Potential Occupational Exposure Hazards in Concrete Countertop Manufacturing

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The National Institute for Occupational Safety and Health (NIOSH), in the Centers for Disease Control and Prevention (CDC), conducts research and makes recommendations for the prevention of work-related injury and illness. The NIOSH health hazard evaluation (HHE) program is available for employees, employers or union representatives to ask our comprehensive team of experts for an investigation of their health and safety concerns. Our team contacts the requestor and discusses the problems and how to solve them. This may result in sending the requestor information, referring them to a more appropriate agency or making a site visit (which may include environmental sampling and medical testing). If we make a site visit, the result is a report of our investigation that includes recommendations specific to any problems found, as well as general guidance for following good occupational health practices.

This article will discuss an HHE at a business in the concrete countertop manufacturing industry. Included in this article are findings and recommendations provided to the company in our report. This and other HHE reports are available online **(see Additional Information Resources sidebar)**.

Concrete Countertop Manufacturing HHE

We received a request for an HHE from a small business specializing in the design, fabrication and installation of custom concrete countertops for residential and commercial applications. The business employed five to six full-time employees. Employees were not reporting any health symptoms believed to be related to working at this business, but because the manufacture of custom concrete countertops is a relatively new niche industry, the managers asked us to evaluate their shop for possible occupational health hazards. Work at this facility involves potential exposure to respirable particulates (from dusts generated when mixing concrete and sanding grouted and finished concrete slabs) including silica and wood dusts, as well as potential exposure to noise, concrete acid stain and skin sensitizing agents contained in epoxy-based sealants.

We made five visits to observe work operations and to conduct exposure assessments for noise, respirable crystalline silica, respirable dust (or respirable particulates not otherwise regulated) and asbestos fibers. We took personal breathing zone (PBZ) air samples for respirable dusts and silica and area air samples for asbestos. We also took samples of settled dust to analyze them for silica and metals. We measured noise exposures from hand-held grinders. Lastly, we evaluated the dust control ventilation systems and observed work practices and equipment.

In evaluating the hazards posed by workplace exposures, we use both mandatory (legally enforceable) and recommended occupational exposure limits (OELs) for chemical, physical and biological agents as a guide for making recommendations. The below section, "Health Effects and Occupational Exposure Limits" further explains the limits we use as a guideline when making our recommendations.

At this company, we found one air sample that exceeded the U.S. Department of Labor Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for exposure to respirable dust (5 mg/m3), and two samples that exceeded the American Conference of Governmental Industrial Hygienists® (ACGIH) Threshold Limit Value® (TLV) for respirable dust (3 mg/m3). The remaining air samples were below these criteria. Settled dust in the drying rooms contained 2 to 3 percent crystalline silica and some metals.

We noted that dust at the facility could be better

controlled with improved work practices and ventilation changes. Noise exposures were below the OSHA PEL of 85 decibels as a daily average.

At this facility, we recommended employees use a rubber trowel to apply the minimum amount of grout compound necessary when wet patching and sanding countertops. This would minimize the creation of small airborne dust clouds when the rapidly spinning sanding disk hits dry grout clumps. Since our visit, the facility has reduced the amount of patch applied by 50 to 75 percent using this technique.

To further decrease dust creation, we advised managers to avoid having two workers sanding at the same time in the same dry room. We recommended enhancements to the exhaust ventilation systems in the drying rooms to improve dust extraction, and use of directly ventilated sanders while patching. We advised employees to check the dust bag and barrel on the dust extractor regularly and empty them when they are half full. Adding a dust collection device for the planer, dedicating the existing vacuum collection system to the panel saw and insuring the portable dust collection system is operating at optimum efficiency would better control dust. The facility now uses separate dust control systems for each tool.

A high efficiency particulate air (HEPA) vacuum cleaner should be used periodically to remove accumulations of settled dusts from the metal conduit and wall-mounted heaters in the dry rooms and horizontal work surfaces where visible dust accumulates. The dry rooms at the facility now get a weekly cleaning to remove settled dust. We also advised employees on the proper way to remove dust from their clothing and body after a work shift. Do not use compressed air to blow dust from clothing, faces, and hair because it sends the dust back into the air where it can be breathed in or blown into the eyes. Instead, use a HEPA vacuum cleaner to vacuum clothing. Employees should wash their face and hands with soap and water. The employees now wash down before lunch and at the end of the day.

Lastly, we advised employees to wear blue nitrile gloves to protect their skin when working with epoxy resins (because these products can be sensitizers, they can cause allergic skin reactions). The facility now uses only blue nitrile gloves for this work. If employees become sensitized to these chemicals, they can be at risk for serious skin reactions with future skin exposures. Therefore, prevention of skin contact with sensitizing chemicals is very important.

