- Breathing zone
- Stationary sampling sites

- MMMF/OM
- MMMF/EM
- RCF/EM

[n=19, n=31, n=1, n=12, n=17, n=12]
Installation of new furnace linings in a steel plant
Repair of the RCF insulation of a roller
Conclusions and recommendations

- Workers were exposed to high levels of airborne RCF during the replacement of oven insulation, but the fibers did not spread widely.

- The exposure should be controlled by effective local exhausts and ventilation.

- Strict surveillance of the selection, use, and maintenance of personal protective equipment is important.

- When technically possible, carcinogenic RCF should be replaced by safer materials (e.g. by AES).
Correct use of personal protective equipment in the replacement of oven insulation