Health and Safety Executive

Silica baseline survey

Annex 4 Quarry industry

Prepared by the **Health and Safety Laboratory** for the Health and Safety Executive 2009

RR689
Annex 4

Health and Safety Executive

Silica baseline survey

Annex 4 Quarry industry

Andrew Easterbrook
Paul Brough
Health and Safety Laboratory
Harpur Hill
Buxton
Derbyshire SK17 9JN

Aims and Objectives

This Silica Baseline Survey aims to develop baseline intelligence on exposure and control of respirable crystalline silica in key industry sectors. These sectors are:

- Brickworks and Tile Manufacture
- Stonemasonry
- Quarrying
- Construction

The objectives are:

1) to establish whether exposure control practices (both the application of engineering controls and the use of RPE) are adequate to reduce exposures below the WEL for RCS
2) to form an opinion about the long-term reliability of the controls
3) to identify common causes of failures of exposure control
4) to provide data by which the effect of HSE interventions can be assessed.

This annexe to the main SBS report includes the site visit data and detailed discussion of observations in the quarrying sector.

This report and the work it describes were funded by the Health and Safety Executive (HSE). Its contents, including any opinions and/or conclusions expressed, are those of the author alone and do not necessarily reflect HSE policy.

HSE Books

First published 2009

CONTENTS

1 INTRODUCTION ... 1
1.1 Silica Baseline Survey ... 1
1.2 Hygiene standards ... 1
1.3 Overview of the UK Quarry Industry ... 1
1.4 Overview of relevant processes:- ... 3
1.5 Quarries – Information Sources ... 4
1.6 Exposure data – Quarrying sector ... 5

2 QUARRY DETAIL ... 7
2.1 Site selection ... 7
2.2 Assessment of controls ... 8
2.3 Exposure measurements ... 9

3 FINDINGS, OBSERVATIONS & IDENTIFIED ISSUES ... 11
3.1 Results ... 11
3.2 Discussion ... 12

4 CONCLUSIONS ... 15

5 RECOMMENDATION ... 17

6 APPENDICES ... 19
Appendix A Tables ... 19
Appendix B: Visit report summaries ... 22
Appendix D Control Competence Survey Tables ... 47
Appendix E Quarrying: Standard Industrial Classification (SIC) ... 51

7 REFERENCES ... 55

EXECUTIVE SUMMARY

Aims and Objectives

This Silica Baseline Survey aims to support development of baseline intelligence on exposure and control of respirable crystalline silica in key industry sectors. These sectors are:

Brickworks and Tile Manufacture

Stonemasonry

Quarrying

Construction

The objectives are:

1. to establish whether exposure control practices (both the application of engineering controls and the use of RPE) are adequate to reduce exposures below the WEL for RCS
2. to form an opinion about the long-term reliability of the controls
3. to identify common causes of failures of exposure control
4. to provide data by which the effect of HSE interventions can be assessed.

This annexe to the main SBS report includes the site visit data and detailed discussion of observations in the quarrying sector.

Main Findings

Lack of formal assessment of silica exposure and the control measures needed is not uncommon.

Of 61 measurements of RCS exposure made, only one indicated 8-hr TWA exposure above the WEL of 0.3 $mg.m^{-3}$ that applied at the start of the study. A further 10 measurements indicated exposure above the new WEL of 0.1 $mg.m^{-3}$. No measurements showed respirable dust exposure above 4 $mg.m^{-3}$ and only one was above half this figure.

Large modern items of mobile and static plant tend to have exposure control measures supplied as standard, but ongoing effectiveness of these depends on effective maintenance.

Small-scale employers exist and may not have arranged access to professional health and safety advice. Large quarry groupings are well-equipped in terms of health and safety expertise, but (lack of) actions by local management and supervision can undermine exposure control regimes (e.g. lack of attention to detail in maintenance of systems.) This might be addressed to some extent by the operation of the Social Dialogue Agreement.

Annual exposure monitoring is common among the larger employers but by no means universal, in common with health surveillance.

Recommendations

Where RPE needs to be used, more robust policies are needed to ensure that fit testing is performed and that staff training is adequate to ensure appropriate use.

1 INTRODUCTION

1.1 SILICA BASELINE SURVEY

HSE has established the Disease Reduction Programme (DRP) as part of the FIT3 strategic programme. The aim of the DRP is to reduce the incidence of work-related ill health caused by exposure to hazardous substances. Respiratory disease, covering occupational asthma as well as the longer latency diseases such as Chronic Obstructive Pulmonary Disease (COPD) and silicosis, accounts for a significant proportion of work-related ill health and so the DRP has a specific project to address this. The Silica Baseline Survey is being undertaken to support the respiratory disease project and focuses on four industrial sectors where ongoing exposure to Respirable Crystalline Silica (RCS) is suspected. These are Construction, the Brick making and heavy clay industry, Stonemasonry and Quarrying. This Annexe to the main SBS report contains the detailed descriptions of site visits, other exposure data, discussion and sector-related conclusions for the quarrying industry.

This report takes forward much earlier HSE work. Many of the documents reporting such work have been quoted here, either directly or with alterations to make the information more specific to the activity under discussion.

1.2 HYGIENE STANDARDS

In the UK exposure to RCS is regulated under the Control of Substances Hazardous to Health Regulations 2002 (as amended) (HSE 2002 and 2004.) There is a duty to apply the “Principles of good control practice” listed in Schedule 2a of the Regulations and exposure should not exceed the Workplace Exposure Limit (WEL) set in EH40, (HSE 2005.) The WEL that applied at the start of this project was 0.3 $mg.m^{-3}$ and it was reduced to 0.1 $mg.m^{-3}$ in October 2006. The new limit was included in the updated List of approved workplace exposure limits published by HSE in 2007 (HSE 2007).

The Social Dialogue Agreement for silica (SDA) (ref NEPSI) is a parallel initiative, agreed at European level. A number of Industry Sector Associations have made a binding agreement to implement the requirements of both the exposure monitoring and reporting protocol and the associated “good practice guides.” The good practice guides are similar to the COSHH Essentials guidance published by HSE and, if implemented in full, should result in exposures below the WEL. Although the SDA is not binding on employers who are not members of the participating trade associations, the nature of NEPSI makes it clear that all the actions suggested in the guidance are acknowledged as practicable by employers, and other organisations should therefore also be able to adopt the same standards.

1.3 OVERVIEW OF THE UK QUARRY INDUSTRY

Industry overview

Quarries produce products such as aggregates, chippings for road re-surfacing and feedstock for chemical processes. Besides use as simple “fill” in construction, the products may be used either immediately on site or elsewhere in other processes such as the production of mortar, ready-mixed concrete or concrete building blocks and in coating plants to make tarmacadam (asphalt “blacktop.”) Particular rocks or minerals provide the raw materials to make cement and agricultural or industrial lime, sand is used to make glass and gypsum is used to make plaster, to give a very few examples. The sector is a complex industry where respirable crystalline silica exposure is dependent on many factors, major ones being the type of rock being worked and the job or activity involved. Because of this multiplicity of factors, overall airborne dust exposure figures are difficult to use meaningfully and combined RCS exposure data can hide many of the relevant features. The term quarrying is effectively synonymous with open-cast mining, which in the UK is generally restricted to the extraction of coal and a few other minerals such as china clay and gypsum.

A consistent aspect of quarrying is the production of large quantities of low value minerals; the value of the product is important because this influences economic considerations when large capital costs are involved. EH74/2 (1999) gave a figure of 35,000 employees in the quarry industry being exposed to silica at between 2,500 and 3,000 quarries. However, the number of 'mineral operations' in the UK was stated to be about 1,400 in 1999 (Lavender, 1999) but the definitions used may be different. The Quarry Products Association (QPA) estimated in 2004 that there were up to 2,000 quarries and about 500 non-quarry sites which house ready-mix concrete, mortar or asphalt enterprises. In contrast, the Office of National Statistics reported just 360 "local units in VAT-based enterprises" in 2005 (see Table 3a for more detail.)

Technical background: Silica and Rock types

As one of the commonest rock-forming minerals, silica is found in most strata, although in differing proportions. It is one of the three principal constituents of granite, perhaps the most familiar igneous rock, formed from the slow crystallisation of magma within the earth's crust. If molten rock of the same composition cools relatively rapidly nearer the surface a micro-granite with small crystals forms but if lava of the same chemical composition is chilled rapidly obsidian, a non-crystalline volcanic glass, is formed instead. Magmas contain a wide range of silica contents and as the silica content falls the rocks produced are said to become less "acidic." Rocks with negligible quartz content are called gabbros, dolerites and basalts in decreasing order of crystal size. Most types of igneous rocks are extracted for use as aggregate or railway ballast because of their strength and hardness.

Silica eroded from igneous and other rocks by natural processes is ultimately incorporated into sedimentary rocks. A degree of winnowing usually occurs before deposition and the grains may be cemented by a variety of minerals which are subsequently deposited over geological time from the circulation of groundwater, often at relatively high temperature and pressure. A deposit consisting only of quartz grains with no other mineral content (such as iron compounds) is called silica sand and is highly prized as a chemical feedstock and for glass making. Rock containing only quartz grains is termed an orthoquartzite and may be cemented by quartz too. Sandstones are common rocks and, as long as they are not too poorly cemented, are useful as building stones or may be crushed for aggregate. They have generally been laid down in desert environments or on coastal shelves as the grain size is such that settlement occurs rapidly. Sandstones may be cemented by silica or other minerals such as calcite, and the carbonate content of a rock may grade through sandy limestones to the point where it is considered to be a limestone. Such deposits would also be typical of shallow-water environments.

Sedimentary rocks may be formed by other mechanisms, e.g. evaporites such as rock salt and gypsum deposits, and limestones formed from the accumulation of calcium carbonate in relatively deep-sea conditions. They all have the potential to contain very fine grained silica crystals. Chalk forms at intermediate depth (principally from the calcareous tests of small animals from the plankton) but also contains sponge spicules and the skeletons of radiolaria, both siliceous. At the higher pressures in still deeper water the carbonates dissolve, leading to the accumulation of a siliceous ooze, while at the greatest depths even the silica dissolves and the only sediment consists of clay minerals. When the outer edge of the continental shelf becomes unstable an area of uncompacted or uncemented sediments slump and flow into the ocean depth as a turbidite. Thus even these sediments, when converted to rock, will contain silica which may become airborne as RCS during crushing etc. Silica forms the greater part of chert and flint, but in these cases it has formed by migration in groundwater and precipitation *in* *situ* and is described as cryptocrystalline, that is it has crystals too small to see by traditional geological methods, but is not amorphous. Grinding calcined flint for the pottery industry was at one time a serious cause of silicosis and one of the earliest recognised industrial diseases.

