

Silica in the spotlight

The European Commission is mulling over whether to establish a Union-wide workplace exposure limit for respirable crystalline silica. Accurate estimation and balanced assessment of the silicosis risk level is crucial, but given the lack of a cohesive monitoring and measurement system, the silica producing and consuming industries must get organised, urges *Michelle Wyart-Remy* of IMA-Europe/EUROSIL.

CRYSTALLINE SILICA is an omnipresent element constituting about 12% of continental landmasses and, in trace to preponderant amounts, is contained in most industrial minerals.

Total European usage of crystalline silica is measured in thousands of millions of tonnes per annum. It is used in many manufacturing industries and has numerous applications in the construction industry. Hence, a vast number of workers can potentially be exposed to crystalline silica dust.

Origins of an issue

It is now six and an half years since the International Agency for Research on Cancer (IARC) sharpened its overall evaluation of crystalline silica (ie. quartz and cristobalite) from probable human carcinogen to human carcinogen (Group 1). The experts had difficulty reaching a consensus and, as a result, their conclusions were qualified by an unusual explanatory note (see accompanying panel).

The IARC overall evaluation

In making the overall evaluation, the working group noted that carcinogenicity in humans was not detected in all industrial circumstances studied. Carcinogenicity may be dependent on inherent characteristics of the crystalline silica, or on external factors affecting its biological activity, or distribution of its polymorphs.

Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1). Amorphous silica is not classifiable as to its carcinogenicity to humans (Group 3).

The scientific findings were extremely difficult to interpret and the monograph certainly did not answer all of the file's uncertainties. However, amongst the numerous controversial pieces of evidence, the experts agreed on a few essential points: the crystalline silica hazard is linked to respirable dust, it is limited to occupational circumstances, and silicotics are at higher risk of developing lung



cancer (although no causal role for silica has been demonstrated). All this launched a considerable scientific debate.

Occupational health issues

The health issues surrounding crystalline silica relate to its respirable fraction. Silica sand sold in the moist or dry state may contain minute amounts of particles that can potentially become airborne (depending on handling and processing practices) and generate respirable dust containing crystalline silica. For example, in foundry work, respirable crystalline silica dust will be released during knock-off and fettling operations.

In humans, the main effect of prolonged and high level exposure at work to respirable crystalline silica dust is inflammation of lung tissue. This evolves into silicosis, a nodular fibrosis that is caused by the local effects of deposition in the lungs of fine respirable particles of crystalline silica.

The incidence of silicosis peaked following the industrial revolution and it has gradually declined with the implementation of controls and preventive measures and with the closure of coal mines in western Europe. The preventive measures included the introduction of occupational exposure limits and safer working techniques such as wet processing, automation, exhaust ventilation systems, and use of respiratory protective equipment, as well as medical surveillance. However, as a result of the over-exposure experienced in the last 20 or 30 years, some new cases of silicosis are still declared each year.

During the 1980s, it was suggested that crystalline silica behaved as a carcinogen. Since the 1997 crystalline silica IARC monograph, the scientific community has extensively debated and researched the issue. The current general thinking is that the relative lung cancer risk is higher in persons with silicosis (and, apparently, not in employees without silicosis exposed to silica dust in quarries and in the ceramic industry).

Workplace protection

In 1998, and in September 2002, the European Commission Committee for classification concluded that crystalline silica classifi-

cation was not a priority. Amongst the reasons for not classifying crystalline silica, it must be pointed out that the evidence showed – as acknowledged by IARC – that crystalline silica toxic effects are limited to the workplace. Therefore, neither the general public nor the environment is at risk. There appears to be no rationale or benefit in labelling as carcinogenic products that may generate respirable crystalline silica dust. The necessary information to professional users is provided through safety data sheets (SDS).

Concurrently, the EC is considering whether a respirable crystalline silica exposure limit should be established at EU level. Having reviewed the scientific literature, the Scientific Committee on Occupational Exposure Limits (SCOEL) issued its draft opinion in June 2002, which was open for public response. SCOEL concluded that: "It arises that an OEL (occupational exposure limit) should lie below 0.05 mg/m³".

Industry's response to SCOEL has been substantial but did not modify the final opinion, which was adopted last June, leaving some serious gaps in the knowledge of what the OEL should be. Following this final opinion, the EC has yet to decide whether to fix an OEL or not. The OEL could be indicative (ILV) or binding (BLV) and could be established within the legal framework of the Chemical Agents Directive (98/24/EC) or Annex III of the Carcinogens Directive (90/394/EEC). In the case of Binding Limit Values, these are adopted through a lengthy procedure involving the Council and the European Parliament. Socio-economic data submitted by industry would be taken into consideration.

