

PROCESSING QUARTZ WITHOUT CREATING DUST



TNO innovation
for life

Between 2,000 and 3,500 people die every year in the Netherlands from occupational diseases, including those resulting from exposure to carcinogenic substances. That number can and must be reduced. Prevention is crucial, as is focusing attention on behaviour on the shop floor and taking precautions. TNO helps companies develop dust-free equipment and working conditions.

The governmental authorities have defined legal threshold values to safeguard employees' health. These limits determine the maximum amount of a hazardous substance to which an employee may be exposed. The Social Affairs and Employment Inspectorate (SZW) has the task of enforcing these limits, with the aim of bringing down the number of work-related cancer cases drastically.

TNO is working on prevention using the latest available systems and technology. We develop tools and design production processes for intrinsically safe and healthy work. Many tools are a source of carcinogenic dust that poses a threat to employees and their working environments. Appropriate control measures can reduce the emissions of these substances drastically and protect the employee effectively.

Designing and producing dust-free tools and production processes is in the first instance a task for the manufacturers. They can call upon TNO, which has wide-ranging expertise in this area. For instance, we develop innovations such as extraction of hazardous substances at the source and filter systems. This lets employers protect their staff effectively by introducing dust-free equipment and processes in the company.

MORTALITY FIGURES FOR WORK-RELATED CANCER

Some 100,000 to 150,000 people in the EU are diagnosed with cancer every year, having been exposed to carcinogenic substances such as respirable quartz, hardwood, or welding fumes while at work. About 80,000 people die as a result each year. These premature deaths equate to almost 1.2 billion years of life lost.

Cancer patients experience a reduced quality of life, require medical care, and are often unable to work or are forced to work less. As well as the individual suffering, there is also a public expense. The cost of health care and reduced productivity as a result of occupational cancer in the EU is estimated to be four to seven billion euros per year. When the pain and suffering caused by illness and the potential for premature death are added into the equation, the total public expense amount increases to approximately 350 billion euros per year.

If we convert the estimates from the EU, which has over 500 million inhabitants, into a number of deaths for occupational cancer in the Netherlands (17 million

inhabitants), we get a figure of 2,000 to 3,500 deaths a year. By comparison, there were 621 road traffic deaths in 2015, and smoking is estimated to have led to the deaths of almost 20,000 people in 2015. The number of fatal accidents in the construction industry in the same year was 27. These figures show that exposure to carcinogenic substances is a major risk factor, which is all the more reason to tackle this problem at the source.

We have identified three sectors in which the exposure to carcinogenic substances is high and where workers are therefore exposed to a health risk: the construction sector, the wood processing industry, and metalworking. The key carcinogenic substances here are respirable quartz, hardwood dust, welding fumes, and hexavalent chromium.

EXCEEDING THE LEGAL LIMITS

When tools are used for processing stony materials, the exposure levels to respirable quartz (a carcinogenic dust) are extremely high. The legal threshold values are exceeded in many cases (see Table 2).

DUST-FREE WORKING: REQUIRED IF EMPLOYEES ARE TO BE PROTECTED AGAINST OCCUPATIONAL CANCER

TABLE 1: RESPIRABLE QUARTZ: OVERVIEW OF THRESHOLD VALUES AND RISKS OF CANCER

The definition given by the International Agency for Research on Cancer (IARC): respirable quartz is a carcinogenic substance (on the list of carcinogenic substances and processes published by the Dutch Ministry of Social Affairs and Employment, 30 December 2016)				
	Threshold value (mg/m ³)	Exposure 'in practice' (mg/m ³)	Risk estimate (number of deaths from cancer)	
			Deaths per 1000 employees	Comments
TWA-8h limit value for the Netherlands (after 1-Jan-2007)	0.075	0.075 to 10 (TNO)		
TWA limit value for Europe (2016)	0.1			
Maximum workplace concentration Germany (2016)	1.25	0.0005 to 0.002 0.00005 to 0.0002	4 (0.4%) (BAuA) 0.4 (0.04%)	
Workplace exposure limit United Kingdom	0.1			
REL TWA** USA (OSHA)	0.050	0.050 0.025 0.1 0.25 to 0.50	6 to 26 (OSHA) (0.6 to 2.6%) 3 to 23 (0.3 to 2.3%) 13 to 60 (1.3 to 6%) 37 to 653 (3.7 to 65%)	
REL TWA** USA (NIOSH)	0,050			