All rock types when buried in the earth's crust are subject to alteration with time, and whatever the starting point the commonest change is probably the deposition of silica. It may cement grains of quartz or other minerals, it may form crystals within the body of the rock or in cavities or it may precipitate out in lenses, veins or sheets. Older rock formations are most likely to have been altered in this way, and therefore to generate airborne silica when crushed, even if the base rock did not contain a high proportion of silica.

Slate is the name given to any rock that cleaves to give thin weatherproof sheets. Some sandstones have been used where they cleave easily, usually along their bedding planes, but these generally produce relatively thick "stone slates" and are little used now, if at all. Almost any rock may be subject to sufficient pressure and temperature in such a combination that the mineral grains are changed and re-orientated so that the resulting rock splits appropriately for use as slate. The base rock may have been mudstones (formed principally of clay-minerals and quartz, as in Devon and North Wales) or fused volcanic ash (as in the Lake District slates) and the cleavage usually supersedes the original cleavage on bedding planes. Dust generated from these rocks may contain up to 25% silica.

1.4 OVERVIEW OF RELEVANT PROCESSES:-

Removal of overburden and site vehicle movements.

When a new quarry is opened, or an existing one extended, access usually has to be gained to the strata of economic interest. Any topsoil and subsoil and overlying strata are removed and either stockpiled for use during remediation, used for this purpose immediately or removed from the site. All this material is likely to contain a greater or lesser proportion of quartz depending on its nature or derivation. Disturbance, especially in dry weather, can lead to RCS exposure, especially from dust re-suspended by vehicle wheels from contaminated haulage routes. This RCS generation mechanism exists throughout most stages of production in most quarries. A variety of actions are applied to control dust from this source. Ideally, potentially-contaminating processes would be isolated: at one location seen during the SBS work the quarry dump trucks ran to and from the primary crusher and these roadways were not traversed by any other traffic. In contrast, at another location the fine material discarded from the primary crusher/screen (located at the working face) was stockpiled close by. Articulated lorries collecting these "scalpings" drove through the whole quarry into the areas most highly contaminated with stone dust and fines, transferring the material onto almost all the roadways in the quarry and beyond. Some roadways are temporary and do not justify the installation of concrete or any cleanable surface: it is nonetheless still possible to minimise the amount of slurry underfoot by use of scraper vehicles, supplemented by the use of water sprays in dry weather.

Extraction of stone.

Many quarries extract rock which is sufficiently hard that explosives are used either to loosen large blocks for removal or to loosen and fragment the material to a size convenient for feeding to the crushers. Holes are bored into the rock to receive the explosives, generating significant amounts of dust in the process (with a silica content reflecting that of the bedrock). The work is done either in-house or by specialist subcontractors using plant which is becoming increasingly sophisticated, incorporating progressively more dust suppression features which may have been, at least in part, the consequence of regulatory pressure. The features may include pressurised control cabins fed with filtered air or the capture of the generated dust by feeding it through a cyclone and binding the collected material using oil mist. Engineered controls are therefore available, but the use of simple compressed-air powered percussive drills without any water mist dust suppression continues. (Many quarries do not need to use explosives, being able to use face shovels of adequate power to dig the deposit directly.)

Loosened stone will usually be transferred by a face shovel or excavator either into an adjacent mobile primary crusher or into a dump truck for transfer to a separate primary crusher. Much plant is becoming larger and tending to incorporate features which either minimise dust generation or prevent operator exposure. Water sprays may be used to prevent dust release from crushers and large face shovels have been fitted with spray bars to suppress the dust generated during digging. The control cabs of both static and mobile plant are now often fitted with ventilation systems that offer both air-conditioning and a filtered-air working environment that benefits both the operative and the control mechanisms.

Primary crushers are often fitted with hydraulically powered picks ("peckers") so that blockages (caused either by oversize stone being fed to the crusher or by 'bridging' where stones fail to be pulled into the crusher by the motion of the machine) can be dealt with. The best arrangement (for minimising exposure to stone dust at the crusher) is for the pecker to be remotely controlled from a clean control room and monitored by video camera. The dust inevitably generated by crushing stone can be contained either by applying water (which requires measures to deal with the resulting slurry) or can be extracted from an enclosure and filtered to prevent dispersion. In all cases maintenance of the equipment is required for it to function effectively. The need for effective dust control increases as the stone is progressively reduced in size and screened. Dust suppression using water becomes incompatible with plant operation as particle sizes are reduced, so capture of the generated dust becomes more important. The removal of the dust and the maintenance of filters then becomes an exceptionally high-risk activity as large quantities of dry potentially silica-containing dust have been gathered and are easily rendered airborne.

Despatch or use of the quarry products also poses an RCS inhalation risk. Attrition of particles during handling can generate more RCS, even if the product of the original process was wet or free from dust. Operations such as bagging loose material or loading vehicles by mechanised shovel or from hoppers may all cause exposure and dust extraction, cabs supplied with filtered air and carefully selected dustless cleaning methods may be needed to control exposure.

Thus almost every activity required to extract earth materials from the ground has the potential to release RCS if generation of dust is not actively or passively prevented.

1.5 QUARRIES – INFORMATION SOURCES

Various sources of information have been used during this study. These have included:

HSE Manufacturing Sector (Metals & Minerals)

British Geological Survey, "mineralsUK" webpage

British Aggregates Association website

Quarry Products Association website

Stone Federation of Great Britain website

UK Office for National Statistics publications

THOR Research Associate, Centre for Occupational and Environmental Health, The University of Manchester

1.6 EXPOSURE DATA – QUARRYING SECTOR

(It should be noted that in all discussion of exposure data there is a discontinuity at 1997. This is because in January 1997 the UK adopted the ISO/CEN convention for respirable dusts as defined in BS EN 401. To maintain the equivalent level of control the then Maximum Exposure Limit (MEL) for respirable crystalline silica was reduced from 0.4 $mg.m^{-3}$ to 0.3 $mg.m^{-3}$ when sampled by the new convention.)

(a) Aggregates, surfacing materials

HSE's NEDB showed that post-1997 (Table 3, Annex 1) three sites had been sampled and that of the 19 samples analysed, none indicated exposure above 0.3 $mg.m^{-3}$, 11% were above 0.1 $mg.m^{-3}$, 58% were above 0.05 $mg.m^{-3}$ and 84% were above 0.02 $mg.m^{-3}$.

A large quarry company supplied sampling data for RCS covering their sites over the period 1999 to 2003. Over the five years, the percentage of samples above 0.1 $mg.m^{-3}$ ranged from 4% to 25%, samples above 0.05 $mg.m^{-3}$ ranged from 13% to 28% and the percentage of samples above 0.01 $mg.m^{-3}$ ranged from 35% to 42%.

Another quarry company sent data for RCS exposure from 2001 (untabulated), showing that for the loaders and weighbridge operators, only two of the twelve samples (from five sites) were above 0.05 $mg.m^{-3}$ and none were as high as 0.1 $mg.m^{-3}$. However, loaders should only be exposed to dust where a filtered air supply to the vehicle cab is inoperative, and weighbridge operators' exposures would only reveal something about the cleanliness of the workroom and the ambient RCS concentrations at the site. There was also no indication of the type of stone quarried at the sites.

(b) Slate Quarries

Specific data on slate splitting is sparse.

HSE sampled for two days at a slate quarry in 1998 and found that at stillages with LEV, the RCS exposures ranged from 0.12 to 0.39 mg.m-3 (8-hour TWAs). Further investigations showed that the LEV could reduce exposures by only between 2- and 4-fold. Lower exposures could be achieved by higher exhaust ventilation air flow, by adding flanges to captor hoods, by optimising alignment of the hoods, by adding exhaust ventilation to the stacks of slates and by minimising the stacking and banging together of slates once split.

In 2002, this quarry was revisited by HSE to investigate the effects of the improvements. At a slate splitting station with LEV but no Localised Air Displacement (LAD,) the results of personal monitoring were 0.10 $mg.m^{-3}$ and 0.15 $mg.m^{-3}$ on consecutive days. At another slate splitting station with both LEV and LAD, the personal results were 0.05 $mg.m^{-3}$ and 0.08 $mg.m^{-3}$ on consecutive days (all results as 8-hour TWAs).

Another company submitted sampling data from 2003 and all four personal samples taken from slate splitters were between 0.1 $mg.m^{-3}$ and 0.3 $mg.m^{-3}$ (8-hour TWAs). HSE visited the site during 2004 and they conducted their own sampling survey. 10 personal samples (all 8-hour TWAs) were taken from two roofing slate manufacturing sheds, the sawing shed, and from a driller in the quarry. The seven samples from the slate manufacturing shed ranged from 0.07 to 0.26 $mg.m^{-3}$ the two samples from the sawing shed showed a value of 0.08 $mg.m^{-3}$, and the sample from the quarry showed a value of 0.85 $mg.m^{-3}$. The drillers wore FFP2 respirators but face-fitting had not been carried out. Advice on appropriate respiratory protection was given to the company as part of the overall advice.

The manager of slate production at the quarry visited for the SBS made their monitoring data for 2005 available. Of 22 personal measurements of RCS exposure, 3 were above 0.3 $mg.m^{-3}$ and a further 9 were above 0.1 $mg.m^{-3}$ 8-hr TWA, i.e. 55% were above the new WEL.

2 QUARRY DETAIL

2.1 SITE SELECTION

As previously mentioned, one of the principal objectives of the study was to obtain baseline occupational hygiene data and information relating to exposure to respirable crystalline silica in the quarrying industry.

In order to achieve this within the timeframe and budget for the study sites for inclusion had to fulfil certain criteria, which included:

- Extraction of stone (prioritised by stone with significant silica content)
- Preferably not including members of large industrial groupings
- Quarrying businesses of differing sizes and capacities

The UK quarrying industry has gone through considerable consolidation over recent years and a large number of the UK quarries facilities are now part of large multi-site corporations. The survey attempted to include quarrying facilities that reflected the different range of businesses in the industry; including large multi-site groupings but weighted towards small, independent operators.