Setting a limit

With silicosis being considered as a possible cause for cancer, the estimation of silicosis risk is central to the setting up of a limit for the prevention of any adverse effects from respirable crystalline silica dust exposure. There is a body of evidence regarding silicosis dose-response, but estimates of silicosis risk are variable and exposure data are often only semi-quantitatively assessed. In addition, different studies have used different criteria to determine the onset of silicosis.

In the UK, the Health & Safety Executive (HSE) reviewed many studies and judged the most robust study to be that of Scottish coalminers that worked major seams of sandstone (almost pure quartz). In this case, relatively high exposures to freshly cut surfaces of respirable quartz were observed, uncontaminated with other minerals.

The risk of developing silicosis 15 years post-exposure, as indicated by an International Labour Organisation score 2/1+, was 2.5% after a 15-year exposure to 0.1 mg/m³ respirable crystalline silica (8-hour TWA). However, the results of this study may be confounded by coal mine pneumoconiosis. In addition, this study must be regarded as a 'worst case' scenario due to the high potency of the airborne respirable crystalline silica in the mine.

The HSE has developed a potency matrix that claims that a series of factors may reduce crystalline silica potency. These include: the wetting of freshly cut surfaces, exposure to 'aged' dusts, the presence of aluminium-containing clay minerals which coat the surfaces of silica particles, and dusts not of extremely small particle size. None of these potency-reducing factors would have been relevant to the Scottish coalminers.

For enforcement purposes, setting up a limit value should take into account the ability to measure personal exposures of this magnitude reliably. Measurements of respirable crystalline silica dust in most industrial situations vary considerably. Owing to the limitations of measurement, it is doubtful that the SCOEL recommendation for an OEL below 0.05 mg/m³ could be enforced effectively. A value of 0.1 mg/m³, which is already implemented in some countries would

be more reasonable and enforceable, while maintaining a good standard of protection for the workforce.

As mentioned earlier, in case of a BLV, industry will be able to submit socio-economic data on the cost of compliance. The silica section (EUROSIL) of IMA - Europe is undertaking a socio-economic impact study at three possible limit values. Also, the HSE is seeking to determine the cost of compliance with possible respirable crystalline silica limit values of 0.01, 0.05, 0.1 and 0.3 mg/m³. It is important that all branches dealing with crystalline silica respond clearly to this opportunity.

Action for industry

Industry as a whole must do everything in its power to eliminate the occurrence of silicosis. The silica production sector is seeking to play its role by launching a number of initiatives.

Regular exposure measurement

IMA-Europe's members have developed a standardised dust monitoring protocol. The industry has been taking measurements for many years but there have been differences in monitoring strategies, sampling analysis and reporting practices. Further, much of the data were only collected for compliance purposes and the results were not necessarily representative of long-term occupational exposure.

It appears that in many cases the workplace was not randomly monitored, but instead the monitoring strategies often favoured sampling of 'worst case' scenarios.

Good practice dissemination

EUROSIL is in the process of developing a good practices document on dust prevention in the workplace for respirable crystalline silica. This will address all the relevant activities in the extraction, processing and handling of silica products.

Continuing health surveillance

Most companies monitor the health of their employees according to a well established health surveillance programme. Others are encouraged to adopt a similar health surveillance programme on the basis of good practices and the results of personal exposure measurements.

Scientific support

Since its foundation in the 1990s, EUROSIL has commissioned a series of scientific research projects. Recently, a mortality study on a British silica sand workers' cohort and *in vitro-in vivo* research were undertaken, and the results will soon be published. The mortality investigation concluded that the "study has not demonstrated any consistent relationship between respirable crystalline silica exposure, in the absence of other known carcinogens, and the development of lung cancer."

In addition, there is gathering of socio-economic data regarding both production and use of silica products. There is an urgent need for co-operation between the producing and consuming industries to prepare a data set for submission to the European authorities as guidance for a realistic and responsible exposure limit should one be established.

Summing up

With respect to existing regulations, notably current exposure limits, should one be established in place in EU member states, continuous improvement in the control of personal exposure to respirable crystalline silica dust is the best strategy for all producing and consuming industries.

