Health and Safety in Quarrying

Part Five: Management of Health Risks

This paper is the last in a series of five based on a CD-ROM of lecture and training material covering the fundamentals of health and safety management. The CD-ROM was prepared by the Camborne School of Mines on behalf of EPIC (NTO) Ltd and the Health and Safety Executive (HSE), and distributed to all providers of quarry-related courses in higher and further education. This final paper looks in detail at health hazards. It starts by identifying the typical health risks in the quarrying industry and summarizes the differences between health and safety risks. The paper continues by outlining strategies for managing health risks including risk assessment, health surveillance and exposure monitoring.

HEALTH RISKS

Health and safety law in the UK places a duty on employers to ensure the health as well as the safety of their employees. Yet each year, across industry, many more people become ill as a result of their work than are killed or injured in industrial accidents. Most diseases caused by work do not kill but can involve years of pain, suffering and discomfort for those affected.

Risks to health from work activities include:
— inhalation of airborne pollutants (such as dust or fumes), triggering asthma and/or other respiratory problems
— high noise levels, causing deafness and conditions such as tinnitus
— excessive vibration, eg from hand-held tools, leading to hand–arm vibration syndrome and circulatory problems
— badly designed places of work, requiring awkward body postures or repetitive movements, resulting in upper-limb disorders, repetitive-strain injury and other musculoskeletal conditions
— skin contact with chemical substances, leading to dermatitis etc
— exposure to ionizing and non-ionizing radiation, including ultraviolet in the sun’s rays, causing burns, sickness and skin cancer.

All of the above can be found in quarrying and open cast mining operations.

It has long been recognized that health risks have not received the same attention as safety risks. Cole1 gives several reasons for this. These are:
• The health risk may not be understood or well defined and the cause/effect relationship not established.
• Health risks tend not to attract widespread publicity or demand the same urgent attention as safety risks.
• Health risks appear to have little, if any, short-term effect and it may be that ill health does not occur for many years after exposure.
• Health risks may be more difficult to address, resulting in attention being directed to risks where control is more visible and likely to attract tangible benefits.
• Comprehensive data on occupational ill health may simply not exist in many cases, and in practice the true extent of occupationally related ill health may be unknown.

Recently the Quarry Products Association produced a health surveillance guide2 that listed a number of the key health hazards in the quarrying industry. As well as the ‘common’ hazards (such as noise, vibration, musculoskeletal hazards and dust) they also included welding fume, petroleum products, methylene chloride and ionizing radiation as being particular to the industry. Three of the key major hazards — dust, vibration and noise — are discussed below.

Dust

Dust is present in all quarrying and open cast mining operations. While it is often considered to be more of an environmental issue, dust is a potential health risk and it is the nature of the dust that determines the associated risk. For example, larger particles of dust can be an irritant to the eyes and throat, while smaller respirable dust particles (less than 5 microns) can be inhaled, deposited in the lung and cause respiratory problems. The highest risk is presented by crystalline silica particles as these are toxic to defensive cells in the lungs and can lead to silicosis. Crystalline silica, or quartz, is found in varying amounts in sand, clays, muds, shale and rocks such as granite3. Long-term exposure to high levels of respirable crystalline silica can also lead to an increased risk of developing lung cancer3.
**Vibration**

Exposure to vibration can lead to physical injury and can be split into two categories: whole-body vibration (WBV) that produces symptoms such as back and neck pain; and hand–arm vibration syndrome (HAVS). In the UK, it is estimated that 9 million people may be exposed to WBV in the course of their work, but the actual health effects of such exposures are largely unknown. In the quarrying industry, vehicles, as well as some types of fixed plant, can produce vibration. HAVS is attributed to powered hand tools and can cause damage to the blood circulatory system, nerves and joints, which may result in severe pain and numbness in the fingers, and loss of sense of touch (vibration white finger).

**Noise**

Noise is regarded as unwanted sound and has the potential to interfere with communication or damage a person’s hearing. The quarrying industry is a noisy industry. The QPA states that typical noise levels could be between 89–108dB(A) for a primary crusher and 106–110dB(A) for hand drills. The principle health effect of being exposed to high levels of noise in the long term is noise-induced hearing loss. Health problems may not be as obvious as a safety failure such as a structural collapse, machinery accident or fire and explosion. Most people may never see cases of occupational ill health while at work. They may miss the connection between the effect and its causes, so it is even more important to adopt a proactive approach to managing health risks.