It was therefore decided that to get exposure data and an assessment of control and RPE competence within the initial remit of fewer than 12 sites, the work would focus on producers of higher-silica materials. It is possible that significant and potentially harmful exposure to RCS could occur in the production of minerals such as rock salt and gypsum, but these are generally mined (and outside the scope of the SBS.) The extensive production of limestone for both aggregate and chemical feedstock (lime production and the chlor-alkali industry) was also excluded, although a major quarry group submitted their selection of monitoring data for 3 extraction sites for 2 years.

The primary focus of the visits was therefore to sites extracting either stone with a high intrinsic silica content, or where the age of the stone was such that high secondary mineralisation with silica would be anticipated. This approach led to the selection of quarries working the following rock types:

· Olivine-dolerite (medium grained basic intrusive igneous rock), quartz mineralised since deposition

· Carboniferous Greywacke

· Carboniferous (Pennant) sandstone

· Aggregate production from N. Wales slate

· Roofing slate production

· Extraction of large blocks of New Red Sandstone for dimension stone production

· Open-cast coal production (where 90% of the stone moved is sandstone) and

· Two sister sites producing sand which were visited primarily for another project.

It was considered that as sand production involved minimal crushing and the handling and screening was of particles of small mass inherently less likely to generate RCS as a consequence of impacts with each other, it would be considered to be lower priority.

After a sufficient number of suitable sites had been identified the sites selected for inclusion in the survey, including a few that had previously benefited from HSE intervention, were chosen at random. Advantage was taken of work proceeding on another project to make joint visits at a quarry producing principally sandstone chippings and a sand quarry. The other work was measuring the RCS concentration at the quarry perimeter as part of an assessment of the risks arising from third-party exposures.

All of the sites volunteered to participate in the survey.

2.2 ASSESSMENT OF CONTROLS

The objective of the SBS was to gather information on the current effectiveness of RCS exposure control in the selected parts of UK industry as well as to measure exposures. A full explanation of the procedure adopted is given in the SBS main project report, but is summarised briefly below.

An important aspect of this study is that control competence is not judged simply by measurement of exposures. The success of exposure control depends on the correct application of a wide variety of measures. Control of emission at source (by engineered controls) is recognised as the most effective measure, but in some circumstances is not practicable, and the use of RPE is necessary to maintain exposure at a safe level. However the ongoing effectiveness of all exposure control regimes depends on the underpinning actions being maintained, termed "competency" here. The SBS site visits assessed the resilience of the control regime by considering the robustness of the range of factors involved. This technique was applied because it was expected to give a better assessment of whether exposures would be likely to remain within the WEL than would a single day's measurement. The views and professional opinion of the visiting occupational hygienist were therefore captured in a structured way that allowed an objective assessment of competence to be made. The same criteria could then be used at some future date to judge change.

It should be noted that the Control competence ratings ranged from 0 to 5, where 0 indicated manifest failure and was numerically valid.

A similar assessment was made of the effectiveness of the RPE regime if use was necessary to maintain control of exposure. For RPE competence a rating of N/A was included instead of 0, which indicated adequate control by other methods. However this does not address the residual need which has to be acknowledged, e.g. for circumstances when engineered controls have to be worked on. The factors considered are shown (with the indicators of the ranges of dutyholder performance) in the site competency assessment checklists, which are reproduced in appendix D of this annexe. A shift in the profile of these indicators will provide strong evidence of the desired improvements in the industries. The factors themselves are shown below:

"Control competence" was assessed by

- Comprehensiveness of COSHH assessment
- Awareness of literature and information sources
- Application of appropriate, effective, well maintained controls at process
- Degree of management and operator understanding of exposures
- Level of operator training
- Designation of areas and use of RPE when appropriate
- Well informed management
- Competence of supervision

i.e. overall evidence of coordinated approach to control – skills and knowledge available

"RPE competence" was assessed by

- Verifiable policy on RPE linked to COSHH assessment.
- Face fit testing programme
- Equipment routinely available and range of products available through selection process
- Appropriate storage facilities
- Initial training and refresher training
- Operator understands role of RPE in controlling exposure
- Clearly defined roles and responsibilities

Achievement of a rating of 4 for control competence and, if necessary, for RPE competence, was intended to identify sites which "achieved the COSHH Essentials standard." This indicated a system of exposure control sufficiently robust that ongoing compliance with the WEL could be anticipated. A grade of 5 would have indicated exemplary performance in every aspect of control: it was not seen anywhere.

Worker exposure to airborne respirable dust and RCS was measured during the time on site and generated a further input to the baseline survey. It has to be recognised that the results of the monitoring show exposures as they were on the day, when a visit was made by appointment.

2.3 EXPOSURE MEASUREMENTS

General

In general, personal monitoring was undertaken in accordance with approved inhalation exposure monitoring strategies described in the Health and Safety Executive publication HS(G)173 - Monitoring Strategies for Toxic Substances.

For each field study personal monitoring was conducted in areas where the operations were deemed to offer the greatest risk of exposure to airborne RCS. For comparison purposes, sampling was also conducted on operatives and in locations that had been included in the dutyholders' exposure monitoring, where these results had been made available in advance of the visit.

Background levels of respirable dust and respirable crystalline silica in the work area atmospheres were measured at strategic static locations in a similar manner.

Occupational Exposure Monitoring Methods:

Respirable dust was measured by drawing air at a defined flow rate (2.2 $l.min^{-1}$) through a pre-weighed membrane filter held in a cyclone sampling head. The flow rate for the pumps was measured and recorded prior to the start of the sampling and re-checked periodically and again at the end of the sampling. The filter heads were mounted as close as possible to the operative's breathing zone, e.g. on the lapel of his overalls.

All samples were analysed at the UKAS-accredited Health & Safety Laboratory (HSL), Buxton. Crystalline silica was quantified by x-ray diffraction (XRD) techniques.

Table 1 Sampling and analytical methodologies used in this investigation

Hazardous Substance	Method Reference	Analytical Technique
Respirable dust	MDHS 14/3 (General methods for sampling and gravimetric analysis of respirable and inhalable dust)	Gravimetric analysis
Respirable Crystalline Silica (RCS)	MDHS 51/2 (Quartz in respirable airborne dust) and MDHS 101	X-Ray diffraction

MDHS – Methods for the determination of hazardous substances

As with most exposure monitoring, it has to be recognised that the results only show exposures as they were on the day, when a visit was made by appointment.

3 FINDINGS, OBSERVATIONS & IDENTIFIED ISSUES

3.1 RESULTS

Brief summaries of the site visit reports are given in appendix B. These include descriptions of the facilities, materials in use and exposure controls, together with the control and RPE competency summaries and monitoring data.

Control competence assessments

Of the 7 quarry sites awarded a rating for adequacy of control measures, one achieved a rating of 4, i.e. achieved a level of control that would be deemed appropriate as per COSHH Essentials and 3 were allocated a “3”. The remaining four sites received lower ratings of 1 or 2.

Table 2 Distribution of control competence ratings

Control Competence Rating:	**0**	**1**	**2**	**3**	**4**	**5 (exemplary)**
Number of sites:	0	1	3	2	1	0

(Range: 0, “Manifest failure to recognise hazard and failure to provide any form of controls,” 4: The COSHH Essentials Standard, 5: Exemplary control consistent with risk. Detail in Appendix D)

The average rating awarded across the nine sites was between 2 and 3, which can be summarised as between ‘Evidence of over-exposure. *Some understanding of hazard and risk and some controls in place but not receptive to need to improve*’ and “*Occasional over-exposure. Reasonable awareness of hazard and risk and desire to improve.*

It was noticeable that very few sites addressed the need to control exposure to RCS via a formal COSHH Assessment. All were aware of the consequences of exposure, most addressed it during staff induction and almost all operated Occupational Health Surveillance. Most of the actions required by the COSHH Regulations were being operated, but the lack of an integrated approach to exposure control was revealed by the deeper questions on the checklist used to compile information before the rating was allocated.

RPE competence assessments

Every quarry site was awarded a rating of 2 for adequacy of RPE, with the sole exception of the open-cast coal site that was maintained in a very clean condition, where RPE was considered not to be necessary as part of an exposure control programme.

The average rating awarded across the eight sites therefore Rating 2, i.e. ‘*RPE used to achieve adequate control. Evidence of provision of suitable and adequate equipment but strong evidence of poor practices in use.*’ The principal reason for the grading was the lack of RPE fit testing performed, the outcome of less-than-rigorous consideration of the various factors underpinning an RPE policy.

This does not address the need for the use of RPE when “dry” LEV (which cannot be washed clean) has to be maintained or serviced. In such circumstances RPE is likely to be needed except in cases where initial wet cleaning can be performed or a type-H vacuum cleaner can be used to collect dust deposits.

Exposure monitoring:

A table showing the results of the measurements made (both measured concentrations and 8-hr TWAs) for RCS and respirable dust is given in each summarised site report in Appendix B. An overall summary of the data appears as table 1 in Appendix A and an analysis appears below.

Table 3 Distribution of measured RCS exposures

Measured exposures	RCS exposure, $mg.m^{-3}$			
	>0.3	**0.1 to 0.29**	**0.08 to 0.099**	**<0.08**
Number of measurements::	1	10	12	38
Cumulative number:	1	11	23	61
Cumulative %:	1.6%	18.0%	37.7%	100.0%

Of 61 measurements of RCS exposure made for the SBS work, only one indicated 8-hr TWA exposure above the WEL of 0.3 $mg.m^{-3}$ that applied at the start of the study. A further 10 measurements (one being compiled from two samples) indicated exposure above the new WEL of 0.1 $mg.m^{-3}$. Another 12 measurements showed exposure of 0.08 or 0.09 $mg.m^{-3}$. The 11 exposures above the 2006 WEL represented 18% of all the measurements made and this proportion is somewhat higher than the figure of 14% estimated by employers in response to the questionnaire issued before the RIA was prepared.

However it should be noted that a further 20% of measurements were within 20% of the WEL giving a total of 37.7% of measurements above 80% the new WEL of 0.1 $mg.m^{-3}$.

Respirable dust exposures were almost all below half the threshold of 4 $mg.m^{-3}$ at which respirable dust comes within the definition of a substance hazardous to health under COSHH. Only one exceeded 2.0 $mg.m^{-3}$, one was above 1.0 $mg \cdot m^{-3}$ and one background sample in a control cabin indicated a concentration of 1.0 $mg.m^{-3}$. 56 out of 67 samples (84%) indicated exposure at or below 0.5 $mg.m^{-3}$, one eighth of the threshold at which respirable dust becomes a substance hazardous to health under COSHH. It should be noted that both the SBS and the industry questionnaires covered only a small proportion of the industry and therefore could not be considered to give an absolutely robust or statistically valid assessment of conditions: they did however show the present position in a sample of locations.

