ISHCCO, Cyprus

Reducing Respirable Crystalline Silica Dust Effectively

A joint project between the EFBWW and FIEC, the European social partners for the construction industry

Co-funded by the European Union

7./8. April 2022
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Diseases caused by respirable silica dust on construction sites

- From many publications it is clear that there are silica-related diseases caused on construction sites and
- their number does not decrease.

Content of crystalline silica in construction materials

- Regardless of the content of silica in the processed material, dust protection measures are always required.
- This also applies to working with artificial stone with quartz contents above 90%.
- Therefore, there shouldn't be much discussion about the silica content of construction materials.
- **Work must always be done with low dust.**

Limit values for silica, respirable and inhalable dust

	mg/m³		
	respirable silica	respirable dust	inhalable dust
Austria, Denmark, France	0.05	5	10
Belgium, Spain	0.1	3	10
Finland	0.05		
Germany	0.05	1.25	10
Hungary	0.1	6	10
Ireland	0.1	4	10
Latvia	0.1		
Netherlands	0.075		
Poland			10
Sweden	0.1	2.5	5
European Union	0.1	The member states must implement this by January 17, 2020 (DIRECTIVE (EU) 2017/2398)	

Exposure Data in the literature

We received 271 exposure datasets from 55 sources, which we use to describe 150 activities on construction sites

	Park (Korea) 2006	Network Italiano 2007	Alazard (FR) 2021	Flanagan (USA) 2006
	Meeker (USA) 2009	CooperM (USA) 2012/2015	Thorpe (GB) 1999	McLean (NZ) 2017
	SUVA (CH)	CooperJ (USA) 2015	Radnoff (Can) 2014	Szadkowska (PL) 2006
	Deurssen '14 (NI)	Tjoe (NI) 2003	Lumens (NI) 2001	Echt (USA) 2004/2007
task / job	**BG BAU (Germ)**	**Kirkeskov (Danem) 2016**	**Beaudry (Can) 2013**	**Betten (Germ) 2005**
Bricklayer	R12: 0.04-0.59; GM 0.22 S12: 0.01-0.04; GM 0.02		S16: 0.017 - 1.0; GM 0.105	I07: GM 3.0 R07: GM 1.3
Cutting stones, dry	S05: 1.0 - 4.0; m 2.83 S05: 0.45 - 1.6; m 0.94	R01: 69.60 S01: 44.37	R06: 8.0 - 58.0 S06: <0.5 - 4.8	R05: 21-115; GM 43.2 S05: 5.7-38; GM 12.7
Cutting stones, wet	S05: 0.09 - 0.61; m 0.26 S05: <0.05 - 0.14; m 0.09	R04: 1.81 - 5.97; m 3.81 S04: 0.920 - 3.405; m 2.161	R04: 0.6, 1.3, 1.9, 6.4 S04: <0.3, <0.3, <0.4, <0.6	R05: 2.9-11; GM 5.73 S05: 1.0-2.2; GM 1.62
Cutting stones with extraction	S05: <0.05 - 0.17; m 0.11 S05: <0.05 - 0.15; m 0.08		R02: 0.2, 0.7 S02: <0.35, <0.5	R05: 1.9-3.6; GM 2.58 S05: 0.79-1.1; GM 0.95
Drilling in concrete	R46: 0.02-10.86; GM 0.86 S46: 0.01- 1.36; GM 0.20	S05: 0.42 - 0.84; m 0.68	R03: 0.25, 5.01, 18.5 S03: <0.02, 0.02, 0.90	R95: GM 1.82 S97: GM 0.20
Concrete grinding	R58: 4.26 - 367.5; GM 50.0 S58: 0.1 - 17.62; GM 2.06			R10: GM 5.5 S10: 0.012-3.21; GM 0.657
Milling slots	R02: 0.69, 2.32 S02: 0.10, 0.32	R32: 10.9 - 183.3; GM 41.3; 95 106.8 S15: 1.058-5.198; GM 2.423; 95 5.035	R53: n.d. - 18.9; GM 3.1 S53: n.d. - 6.9; GM 0.7	I05: GM 11.0 R05: GM 2.9
Milling slots with extraction	R05: 11.08 - 22.91 S05: 1.88 - 3.89	R11: 0.2 - 21.6; GM 3.94; 95 17.3 S02: 0.346, 0.672		R04: <0.55-2.82; m 1.56 S04: <0.016-0.35; m 0.137
mixing mortar / glue / concrete		R08: <0.18 - 5.02; m 1.78 S02: 0.02, 0.048	R05: 0.45 - 1.83 S05: <0.009 - 0.03	R32: GM 1.39 S32: GM 0.04
Tuckpoint grinding	S05: 3.06 - 7.24; m 4.99 S05: 5.25 - 25.8; m 10.9	R10: 0.55-8.0; GM 2.4 S10: 0.089-1.6; GM 0.35	S97: 0.00 - 24; GM 0.25	R 97: GM 6.05 S101: GM 0.60
Inner wall construction	R115:0.30-21.2; GM 1.18; 95 12.3	R05: 0.55-4.00; GM 1.5 S05: 0.016-0.084; GM 0.036	R36: 0.2 - 10.6; GM 2.1 S36: n.d. - 0.2; GM 0.04	
Carpenter	R21: 0.03-4.67; GM 0.22 S21: 0.01-0.09; GM 0.02	I38: 0.08 - 8.40; GM 1.26 R25: <0.09 - 1.5; GM 0.27	S11: 0.013 - 0.041; GM 0.023	