**OCCUPATIONAL HEALTH**

Quarrying operations should have some form of occupational health programme in place. Occupational health is about protecting the physical and mental health of workers and ensuring their continual welfare in their working environment. In addition to preventing ill health, other important aspects of occupational health include:

- ensuring fitness and physical capability to perform a job safely
- health education and promotion
- providing medical services including health surveillance
- rehabilitation after illness or injury.

Health surveillance is specifically mentioned in both the Management of Health & Safety at Work Regulations, 1999, and the Quarry Regulations, 1999, and will be discussed later in this paper.

**HEALTH RISK ASSESSMENT**

Health risks should be identified, assessed and controlled through the process of risk assessment in the same way as for safety risks (risk assessment is a requirement of the Management of Health & Safety at Work Regulations, 1999, as well as being the key element in any formal safety management system). Although the principles are the same, there are some specific differences which are shown in figure 1 and expanded upon in this section.

The workplace risk assessment covers the elements of hazard identification and risk assessment.

**HAZARD IDENTIFICATION**

Most hazards can be identified based on knowledge and observation of the work activity, although expert advice or assistance may be sought, if necessary, from specialists such as occupational health practitioners. Useful advice is also available from other sources such as data sheets supplied with equipment or chemicals.

As a good starting point the most common agents likely to present health hazards at quarries are listed in table 1 according to work activity.

**RISK ASSESSMENT**

Like safety risks, health risks can be assessed either subjectively or quantitatively. Quantitative assessment tends to be carried out by occupational health practitioners using dose response relationships. These provide ➤
the basis for estimating the response associated with particular hazards (such as chemicals) and are expressed as a risk or as percentage of population adversely affected. These types of assessments tend to be based on long-term epidemiological studies.

For individual quarry operations, as part of their risk-assessment programme under the Management of Health and Safety at Work Regulations, 1999, health risks can be assessed subjectively. In order to be able to make an assessment of the risk of health hazards, the two major elements that need to be considered are (fig. 2):

• The potential consequences of exposure to the hazard.
• The potential exposure to the hazard.

**Potential severity**
The potential severity of exposure to the hazard is related to the properties of the hazard. For example:
— the toxicity of a chemical
— the sound-pressure level at the operators ear and the frequency of a noise source
— the intensity and penetrability of ionizing radiation.

**Potential exposure**
Potential exposure means the opportunity to do harm. In assessing the potential exposure to the hazard it is necessary to consider:
— the proportion of the workforce who are or will be exposed to the hazard (in particular the frequency of exposure and length of time of exposure).
— any risk-reducing control measures that are in place and their effectiveness in reducing the risk.

Where necessary, some form of sampling and exposure measurements should be undertaken to determine the extent of the hazard at the time of the assessment. These can be compared with any occupational exposure limits (such as threshold limit levels (TLVs)) that have been set for the industry, as well as any in-house standards. Such exposure measurements may also assist in determining any remedial action that is necessary.

**CONTROLLING THE RISK**
If the assessment of risk shows that further action is necessary control measures should be selected according to the hierarchy of risk control, namely:
• Elimination of the risk. This can be achieved through redesigning the activity or equipment to eliminate the release of the hazard.
• Reduction of the risk at source through engineering controls. This can be achieved by enclosing the activity or equipment to capture and/or absorb the hazard, dilute the hazard or release it into a safer place. Examples of the control of noise

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Table 1: Hazards in quarries and asphalt plants (QPA, 2003)

<table>
<thead>
<tr>
<th></th>
<th>Dust</th>
<th>Noise</th>
<th>Vibration</th>
<th>Oil, fuel, grease</th>
<th>Skin/respiratory sensitizers</th>
<th>Manual handling</th>
<th>Eyesight</th>
<th>Welding fume</th>
<th>Asbestos</th>
<th>DSE</th>
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**FIG. 2 Components of health risks**

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include placing sound-absorbent material around the machinery, covering the source of the noise and arranging the equipment to create screens and reduce the level of reflected sound.

- Minimizing the risk through procedural controls. This involves implementing systems and procedures so that work is carried out in such a way that it limits exposure to the hazard. In terms of noise control this would include isolating people away from the noise source.
- Use of appropriate personal protective equipment (PPE). According to this hierarchy, the use of PPE is the last resort for the control of the exposure of employees to hazards. This is because PPE only protects the wearer and then only if worn properly. Situations where the use of PPE may be necessary are:
  - where adequate control of exposure cannot be achieved by elimination, reduction at source or minimization through administrative controls
  - as a ‘stopgap’ measure where a risk assessment indicates that further control measures are necessary and until those further measures have been introduced and are deemed effective.

