Workplace Health and Safety Queensland

Tunnelling road header operations: dust conditions and their control (summary report)

A report supporting the Occupational Disease Strategy 2007-2010

Introduction

The *National Occupational Health and Safety Strategy 2002-2012* (strategy) principal priorities included a reduction in both the high incidence and severity of occupational disease in the workplace, and to develop the capacity of workplaces to manage occupational health and safety (OHS) more effectively. The strategy specifically targeted eight work-related diseases, one of these being respiratory disease.

Workplace Health and Safety Queensland's (WHSQ) Occupational Disease Strategy 2007-2010 is a program in support of the federal strategy and identifies continuing silica exposures to workers in several different industries within Queensland.

It is necessary to consider respiratory disease (and its causative agents) a high priority and to develop programs that specifically target the disease or its causative agents (in this case quartz, free silica or respirable crystalline silica).

What was the purpose of this intervention?

The intervention targets respirable dust and respirable crystalline silica (RCS) and their control in road tunnelling.

The purpose of the intervention is to:

- determine the respirable dust and RCS concentrations associated with road header tunnelling operations
- evaluate the dust controls being used to determine the extent of compliance
- provide timely feedback and enhance the operator's capacity to control this risk.

Respirable crystalline silica (RCS) remains an important risk factor for respiratory disease amongst tunnelling workers. While silicosis is a historically important disease in tunnelling, RCS is now known to cause chronic obstructive lung disease including chronic bronchitis and emphysema. Chronic exposure to elevated levels of RCS is found to cause cumulative loss of respiratory volume, and still poses a risk of silicosis. Levels which are a concern for silicosis are also now a concern for lung cancer.

The occupational exposure standard (ES) applicable to RCS exposures is 0.1 mg/m^3 expressed as an 8 hr time weighted average concentration. For much of the work in this program, shift length was 10 hrs, and the ES requires downward adjustment to 0.07 mg/m^3.

Tunnelling operations under Queensland law fulfil OHS obligations on exposure to dusts and RCS through Sections 27 and 27A of the *Workplace Health and Safety Act 1995*, since normal regulatory requirements do not apply to dust and RCS exposures. Legislative requirements are supported directly by the Tunnelling Code of Practice 2007 (COP).

What did the intervention involve?

This program involved regular visits to three tunnel sites to conduct monitoring for respirable dust and RCS. Measurements were made by collecting personal samples in the breathing zones of workers followed by laboratory assessments for both respirable dust and RCS.

Some limited closed cab environments, rather than the operator, could be monitored. Peak respirable dust measurements were also made using a DustTrak™ direct reading monitor to review the phases of operation with the greatest potential for dust generation. Ventilation velocity was measured in various tunnels to assess if performance was in keeping with the recommendations of the Tunnelling COP.

What did the intervention target?

This intervention targeted the road header and ancillary operations on three sites in a large tunnelling operation. The program concentrated on seven separate Similarly Exposed Groups (SEGs). "Exposure" here refers to the dust concentrations in which the various SEGs worked, but which may be moderated by the use of respiratory protective equipment (RPE). The groups were:

- road header operators in open cabs
- road header operators in closed cabs
- shotcreters
- drillers, roof bolters and tunnel labourers
- fitters, boilermakers and electricians
- truck, equipment and crane drivers
- supervisory staff.

Targeted observations were made on the following four dust controls being used:

- direct extraction of dust close to source
- air pressurised, filtered closed cabs
- water suppression of dust in rock winning
- universal use of respiratory protective equipment (RPE).

What were the results of the intervention?

Dust and RCS concentrations

Some 90 paired samples for respirable dust and RCS were obtained from three sites. Average respirable dust concentrations are shown in Figure 1 and average RCS concentrations in Figure 2. Observations of visible dust clouds showed that the open cabin road header operators were likely to be the SEG with potentially the greatest exposures.

