DUST CONTROL AND OCCUPATIONAL EXPOSURE TO SILICA IN THE UNITED KINGDOM

J. TICKNER, M.Sc.

Health and Safety Executive, Bootle, Merseyside, United Kingdom

INTRODUCTION

In the United Kingdom, measures to limit exposures to crystalline silica have been incorporated in industrial health and safety legislation for well over 100 years. In general, statutory requirements for dust control have appeared in Regulations relating to individual industries such as potteries or foundries and have specified the means by which control is to be applied (e.g. the use of extract ventilation or the wetting of dusty materials).

The development of quantitative techniques for dust sampling, together with procedures for assessing exposures and the evolution of exposure limit philosophies opened up possibilities for determining the practical effectiveness of control measures. For the past 10 years or so, comprehensive reviews of occupational exposures have been prepared by the Health and Safety Executive for a wide range of substances hazardous to health. These reviews are presented to the Advisory Committee on Toxic Substances (ACTS), which is a tripartite body set up to advise the Health and Safety Commission and which determines occupational exposure limits for the United Kingdom.

In 1987, a review of exposure to crystalline silica was prepared, which considered sampling data and information on control measures from a variety of sources. Much of the data in this paper is based on that review.

DEVELOPMENTS IN LEGISLATION

At the same time as the ACTS review of crystalline silica was in progress, proposals for an important new set of Regulations were reaching a critical stage in their development. Until now, the conventional historical pattern for health and safety legislation has been to make Regulations for specific substances (e.g. asbestos, lead), or for individual industries such as ship building or construction. This meant that provisions for safeguarding occupational health often appeared in piecemeal fashion and controls required in one industry would not necessarily be required in the same form in similar circumstances in another.

New legislation, to be known as the Control of Substances Hazardous to Health Regulations is now proposed which will require adequate control of all substances hazardous to health wherever they are used at work. For a substance such as silica, which is found in a wide range of industries, the new Regulations should be of great assistance in achieving a uniform standard of control to meet formal occupational exposure limits.

THE INCIDENCE OF EXPOSURE TO SILICA

Crystalline silica is found in a wide range of materials used for a variety of purposes in manufacturing industry as well as in quarrying and tunnelling activities. The United Kingdom has long had experience of the traditional "dusty trades" such as potteries and foundries, which make extensive use of silica-containing materials and there is also extensive manufacture of bricks, tiles and refractory materials. Significant silica exposure is also found in stonemasons' work. The size of the industrial sectors where exposure to crystalline silica is found has changed considerably over the past 30 years. A general diminution in the extent of manufacturing industry has led to a corresponding reduction in the numbers of persons exposed to silica in some industries. In potteries for example, the total number of persons employed in the industry is estimated to be 30,000 - 40,000 which is about half the total employed in the early 1950s. For foundries, the decline is considered to be even more marked.

For non-manufacturing industry, quarrying is the largest sector where exposure to silica occurs. Significant exposure is found during the working of a wide variety of materials including granite, basalt, sandstone, coal and limestone. Tunnelling can also produce extensive exposure during major civil engineering projects.

DISTRIBUTION OF EXPOSURE DATA

Because of the wide range of industrial activities where silica exposure is found, the quantity of personal sampling data and the assessment of exposures and control measures are very variable. In some sectors, such as brick and tile manufacture, only limited data is available while for others, detailed assessment of specific processes have been made. Foundry data, for example, covers a wide range of activities including knockout, fettling and grinding, where control problems have been difficult to solve.

A total of some 3,000 personal exposure samples were assessed for the ACTS Silica Review. The data was all collected by Health and Safety Executive staff, usually by an occupational hygiene Specialist Inspector directing a small team of scientific staff who collected and analysed the samples. Much of the data was obtained in the period 1979–1986 and resulted from factory and site visits made for one of two purposes:

1. As part of a prospective survey of particular industries such as potteries in order to determine the extent and patterns of exposure.

2. In response to requests from HM Inspectors of Factories to assess conditions at specific premises. In these cases, the Specialist Inspector would undertake a comprehensive occupational hygiene survey, sampling as necessary, and make recommendations for improvements and/or enforcement action based on his professional judgement.

In general only a small proportion of the results obtained were taken over an 8-hour sampling period but many of the work activities involved were such that 8-hour time weighted averages could be reliably assessed from exposures of shorter duration. In some instances, notably stonemasons work, airborne crystalline silica is generated intermittently and the estimation of a true time-weighted average is more difficult unless sampling extends over the full 8 hours.

Samples obtained for enforcement purposes tend to be biased towards higher levels of exposure, as the survey request will have followed from an initial observation that airborne concentrations appear to be high. It is also true that high levels of airborne silica may not always indicate high exposure as the sampling does not take into account whether respiratory protective equipment is being worn.

Of the total number of samples, approximately 1100 were obtained for manufacturing industry in all forms, 1300 for tunnelling and 500 for quarrying. In manufacturing industry, approximately 46% of the samples were obtained in foundries, 37% in potteries, 10% in brick and tile manufacturing and the remainder in refractory and stonemasons work. This distribution of samples does not reflect the distribution of the exposed population, and is biased towards the foundry industry, partly because high airborne silica concentrations have been found and partly because there is a variety of processes in foundries at which silica-bearing dust is generated.

