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Target Audience:
FOD Inspectors

EXPOSURE TO SILICA DURING HYDRO-DEMOLITION USING HIGH PRESSURE WATER JETS

This SIM gives details of potential problems involved with personal monitoring of exposure to respirable silica during the removal of concrete using high pressure water jets. Improved sampling techniques used by HSL have now shown the risk to be negligible.

BACKGROUND

- 1 Due to the deterioration of the concrete used for motorway bridge construction, repair work has become necessary. Furthermore the increase in commercial vehicle weights has also required many bridges to be strengthened. To carry out either type of work the concrete has to be removed leaving the metal reinforcing bars intact with minimal damage to the surrounding concrete. This can be done using a high pressure water jet (680-1700 bar) and is referred to as hydro-demolition. Hand-held jetting guns are used to do this work, particularly underneath the bridge.
- 2 The high pressure water jet breaks up the concrete into small lumps and fine particles. These are washed away as a slurry which requires a high flow rate of water (20-50 litres/minute). To prevent the spread of airborne debris the working area is surrounded by plastic sheeting. This results in the operator working in a dense cloud of spray.
- 3 Dust particles produced during jetting can become airborne in water droplets. Heat produced during jetting together with the speed of the water droplets can cause them to evaporate, leaving airborne dust particles. There is therefore a foreseeable risk that the operator could inhale respirable silica particles.
- 4 A construction company carrying out concrete repair work commissioned consultants to carry out monitoring of exposure to dust and silica. High levels of both respirable dust and respirable silica were recorded. The levels for respirable silica were far in excess of the maximum exposure limit (MEL). This caused concern in the industry and HSE was asked for guidance. As the original figures appeared excessively high HSL were asked to undertake further monitoring of personal exposures during high pressure water jetting to establish whether or not the results could be repeated.

SAMPLING RESULTS

- 5 Sampling was extremely difficult due to the wet conditions. Pumps frequently failed, water gained access to the sampling heads and larger particles of grit were able to ricochet

and impinge onto the collection filter. It was eventually established that these larger particles were causing the high results obtained by the consultants. Although the original measurements were an overestimate of personal exposures further work was needed to establish reliable results.

6 The use of the conventional type of cyclone sampler for respirable dust had to be abandoned. Instead a smaller total dust sampling head was used. The operators normally wear two water proofs. The sampler was positioned underneath the outer hood of the operator's water proof and attached to a head band, providing a position representative of their breathing zone. The sample head in this position still allowed an air flow but was protected from larger water droplets and particles of grit landing on the filter. The technique is the same as that used to carry out in-visor sampling of welding fume and is therefore appropriate given the operator wears a helmet and full face visor.

7 This technique could only measure total inhalable dust and not the amount of respirable silica present on the filter. Electron microscopy was therefore used to estimate total quartz and respirable silica.

8 Operators take turns using the jetting gun with an operator typically jetting for less than 4 hours per day. The total quartz concentrations expressed as an 8-hour TWA ranged from 0.04 to 0.73 mg/m³ with the average being 0.28 mg/m³. Using an electron microscope it was estimated that respirable-size particles made up between 1-10% of the total quartz. At worst, the respirable silica concentration expressed as an 8-hour TWA would be no more than <0.073 mg/m³ which is well below the current MEL of 0.3 mg/m³. The average total dust concentration expressed as an 8-hour TWA was 5 mg/m³. No attempt was made to estimate the total respirable dust as this would obviously be below 5 mg/m³.

9 The improved sampling technique developed by HSL suggests that the risk of exposure to silica during hydro-demolition is negligible.

ACTION BY INSPECTORS

10 Inspectors should be aware that given the low levels of silica found during hydro-demolition it is unlikely that specific action will be required.

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