When the SBS measurements are considered alongside the broad range of observations made and information received from dutyholders, it becomes possible to form an impression on whether good occupational hygiene standards are being employed at any site and, more importantly, whether any exposure measurements indicate a situation likely to persist in the longer term. Thus, whatever the range of exposures measured during a site visit, a “Control Competence” grading of less than 4 (indicating a failure to follow the principles of good practice as explained in COSHH essentials) will make ongoing compliance with the 2006 WEL unlikely. Most quarries that were part of larger groupings performed exposure monitoring on an annual basis.

3.2 DISCUSSION

The prevailing economic climate applies pressures which cause a variety of outcomes. There has been considerable consolidation of the sector and (on exposure outcomes) this might be seen as having a net beneficial effect. The fact that previously small businesses are part of larger groupings leads to both the strategic investment of larger funds but also the pressure for higher productivity. These two together lead to the purchase of bigger and more expensive items of plant with the secondary effect that these items are more likely to be supplied with enclosed cabs and other H&S features (such as vibration & noise reduction, ergonomic cabs,) besides air-conditioning supplied with filtered air as original fittings. The price of such large items of plant also means that they are more likely to be purchased with some kind of warranty, and that maintenance to ensure the effective functioning of such valuable assets is a significant management priority. Warranties tend to reinforce maintenance as the manufacturer specifies schedules and the contracts are invalidated if they are neglected.

A second significant benefit of consolidation is the availability of broader and deeper H&S expertise [i.e. more better-qualified people] within larger business groups. When a large organisation has a fully-qualified Safety Officer working to ensure compliance through the organisation and reporting to the board of directors, pressure to adopt good practice is likely to be applied and the funds necessary for improvements are more likely to be made available. This is not necessarily the case with trade associations which, although they will typically brief members on legislative requirements, have not traditionally operated any compliance or enforcement regime.

The Quarry Products Association (QPA) is the UK rapporteur for the aggregate industry under the SDA. In addition to the COSHH obligation to implement the principles of good control practice and to prevent RCS exposures exceeding the WEL, UK QPA members are required to operate a regime for checking compliance against the SDA Good Practice Guide. This is part of the recording and reporting arrangements forming part of the Agreement, in addition to other safety performance indicators reported to the trade association. The SDA guide reflects COSHH Essentials, but is somewhat broader. The QPA has a total membership of about 150 of whom about 80 members operate quarries in Great Britain, employing approximately 14.5 thousand workers. Employers who are members of other trade associations or of none remain subject only to HSE regulatory arrangements.

Issues

The potential liabilities arising from the neglect of exposure controls are significant, but are not necessarily an issue always perceived as demanding immediate management attention. In these circumstances, particularly if pressure is being applied for higher output per person, RCS exposure control (the net outcome of numerous smaller actions) can slip as other more immediate demands are addressed. The changes of management structure that accompany re-organisations when companies assimilate new acquisitions can add to the factors which distract dutyholders from attention to the detail that keeps plant maintained and RCS exposure controls functioning effectively. QPA members implementing the SDA are subject to a level of internal performance reporting which might help address this risk; however smaller independent operators which are not members of a trade body remain subject only to UK legislation and HSE oversight.

In the circumstances and where a formal assessment of RCS exposure (and exposure prevention) has not been made, ongoing effectiveness is perhaps even less likely to be maintained.

Nearly 40% of measurements made during the SBS indicated exposure above 80% of the WEL. Given that only a single site achieved a Control Competence grading of 4, i.e. it achieved the "COSHH Essentials standard," and that twice as many were graded 1 and 2 as were given a 3 (4 sites compared with two) it must be acknowledged that it is likely that exposures will tend to increase in the absence of external scrutiny.

The results of the SBS therefore indicate that a considerably higher proportion of employees might be exposed to RCS above the new the WEL of 0.1 $mg.m^{-3}$ 8hr TWA than the industry was predicting a few years ago.

Small organisations still exist without safety expertise: for consistency the 2005 ONS figures are discussed throughout the SBS work, but it is significant that the 2006 figures show 7% fewer “local units” in quarrying (335 instead of 360.) (Table 3a, appendix A)

In some cases even where significant resources and effort have been applied to the installation of engineered exposure controls the work has not been followed through to the point where all unacceptable exposures have been identified.

4 CONCLUSIONS

Lack of formal assessment of silica exposure and the control measures needed was not uncommon.

Approximately 40% of measurements showed exposure to RCS either above or within 20% of the new WEL of 0.1 $mg.m^{-3}$ (i.e. $\geq$0.08 $mg.m^{-3}$).

Large modern items of mobile and static plant tend to have exposure control measures supplied as standard, but ongoing effectiveness of these measures depends on the standard of maintenance.

Small-scale employers exist and may not have arranged access to professional health and safety advice. Large quarry groupings are well-equipped in terms of health and safety expertise, but in any organisation actions (or lack of them) by local management or inadequate supervision can undermine exposure control regimes (e.g. poor attention to detail in maintenance.) This may be addressed to some extent by the SDA.

Annual exposure monitoring is common among the larger employers but by no means universal, in common with health surveillance.

Where RPE needs to be used more robust policies are needed to ensure that fit testing is performed and that staff training is adequate to ensure appropriate use.

5 RECOMMENDATION

Where RPE needs to be used, more robust policies are needed to ensure that fit testing is performed and that staff training is adequate to ensure appropriate use.

6 APPENDICES

APPENDIX A TABLES

Table 1 Quarry sector: Summary of SBS results

Table 2: RIA Questionnaire responses - Summary tables of employee exposure to RCS for the Quarrying industry

Table 3: Employment statistics 2005

Table 1 Quarry sector: Summary of SBS results

Site	Activities	Control strategy	Samples collected		Number of measurements (8-hr TWAs)					Competency Descriptor Ratings		Material type
					RCS			Respirable Dust				
			Personal	Static	≥0.3 $mg.m^{-3}$	0.3>x≥ 0.1 $mg.m^{-3}$	Peak exposure $mg.m^{-3}$	Exposure above 4 $mg.m^{-3}$	Peak exposure $mg.m^{-3}$	Control	RPE	
Q1	A, C & D		8	1	0	0	0.03	0	0.71	3	2	Quartz-veined Dolerite
Q2	A, B & D		15	2	0	2	0.18	0	0.76	2	2	sandstone
Q3	A	W	13	0	0	0	0.05	0	0.51	4	N/R	Sandstone, coal
Q4	A		3	1	0	1	0.19	0	0.41	1	2	Sandstone
Q5	A, B& D		7	0	0	1	0.16	0	0.59	2	2	N Wales slate
Q6	A & E	LEV	4	2	1	3	0.79	0	2.52	3	2	N Wales slate
Q7A & B	D	W,	6	2	0	2	0.15	0	1.39	3	2	Silica sand
Q8	A, B,	W, LEV	3	1	0	0	0.06	0	0.22	2	2	Greywacke
Totals:			**61**	**9**	**1**	**9**		**0**				
Percentages:					**2%**	**14%**						
"Average:"										**2.5**	**2.0**	

Activities: A Extraction of stone, B Primary crushing at face C: Primary crushing remote, D Secondary crushing and screening, E Sawing & splitting slate.

Control strategy: Silica Essentials Control approaches: W = Water suppression, LEV = Local exhaust ventilation.

Table 2: RIA Questionnaire responses - Summary tables of employee exposure to RCS for the Quarrying industry

Sector	Total No. of workers Surveyed/Sector	Total exposed to RCS	0.3 mg.m^{-3} RCS or above	0.1 mg.m^{-3} RCS or above	0.05 mg.m^{-3} RCS or above	0.01 mg.m^{-3} RCS or above
Quarry	12230 (100%)	2571 (21.0%)	76 (0.6%)	371 (3.0%)	437 (3.6%)	951 (7.8%)
	Proportion of total of 2571 exposed:	100%	3.0%	14.4%	17.0%	37.0%

Note 1 –from 2003 HSE questionnaire

Table 3: Employment statistics 2005

a) SIC1411 Quarrying of stone for construction

Enterprise level	Employment size band:							
	0 - 4	**5 - 9**	**10 - 19**	**20 - 49**	**50 - 99**	**100 - 249**	**250+**	**Total**
Number of local units in Vat-based enterprises	185	70	55	40	5	5	0	360
(2006)	(170)	(80)	(50)	(30)	(5)	(5)	(0)	(335)
Number of Vat-based enterprises	95	40	30	25	5	5	0	195
(2006)	(95)	(45)	(30)	(25)	(5)	(0)	(0)	(200)

b) SIC1413 Quarrying of slate

Enterprise level	Employment size band:							
	0 - 4	5 - 9	10 - 19	20 - 49	50 - 99	100 - 249	250+	Total
Number of local units in Vat-based enterprises	10	5						15
Number of Vat-based enterprises:		5						5

APPENDIX B: VISIT REPORT SUMMARIES

In the results tables in this section the following abbreviations are used to describe sample types: PL: Personal, Long term, SL: Static, long term, CM: Combined measurement.

Site Q1 Site 1

Description of Facility / Operations

The offices, weighbridge and laboratory are grouped in one block separated from the quarry area by the fixed crushing, screening and coating plant. Tipper trucks run from the working face to the primary crusher, which feeds the secondary stockpile by conveyor. Stone is drawn from under from this stockpile for further processing or it can be transferred by front-end loader to vehicles for sale if required. The plant workshop is situated between the quarry face and the primary crusher, keeping quarry vehicles out of the area used by road vehicles and vice-versa. All the “quarry” fixed plant is controlled from a separated cabin; the coating plant is within the “road vehicle area” but entirely separate again.

Material

The quarry extracts olivine-dolerite, a medium-grained rock with negligible quartz content. However secondary mineralisation has created veins and sheets of quartz which are visible in the quarry walls.

Control measures

The vehicles serving the working face did not have to cross or share roadways with other traffic to reach the primary crusher. This assisted in the containment of stone debris and minimised the potential for RCS generation by re-suspension of dust.

Site vehicles were almost all relatively new, in good condition and fitted with air-conditioned cabs supplied with filtered air.

Closed-circuit television was used to monitor the crushers from the control cabin and the pecker fitted at the primary crusher was also controlled from here. However the cabin, although air-conditioned, had no air supply, filtered or otherwise. In addition there was inadequate provision for boot cleaning at the entrance and no “dustless” cleaning method, as the vacuum cleaner in the room did not have type H/HEPA filtration and wet cleaning was not operated either.