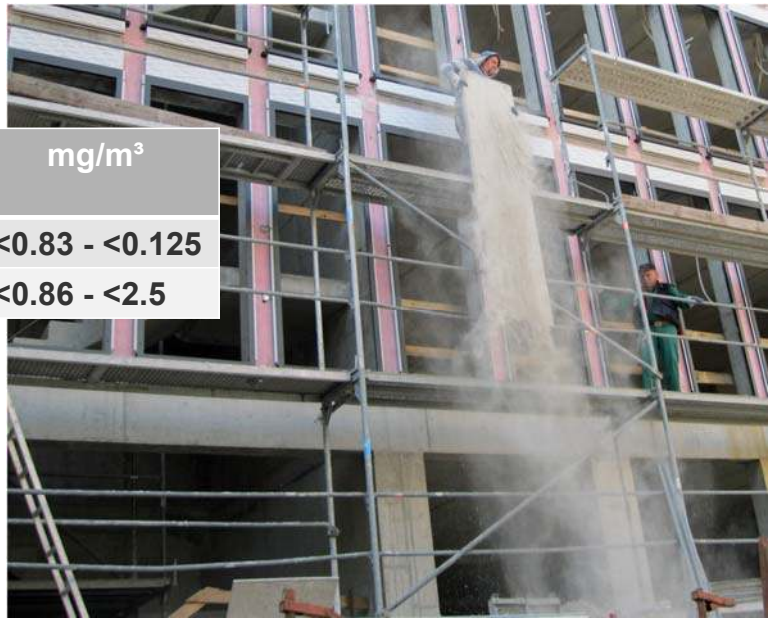
Exposure data and practical experience

Scaffold dismantling without protective measures

	N	com-panies	construction sites	mg/m³
RCS	6	1	2	<0.83 - <0.125
resp. dust	12	4	6	<0.86 - <2.5

- always below detection limit

These data do not represent the practice



Exposure data and practical experience

Mortar mixing, mixing machine with extraction

	N	range	GM	95%
resp. dust	14	0.5 – 1.05	0.68	1.05

but - squeezing the bags remains a source of dust

Exposure data and **practical experience**

- There is no or only little exposure data on this and some other low-dust techniques.
- However, practical experience shows that the application of such measures significantly improves the exposure situation
- Thus, such techniques were considered when good practice was derived (highlighting that more data might be needed for a through scientific assessment)

List of low dust techniques

- **Low-dust cleaning with vacuum cleaner for construction sites**
- **Wet work**
- **Handheld machines with extraction device**
- **Drill holes with low-dust**
- **Air cleaner**
- **Pre-separator for a lot of dust**
- **Dust barriers**
- **Low-dust mixing**
- **Silos, One-Way-Container**
- **Scattering low dust quartz sand**
- **Dust on construction site roads**
- **Liquid soil**

www.bgbau.de/themen/sicherheit-und-gesundheit/staub/low-dust-techniques/

Developing best/good practice

In many papers, in addition to technical protective measures respiratory protection is required as a backup measure.

- Lorsque que les mesures de protection collective ne suffisent pas à éliminer le risque, mettre à la disposition du personnel des EPI adaptés („When collective protection measures are not sufficient to eliminate the risk provide personnel with suitable PPE"; INRS, 2018)
- Con sistema de captacion de polvo y EPR („With dust collection system and respiratory protection"; FCC, 2020)
- Often respiratory protective equipment is an essential part of silica dust control, in addition to engineering controls. Many of these disposable masks are 'single shift' products and so should not be used for more than a single day. (SLIC, 2016)

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Developing best/good practice

But mostly, partly in the same papers, the lack of effectiveness of respiratory protection on construction sites is pointed out.