Health Effects and Occupational Exposure Limits

OELs have been developed by federal agencies and safety and health organizations. They suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. However, a

General Recommendations for Your Facility

How can concrete countertop manufacturing workers and managers reduce or remove potential hazards? Consider the following actions:

Dust Control

- Controlling dust generation (especially concrete dust that can contain silica) is a critical aspect of shop operations. Using dedicated and engineered local exhaust ventilation (LEV) systems to collect dust where it is generated is particularly important.
- Don't use compressed air to blow dust off work clothes; instead, use a high efficiency vacuum cleaner and wash face and hands with soap and water at the end of the
- work day.
- Check the dust bag and barrel on dust extractors or vacuums and empty them when they are half full.
- Periodically remove settled dust from horizontal workshop surfaces using a HEPA vacuum.
- For sanding, consider the use of directly ventilated sanders to reduce dust concentrations. One study reported that use of directly ventilated handheld sanders reduced inhalable dust concentrations by 93 to 98 percent.
- Vane axial fans (propeller type) are recommended for dusty environments. They don't accumulate as much dust as centrifugal fan blades and are more efficient at moving dusty air.
- Use wet methods when cutting and polishing concrete slabs.
- If you notice the shop has increasing dust build-up on horizontal surfaces, source controls for dust (such as LEV) may not be working well enough. Close observations of all shop operations, inspection of dust controls and review of work practices is warranted to determine why dust is not being captured, or to determine uncontrolled points of emissions.

Personal Protective Equipment (PPE):

Assessment of PPE Use

- Complete a comprehensive assessment (required by OSHA for all employers) to determine if hazards are present, or likely to be present, that would require the use of PPE (such as safety glasses, protective gloves, respirators, or other PPE). Employees must be trained in the use and maintenance of the PPE. OSHA requires written documentation that PPE hazard assessment and employee training have been completed. Information about PPE can be found on the OSHA Web site (http://www.osha.gov/SLTC/personalprotectiveequipment/index.html).

Skin Protection

- Use nitrile gloves when working with sensitizing resins and sealers (for example, Ancamine and other chemicals noted on the product label or the material safety data sheet as a skin sensitizer). Latex or thin plastic (food handler) gloves are not designed for skin protection against sensitizing agents in resins and sealants. Consult a reference guide such as "Quick selection guide to chemical protective clothing" (see Additional Information Resources) to determine appropriate gloves (as well as other PPE) for the chemicals at your facility.

Hearing Protection

- Consult OSHA guidelines for hearing loss prevention programs if necessary. The OSHA noise regulation and hearing conservation amendment provides minimum guidelines. Additional information on hearing loss prevention programs that goes beyond OSHA requirements has been published (see Additional Information Resources).
- Wear hearing protection devices (in other words, foam earplugs or protective muffs) if necessary. Moderate, flat-attenuating devices (referred to as musician earplugs) can improve communication and one's ability to hear warning signals by attenuating noise in a more uniform manner. They can be found on the Internet under musician earplugs or high fidelity earplugs.

Respiratory Protection

- Provide employees with respiratory protection if a hazardous product cannot be substituted with a less hazardous product. PPE is the least effective means for controlling employee exposures because it requires a high level of employee involvement and commitment. It should not be the only method for reducing exposures. Employees wearing respirators must be properly fitted, receive training on their use and undergo medical evaluations. Companies requiring respirator usage must prepare a written respirator program that documents how they comply with OSHA respiratory protection program requirements. If you use a respirator or other PPE, consult federal standards for proper use, maintenance and storage. Refer to the OSHA respiratory protection standard (29 CFR 1910.134) if you are required to wear a respirator, or to Appendix D of the standard if your use is voluntary (see Additional Information Resources).
- Make sure respirator users do not have facial hair because it prevents respirators from sealing to the face and reduces their effectiveness.

Additional Information Resources

NIOSH HHE reports:
http://www.cdc.gov/niosh/hhe/

OSHA noise regulation and hearing conservation amendment:
CFR [2003]. 29 CFR 1910.95. Code of Federal Regulations. Washington, DC: U.S. Government Printing Office, Office of the Federal Register.

Additional hearing loss prevention program information:
NIOSH [1996]. Preventing occupational hearing loss – A practical guide. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 96-110.

Royster JD, Royster LH [1990]. Hearing conservation programs: practical guidelines for success. Chelsea, MI: Lewis Publishers.

Suter AH [2002]. Hearing conservation manual. 4th ed. Milwaukee, WI: Council for Accreditation in Occupational Hearing Conservation.

Respirator Usage
OSHA [1998]. OSHA Small Entity Compliance Guide for the Revised Respiratory Protection Standard. http://www.osha.gov/Publications/secgrev-current.pdf.