The primary crusher and the stockpiles were fitted with water spray dust-suppression.

The main office block was cleaned regularly but the vacuum cleaner did not have HEPA-grade filtration.

Respirators were specified for use during some maintenance tasks and FFP3 masks were used. However no face-fit tests had been performed, although occupational health surveillance was routine.

	3 – See Appendix D for descriptors
	2 – See Appendix D for descriptors

Notes:

Control Competency: No filtered air supply to crusher control room, poor cleaning and methods. Mobile plant good condition & cabs supplied with filtered air. Most traffic kept off contaminated roadways

RPE Competency: Limited evidence of selection process, no face fit testing. No evidence of adequate training. No assessment of residual risk.

Results Table

Sample No	Sample type	Sample Position	Duration, Mins	Exposures, $mg.m^{-3}$			
				RCS		Respirable dust	
				Task	8-hr TWA	Task	8-hr TWA
1	PL	NS Quarry Dump truck operator	380	<0.02	<0.02	0.18	0.22
2	PL	JC: Stock dumper driver	338	0.01	0.02	0.18	0.23
3	PL	RC, Mobile plant fitter.	321	0.03	0.03	0.57	0.71
4	SL	Background at quarry plant fuel tank (flow fault)	238	<0.02		0.06	
5	SL	Ditto by IOM sampler/size-selective foam	262	<0.02		0.11	
6	PL	RB, Face machine operator	268	<0.02	<0.02	0.16	0.20

Sample No	Sample type	Sample Position	Duration, Mins	Exposures, mg.m^{-3}			
				RCS		Respirable dust	
				Task	8-hr TWA	Task	8-hr TWA
7	PL	MS, Crusher plant operator	545.6	<0.02	<0.03	0.39	0.49
8	PL	WH, Loading shovel driver	574	<0.02	<0.03	0.15	0.19
9	PL	HP, static plant fitter.	Invalid sample				
10	PL	SH, Asst Quarry Mgr, supervising	230	<0.02	<0.03	0.39	0.49
11	PL	AG, Quarry laboratory	289	0.02	0.02	0.46	0.57

Monitoring Results.

Eight personal samples all indicated 8-hour equivalent TWA RCS exposures of less than 0.03 mg.m^{-3}. The 8-hr TWA respirable dust exposures ranged from 0.22 to 0.71 mg.m^{-3}, but the sampler issued to the plant fitter was unable to be analysed as the cyclone cavity was almost completely filled with dust. There was therefore no measurement of the exposure of this person.

Site data transferred to summary (Appendix A table 1):

Site	Activities	Control strategy	Samples collected		Number of measurements (8-hr TWAs)					Competency Descriptor Ratings		Material type
					RCS			Respirable Dust				
			Personal	Static	≥0.3 mg.m^{-3}	0.3>x≥0 .1 mg.m^{-3}	Peak exposure mg.m^{-3}	Exposure above 4 mg.m^{-3}	Peak exposure mg.m^{-3}	Control	RPE	
Q1	A, C & D		8	1	0	0	0.03	0	0.71	3	2	Quartz-veined Dolerite

Activities: A Extraction of stone, B Primary crushing at face C: Perimary crushing remote, D Secondary crushing and screening

Control strategy: Silica Essentials Control approaches: W = Water suppression, LEV = Local exhaust ventilation, LEV = Local exhaust ventilation

Site Q2

Description of Facility / Operations

The quarry extracts Pennant (Carboniferous) sandstone for use either directly as aggregate or for further processing in the on-site coating plant. Drilling and blasting are subcontracted.

Stone is loaded from the working face direct into the moveable primary crusher. The partly-screened output is taken away to the secondary crusher feed stockpile, while the fines ("scalpings") are tipped in broadly the same area of the quarry as the working face. Articulated road lorries drive right up to this area of the quarry to be loaded with scalpings by the face area loader.

The various fractions from the secondary crushers and screens are transported from hoppers to the coating or bagging plants, to the fines waste tip in the quarry or to be stockpiled against the quarry walls. When the stocks were too great to allow tipping against the foot of the piles it seemed common practice to tip from the top of the quarry wall, a drop of some 5 metres down to the top of the pile, consequently creating a large dust cloud. In the same area the loading shovel was habitually used with the door open and frequently disappeared in the dust cloud created when loading articulated lorries.

The bagging plant was sited on the opposite side of a public road from the quarry. It contained stocks of bought-in building sand and sharp sand besides the various quarry products. 25-kg plastic sacks were filled from a hopper and heat-sealed in what was effectively a 3-sided shed, while big bags were loaded at an external hopper. Dust was noticeable underfoot in the shed, and a broad broom had been used to sweep dust into a heap, reportedly the normal cleaning routine.

Operatives worked 10-hour days including one 30-minute lunch break. (47.5 hours each week)

The amenity block contained clean and "dirty" locker rooms, washroom and separate mess-room, all in good condition and cleaned more than once per day.

Material

The quarry extracts Pennant (Carboniferous) sandstone. The base rock, being sandstone, is predominantly fine-grained quartz, with a small proportion of mica.

Control Measures

The primary crusher was reportedly purchased complete with water-spray dust suppression, although the supply and drainage had not been arranged and was therefore not in use. The secondary crushers and screens were housed in an enclosure which would have prevented a certain proportion of the dust released had the doors been kept closed. However it was reported that it had been found necessary to run it with the high-level doors open (i.e. the enclosure “breached”) to allow the video cameras monitoring the crushers to work. A dust cloud was always visible escaping from the crusher housing. The crusher control room was separate but its filtered air supply was inoperative: the interior was heavily dust-contaminated and the recirculating air-conditioning would have had no effect on dust exposure.

Most of the mobile plant in use had air-conditioned cabs fed with filtered air. However there did not appear to be a scheduled filter change programme and at least one machine was observed being used with the door open because of a failure of the ventilation system. This might have been a consequence of the choking of the inlet filters. When another was examined the felt lining the roof released a large quantity of dust when touched, suggesting that the filtration in the air supply was ineffective. The secondary crushers and screens are enclosed and controlled from a separate control room, but the filtered air supply was inoperative and cleaning was badly neglected.

It was noticeable that lorries arriving to collect the various products including coated stone (blacktop or tarmac) had to traverse the same set of roadways in the main quarry area as all the internal vehicles. Vehicles leaving the site should have used a wheel-wash, but it was inoperable as the associated reservoir/settling pond was completely choked with sediment. Similarly, sets of settling ponds at two different locations in the quarry were observed to be completely full of silt.

There had recently been both a change of manager and a small number of redundancies. Either or both of these could have accounted for the preceding neglect of the environmental control features at the site.

Control competency rating (0 - 5)	2– See Appendix IV for descriptors
	2 – See Appendix IV for descriptors

Notes:
Control Competency: (1)The filtration of air supplies to occupied spaces (Control rooms and mobile plant cabs) had been neglected
(2) installed engineered dust suppression on the primary crusher and optimum screen size had not been commissioned
(3) Cleaning of control rooms and offices in the quarry was inadequate
RPE Competency: Note: No fit testing performed.

Results Table

Sample No	Sample type	Sample Position	Duration, Mins	Exposures, mg.m^{-3}			
				RCS		Respirable dust	
				Task	8-hr TWA	Task	8-hr TWA
1	SL	In weighbridge office	364	<0.013		0.04	
2	PL	IR: Dumper, loading shovel & Bagging plant	315	0.07	0.09	0.30	0.36
3	PL	AP: Bagging plant	306	0.02	0.03	0.14	0.17
4	PL	JW Komatsu loading shovel, stock area	231	0.07	0.08	0.17	0.20
5	PL	AD driving dumper, excavator etc	231	0.06	0.07	0.21	0.25
6	PL	AL Backhoe, face crusher	224	0.06		0.22	0.26
7	PL	MB, Volvo 40 & secondary crusher control cabin	252	N/A		0.16	0.18
8	PL	EJ, Welder	250	0.07	0.09	0.40	0.47
9	PL	JV, crusher & screen control cabin	143	0.09	0.10	0.64	0.76
10	SL	In weighbridge office	440	<0.01		<0.01	
11	PL	DO'S: Tractor driver, fuel bowser,	479	0.08	0.09	0.46	0.55
12	PL	JV, crusher & screen control cabin	343	0.13		0.56	0.66

Sample No	Sample type	Sample Position	Duration, Mins	Exposures, $mg.m^{-3}$			
				RCS		Respirable dust	
				Task	8-hr TWA	Task	8-hr TWA
13	PL	RM, 8T loader at face & loading scalpings, etc	290	0.09		0.25	0.30
14	PL	PH, JCB round site & in crusher control cabin	191	0.04	0.04	0.25	0.30
15	PL	JW Komatsu loading shovel, stock area	229	0.06	0.08	0.20	0.23
16	PL	AD driving dumper, excavator etc	230	0.15		0.50	0.59
17	PL	JS, relief driver of all vehicles	240	0.03	0.03	0.14	0.17

Summary of results:

The respirable dust concentration ranged from <0.01 $mg.m^{-3}$ (background, in weighbridge office), to 0.76 $mg.m^{-3}$

The respirable crystalline silica exposures ranged from <0.01 $mg.m^{-3}$ (background, in weighbridge office), to 0.15 mg m^{-3}. The highest exposure result was taken from the secondary crusher and screen operative who occasionally visited the plant enclosure.

Site data transferred to summary (Appendix A table 1):

Site	Activities	Control strategy	Samples collected		Number of measurements (8-hr TWAs)					Competency Descriptor Ratings		Material type
					RCS			Respirable Dust				
			Personal	Static	≥0.3 $mg.m^{-3}$	0.3>x≥0 .1 $mg.m^{-3}$	Peak exposure $mg.m^{-3}$	Exposure above 4 $mg.m^{-3}$	Peak exposure $mg.m^{-3}$	Control	RPE	
Q2	A, B & D		15	2	0	2	0.18	0	0.76	2	2	sandstone

Activities: A Extraction of stone, B Primary crushing at face C: Primary crushing remote, D Secondary crushing and screening

Control strategy: Silica Essentials Control approaches: W = Water suppression, LEV = Local exhaust ventilation,

Site 3

Description of Facility / Operations

The quarry extracts coal for use at a power station approximately 10 miles away. The vast majority of the activity on site however involves, moving the overburden.. Coal is dug and hauled to a stockpile, crushed and blended before being loaded into lorries for despatch. At one end of the site there are some coal seams within 10 m of the ground surface but the more important ones are at a greater depth (some 25 metres.) The upper overburden consists of clay subsoil over sandstones. The strata down to the lower seams were reported to be all sand- or gritstones. The process involves extracting overburden with very large face-shovels, transporting the spoil in large (100 & 125-Tonne trucks,) tipping and grading it. Mobile and static plant maintenance is undertaken on a concrete apron or in a dedicated workshop on site.