TABLE 2: EXCESS FACTORS FOR VARIOUS QUARTZ PROCESSING ACTIVITIES

	Type of equipment	Material	Production (running time)	Concentration of respirable quartz (mg/m ³)*	Excess factor**
	Slot saw 125 mm	Sand-lime brick	500 metres per 8 hours	348	4,600
	Saw 300 mm dry	Sand-lime brick	100%	200 to 400	2,500 to 5,000
	Grinder 125 mm	Sand-lime brick	500 metres per 8 hours	178	2,400
	Grinder 125 mm	Concrete	100%	122	1,600
	Cutter	Concrete	100%	9.1	120
	Drill, 30 mm	Concrete	750 holes/ 8 hours	7.0	90
	Drill, 12 mm	Sand-lime brick/concrete	2000 holes/ 8 hours	4.8	70
	Brush	Concrete	100%	4.7	60
	Saw 300 mm (wet)	Concrete/ Sand-lime brick	100%	1.1	15
	Drill 300 mm (wet)	Concrete	50 holes/ 8 hours	< 0.03	< 0.5
	Drill 10 mm (wet)	Concrete	500 holes/ 8 hours	< 0.03	< 0.5

* Concentration measured in Worst Case Room, in the respiration zone of the employee, tools running at 100 %, room volume 15 m³ and air supply 150 m³/hour.

** Excess factor with respect to the legal limit for respirable quartz (0.075 mg/m³)

TNO has carried out experimental investigations in the Worst Case Room, a special test room, simulating equipment switched on for 100 % of the time, without measures being taken and in a small working space. This results in the legal limit value for respirable quartz being exceeded for drilling, grinding, sawing and cutting, as well as other processing activities, by factors ranging from 15 up to no less than 5,000. If we then apply innovative technological solutions, the exposure is greatly reduced (see Table 3). A reduction in exposure by factors of 35 to 8,700 with respect to the unfavourable situation (in which these technological solutions were not used) is possible by choosing the right tools and using them correctly. This represents a major opportunity for businesses to encourage safe working with respirable quartz.

TNO's results with the equipment running for 100 % of the time and measured in the respiratory zone of the worker are given in Table 3 on the following page.

DRASTIC REDUCTION OF THE NUMBER OF VICTIMS OF OCCUPATIONAL CANCER?

TABLE 3: PREVENTION FACTORS FOR VARIOUS QUARTZ PROCESSING ACTIVITIES

	Type of equipment	Material	Production (running time)	Prevention factor*
	Slot saw 125 mm	Sand-lime brick	500 metres per 8 hours	5,000 to 8,300
	Saw 300 mm dry	Sand-lime brick	100%	750 to 5,500
	Grinder 125 mm	Sand-lime brick	500 metres per 8 hours	600 to 5,700
	Grinder 125 mm	Concrete	100%	600 to 8,700
	Cutter	Concrete	100%	35 to 300
	Drill, 30 mm	Concrete	750 holes/ 8 hours	50 to 200
	Drill, 12 mm	Sand-lime brick/ concrete	2000 holes/ 8 hours	50 to 200
	Brush	Concrete	100%	500
	Saw 300 mm (wet)	Concrete/ Sand-lime brick	100%	35 to 300
	Drill 300 mm (wet)	Concrete	50 holes/ 8 hours	200
	Drill 10 mm	Concrete	500 holes/ 8 hours	200

* The prevention factor is the measured concentration without precautions divided by the measured concentration with precautions taken

USING THE RIGHT DUST-FREE EQUIPMENT

The TNO recommends the following step-by-step plan for controlling the release of respirable quartz:

- Step 1: Choose quartz-free / quartz-poor building materials.**
- Step 2: Choose to build PREFAB.**
- Step 3: Choose dust-free processes and tools (see dustfreeworking.tno.nl)**

When using hand-held and other tools, the exposure to respirable quartz is acceptable, even in worst case scenarios, if the proper measures are taken. The legal limit values for respirable quartz were not exceeded when measured in the TNO's Worst Case Room.

ENFORCEMENT

The SZW Inspectorate has the task of enforcement, they check workplaces for releases of visible dust towards the respiratory zone of the worker in activities such as drilling, cutting, grinding, and sawing. If dust is released towards the respiratory zone during the activities, this suggests that appropriate measures are either absent or not working properly. In both situations, the company must take action. The SZW Inspectorate can impose fines if necessary or can even halt the work.

Further information about the enforcement policy as adopted by the SZW Inspectorate can be found on www.inspectieszw.nl.

DUSTFREEWORKING.TNO.NL

HEALTHY LIVING

Our ambition is a healthy and productive population. For this healthy living of the future, we develop innovations for safe and healthy working. Prevention is key.

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