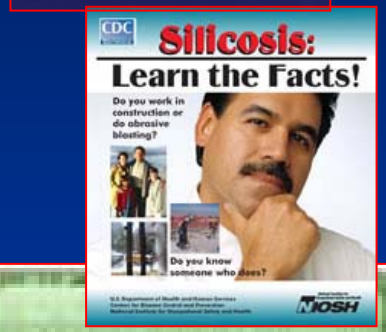
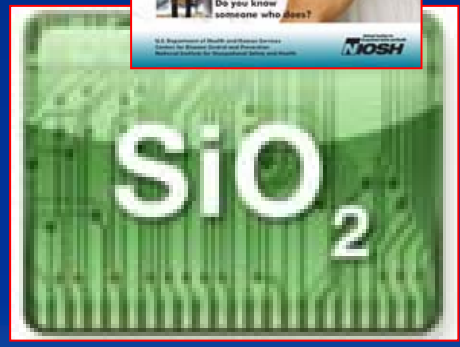


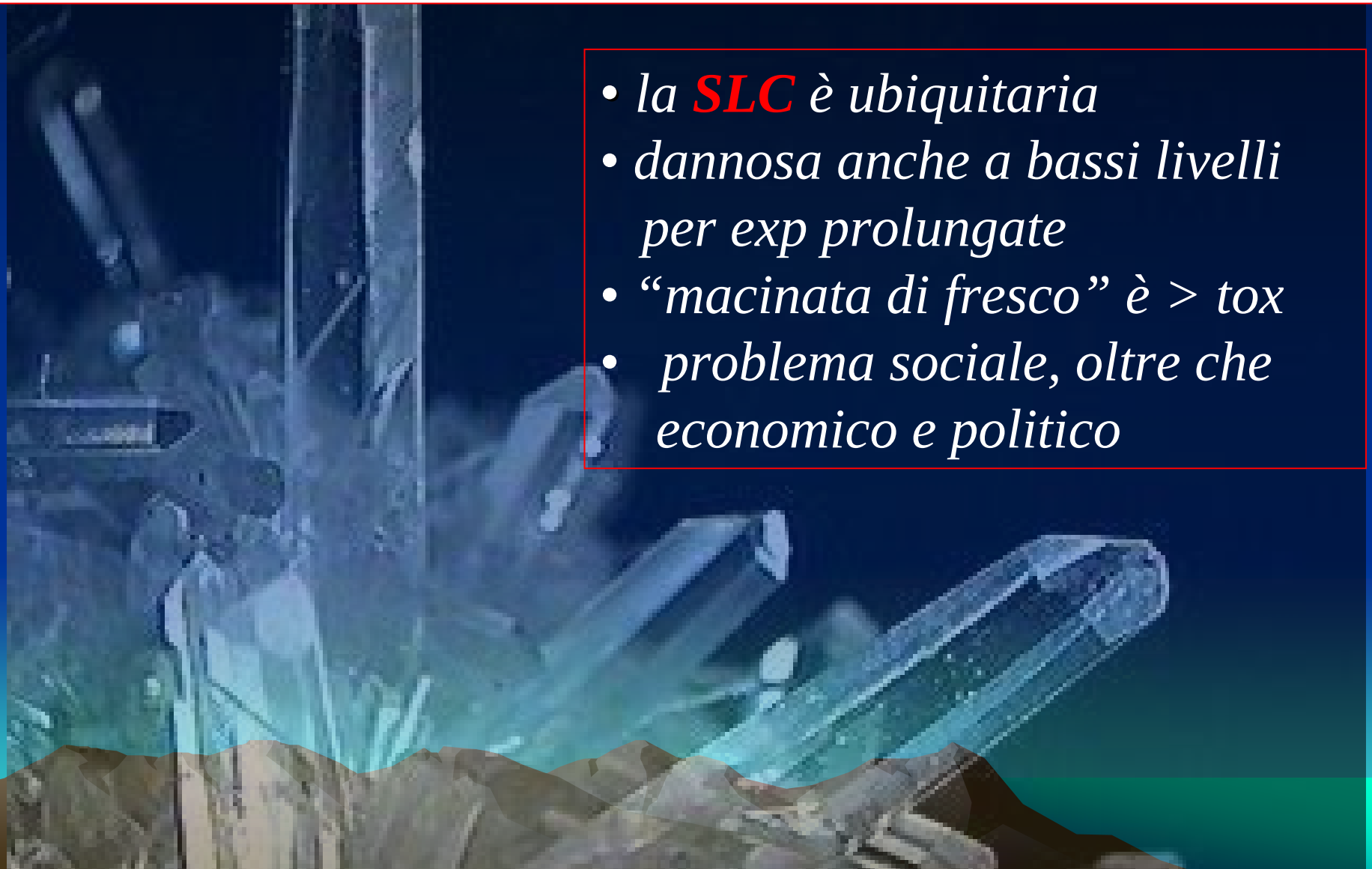


Esposizioni sconosciute o impreviste a silice

Dott. Fulvio Cavariani
labig@asl.vt.it
www.prevenzioneonline.net

Modena, 8 ottobre 2008

Perché i danni da exp a SiO_2 sono così difficili da prevenire??

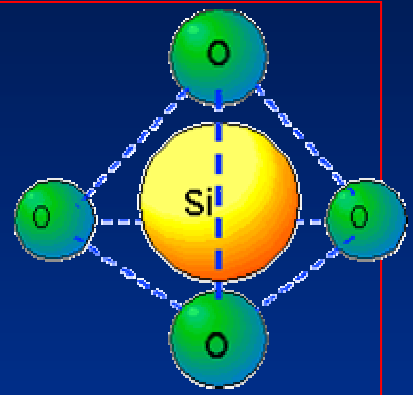


- *la **SLC** è ubiquitaria*
- *dannosa anche a bassi livelli per exp prolungate*
- *"macinata di fresco" è > tox*
- *problema sociale, oltre che economico e politico*

Polimorfismi della silice libera cristallina

1) Quarzo

- molto diffuso