Drilling (a significant source of potential exposure) and blasting are subcontracted. There is a main amenity and office block and a subsidiary mess room at a remote point on the site between the main excavation and the area where soil is currently tipped. This allows the dumper drivers to take their breaks without the journey back to the main facilities near the road access.

Operatives work from 07.00 to 19.00 on Mondays to Thursdays, 07.00 to 18.00 on Fridays, with two breaks totalling an hour each day. This was reported to give a total of 58 hours each week

Material

Coal is extracted by open-cast methods. At one end of the site there are some seams within 10 m of the ground surface but the more important ones are at a greater depth (some 25 metres.) The upper overburden consists of clay subsoil underlain by sandstones. The strata down to the lower seams were reported to be all sand or gritstones.

Control Measures

Face shovels have water spray bars fitted to buckets; haulage roadways are kept scraped clean of slurry and wetted by bowser (trade-off against adhesion). Vehicle cabs are fed pressurised filtered air, filters changed to enhanced schedule. Accommodation cleaned frequently. Contact drilling rigs have dust suppression fitted.

No work was considered to require the use of RPE

Control competency rating (0 - 5)	4 – See Appendix D for descriptors
	N/R – See Appendix D for descriptors

Notes:

Control Competency:

Great care is taken to minimise dust generated at the site and prevention of generation is recognised as a key control

RPE Competency: No respirators used.

Results Table

Sample No	Sample type	Sample Position	Duration, Mins	Exposures, mg.m^{-3}			
				RCS		Respirable dust	
				Task	8-hr TWA	Task	8-hr TWA
1	PL	AR, Dozer grading tipped overburden	544	0.030	0.045	0.34	0.51
2	PL	MG, “RH200” excavator on gritstone overburden removal	543	0.036	0.054	0.15	0.22
3	PL	SW, “120” face shovel on clay overburden removal	535	0.014	0.020	0.13	0.19
4	PL	FR, Loading shovel on coal seam in quarry	530	<0.009	<0.013	0.07	0.11
5	PL	SW excavator operator: overburden & coal	533	0.018	0.027	0.20	0.31
6	PL	DL, Dump truck driver	282	<0.016	<0.024	0.07	0.10
7	PL	JC Dump truck driver	274	<0.017	<0.026	0.07	0.10
8	PL	MC Dump truck driver	519	<0.009	<0.013	0.12	0.17
9	PL	AM Grader driver	264	0.032	0.048	0.10	0.15
10	PL	DK, Coal shovel in yard	453	<0.011	<0.017	0.03	0.04
11	PL	DB Dump Truck driver	248	<0.018	<0.028	0.21	0.32

Sample No	Sample type	Sample Position	Duration, Mins	Exposures, mg.m^{-3}			
				RCS		Respirable dust	
				Task	8-hr TWA	Task	8-hr TWA
12	PL	IA, Plant fitter at maintenance pad.	249	<0.018	<0.027	0.15	0.22
13	PL	Mr B Fitter on plant in quarry – fuelling etc.	102	<0.043	<0.064	0.08	0.12

<u>Summary of results:</u>

The respirable dust exposure concentrations ranged from 0.03 to 0.34 mg m^{-3} and the calculated respirable 8hr TWA exposures ranged from 0.04 to 0.51 mg m^{-3}.

The RCS measured exposure concentrations ranged from <0.01 to 0.036 mg m^{-3} and the 8hr TWA exposures ranged from <0.013 to 0.054 mg m^{-3}.

The highest RCS exposure was experienced by an excavator operator removing overburden (50% of lowered WEL), closely followed by Dozer and grader drivers, but the overburden grading dozer driver had the highest respirable dust exposure (at only 13% of the threshold at which it comes under COSHH).

<u>Site data transferred to summary (Appendix A table 1):</u>

Site	Activities	Control strategy	Samples collected		Number of measurements (8-hr TWAs)					Competency Descriptor Ratings		Material type
					RCS			Respirable Dust				
			Personal	Static	≥0.3 mg.m^{-3}	0.3>x≥0.1 mg.m^{-3}	Peak exposure mg.m^{-3}	Exposure above 4 mg.m^{-3}	Peak exposure mg.m^{-3}	Control	RPE	
Q3	A	W	13	0	0	0	0.05	0	0.51	4	N/R	Sandstone, coal

Activities: A Extraction of stone, B Primary crushing at face C: Primary crushing remote, D Secondary crushing and screening

Control strategy: Silica Essentials Control approaches: W = Water suppression, LEV = Local exhaust ventilation,

Site 4

Description of Facility / Operations

Quarry re-opened and worked intermittently for small-scale extraction of large blocks of stone for despatch by road for dimension stone production. Facilities limited to mess-room in part of ex-transport container, reached through tool store section. Quarry pumped out before commencement of each extraction period, so stone usually saturated when worked.

Material

Red sandstone, some strata cemented by magnesium carbonate (but not commonly worked.).

Control Measures

Reliance is placed upon the fact that the stone is usually wet.

RPE is used when drilling, either to extract stone or for splitting slabs.

	1 – See Appendix D for descriptors
	2* – See Appendix D for descriptors
Notes: **Control Competency:** Almost no actions have been taken to minimise the dust generated. **RPE Competency: Note:** * **-** Face fit testing not performed (in terms of size / fit etc.).	

Results Table

Sample No	Sample type	Sample Position	Duration, Mins	Exposures, $mg.m^{-3}$			
				RCS		Respirable dust	
				Task	8-hr TWA	Task	8-hr TWA
1	PL	MH, Drilling & splitting dry stone blocks	279	0.19	0.19	0.41	0.41
2	PL	RO, supervisor & driving “fork” loader	439	0.04	0.04	0.05	0.05
3	PL	CB, Volvo EC 650 Excavator	160	0.06	0.06	0.23	0.23
4	SL	Background in mess area of site cabin.	411	0.01		0.02	
5	PL	RO, supervisor & drDing “fork” loader	147	0.04	0.04	0.16	0.16
6	PL	CB, Volvo EC 650 Excavator	171	0.11	0.11	0.29	0.29
7	PL	MH, Drilling & splitting “wet” stone blocks	162	<0.03	<0.03?	0.05	0.05
8	CM	MH, drilling			0.13		0.28
9	CM	RO, Supervisor			0.04		0.09
10	CM	CB, Excavator			0.08		0.26

Summary of results:

The 8-hour equivalent TWA exposures were calculated from a combination of the a.m. and p.m. measurement results. The excavator driver was exposed to 0.26 $mg.m^{-3}$ respirable dust, while the drilling operative was exposed to 0.28 $mg.m^{-3}$. RCS exposures were 0.08 and 0.13 $mg.m^{-3}$ respectively.

Site data transferred to summary (Appendix A table 1):

Site	Activities	Control strategy	Samples collected		Number of measurements (8-hr TWAs)					Competency Descriptor Ratings		Material type
					RCS			Respirable Dust				
			Personal	Static	**≥0.3 mg.m^{-3}**	**0.3>x≥0.1 mg.m^{-3}**	Peak exposure mg.m^{-3}	Exposure above 4 mg.m^{-3}	Peak exposure mg.m^{-3}	Control	RPE	
Q4	A		3	1	0	1	0.19	0	0.41	1	2	Sandstone

Activities: A Extraction of stone, B Primary crushing at face C: Primary crushing remote, D Secondary crushing and screening

Control strategy: Silica Essentials Control approaches: W = Water suppression, LEV = Local exhaust ventilation,

Site 5

Description of Facility / Operations

The industrial minerals operation on the site works from a level area adjacent to rejected stone tipped from other operations. A mobile primary crusher is located at the working face; subsequent static crushers and screens are fed by front-end loader from the primary crusher discharge pile. The screened output is stockpiled and loaded as required into road vehicles for despatch.

Selected stone is conveyor-fed from the secondary crushing area to a large crusher and dust-extracted screening plant to produce fine chippings (typically used to coat roofing felt.) The plant is housed in a shed approx. 30m by 60m by 15m high, which also contains a disused grinder previously used to produce “fullersite,” fine slate powder that is sold as an inert filler material. This material is now brought from another site but bagged here in a separate shed.

Material

North Wales slate (metamorphosed mudstones.)

Control Measures

The secondary crushers are controlled from a sealed cabin. Mobile plant has cabs fed with filtered air. Installed vacuum cleaning system in mill shed, but heavy dust deposits on ledges. Separate mess facilities, adequately cleaned. PPE not recognised as necessary for crushing mill plant maintenance.

	2– See Appendix D for descriptors
	2– See Appendix D for descriptors

Notes:

Control Competency:

Mobile Plant fitted with filtered-air supply to cabs, central vacuum cleaning system in mill shed, but evidence of major dust release. Spillage of slate fines apparent in “Fullersite” bagging shed.

RPE Competency:

RPE – **-** Face fit testing not conducted. Regulation 7 of COSHH states that the initial selection of RPE (full / half face including disposables) should include fit testing to ensure that the correct device has been chosen (in terms of size / fit etc.)..