Ensuring the use of control measures

Having introduced new control measures it is essential that they are used by employees, so systems should be put in place to ensure that such measures are used effectively. This is a responsibility of both the employer and employee and can be achieved by ensuring that the workforce receive adequate instruction and training through:
- working procedures, codes of practice or other procedural controls

- educating the workforce on the hazards and risks involved in their work and how control measures will protect their health
- effective supervision.

Employees must use these control measures in compliance with any such instruction and training.

Systems should be put in place to ensure that the effectiveness of all the risk-reducing control measures does not decrease over time. Any engineering controls should be subject to regular checking and maintenance. The frequency of this should be determined by the risk assessment and based on the engineering reliability of the control measures and the consequences of their failure with respect to exposure.

MONITORING

Ongoing monitoring of the level of risk is important for both safety and health risks. For safety risks this can be done by regularly reviewing the risk assessment and ensuring that the control measures are continually effective in reducing the level of risk. For health hazards, monitoring the level of risk can also be achieved by sampling and exposure monitoring and through health surveillance.

Sampling and exposure monitoring is a form of active monitoring, whereas health surveillance is a form of reactive monitoring (fig. 3).

Sampling and exposure monitoring

Sampling and exposure monitoring can be used to:
- check the effectiveness of risk-reducing control measures, as a failure in these measures results in an increased risk of harm occurring
- confirm that occupational exposure limits (OELs) are not exceeded
- tie in with the medical surveillance programme.

FIG. 3 Monitoring of health risks

Table 2 Exposure standards for some health hazards

<table>
<thead>
<tr>
<th>Dust</th>
<th>Crystalline silica (source: HSE, 2003 Chemical Hazard Alert 33)</th>
<th>0.1 mg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal dust (respirable)</td>
<td></td>
<td>2 mg/m³</td>
</tr>
<tr>
<td>Limestone (respirable)</td>
<td></td>
<td>4 mg/m³</td>
</tr>
<tr>
<td>Noise</td>
<td>First action level from Noise at Work Regulations, 1989, where assessment must be carried out and PPE provided upon request</td>
<td>85 dB(A)</td>
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<tr>
<td></td>
<td>Second action level where reduction of exposure is required and PPE is to be provided (source: Noise at Work Regulations, 1989)</td>
<td>90 dB(A)</td>
</tr>
<tr>
<td>Vibration</td>
<td>Hand-arm vibration (recommendation) (source: QPA, 2000)</td>
<td>2.8 m³/s</td>
</tr>
</tbody>
</table>

Health Surveillance

Health surveillance involves having a system to look for early signs of ill health caused by work in order to:
- detect adverse effects early
- prevent further harm being caused.
Health surveillance is mandatory in some cases, such as work with certain chemicals or with ionizing radiation (as defined in Regulations). It will also be appropriate where the risk assessment has identified a high level of exposure to other hazards. The criteria for carrying out occupational health surveillance are (after QPA):

— there is an identifiable disease or condition associated with the work
— there are valid techniques to detect the condition at an early stage
— there is reasonable likelihood that the disease or condition will occur in the particular circumstances of the exposure
— that health surveillance will be of benefit to individuals or groups of workers.

Health surveillance includes health surveys, examinations and inspections of persons at appropriate intervals. Unless stated by corporate regulations or legislation, these intervals will be determined by the occupational health practitioner and are typically based on occupational categories and job-specific hazards from the risk assessment. Some form of initial ‘baseline’ exposure sampling may also need to be undertaken to assist with this.

Health surveillance can be carried out at several levels depending upon the complexity of the health effect being monitored. For example: supervisors with some training can recognize the onset of many conditions and have the advantage of being in daily contact with the workforce; an occupational health nurse can administer standardized tests, such as audiometric testing, lung function tests etc; while a doctor with appropriate qualifications and experience would be required to carry out more detailed clinical examinations, such as assessments of hand–arm vibration syndrome.

It is becoming increasingly common to carry out new-employee health assessments to ensure that staff are fit for the duties that they are required to perform. This may take the form of health questionnaires together with medical examinations where appropriate. Health questionnaires can also be administered as part of the ongoing surveillance programme, along with the appropriate testing techniques (such as audiograms, lung function tests etc). These techniques, together with the frequency at which the assessments take place, depend on the hazard and associated risk.

REFERENCES