- presente nella crosta terrestre
- componente della maggior parte di depositi (*fossili*) minerali
- molte exp a *polveri miste* contenenti **SLC**



2) Cristobalite e 3) Trimidite

- derivate dalle alte temperature

(es.: fonderie, ceramiche)

α-quarzo → β-quarzo → β-tridimite → β-cristobalite

~570 °C ~870 °C ~1470 °C

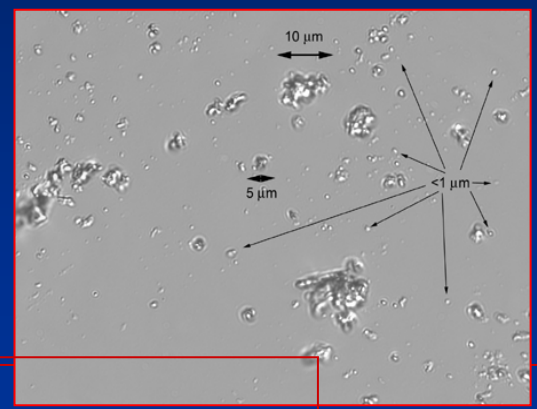
IARC [1997]

Fattori determinanti tossicità/malattia

Intensità dell' esposizione a polveri

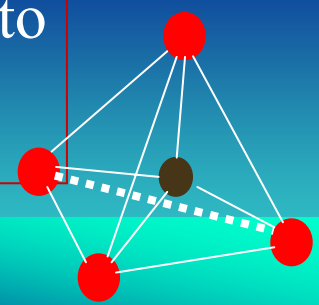
- *concentrazione (include dose cumulativa di polvere)*
- *frazione respirabile*
- *SLC contenuta nella polvere totale*