Results Table

Sample No	Sample type	Sample Position	Duration, Mins	Exposures, $mg.m^{-3}$			
				RCS		Respirable dust	
				Task	8-hr TWA	Task	8-hr TWA
1	PL	PD Slate mill operator, maintenance	234	0.13	0.16	0.48	0.59
2	PL	AG, Komatsu 450 shovel on stone stock feeding primary crusher,	260	0.05	0.06	0.25	0.31
3	PL	WL, Loader on stockpiles	335	0.07	0.09	0.25	0.31
4	PL	NT Shovel loading secondary crusher & trucks	395	0.03	0.03	0.13	0.16
5	PL	VJ, Crusher operator	366	0.06	0.08	0.21	0.27
6	PL	LG, Supervisor	275	0.05	0.07	0.22	0.27
7	PL	PD, Plant Maintenance, relieves drivers for breaks	150	0.07	0.08	0.25	0.31

Summary of results:

Respirable dust exposure ranged from 0.16 to 0.59 $mg.m^{-3}$ and RCS exposure ranged from 0.03 to 0.16 $mg.m^{-3}$. Maintenance caused exposure above 0.1 $mg.m^{-3}$ (although within the WEL that applied at the time) and the stockpile loader's exposure was marginally below 0.1 $mg.m^{-3}$

Site data transferred to summary:

Site	Activities	Control strategy	Samples collected		Number of measurements (8-hr TWAs)					Competency Descriptor Ratings		Material type
					RCS			Respirable Dust				
			Personal	Static	≥0.3 $mg.m^{-3}$	0.3>x≥0.1 $mg.m^{-3}$	Peak exposure $mg.m^{-3}$	Exposure above 4 $mg.m^{-3}$	Peak exposure $mg.m^{-3}$	Control	RPE	
Q5	A, B& D		7	0	0	1	0.16	0	0.59	2	2	N Wales slate

Activities: A Extraction of stone, B Primary crushing at face C: Primary crushing remote, D Secondary crushing and screening

Control strategy: Silica Essentials Control approaches: W = Water suppression, LEV = Local exhaust ventilation, LEV = Local exhaust ventilation

Site 6

Description of Facility / Operations

Production of roofing slates by sawing then traditional hand-cleaving of blocks.

Material

North Wales slate (metamorphosed mudstones.)

Control Measures

Stockyard pecker and loaders fitted with filtered a/c cabs. Saw shed operated from refuges, air conditioned but not supplied with filtered air. Considerable effort invested LEV at slate splitting booths and in Local Air Displacement (LAD). RPE: no face fitting had been provided. Health surveillance operated. Separate canteen building.

	3 – See Appendix D for descriptors
	2 – See Appendix D for descriptors
Control Saw shed operated from refuges, major investment in LEV/LAD at slate splitting, cropping machines in extracted enclosure, good maintenance regime. Packing slates not addressed as exposure generator. **RPE** **Note:** RPE available for use should LEV/LAD fail. No RPE fit testing done.	

Results Table

Sample No	Sample type	Sample Position	Duration, Mins	Exposures, $mg.m^{-3}$			
				RCS		Respirable dust	
				Task	8-hr TWA	Task	8-hr TWA
8	PL	EW, Saw shed loader driver	206	0.07	0.07	0.54	0.54
9	SL	Area 4 saw control cabin	183	0.12	0.12	1.00	1.00
10	PL	JC, packing finished slates	106	0.79	0.79	2.52	2.52
11	PL	MW, stacking split slates on pallets for dressing	133	0.27	0.27	0.93	0.93
12	SL	by slate dressing m/c enclosure	131	0.10		0.64	
13	SL	Ditto, sampled with size-selecting foam in IOM Head	131	0.09		0.59	
14	PL	MB, splitting slate blocks	84	0.18	0.18	0.85	0.85

Summary of results:

The respirable dust concentrations ranged from 0.54 to 2.52 $mg.m^{-3}$ and the 8hr TWAs were the same as an 8-hour day is worked. The measured respirable crystalline silica concentrations ranged from 0.07 to 0.79 $mg.m^{-3}$, the high measurement being due to the packing of finished slates into crates using a mallet.

Site data transferred to summary (Appendix A table 1):

Site	Activities	Control strategy	Samples collected		Number of measurements (8-hr TWAs)					Competency Descriptor Ratings		Material type
					RCS			Respirable Dust				
			Personal	Static	≥0.3 $mg.m^{-3}$	0.3>x≥0.1 $mg.m^{-3}$	Peak exposure $mg.m^{-3}$	Exposure above 4 $mg.m^{-3}$	Peak exposure $mg.m^{-3}$	Control	RPE	
Q6	A & E	LEV	4	2	1	3	0.79	0	2.52	3	2	N Wales slate

Activities: A Extraction of stone, B Primary crushing at face C: Primary crushing remote, D Secondary crushing and screening, E Sawing & splitting slate

Control strategy: Silica Essentials Control approaches: W = Water suppression, LEV = Local exhaust ventilation,

Sites 7a and b

Description of Facility / Operations

Sister sites extracting silica sand. One dredging & screening wet, other digging dry, kilning & screening.

Material

Silica sand

Control Measures

Wet screening at one site. Dry sand production: LEV at sub-bulk bag filling plant but limited application elsewhere. Roadways swept. Local exhaust ventilation (LEV) testing is conducted on an annual basis.

	3 – See Appendix D for descriptors
	3* – See Appendix D for descriptors
Notes: **Control:** Filtered supply to pressure-ventilated cabs of vehicles not fully maintained **RPE:** FFP2 in use where RCS exposures measured at 0.15 $mg.m^{-3}$. No face fit testing performed.	

Tables of Results

Site A Sample No	Sample type	Sample Position	Duration, Mins	Exposures, $mg.m^{-3}$			
				RCS		Respirable dust	
				Task	8-hr TWA	Task	8-hr TWA
07178/06	PL	RC, Plant operator, bagging	307	0.03	0.04	0.24	0.30
07179/06	PL	Mr W, plant operator, bagging	338	0.06	0.08	1.11	1.39
07180/06	PL	Mr W, plant operator cleaning screen house and driving Volvo120B	339	0.15	0.19	0.63	0.79
07181/06	PL	MB, plant operator, bagging	305	0.07	0.09	0.39	0.49
07182/06	PL	Mr B, FLT driver	308	0.10	0.13	0.64	0.80
07183/06	PL	MC, driver of Volvo 120 E shovel	347	<0.02	<0.03	0.08	0.10
07184/06	SL	Fixed point in screen house during cleaning	319	0.15		0.54	
07185/06	SL	Fixed point adjacent bagging area	66	0.23		0.90	

Site B Sample No	Sample type	Sample Position	Duration, Mins	Exposures, $mg.m^{-3}$			
				RCS		Respirable dust	
				Task	8-hr TWA	Task	8-hr TWA
07178/06	PL	RC, Plant operator, bagging	307	<0.1	<0.12		
07179/06	PL	Mr W, plant operator, bagging	338	<0.1	<0.12		

Summary of results:

The respirable dust concentrations ranged from 0.08 mg.m^{-3} to 1.11 mg.m^{-3} and the calculated respirable 8hr TWA exposures ranged from 0.1 to 1.4 mg.m^{-3}.

The respirable crystalline silica content measured concentrations ranged from <0.02 to 0.15 mg m^{-3} and the 8hr TWA exposures ranged from <0.03 to 0.19 mg m^{-3}.

The highest RCS exposure result was associated with duties in the screen house, where a background (static) measurement confirmed the concentration.)

Site data transferred to summary (Appendix A table 1):

<table>
<tr><th rowspan="3">Site</th><th rowspan="3">Activities</th><th rowspan="3">Control strategy</th><th colspan="2" rowspan="2">Samples collected</th><th colspan="5">8-hr TWA Exposure measurements</th><th colspan="2" rowspan="2">Competency Descriptor Ratings</th><th rowspan="3">Material type</th></tr>
<tr><th colspan="3">RCS</th><th colspan="2">Respirable Dust</th></tr>
<tr><th>Personal</th><th>Static</th><th>≥0.3 mg.m^{-3}</th><th>0.3>x≥0.1 mg.m^{-3}</th><th>Peak mg.m^{-3}</th><th>above 4 mg.m^{-3}</th><th>Peak mg.m^{-3}</th><th>Control</th><th>RPE</th></tr>
<tr><td>Q7A & B</td><td>D</td><td>W</td><td>6</td><td>2</td><td>0</td><td>2</td><td>0.19</td><td>0</td><td>1.39</td><td>3</td><td>2</td><td>Silica sand</td></tr>
</table>

Activities: A Extraction of stone, B Primary crushing at face C: Primary crushing remote, D Secondary crushing and screening, E Sawing & splitting slate

Control strategy: Silica Essentials Control approaches: W = Water suppression, LEV = Local exhaust ventilation, LEV = Local exhaust ventilation

Site 8

Description of Facility / Operations

Small quarry employing 11, 3 in quarry. The stone is quarried from beneath a clay overburden, producing 235,000 tonnes per annum. Both primary and secondary crushers/screens at face, stone stacked in piles around the quarry, loaded by shovel into the company's own fleet of tippers for delivery.

Operatives work 8-hr days.

Materials

Greywacke (originally slumped continental margin sediments)

Control Measures

Water spray dust suppression system fitted to the primary crusher. All the vehicles within the quarry with the exception of the tele-loader fitted with air conditioning. Filters were cleaned weekly and replaced ever 500 hours as recommended by the manufactures. (All the vehicles were of recent manufacture and were in good condition.)

Respiratory Protective Equipment (RPE) not worn by the operators during normal operation. Disposable RPE was available for use during the setting up of the crusher and screens

Control competency rating (0 - 5)	**2**– See Appendix D for descriptors
	2– See Appendix D for descriptors

Notes:

Control Competency:

The manager was responsible for H & S on site. The inspection of risk assessment and safety report documents relating to potential RCS exposures was not conducted. The operations manager stated that no air sampling for RCS had been conducted. The company had a buying policy which ensured that air filtration and conditioning was standard on all vehicles regularly used in the quarry, this formed the main control measure in controlling operators exposure to RCS. The primary crusher was fitted with a water spray bar to reduce the RCS containing dust at source. Although no formal COSHH assessment had been conducted, suitable controls had been put in place by the company based on what they perceived as good practice within the quarry industry.

RPE Competency:

* Face fit testing had not been conducted. Regulation 7 of COSHH states that the initial selection of RPE (full / half face including disposables) should include fit testing to ensure that the correct device has been chosen (in terms of size / fit etc.).Following a discussion with HSL staff on site the company intended to upgrade the FFP2 disposable mask for an FFP3 disposable mask

<u>Results Table</u>

Sample No	Sample type	Sample Position	Duration, Mins	Exposures, $mg.m^{-3}$			
				RCS		Respirable dust	
				Task	8-hr TWA	Task	8-hr TWA
02776/07	PL	RD, shovel driver	240	0.029	0.029	0.18	0.18
02777/07	PL	RH, 360 operator	234	0.056	0.056	0.22	0.22
02778/07	SL	Fixed point sample in tipper SF55 AVE	183	<0.001		<0.1	
02779/07	PL	BW, loading volumetric cement mixer and driving tele-handler	305	<0.001	<0.001	<0.1	<0.1

Summary of results:

The measured respirable dust concentrations ranged from below the limit of detection to 0.22 $mg.m^{-3}$ and the 8hr TWA exposures were the same.