AIRBORNE DUST CONCENTRATIONS

In considering the sampling data, it may be useful for comparison purposes to record the relevant current United Kingdom occupational exposure limits. These are:

1. 0.1mg/m^3 for respirable crystalline silica.
2. 5mg/m^3 for respirable dust for which no lower limit is specified elsewhere.
3. 10mg/m^3 for total inhalable dust for which no lower limit is specified elsewhere.

Most of the 3000 or so samples covered by the review were analysed to determine airborne dust concentrations for each of these categories.

For manufacturing industry, 65% of 1058 samples indicated less than 0.1mg/m^3 respirable crystalline silica and 19% were in excess of twice the exposure limit. The majority of the higher dust concentrations occurred in the foundry industry, largely at fettling processes. Tunnelling gave a similar distribution of samples for respirable crystalline silica, with 35% of 1292 samples in excess of 0.1mg/m^3 and 15% above 0.2mg/m^3. In quarrying, higher dust concentrations were generally found—64% of 474 samples exceeded 0.1mg/m^3, with 10% in excess of 0.5mg/m^3.

For respirable dust, the proportion of samples exceeding the 5mg/m^3 limit was in the range 5%—10% for all industries, with variations within this range dependent upon the proportion of silica in the material being worked. A uniform pattern of total inhalable dust concentrations was also observed for all industries, with 75% of samples less than the 10mg/m^3 exposure limit.

CONTROL MEASURES

Partly as a result of developments in legislation, renewed attention is being paid to the control of occupational exposure to hazardous substances in the United Kingdom at present. Effective control is perceived as encompassing a wide range of factors including both "hardware" such as extract ventilation and engineering modifications to process plant and the supporting "software" which ensures that the hardware is used to the best effect. The overall management bealth and safety structure, line management supervision, the provision of adequate training in the use of control measures and a good system of preventive maintenance are all part of this support system without which the control measures installed will inevitably lose their effectiveness.

All the major conventional means of preventing and controlling the generation of dust were found in the industries surveyed, including substitution, enclosure, control at source by local exhaust ventilation and process modification. In some circumstances, respiratory protective equipment was also needed in order to reduce exposures to less than the appropriate occupational exposure limit. In common with most other countries, however, the United Kingdom Health and Safety Executive policy regarding the use of respiratory protective equipment is to accept it only as a solution of last resort and to seek effective control by other means wherever possible.

For most of the processes and activities surveyed, effective control of airborne respirable silica to less than 0.1mg/m^3 could be achieved without great difficulty. In potteries, for example, high silica-content material can often be replaced by less hazardous alternatives (e.g. the substitution of calcined flint by calcined alumina) and wetting of materials is a very effective way of inhibiting dust generation during handling. However, a good standard of general cleanliness and housekeeplng is still required to ensure that scrap spillages are effectively removed and not allowed to dry out and create a potential dust problem.

Foundry processes are more difficult to control effectively, problems are much reduced in modern plant of good design. Fettling remains the most problematic of processes, although advances have been made recently in the automatic fettling of small simple castings, which remove the operator from the source of dust. For larger castings, fettling must still be done with a hand-held or swing-frame grinder. Where the work can be done in a booth with an efficient extraction system, good control should be possible but for very large castings there may be no practicable alternative to the use of respiratory

protective equipment to supplement conventional control measures. A similar situation occurs with repair and re-lining work on furnaces and ladles, where high concentrations of crystalline silica are generated during work on refractory linings. Again, at present it will often be necessary to supplement a good standard of ventilation with the use of respiratory protective equipment.

The major activity in the quarrying industry is the production of large quantities of low-value minerals such as roadstone. Plants with throughputs of 500 tonnes per hour are not uncommon and airborne dust quantities produced during mechanised processing are large—up to 0.5% of the process mineral throughput can be retrieved by dust collection. Wet suppression, enclosure and local exhaust ventilation techniques are used as circumstances demand, but are not always able to achieve control of exposures to the same standard as manufacturing industry.

CONCLUSIONS

Personal sampling data over a wide range of industries in which crystalline silica-containing material are used indicate that for many processes effective control of airborne dust can be achieved to current United Kingdom occupational exposure limits. Some problems remain difficult to solve, and in these cases respiratory protective equipment is used to supplement engineering control measures.

Control measures are not always used to their maximum effectiveness. Where this occurs, there is usually a need for improving the general awareness of the importance of dust control from the occupational health and safety viewpoint and securing greater commitment to the effective use of existing control measures. Developments in legislation in the United Kingdom and the preparation of supporting technical guidance by the Health and Safety Executive should assist in generally raising standards of control in industry.

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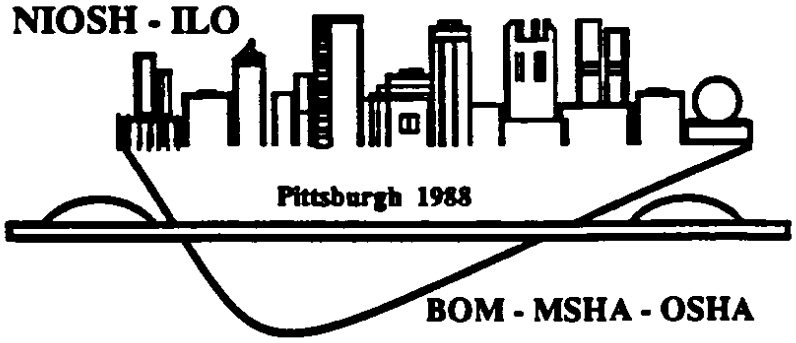

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