Dimensione delle particelle

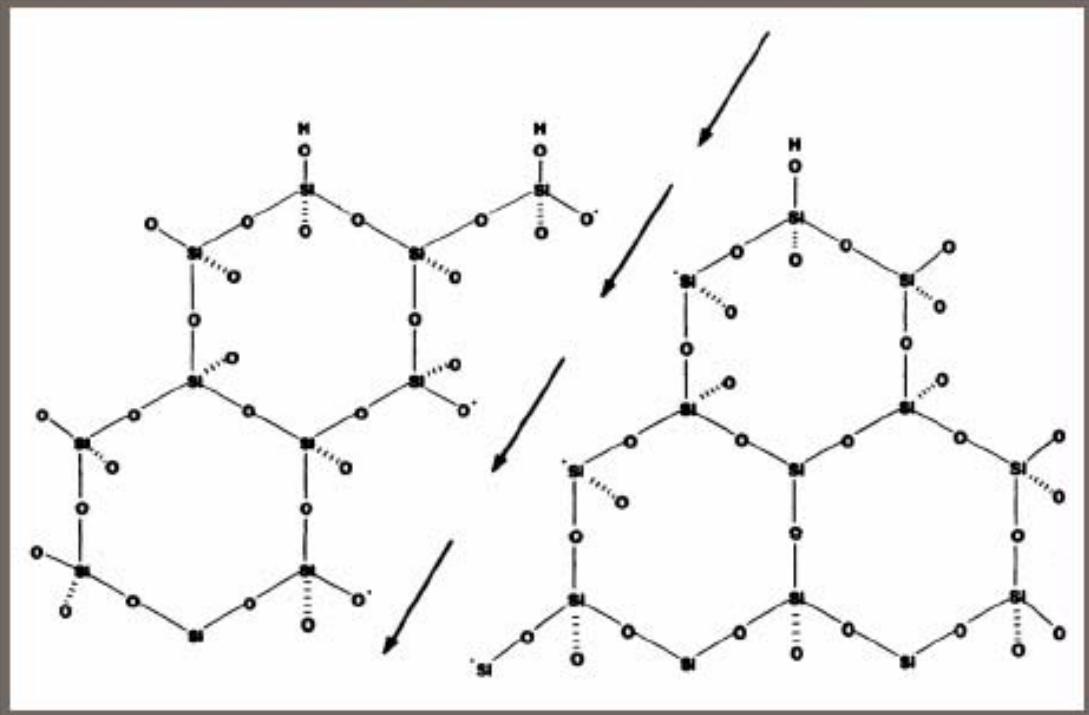


Citotossicità → radicali di superficie altamente reattivi specialmente dopo macinazione della silice

Rottura dei legami **Si-O** genera adsorbimento nei materiali biologici



Una macinazione genera radicali liberi

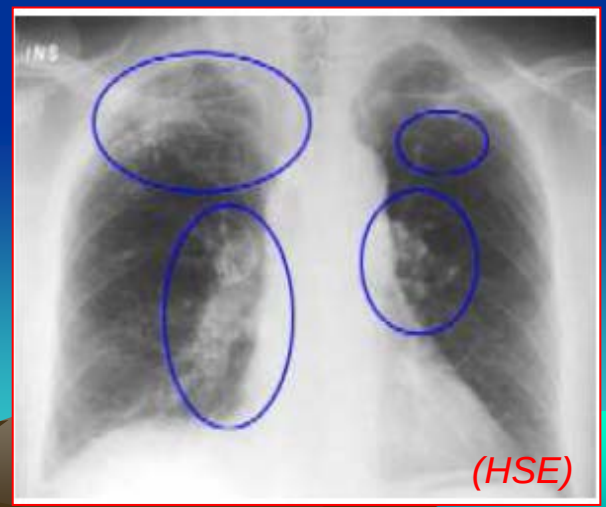


Castranova, Dalal and Vallyathan. In: Silica and Silica-Induced Lung Diseases. CRC Press pp 91-105, 1996.

Silicosi = problema di Sanità Pubblica

- 700 decessi/anno per silicosi
  (ISTAT: ICD IX 500-502)
- 200 nuovi casi/anno *(INAIL)*

→ ***Patologie prevenibili ?***



Attività a rischio di esposizione a SLC

Industria

- Ceramica
- Costruzioni
- Demolizioni edili
- Elettronica
- Fonderia
- Cemento
- Vetro
- Abrasivi
- Pittura
- Detergenti
- Mineraria
- Acciaio
- Refrattari
- Scavi/perforazioni
- .....
- .....

Attività

- Sabbiatura
- Ristrutturazioni edili
- Edilizia in genere
- Manutenzione edile
- Foggiatura (*ceramica*)
- Pulizie industriali
- Movimentazione terra
- Plastica/metalli
- Forni/fornaci
- Fusione metalli
- Lavoro in cava
- Lavorazione pietre
- .....
- .....