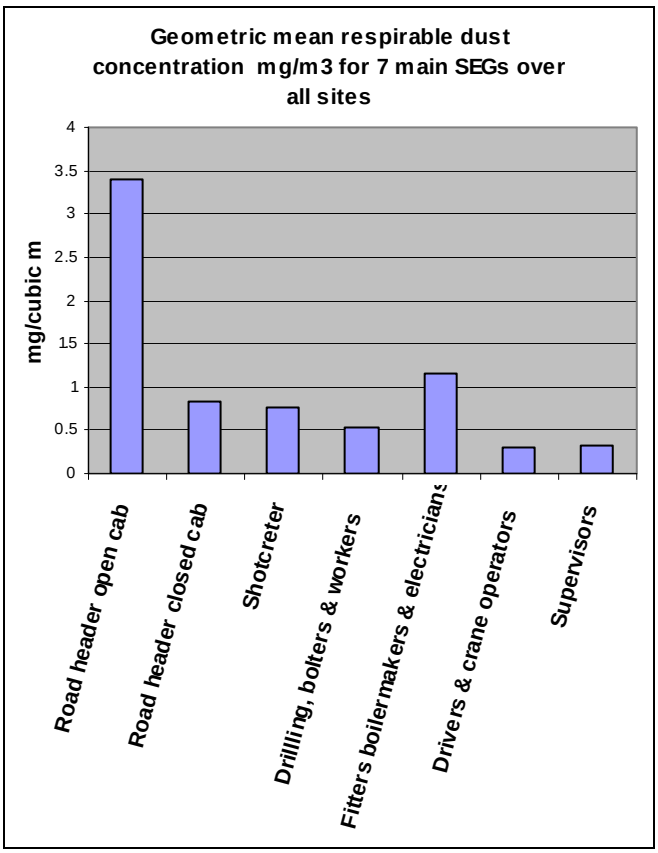

Figure 1: Average respirable dust concentrations for all 7 SEGs.

The SEG represented by open cab road header operators recorded the highest concentrations for both respirable dust and RCS. This SEG averaged eight times the ES for RCS. The highest daily respirable dust concentration recorded for this SEG was 20 mg/m^3 with an RCS estimated at about 4 mg/m^3.

Closed cab road header operators faced a much reduced risk to both respirable dust and RCS. However, individual respirable dust concentrations as high as 5 mg/m^3 were recorded, and the average mean RCS exposure was still two times the ES for RCS.

The average respirable dust and RCS concentrations of the remaining SEGs (shotcreters, drillers, roof bolters, fitters, drivers etc.) were much lower. Although all their *averages* were compliant with the reduced ES for RCS, there were still many excursions (41 percent) above the ES which required significant management.

Spot readings by DustTrak™ as high as 100 mg/m^3 of respirable dust were recorded behind the road header opposite the dust extraction inlet.