The respirable crystalline silica content measured concentrations ranged from below the limit of detection to 0.22 $mg.m^{-3}$

Site data transferred to summary (Appendix A table 1):

Site	Activities	Control strategy	Samples collected		Number of measurements (8-hr TWAs)					Competency Descriptor Ratings		Material type
					RCS			Respirable Dust				
			Personal	Static	≥0.3 $mg.m^{-3}$	0.3>x≥0.1 $mg.m^{-3}$	Peak exposure $mg.m^{-3}$	Exposure above 4 $mg.m^{-3}$	Peak exposure $mg.m^{-3}$	Control	RPE	
Q8	A, B,	W, LEV	3	1	0	0	0.06	0	0.22	2	2	Greywacke

Activities: A Extraction of stone, B Primary crushing at face C: Primary crushing remote, D Secondary crushing and screening, E Sawing & splitting slate

Control strategy: Silica Essentials Control approaches: W = Water suppression, LEV = Local exhaust ventilation,

APPENDIX D CONTROL COMPETENCE SURVEY TABLES

Control competency descriptors

Control Rating	Description
0	Evidence of unacceptable levels of over-exposure brought about through manifest failures to recognise hazard and risk coupled with a failure to provide any form of controls. (As a guide exposures at least twice relevant occupational exposure limit)
1	Evidence of unacceptable levels of over-exposure brought about through failures to recognise hazard and risk and take appropriate steps to control. Typically: • Absent or inadequate COSHH assessment • Evidence of rudimentary or inappropriate engineering controls • Controls appropriate only for lower level of risk • No supporting evidence of adequate control • No records of examination and test of lev • Poor maintenance of plant, enclosures and controls • Poor training of operators • No awareness of hazard, levels of exposure or risk • Poor management
2	Evidence of over-exposure. Some understanding of hazard and risk and some controls in place but not receptive to need to improve. Typically: • Inadequate COSHH assessment • Engineering controls poorly maintained and/or poorly positioned • Uncertain of adequacy of control • Limited understanding of exposures • Limited training of operators • Some use of RPE • Poorly informed management and supervision
3	Occasional over-exposure. Reasonable awareness of hazard and risk and desire to improve. Typically: • Reasonable COSHH assessment recognising main concerns • Application of reasonably effective controls at process • Reasonable levels of maintenance • Some understanding of exposures but few over-exposures • Limited training of operators • Some use of RPE • Reasonably informed management • Some supervision

<table>
<tr><th>Control Rating</th><th>Description</th></tr>
<tr><td>4

The COSHH Essentials Standard</td><td>Adoption of good control practice consistent with risk. Reasonable awareness of hazard and risk and knowledge to implement effective strategies. Typically:

• Comprehensive COSHH assessment
• Aware of literature and information sources
• Application of appropriate, effective, well maintained controls at process
• Management and operator understanding of exposures
• Well trained operators
• Designated areas and use of RPE when appropriate
• Well informed management
• Competent supervision
Evidence of coordinated approach to control – skills and knowledge available</td></tr>
<tr><td>5</td><td>Exemplary control consistent with risk. Typically:

• Comprehensive COSHH assessment
• Literature and guidance to hand
• Competent well-trained staff at all levels
• Documented procedures
• Exposure and risk understood at process
• No evidence of over-exposure
• Evidence of engagement of all stakeholders
• All aspects of process considered</td></tr>
</table>

RPE competency descriptors

Rating	Description
NR	RPE not required to achieve adequate control
1	RPE required to achieve adequate control. No evidence of use or provision of suitable and adequate RPE
2	RPE used to achieve adequate control. Evidence of provision of suitable and adequate equipment but strong evidence of poor practices in use: • Limited evidence of selection process and face fit testing. • Equipment normally available but anticipated problems with use • Poor storage • No evidence of adequate training programme • No assessment of level of residual risk
3	RPE used to achieve adequate control. Evidence of provision of suitable and adequate equipment and some evidence of good practices. Limited evidence of management controls in use: • Face fit testing • Equipment readily available and used • Appropriate storage facilities • Adequate initial training • Operator can answer questions about use of RPE • Some understanding of role of rpe in reducing residual risk
4	RPE used to achieve adequate control. Verifiable policy on RPE linked to COSHH assessment. Strong evidence of selection of suitable and adequate equipment and good practices in use. Appropriate zoning of workplace and adequate supervision and control. Some minor concerns over procedural aspects and management control of programme: • Verifiable policy on RPE linked to COSHH assessment. • Face fit testing programme • Equipment routinely available and range of products available through selection process • Appropriate storage facilities • Initial training and refresher training • Operator understands role of RPE in controlling exposure • Clearly defined roles and responsibilities
5	RPE used to achieve adequate control. Evidence of exemplary RPE programme with only minor deviations from agreed practices and policies. • Verifiable policy on RPE linked to COSHH assessment. • Face fit testing programme • Wide range of appropriate equipment available for all users • Appropriate storage facilities and procedures to allow audit • Initial training and routine refresher training • Operators understand role of RPE in controlling risk • Everyone understands roles and responsibilities

APPENDIX E QUARRYING: STANDARD INDUSTRIAL CLASSIFICATION (SIC)

Quarries - Standard Industrial Classification (SIC)

For the purposes of statistical analysis data was obtained from the Office of National Statistics (ONS). Businesses that are considered quarrying type activities by ONS are designated the Standard Industrial Classification (SIC) code 14.1 - Quarrying of stone. The description of the class is reproduced below.

14 OTHER MINING AND QUARRYING

14.1 Quarrying of stone

14.11 Quarrying of stone for construction

This class includes:

- quarrying, rough trimming and sawing of monumental and building stone such as marble, granite, sandstone, etc.

This class excludes:

- cutting, shaping and finishing of stone outside quarries cf. 26.70

14.12 Quarrying of limestone, gypsum and chalk

This class includes:

- quarrying, crushing and breaking of limestone for industrial and constructional uses

- mining of gypsum and anhydrite

- mining of chalk

- mining of marl

14.13 Quarrying of slate

14.2 Quarrying of sand and clay

14.21 Operation of gravel and sand pits

This class includes:

- extraction and dredging of industrial sand, sand for construction and gravel

- breaking and crushing of shingle, gravel and sand

This class excludes:

- mining of bituminous sand cf. 11.10 [extraction of crude petroleum and gas]

14.22

Mining of clays and kaolin

This class includes:

- extraction of clays for brick, pipe and tile making

- extraction of special clays including ball clay, china clay, fire-clay, fuller's earth, etc.

14.3 Mining of chemical and fertilizer minerals

14.30 Mining of chemical and fertilizer minerals

This class includes:

- mining of natural phosphates and natural potassium salts

- mining of native sulphur

- extraction and preparation of pyrites and pyrrhotite

- mining of natural barium sulphate and carbonate (barytes and witherite), natural borates, natural magnesium sulphates (kieserite)

- mining of earth colours and fluorspar

This class also includes:

- guano mining

This class excludes:

- production of salt cf. 14.40

- roasting of iron pyrites cf. 24.13

- manufacture of synthetic fertilizers and nitrogen compounds cf. 24.15

14.4 Production of salt

14.40 Production of salt

This class includes:

- extraction of salt from underground including by dissolving and pumping

- salt production by evaporation of sea water or other saline waters

- production of brine and other saline solutions

- crushing, purification and refining of salt

This class excludes:

- potable water production by evaporation of saline water cf. 41.00

14.5 Other mining and quarrying not elsewhere classified

14.50 Other mining and quarrying not elsewhere classified

This class includes:

- mining and quarrying of various minerals and materials:

. abrasive materials, asbestos, siliceous fossil meals, natural graphite, steatite (talc), feldspar, etc.

. gem stones, quartz, mica, etc.

. natural asphalt and bitumen

Source – ONS: UK SIC 1992: EXPLANATORY NOTES

7 REFERENCES

HSE 2002 The Control of Substances Hazardous to Health Regulations 2002, SI 2002/2677 The Stationery Office 2002 ISBN 0 11 042919 2

HSE 2003 Regulatory Impact Assessment (RIA) on proposals to reduce the UK Occupational Exposure Limit for Respirable Crystalline Silica, available as http://www.hse.gov.uk/ria/chemical/reduceoccexp.pdf

HSE 2004 The Control of Substances Hazardous to Health (Amendment) Regulations 2004, SI 2004/3386 The Stationery Office 2004 ISBN 0 11 051407 6

HSE 2005 EH40/2005 Workplace exposure limits, ISBN 0-7176-2977-5, as amended 2007 (http://www.hse.gov.uk/COSHH/table1.pdf)

HSE 2007 Table 1:List of approved workplace exposure limits http://www.hse.gov.uk/COSHH/table1.pdf

HSG 173 'Monitoring strategies for toxic substances' ISBN 0 7176 1411 5

MDHS 14/3; General methods for sampling and gravimetric analysis of respirable and inhalable dust. Available at http://www.hse.gov.uk/pubns/mdhs/pdfs/mdhs14-3.pdf

MDHS 51/2: Quartz in respirable airborne dust, HSE 1988 ISBN 0 7176 02559

MDHS 101 - Crystalline silica in respirable airborne dusts. HSE 2005 ISBN 0-7176-2897-3

Nepsi: European Network for Silica, http://www.nepsi.eu/home.aspx

ONS (2003): UK Standard Industrial Classification of Economic Activities 2003 – SIC (2003)"

ONS 2005: UK Business: Activity, Size and Location – 2005, UK Office for National Statistics.

Published by the Health and Safety Executive 02/09

HSE

Health and Safety Executive

Silica baseline survey

Annex 4 Quarry industry

Aims and Objectives

This Silica Baseline Survey aims to develop baseline intelligence on exposure and control of respirable crystalline silica in key industry sectors. These sectors are:

- Brickworks and Tile Manufacture
- Stonemasonry
- Quarrying
- Construction

The objectives are:

1) to establish whether exposure control practices (both the application of engineering controls and the use of RPE) are adequate to reduce exposures below the WEL for RCS
2) to form an opinion about the long-term reliability of the controls
3) to identify common causes of failures of exposure control
4) to provide data by which the effect of HSE interventions can be assessed.

This annexe to the main SBS report includes the site visit data and detailed discussion of observations in the quarrying sector.

This report and the work it describes were funded by the Health and Safety Executive (HSE). Its contents, including any opinions and/or conclusions expressed, are those of the authors alone and do not necessarily reflect HSE policy.

RR689

www.hse.gov.uk