Materiali

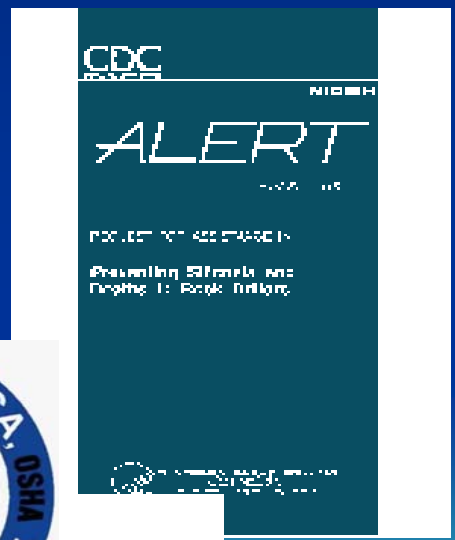
- Abrasivi
- Carbone
- Rocce e minerali
- Grafite naturale
- Minerali
- Pitture
- Pavimenti
- Perlite
- Cariche inerti
- Materiali edili
- Cemento
- Sabbie
- Pietre ornamentali
- .....
- .....

WARNING!

Crystalline Silica
Work Area

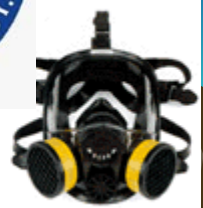
Improper handling or exposure
to the dust may cause silicosis
(a serious lung disease) and death.

RESPIRATOR
REQUIRED



Silicosis & Silica Du

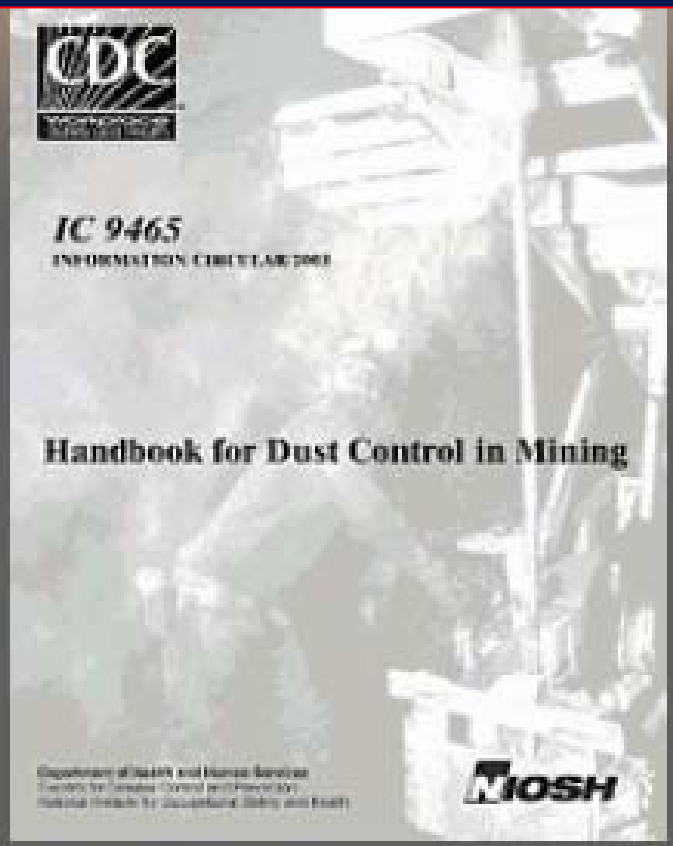
Prevention & Safety



NIOSH HAZARD ID

Respirable Crystalline Silica Exposures During Tuck Pointing

See also J Occup Environ Hygiene Nov 2007 issue



NIOSH Publication No. 2003-147

“New reports of silicosis in industries and work settings not previously recognized to be at risk still occur”.

("Nuove segnalazioni di casi di silicosi continuano a verificarsi in industrie e in attività precedentemente non riconosciuti essere a rischio.”)

(American Thoracic Society, Official Statement Adverse Effects of Crystalline Silica Exposure, June 1996)

Silicosi in

Laboratorio odontotecnico e fornitura materiali per protesi dentarie

- SLC come riempitivo di materiali dentali, miscele per calchi dentali con resine *(alto contenuto in SLC, cristobalite)*
  - sabbiatura calchi dentiere
  - rettifica porcellana e getti
  - pulizia con abrasivi

(Assessment of Potential Silica Exposure During Finishing of Dental Restorative A. BOGDAN, 3M ESPE Dental Products, St. Paul, MN, USA)

Sabbiatura Jeans

"… condizioni di lavoro incontrollate e primitive, senza misure di protezione ".
diversi casi di silicosi in giovani maschi
casi di silicosi ~ 3 anni come sabbiatore