- I have never encountered fully effective protection where tight fitting facepieces have been selected (APPG, 2019);
- Do not allow facial hair for employees using respirators. Facial hair can interfere with the sealing surface of respirators (Grant, 2019);
- Workers must be clean-shaven to get an effective seal to the face with a tight-fitting mask. Long hair can interfere with the seal (SLIC, 2016).

How helpless the demand for respiratory protection is, is shown by the demand that workers must be clean-shaven
(not only with today's beard fashion)

Developing best/good practice: Use the STOP – Principle!

- If compliance with the limit values is possible through technical or organizational measures, no additional PPE is recommended
  - neither employers nor employees understand why they should use extraction on the handheld tools and still wear respiratory protection
  - according to the STOP principle technical measures have to be taken before personal measures
- If there is any doubt as to whether a technical or organizational measure is sufficient, air cleaners are recommended as backup measure to achieve low-dust working
- In addition, air cleaners also protect neighbouring trades, residents and the environment

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Developing best/good practice: Use the STOP – Principle!

Combination of technical measures - jackhammer with extraction and air cleaner

Activity related exposures

Description of dust exposures during activities on construction sites (33 chapters)

2. Blasting

In sandblasting, surfaces are treated with an abrasive. Compressed air is used to generate a powerful jet of air that blasts the abrasive at high speed onto the surface to be treated. Although quartz sand is no longer permitted as an abrasive in most countries, silica dust is released from surfaces.

Exposure data

activity	BG BAU	INAIL (Italy) 2019	Flanagan (USA) 2006 Easterbrook (GB) 2009
abrasive blasting			R65: GM 3.74 S64: GM 0.24
blasting, dry	R90: GM 2.43; 95 63.8 S90: GM 0.122; 95 2.819	R04: m 1.06 S04: m 0.092	R02: 18.66, 75.04 S02: 0.16, 1.22
blasting, wet	R38: GM 0.87; 95 4.97 S38: GM 0.40; 95 0.332		

S: silica; R: respirable — GM: geometric mean; 95: 95 percentile; m: mean

Sandblasting produces high concentrations of fine dust. Workers must generally be protected by full protective suits, if only because of the risk of injury from the parts flaking off the surfaces being treated. This also includes a helmet with forced ventilation.

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The project report contains

- Discussion of silica related diseases and silica content of construction materials
- Listing of European limit values for dusts
- 271 exposure data sets from 55 sources describe many activities on construction sites
- Low dust techniques
- Detailed discussion of the lack of effectiveness of respiratory protection on construction sites (especially with today's fashion for wearing beards).

Therefore, the combination of technical measures - extraction at the machine and air cleaner - is recommended, no respiratory protection

Mapping of construction activities

Guide to low-dust, possibly dust-free work

- Low-dust work is possible in many activities.
- With some techniques it should be possible to work almost dust-free.
- If one technical measure is not sufficient to stay below the limit values, so technical measures must be combined.

The goal is to work with low dust and not to generate dust, pollute the environment and wear respiratory protection.

Mapping of construction activities

Bricklayer

	✓		✗	
MIX THE MORTAR	use of large silos or One-Way (single-use) container	use of bagged materials and extraction at the mixer	use of bagged materials	
LAYING STONES WITHOUT CUTTING	cleaning the site every day		without cleaning	
CUTTING STONES	cutting dry with extraction, indoors additional air cleaner or cutting wet with daily fresh water; cleaning the site every day	cutting wet	cutting dry without extraction	
REMOVING BUILDING RUBBLE	push the debris together with a robust hoover nozzle, put the coarser debris into the wheelbarrow and vacuum up the remaining dust. Indoors also use an air cleaner	the debris should be sprayed, the coarser parts are placed in a wheelbarrow or bucket, the remaining debris is vacuumed up	without protective measures	
CLEANING	with vacuum cleaner		with broom	

Mapping of construction activities

Innovations and problems

Innovations

Dissolvable bags, Dorsicoat, Dustex, P1 System, Dust reducer, Hytile tilecutter, Maxit mörtelpad, Piranha Cutter, Ripper, Dustmonkey, …

Problems

Cutting of roof tiles on the roof; dismantling scaffolding; dust collection bags in vacuum cleaners are too expensive; extraction systems for wall sawing with large saw blades; …

The next step? Talk to the manufacturers to design a standardized disposal bag that can then be offered very cheaply as a kind of giveaway.

www.efbww.eu search ‚silica‘

www.fiec.eu/our-projects/completed-projetcs/rcsd