WORKPLACE SOLUTIONS

From the National Institute for Occupational Safety and Health

Control of Hazardous Dust When Grinding Concrete

Summary

Construction workers are exposed to hazardous dust when using handheld electric grinders to smooth poured concrete surfaces after forms are stripped. The National Institute for Occupational Safety and Health (NIOSH) found that exposures could be reduced if a local exhaust ventilation (LEV) shroud was attached to the grinder.

Description of Exposure

Breathing dust that contains crystalline silica can lead to the development of silicosis, a deadly lung disease. No effective treatment exists for silicosis, but it can be prevented by controlling workers' exposure to dust containing crystalline silica. Exposure to crystalline silica has also been linked to lung cancer, kidney disease, reduced lung function, and other disorders [NIOSH 2002a].

Workers in the construction industry may breathe dust that contains silica during various tasks including cutting brick and block, tuckpointing masonry, using a jackhammer to break concrete or rock, or grinding concrete. A NIOSH [2001] study found that workers grinding concrete to smooth poured concrete surfaces after forms are stripped were exposed from 35 to 55 times the NIOSH recommended exposure limit (REL) for airborne dust containing crystalline silica. NIOSH evaluated the use of LEV shrouds on handheld concrete grinders to see whether they reduce worker exposure to dust [Echt and Seiber 2002; NIOSH 2002b].

NIOSH Study

The concrete finishers in the NIOSH studies were responsible for smoothing poured concrete walls and columns. The LEV system consisted of a grinder that was equipped with a ventilation shroud, a length of flexible corrugated hose, and a portable electric vacuum cleaner that acted as the fan and dust collector for the ventilation system (Figures 1 and 2). The concrete surfaces were flat and allowed the shroud to make a good seal with the concrete. Four commercially available shrouds were used in the NIOSH study. All grinder/shroud combinations reduced dust exposure by at least 90%.

Figure 1. Grinder in use with the control in place.

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Grinders

The grinders used were rated at either 10,000 or 11,000 rpm: Metabo model W7-115 Quick 10,000-rpm grinder and Metabo model 11025 grinder (Metabowerke GmbH; Nürtingen, Germany); Bosch model 1347A grinder (Robert Bosch GmbH; Stuttgart, Germany); and Milwaukee model 6153–20 grinder (Milwaukee Electric Tool Corp.; Brookfield, WI). The grinders were fitted with 4-inch diameter diamond cup wheels (PW series, Pearl Abrasive Co.; Commerce, CA).

LEV shrouds

Four LEV shrouds were used in the study. The shrouds were selected based on their rugged appearance, how easily they could be mounted on the grinders, and their availability for purchase. The shrouds used were Vacuguard (Pearl Abrasive Co.; Commerce, CA), Dustcontrol (Transmatic Inc; Wilmington, NC); and "full-dust shroud" and "cut (edging) shroud" (Sawtec; Oklahoma City, OK).

Vacuum cleaners and hoses

The grinder/shroud pairs were connected via 1.5-inch (inside diameter) corrugated flexible hose to two types of industrial vacuum cleaners (DC 2700 and DC 3700; Dustcontrol AB, Norsborg, Sweden). The manufacturer reports that the DC 2700 vacuum has a maximum flow capacity of 112 cubic feet per minute (190 cubic meters per hour), and a maximum negative pressure of 84 inches w.g. (21 kPa). The DC 3700 has a maximum flow capacity of 188 cubic feet per minute (320 cubic meters per hour) and a negative pressure of 96.5 inches w.g. (24 kPa).

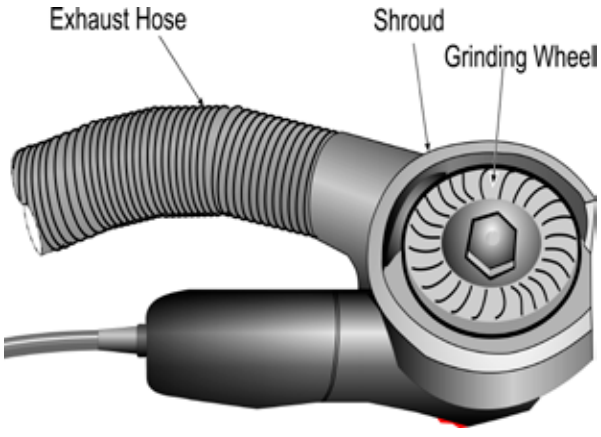

Figure 2. Diagram of grinder showing main parts.