[Akgun et al. 2005, 2006; Sevinc et al. 2003, Turchia*]*

Produzione materassi *(tatami)*

- uso di piante con fango secco
  - polveri respirabili
  - ~ 26% di silice
  - > 16/600 casi di silicosi

[*Xiao et al. in Occup Environ Med 2004, Cina*]

Hazards in a traditional industry

World at work: Manufacturing "Tatami" mats in China

G-B Xiao, K Morinaga, R-Y Wang, X Zhang, Z-H Ma

Exposure to dust may cause respiratory problems

Tatami matting produced from rush is used in almost all households in Japan. Now most matting products are imported from China. Rush cultivation and processing began in the 1980s in China, being introduced from Japan. In 1999, the cultivation area had increased to 3980 hectares, and exports of matting to Japan were 45 000 metres in a local area of China. Chinese researchers have recently found some serious occupational hazards in the industry.

TASKS OF THE JOB

To keep the colour of the rush, the raw rush was has to be initially smeared with mud (fig 1), and then dried by heat [illegible] before being processed into a mat. A growing number of rural workers are employed in the process, which includes drying, selecting, weaving, and other activities.

HAZARDS OF THE JOB AND IN THE WORKPLACE

In the late 1990s it was found that workers were heavily exposed to dust from the mud during the process in the rush matting enterprises in China (figs 2 and 3). The geometric means (GM) of total dust concentration in the workplace was 20.00 mg/m³, and that of respirable dust was 8.22 mg/m³. The content of free silica in the worksite sedimentation dust was 25.6% on average. Exposure to crystalline silica can result in adverse pulmonary responses such as acute silicosis, accelerated silicosis, chronic silicosis, and complicated silicosis. Among 661 workers who underwent chest x ray examination, the prevalence of small p opacities of profusion category ≥1/0 was 2.57%. The NIOSH recommended exposure limit is 50 μg/m³ for up to 10 h/day for a 40 hour working week. The Chinese maximum allowable concentration is 2 mg/m³ for total dust (10–50% SiO₂), and 1 mg/m³ for respirable dust (10–50% SiO₂). There is evidence that exposures routinely exceed the standards. Although it is well known that smoking contributes to the development of pneumoconiosis, some workers still smoke during the operations (fig 4).

MEASURES TO PROTECT WORKERS

Many preventive measures have been recommended by the Municipal Agency for Public Health Inspection to help the enterprises to protect workers:

- Guiding the industry towards providing a healthy and safe workplace; production will not be allowed to continue without meeting the requirements.
- Conducting technological innovation (mechanical processes) and using industrial engineering to reduce dust levels close to national occupational exposure limits. Otherwise,

Figure 1 Raw rush being immersed in mud, and then dried.

Figure 2 Quality control by selecting and refining the dried mud.

Gioielleria

- "*gesso*" forgiatura
  tecnica di colata "*a cera persa*"
  70% di quarzo e cristobalite ("*gesso*")
  > 100 orafi con silicosi

[ASL 8 Arezzo, 2002]

Rischio di patologie in...

Ricostruzione e applicazione unghie finte

Occupational Airways

A newsletter of the Occupational Health & Special Projects Program, Division of Environmental Epidemiology and Occupational Health (EEOH), Connecticut Department of Public Health, 410 Capitol Avenue, MS# 11OSP, P.O. Box 340308, Hartford, CT 06134-0308 (860) 509-7744

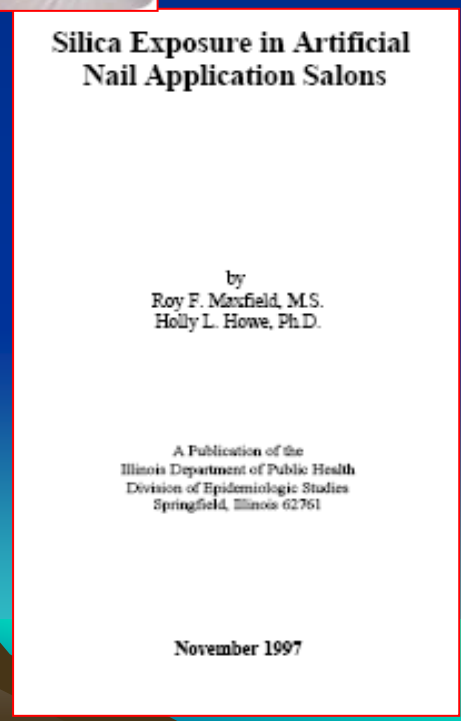
Vol. 3. No. 2 — August 1997

This issue:
- ⇒ Worker Dust and Vapor Exposure in Nail Salons
- ⇒ Control of Acrylic Nail Emissions
- ⇒ Summary Table of Reported Cases of Selected Respiratory Diseases