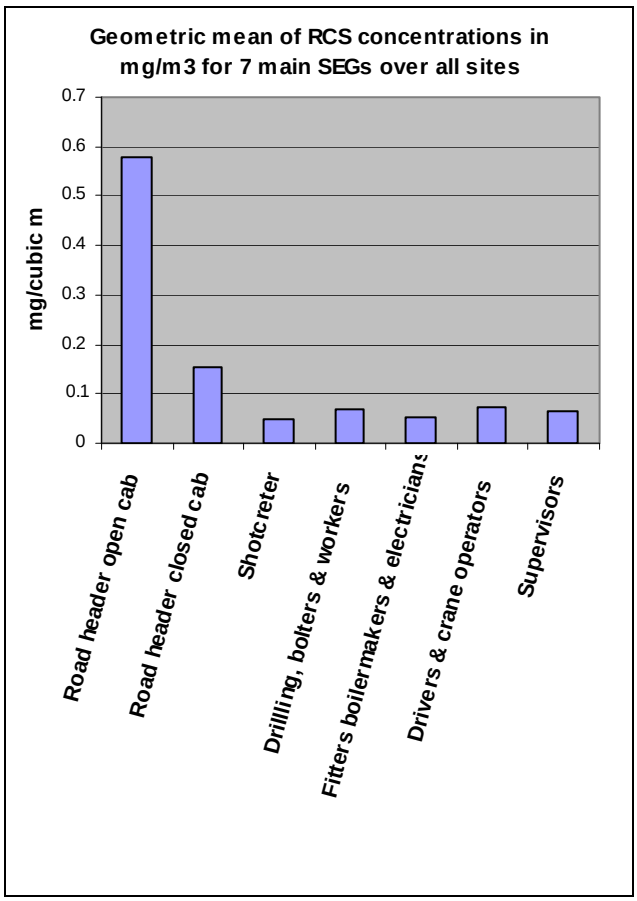

Figure 2: Average RCS concentrations for all 7 SEGs

Controls

Most of the face working procedures required simultaneous application of two or three controls to deal with the excessive dust risks. Primary control of such high dust levels in tunnelling has to commence with extraction at the source. Extensive ventilation, with varying degrees of effectiveness, was applied to rock winning operations. Multiple road header operations in the one drive, particularly when working both first and second benches, provided significant ventilation challenges, as well as requiring several levels of the control hierarchy. Water suppression was partly effective but not universally employed. Open cab road header operators were all provided with airline supplied half-face piece RPE to protect against the excessive dust conditions regularly encountered.

Pressurised, filtered air, closed cabin ventilating systems can provide good dust control provided all windows and doors remain closed, and seals are effectively maintained. Nonetheless, some excessive dust concentrations were observed inside the closed cabins, indicating that additional control measures were still required.

Closed cab operation provided an 80 percent reduction in average dust and RCS concentrations compared with open cab machines. The first and second level controls were necessary so that relatively simple disposable P2 RPE could be used effectively. Use of disposable P2 RPE for all other SEG tasks was mandatory and appropriate; none of their *average* exposures was trivial and were all well above half the relevant adjusted ES for RCS.

Where to from here?

In terms of the purpose of the intervention, this review has measured and identified a risk from potential RCS exposures for all workers, and a significant potential risk for all road header operators, particularly open cab road header operators.

Secondly, adequate dust control should have been achieved through simultaneous use of up to three levels of the control hierarchy. The use of continuous mandatory RPE was the penalty for underperforming higher order controls. However, this intervention did not attempt to verify the performance of the last resort control, the RPE, through fit test and fit checking.

Thirdly, regular feedback provided throughout the program enhanced the operator's capacity both to understand the level of potential risk and to implement corrective controls when required.

Tunnelling on this scale is a recent major undertaking for Queensland. It will employ a significant workforce for many years with current and planned projects. This initial intervention will provide some guidance about the extent of risks involved and of the level of controls required to address those risks.

Constant review of dust concentrations is essential to ensure that controls remain adequate in all such tunnelling operations. Although larger inhalable dust is often visible in the tunnel, respirable dust remains essentially undetected by the naked eye and this adds to the operators' genuine lack of perception of the risk it poses.

Because of the potentially high levels of RCS exposure, workers who make this kind of work a long term profession should be considered as candidates for health surveillance.

Further information

Further information is available from www.worksafe.qld.gov.au or by calling the WHS Infoline on 1300 369 915.

The following publications are available on the website:

- *Silica and the lung – fact sheet*
- *Silica –identifying and managing crystalline silica dust exposure - Information guide*
- *Silica – managing exposure in the workplace: Occupational Disease Strategy 2007–2010*
- *Workplace Health and Safety Act 1995*
- *Workplace Health and Safety Regulation 2008*
- *Hazardous Substances Code of Practice 2003*
- *Tunnelling Code of Practice 2007Tunnelling road header operations: dust conditions and their control - Summary report.*