Controls

NIOSH and its partners have developed recommendations to protect workers from exposure to crystalline silica dust during construction activities [NIOSH 1996; Echt and Seiber 2002; NIOSH 2002a; Heitbrink and Collingwood 2005]. Some of the benefits of using the dust control noted in this report include reducing worker exposure to hazardous dust and potentially allowing for use of less protective respiratory protection, reduced cleanup time, and reduced cleanup exposures.

Vacuum cleaners

The choice of a vacuum cleaner depends on the task. It must be carefully selected to include features such as the following:

- Sufficient flow rate to capture the dust and transport it to the vacuum source
- Uses a high-efficiency particulate air (HEPA) filter to reduce the chance of releasing dust containing crystalline silica from the vacuum into the worksite
- Uses pre-filter or cyclone to increase the length of service of the HEPA filter
- Uses filter replacement indicator
- Filters can be cleaned and replaced or full collection bowls or bags can be replaced without exposing the operators to dust

The vacuum cleaner should draw at least 10 amps if it is used as part of a ventilated grinder system, so it can overcome filter loading. Some vacuum cleaners are equipped with a pressure gauge that indicates when the air flow rate is too low to be effective. If the vacuum cleaner does not have a pressure gauge, workers can monitor the air flow by looking at the dust plume. If dust is escaping under the shroud, the dust collected on the pre-filter needs to be dislodged or the vacuum cleaner bags or filters need to be changed.

Hose

A 1.5- or 2-inch diameter hose with a relatively smooth interior and a length of no more than 15 feet should provide adequate air flow. The hose should have as few elbows or turns as possible. A study on tuckpoint grinders [Heitbrink and Collingwood 2005] reported that 2-inch diameter hoses provided better air flow than smaller (e.g., 1.5 inch) diameter hoses. Dust has a greater tendency to settle in larger diameter hoses and should be cleared before and after each use.

Shroud

The shroud can be purchased with the grinder, separately, or as a unit with the vacuum cleaner and hose. The shroud should totally enclose the spaces around the exhaust entry point for the hose. The exhaust shroud should have an entry point for the hose matching the diameter of the hose.

Work practices

- Keep the shroud flat against the surface of the concrete while grinding.
- Shake the hose as needed to loosen the settled dust and prevent the hose from clogging.
- When using the grinder, look to make sure no dust is escaping from the shroud.
- If dust is escaping, turn off the unit and clean or change the filter as recommended by the manufacturer. Sometimes the build-up on the filter can be dislodged by simply moving or shaking the cleaner, or turning the motor off and on a few times. Build-up on the filters slows down the air flow through the system and reduces dust capture.
- Change vacuum cleaner bags before they leak.
- When changing filters, bags, or self-contained collection bowls, use proper disposal practices and use respirators if appropriate.

Since NIOSH last investigated concrete grinders in 2002, several grinder manufacturers have introduced tools with dust controls. Studies since the NIOSH investigation show the effectiveness of LEV controls in reducing respirable dust when using concrete grinders [Croteau et al. 2004; Akbar-Khanzadeh et al. 2007].

Respirators

Workers and employers should be aware of the high risk of dust exposure in poorly ventilated areas (such as in corners or inside buildings). This may result in increased exposure to hazardous dust.

The dust control cited in this report may greatly reduce worker exposure to hazardous dust; however, respirators are still necessary to reduce exposure to crystalline silica below the NIOSH REL of 50$\mu g/m^3$. Follow the Occupational Safety and Health Administration (OSHA) Respiratory Protection Standard (29 CFR* 1910.134) (www.osha.gov/SLTC/etools/respiratory/index.html). The provisions of the program include procedures for selection, medical evaluation, fit testing, training, use, and care of respirators.

*Code of Federal Regulations. See CFR in references.

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For More Information

The information in this document is based on NIOSH field studies. More information about silica hazards and controls is available on the NIOSH Web site at www.cdc.gov/niosh/topics/silica/default.html.

To receive copies of the NIOSH field study reports that formed the basis of this document or to obtain information about other occupational safety and health topics, contact NIOSH at

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As part of the Centers for Disease Control and Prevention, NIOSH is the Federal agency responsible for conducting research and making recommendations to prevent work-related illness and injuries. All *Workplace Solutions* are based on research studies that show how worker exposures to hazardous agents or activities can be significantly reduced.

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