Worker Dust and Vapor Exposure in Nail Salons

application, and 30 minutes to 1 hr for "fill ins", which are done when the natural nail grows and the space between the artificial nail and the cuticle needs filling in.[1,2,4,5]

The first artificial fingernails were made by applying methyl methacrylate (MMA) dental acrylate to fingernails. In 1974, the Food and Drug Administration (FDA) banned the use of MMA from all artificial nail preparations because it caused nail deterioration and dislocation and allergic dermatitis in customers and nail technicians. MMA has been substituted with ethyl and other methacrylates. Despite the ban, studies have found that there are



Silica Exposure in Artificial Nail Application Salons

by
Roy F. Maxfield, M.S.
Holly L. Howe, Ph.D.

A Publication of the
Illinois Department of Public Health
Division of Epidemiologic Studies
Springfield, Illinois 62761

November 1997

Silica was present in quantities between 1 to 20% by weight in the polymer powders sampled.

Esposizione non occupazionale? *(> 0.1% di SLC)*

collanti, malta, sigillanti

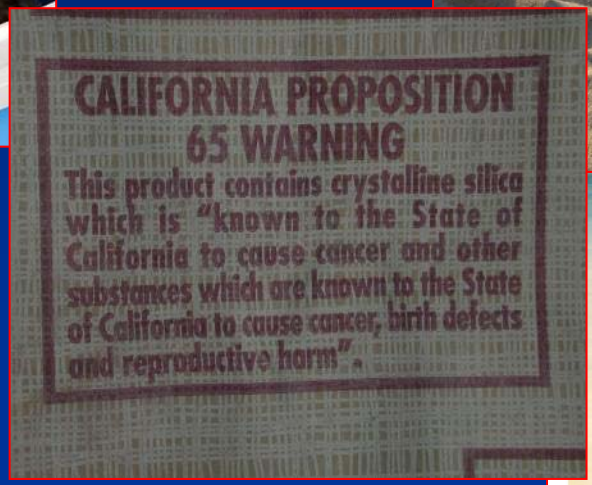
vernici

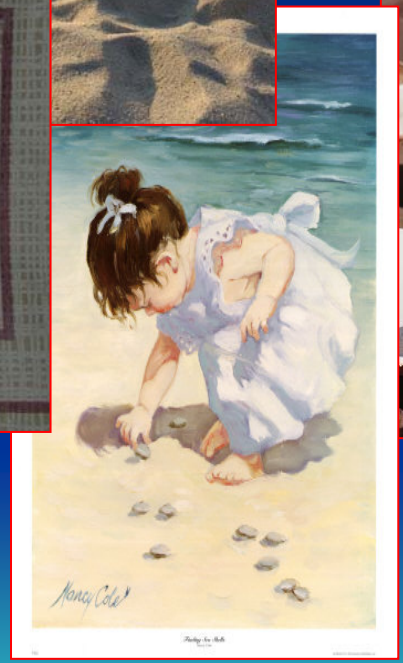
paste abrasive

stucchi

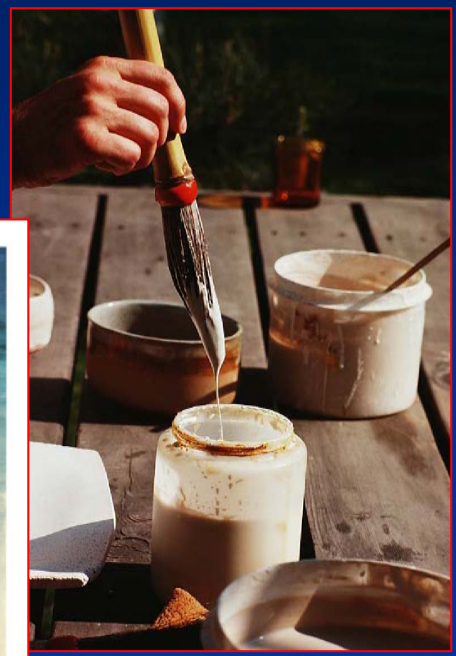
Esposizioni non-professionali a SLC …..

