

Water Spray Control of Hazardous Dust When Breaking Concrete with a Jackhammer

Summary

Construction workers are exposed to hazardous dust when using jackhammers to break concrete pavement. NIOSH found that exposures could be reduced by using a water-spray attachment.

Description of Exposure

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

Workers in the construction industry may breathe dust that contains crystalline silica during many tasks including grinding concrete, cutting brick and block, tuckpointing masonry, or using a jackhammer to break concrete. A study to measure exposures found that jackhammer operators who

break concrete were exposed to about 6 times the NIOSH recommended exposure limit (REL) [Valiante et al. 2004]. NIOSH evaluated the use of jackhammers for breaking concrete pavement and examined engineering controls to see whether they reduce worker exposures to dust [Echt et al. 2003].

NIOSH Study

NIOSH studied a water-spray attachment (Figure 1) to suppress dust created during concrete pavement breaking with jackhammers [Echt et al. 2003]. This low-flow, water-spray control reduced dust exposures by 70%–90%.



Figure 1. The water spray attachment, showing the method used to attach the nozzle to the tool.

Water-Spray Control

The water-spray attachment was made by a contractor who participated in the NIOSH study (Mt. Hope Rock Products, Inc., Wharton, NJ, a division of Tilcon New York, Inc., West Nyack, NY). There is continuing development of water-spray controls similar to the one used in the NIOSH study. For example, The New Jersey Laborers Health and Safety Fund (NJLHSF) has also developed a simple durable, low-cost water-spray attachment for use on a jackhammer (www.njlaborers.org/index.php3). The NJLHSF version of a water-spray attachment used the control described in this document as a starting point. A detailed description of the NJLHSF water-spray attachment and estimated cost can be found at their Web site (www.njlaborers.com/health/jackhammer.php3).

NIOSH is not aware at this time of off-the-shelf, commercially available retrofit kits or jackhammers that come with built-in water spray units. However, it is relatively simple to build a water spray control for a jackhammer using the diagram in Figure 2 and the parts and instructions below:

- **Water-spray nozzle:** Use a solid-cone, furnace-spray water nozzle with an 80-degree spray angle (Type B, 11.00 GPH, 80°, Delavan Inc. Fuel Metering Products, Bamberg, SC www.delavaninc.com). Mount the nozzle in a bracket welded on the end of the jackhammer. The spray angle (the angle included between the sides of the cone formed by the water discharged by the nozzle) and the spray pattern are two critical design parameters required to match the performance of the tested device. Spray nozzles make several spray patterns such as hollow cone, full cone, and flat spray. This control used a solid cone nozzle.



Figure 2. Diagram of water-spray control used in NIOSH study

- **Water flow rate:** The nozzle used in the NIOSH study delivered about 350 milliliters (11.8 ounces) of water per minute. This flow rate is the third critical design parameter for performance of this control. It is effective in reducing dust and it did not add a lot of water to the work surface or significantly wet workers' clothing or shoes. Higher flow rates may not greatly increase dust control, and lower flow rates may reduce performance.
- **Bracket:** Use a bracket for mounting the water-spray nozzle on the jackhammer. Mounting the nozzle above the end of the jackhammer will prevent the nozzle from striking the pavement.
- **Water-supply lines:** Connect the nozzle by flexible 16 pounds-per-square-inch (psi), 3/8-inch-diameter hydraulic line to a quarter-turn valve mounted near the operator's hand position for turning the water on or off. A 3/8-inch-diameter air hose connects the valve to a 60-gallon water tank (pressurized to 22 psi) mounted on the air-compressor trailer (Figure 3). Control the pressure in the tank with a regulator.
- **Water source:** Use a water tank or a direct connection to a local water supply such as a water main. If a tank is used, water can be supplied to the attachment by pressurizing the tank or pumping water from the tank. If a pressurized tank is used, a compressor is needed to pressurize the tank, a regulator to control the pressure, and a pressure relief valve to guard against the tank bursting. Rust from a steel tank may clog the spray nozzle. However, a plastic water tank can be used with a battery-powered water pump instead of a steel pressurized tank. The larger the tank, the less it will have to be refilled. A 50-gallon tank will easily supply one jackhammer water-spray control used constantly for a full 8-hour shift. A trailer or hand truck may be necessary for moving the tank around the worksite.

Controlling Dust Exposures

The results of the NIOSH study showed that the control devices may reduce exposure to dust for jackhammer operators and other workers near the work area.

Employers and jackhammer operators should take the following steps to reduce worker exposure to hazardous dust:

Site Set-Up

- Develop a site-specific safety and health plan for all job sites where jackhammers are used that considers engineering controls, personal protective equipment, and work practices.



Figure 3. Water tank mounted on compressor trailer

- Minimize the number of workers in the construction area where jackhammers are used.
- Post signs to warn workers about the hazard and to inform them of required protective equipment. Workers should also be cautioned about icing, slips, and falls (particularly if they make a mud hole), and about ground faults for any electrical system in use.
- During jackhammer use, perform air monitoring of respirable crystalline silica exposures to make sure the engineering controls are working and to determine whether workers need respiratory protection.
- Make medical examinations available to all workers exposed to crystalline silica.

Engineering Controls

- Equip jackhammers with dust-reduction control devices such as the water-spray attachment described in this report. When a water-spray attachment cannot be used (for example, on the upper floor inside an occupied building), use other control measures such as a vacuum or other local exhaust ventilation (LEV) device [Echt et al. 2003]. Spraying the work area with a garden hose is not an appropriate replacement for the water-spray control.
- Train workers in the proper use and maintenance of the dust-reduction device. Make sure that the control is working properly and test the water flow rate before and after each shift; a watch with a second hand and a kitchen measuring cup could be used for this task. An 8-ounce cup should fill in about 40 seconds.

Personal Hygiene and Protective Clothing

- Wash hands and face before eating, drinking, or smoking. Do not eat, drink, or use tobacco products in the work area.
- Change into disposable or washable work clothes at the worksite. If possible, shower and change into clean clothes before leaving the worksite. If it is not possible to shower or change into clean clothes, use a vacuum to remove dust from clothes.
- Park cars where they will not be contaminated with silica dust.
- Do not remove dust from the work area by blowing with compressed air or dry sweeping. Also, do not blow dust from clothing or skin with compressed air.

Protective Equipment

- Use hearing and eye protection devices. When water-spray attachments are used with jackhammers, waterproof personal protective equipment may be necessary.
- Use respiratory protection when needed. The controls cited in this report may greatly reduce worker exposure to dust; however, respirators may still be necessary to reduce exposure to crystalline silica below the NIOSH REL of $50\mu\text{g}/\text{m}^3$. It may be possible to use less restrictive respirators such as a disposable N-95 filtering facepiece since the amount of hazardous dust is decreased by the controls. The respirators are less cumbersome and cost less than the respirators typically required for jackhammer operators. Employers should follow the Occupational Safety and Health Administration (OSHA) Respiratory Protection Program (29 CFR 1910.134).

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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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