Protecting Tuckpointing Workers from Silica Dust: Draft Recommendations for a Ventilated Grinder

William A. Heitbrink, PhD, CIH
Scott Collingwood

January 2005

Contents

Background,

This report presents draft recommendations for using a ventilated grinder to reduce the

of about 0.1 mg/m^3. As of 2004, OSHA was in the process of revising this PEL, which has been in effect since the 1970s. For more information see http://www.osha.gov/SLTC/silicacrystalline/index.html.)

The authors maintain that the local exhaust ventilation provided by the vacuum cleaner equipment is the best option for controlling the extremely high levels of silica dust generated during tuckpointing. Water spray, used as a dust suppressant in some construction tasks, cannot be applied during tuckpointing because its use poses an electric shock hazard; water leaking into the unsealed grinder motor could cause a short-circuit. In addition to reducing the silica hazard, the dust removal provided by the vacuum cleaner provides a clearer view of the work surface and reduces time spent on clean-up, according to the authors. Still, some contractors have been reluctant to use the ventilated grinders because of concerns that the extra equipment would get in the way of the work and slow down the job. But a contracting firm that has been using a ventilated grinder for two years told the authors that the dust control system they've used has not affected the rate of work for their company. This firm does not consider it necessary to include in their contract proposals additional time allowances for use of the dust control equipment.

Research Methods

For this study the researchers conducted laboratory and field trials of several grinder exhaust systems, all containing the following components:

- A shroud partially enclosing the grinding disc
- An industrial vacuum cleaner providing air flow and filtration
- A flexible hose between the shroud and the vacuum cleaner/filter.

Previous experimental studies have shown that the vacuum cleaner needs to maintain a minimum air flow volume of 80 cubic feet per minute (cfm) for optimal dust control (Heitbrink and Watkins 2001). The vacuum cleaner's ability to maintain this air flow is influenced by the grinder shroud design, the type and size of hose, the mass of dust

Preliminary Findings

Exposure monitoring results

The researchers reported on 22 respirable crystalline silica exposure results obtained for tuckpointing workers using the ventilated grinders. The silica levels in these samples ranged from 0.01 mg/m^3 (the analytical limit of detection) to 0.86 mg/m^3, all substantially lower than the levels of 5 mg/m^3 that were found during uncontrolled tuckpointing (Shields 1999). Nine of the 22 readings were at or below the NIOSH REL of 0.05 mg/m^3. Eight readings exceeded the OSHA PEL or 0.1 mg/m^3, but all were still less than 10 times the PEL. These field results indicate that a respirator with an assigned protection factor of 10 (such as a half-facepiece air-purifying respirator) would provide sufficient protection from the silica dust hazard under conditions similar to those present at the study sites.

The video exposure monitoring showed that the ventilated grinders effectively captured the dust during m

removes much of the dust before it reaches the filters, thus reducing filter loading and clogging.)

Hose: The researchers recommend using a 2-inch diameter hose with a length of 10 to 15 feet and a relatively smooth interior surface. The hose should be set up to have as few elbows or sharp turns as possible.

Shroud: The shroud can be purchased separately or as a unit with the vacuum cleaner and hose. The shroud should totally enclose the spaces around the exhaust take-off (entry point for hose). The leading edge and the front side of the blade can probably be exposed without reducing dust capture efficiency. The exhaust shroud's take-off should have a 2-inch diameter.

Note: The test data for the equipment evaluated during this study are available from the authors. Contact information is provided on the inside front cover of this report.

Work practices

To ensure that the ventilated grinder provides adequate dust control, tuckpointing workers should follow these work practices:

- Keep the exhaust take-off flat against the work surface.
- Shake the hose as needed to loosen settled dust and prevent the hose from clogging.
- Throughout the operation, visually check to make sure no dust is escaping from the shroud. If dust escapes, turn off the unit and clean or change the filter, as recommended by the vacuum cleaner manufacturer. Occasionally the build-up on the filter can be dislodged by simply moving or shaking the vacuum cleaner, or turning the motor off and on a few times. Build-up on filters slows down the air flow through the system and diminishes dust capture.
- Work against the natural rotation of the blade. The tool must be positioned so that the debris from grinding is blown into the exhaust take-off.
- Change vacuum cleaner bags before they break. Overloaded vacuum cleaner bags can be ruptured because of the pressure differences in the system. This may be a significant limitation of less expensive equipment.
- Position the vacuum cleaner below the level of the work, to keep dust from falling out of the hose.
- Be aware of the potential for elevated exposure when working in poorly ventilated areas (such as in corners or inside buildings), as well as when tuckpointing on

Bibliography

American Conference of Governmental Industrial Hygienists (ACGIH). 1995. *Industrial Ventilation: A Manual of Recommended Practice,* 22nd ed. Cincinnati, Ohio: ACGIH.

Bennett, J.S., W.A. Heitbrink, and A. Echt. 2002. A numerical and experimental investigation of crystalline silica exposure control during tuck-pointing. Presented at 2002 American Industrial Hygiene Conference and Exposition. June 1-6, 2002. San Diego, California.

Dustcontrol. 2003. Mobile Equipment catalog 2003/2004. Norsborg, Sweden. http://www.dustcontrol.com/internat/catalog.asp.

Heitbrink, W.A. and D.S. Watkins. 2001. The effect of exhaust flow rate upon the respirable dust emissions for tuckpointing operations. In: In-Depth Study Report: Control Technology for Crystalline Silica Exposures in Construction. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. ECTB No. 247-18.

Meijer, E., H. Kromhout, and D. Heederick. 2001. Respiratory effects of exposure to low levels of concrete containing crystalline silica. *American Journal of Industrial Medicine,* 40:133-140.

Shields, C. 1999. Massive respirable silica exposures in tuckpointing (power grinding). Presented at 1999 American Industrial Hygiene Conference and Exposition, Toronto, Ontario, Canada, June 5-11. Roundtable 246.

Annex A. Evaluation of Grinder Ventilation Systems

The ventilation system consists of an industrial vacuum cleaner, flexible hose, and hood

Annex B. Effect of Work Surface on Air Flow

Figure 1 below illustrates the importance of keeping the exhaust take-off (entry) flat against the work surface. The 4-inch diameter grinding wheel is turning faster than 10,000 revolutions per minute (rpm), and the mortar debris has a velocity of 11,000 feet per minute (fpm), about 120 miles per hour. The air flow into the exhaust shroud is only 4000 fpm (about 45 mph). As a result, the exhaust shroud can only capture the dust that is directed into the exhaust take-off. When the mortar is intact and the exhaust take-off is flush against the surface, the dust is effectively captured (A). When there is a gap between the work surface and the exhaust take-off, dust escapes from the system (B).