Lettiere per
animali domestici





Giocare con
la sabbia



Hobby: Ceramiche
artistiche

….nessun dato …..

Non-occupational exposure to silica dust in vicinity of slate pencil industry, India

→ SLC 41.07–57.22 µg/m3

(Bhagia LJ., National Institute of Occupational Health (NIOH), Meghani Nagar, Ahmedabad , june 2008)

Airborne crystalline silica concentrations at coal-fired power plants associated with coal fly ash. → SLC mean value of 0.048 mg/m3.

(Hicks J., Yager J., J Occup Environ Hyg. 2006 Aug)

Soldati U.S.A. della Guerra del Golfo

Contaminant	KTO Estimated Cumulative Exposure (mg/m^3)	Acceptable (NOAEL) Cumulative Exposure (mg/m^3)	KTO Estimated Total Dose (mg)[66] (inhalation rate of 24 cubic meters per day)	KTO Estimated Total Dose (mg)[66] (inhalation rate of 29.2 cubic meters per day)	Acceptable (NOAEL) Total Dose (mg)
Silica	0.02 to 0.10	1	49 to 208	60 to 254	3,066
Soot	0.08 to 0.35	87.5	184 to 735	224 to 897	766,500

Note: 1) The estimated cumulative exposure values for silica and soot are based on maximum recorded values at each location, assume an occupationally equivalent exposure of 1.76 years that is based on an average period of deployment of 153 days[67] , and assume an average inhalation rate of 24 m^3/day. 2) The acceptable cumulative exposure and total doses assumed exposure to respirable, crystalline silica. This dose may be overestimated because it is assumed that all silica is in the more toxic crystalline form as opposed to the benign amorphous form. The comparable values for soot are based on total soot from all sources without regard for whether it originated from industrial combustion sources, oil well fires, or transportation sources.

Estimated Exposures vs. Health Standards[65]

Possibile superamento del TLV-TWA in pochi minuti di esposizione

- Concentrazione osservate: ***SLC*** *respirabile > 14 m*
- Tempo rilevato in cui si è superato il TLV-TWA: *

>14 mg/m³
~ 1 minuto

Foto: Ken Linch, NIOSH: Linch KD [2002]. Il Appl Occup Hyg

Sabbiatura

- ***> 20 mg/m³ di SLC respirabile***
- ***SLC > 15% nella sabbia***

(AUSL VT, 2005)

Edilizia: ristrutturazione di un'abitazione

	Polvere respirabile *(mg/m³)*	SiO_2 *(mg/m³)*
Range	3.4 – 12.5	0.05 - 0.09

(ASL VT 2006 / 07)

Edilizia stradale

	Polvere respirabile *(mg/m³)*	SiO_2 *(mg/m³)*
Range	0.6 – 34.0	0.12 – 0.50

Movimentazione terra

(ASL VT 2006 / 07)

Agricoltura: mietitrebbiatura

	Polvere respirabile *(mg/m³)*	SiO_2 *(mg/m³)*
Range	3 - 52	0.03 - 0.16

(ASL VT AIDII, 2008)

Agricoltura: raccolta nocciole

	Polvere respirabile *(mg/m³)*	SiO_2 *(mg/m³)*
Media *(SD)*	2.19 *(1.57)*	0.16 *(0.12)*

(AUSL VT, 2007)

Industria ceramica: sversamento smalti

Considerazioni conclusive

- **Siamo lontani dalla conoscenza di exp anche rilevanti**
- **La SLC è diffusa in molte attività ed è possibile una exp elevata senza u**
- **Le SDS e le etichette de riportano la presenza d**
- **VL diversi nelle SDS**

European Workplace Limits

HSE

- Italy 0.05 mg.m^{-3}
- Netherlands 0.075 mg.m^{-3}
- Belgium, Greece, Denmark, Portugal, Sweden, France, UK, Spain 0.1 mg.m^{-3}
- Luxembourg, Switzerland, Germany, Austria 0.15 mg.m^{-3}

Si ringrazia Faye L.Rice (NIOSH)

Network Italiano Silice

(Coordinamento Regioni, ISPESL, ISS, INAIL)

Azienda Unità Sanitaria Locale Viterbo

MONITORAGGIO SILICE ITALIA:

RISULTATI DEL SISTEMA DI PREVENZI

Domus La Quercia

Viale Fiume, 112

VITERBO

27 - 28 ottobre 2008

SILICOSI ? No, Grazie!