OSHA Respiratory Protection Standard and Information for Employees Using Respirators when not Required Under Standard - 1910.134 Appendix D. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=12716&p_table=standards.

PPE Guidance
OSHA guidance on PPE:
http://www.osha.gov/SLTC/personalprotectiveequipment/index.html

Forsberg K, Mansdorf SZ [2007]. Quick selection guide to chemical protective clothing. 5th ed. Hoboken, NJ: John Wiley & Sons, Inc.

small percentage of workers may still experience adverse health effects even if they are not exposed to substances at levels higher than the OELs because of individual factors such as their personal susceptibility, pre-existing medical conditions or hypersensitivity (allergy). Some hazardous substances may act in combination with other workplace exposures, the general environment or with medications or personal habits of the worker to produce health effects even if the occupational exposures are below the exposure limit. Some substances can be absorbed by direct contact with skin and mucous membranes in addition to being inhaled, which contributes to the person's overall exposure.

OSHA mandates legally enforceable PELs for workplaces covered by the Occupational Safety and Health Act. However, not all hazardous chemicals have specific OSHA PELs, and the legally enforceable and recommended limits for some substances may not reflect current health-based information.

To eliminate or minimize identified hazards, we encourage (in order of preference) the use of the traditional hierarchy of controls: (1) substitution or elimination of the hazardous agent; (2) engineering controls (for example, local exhaust ventilation, process enclosure, dilution ventilation); (3) administrative controls (for example, limiting time of exposure, employee training, work practice changes, medical surveillance); and (4) personal protective equipment (for example, respiratory protection, gloves, eye protection). This approach groups actions by their likely effectiveness in reducing or removing hazards. In most cases, the preferred approach is to eliminate hazardous materials or processes and install engineering controls to reduce exposure or shield employees. Until such controls are in place, or if they are not effective or feasible, administrative measures and/or personal protective equipment may be needed.

Primary Concerns for Workers Who Manufacture Concrete Countertops Respirable Particulates Not Otherwise Regulated

Workers who manufacture concrete countertops can be exposed to dusts, or mixtures of dusts, not associated with a specific toxic chemical. Occupational health specialists refer to these as particulates not otherwise

regulated. Although larger dust particles are trapped by the body's natural defense mechanism (e.g., mucous lining the upper respiratory tract), respirable dust particles are small enough to penetrate to the deepest parts of the lungs and cause harmful health effects. OSHA mandates generic criteria for airborne particulates that do not produce significant disease or toxic effects when exposures are kept under reasonable control.

Noise

Hearing loss because of excessive noise exposure is an irreversible condition that gets worse the more a person is exposed. Noise produces hearing loss greater than hearing loss caused by the natural aging process. It damages nerve cells of the inner ear, and unlike some hearing disorders, noise-induced hearing loss cannot be treated medically. While hearing loss may sometimes result from one exposure to a very brief loud noise or explosion, it typically begins to develop at 4,000 or 6,000 Hertz (Hz) (the hearing range is 20 Hz to 20,000 Hz) and gradually spreads to lower and higher frequencies. Often, significant hearing loss has occurred before the person recognizes his or her condition. Such impairment is usually severe enough to permanently affect a person's ability to hear and understand speech under everyday conditions. Workers who manufacture concrete countertops can be exposed to noise from various sources including shop machinery (cement mixers, saws, drills), and from hand-held tools such as grinders and polishers.

Silica

Silica is a natural mineral that exists in several forms, but only exposure to crystalline silica can produce the pulmonary condition called silicosis. Although this disabling, progressive and sometimes fatal disease usually occurs after 15 or more years of exposure, NIOSH has found that it can develop after only a few years of exposure to high concentrations of crystalline silica. Initially, silicosis may not produce symptoms. However, as the disease progresses, it is characterized by shortness of breath and a reduction in pulmonary function. Individuals with this disease are also at increased risk of developing tuberculosis. The smallest particles of quartz and other major forms of crystalline silica (cristobalite and trydimite) can be inhaled into the deepest part of the lung and are more hazardous. The NIOSH recommended exposure limit (REL) for respirable silica (all forms) is intended to prevent silicosis; however, evidence indicates that crystalline silica is also a potential occupational cause of cancer. Workers who mix, cut, sand or grind on concrete can be exposed to respirable crystalline silica depending on the nature of the work practices and the effectiveness of dust controls installed in the shop. ISFA

About the Author

This report was put together by Maureen Niemeier, BBA (a freelance technical writer), and Eric J. Esswein, MSPH, CIH, working with the National Institute for Occupational Safety and Health (NIOSH). This article is based on a health haza evaluation NIOSH conducted at a concrete countertop manufacturing facility an is designed to be an education resource. More information on NIOSH is availab at www.cdc.gov/niosh.