

Clearing the Air in Foundries

Silica presents the greatest threat to air quality in foundries. Photos courtesy of John W. Diether.

BY JOHN W. DIETHER

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Foundries are one environment where the potential for hazardous airborne exposure is great. Without intervention, silica dust and fumes from various molten metals, such as lead, nickel and chromium, can cause serious health problems.

Illness Related to Polluted Air

The disease most closely linked to prolonged exposure to airborne respirable silica is silicosis. This irreversible condition results when fine dust particles are lodged in the alveoli, or outer branches of the lungs. Scar tissue forms around silica particles and reduces the functional volume of the lung, which in turn leads to fatigue, shortness of breath and chest pain. Silicosis can be fatal if it seriously impairs respirato-

ry function. Excessive silica inhalation also is associated with respiratory diseases, including an increased susceptibility to tuberculosis. According to the National Institute for Occupational Safety and Health, silica is a carcinogen and excessive exposure can increase the risk of lung cancer. Heart problems and pulmonary hypertension also may occur.

Exposure to uncontrolled metal fumes produces varying physical symptoms, depending on the composition of the alloy. Lead exposure, for example, causes severe gastrointestinal disturbance and anemia. It also can lead to kidney and neurologic disorders. Chromium and nickel can be corrosive and carcinogenic to the upper respiratory system and lungs.

Although inhalation hazards cannot be eliminated, exposure to them can be minimized using two universal hazard control principles: ventilation and isolation techniques. Properly used ventilation techniques divert or dilute contaminants and make the air safer to breathe. Isolation techniques separate a

*Fume emission peaks
immediately after the
metal is poured.*

worker from a potential hazard using a physical barrier, distance or time.

Controlling Metal Fumes

The threat to air quality in foundries begins in the scrap yard, where metal from various sources is melted and poured into molds to form castings. As the scrap is melted, some of the metal vaporizes and condenses into fumes of extremely fine airborne particles. Vapor from scrap metal can be extremely risky as it may contain unknown contaminants or toxic components.

Ventilation controls that capture fumes before they enter the work environment are the most effective in reducing employee exposures. During melting operations, close-fitting exhaust hoods should be placed directly over furnace openings. Most close-fitting furnace hoods are designed to swing away from the furnace while not in use, so they do not interfere with routine operations, such as slagging — skimming the surface of the molten metal — and charging, or filling, the furnace. For furnaces with multiple openings, a hood can be provided for each opening and connected to a common exhaust duct. Close-capture techniques require a smaller volume of air, thereby reducing purchasing and operating costs associated with traditional ventilation systems.

Fume emission peaks immediately after the metal leaves the furnace and is poured. Thus, for large pouring jobs, combined isolation and ventilation techniques provide the most effective exposure control. For example, certain types of high-volume shuttle ladles possess an equipment cab that is completely enclosed and equipped with its own ventilation system. This dual application of isolation and ventilation protects the operator during both shuttling — transporting molten metal from one area to another — and pouring.

In addition to minimizing hazards to the ladle operator, the general foundry atmosphere needs to be protected. The use of a ventilation hood positioned directly above the physical point of pouring will capture emissions at their source.

The principles of isolation and ventilation also can be applied to smaller pouring jobs. One of the more sophisticated

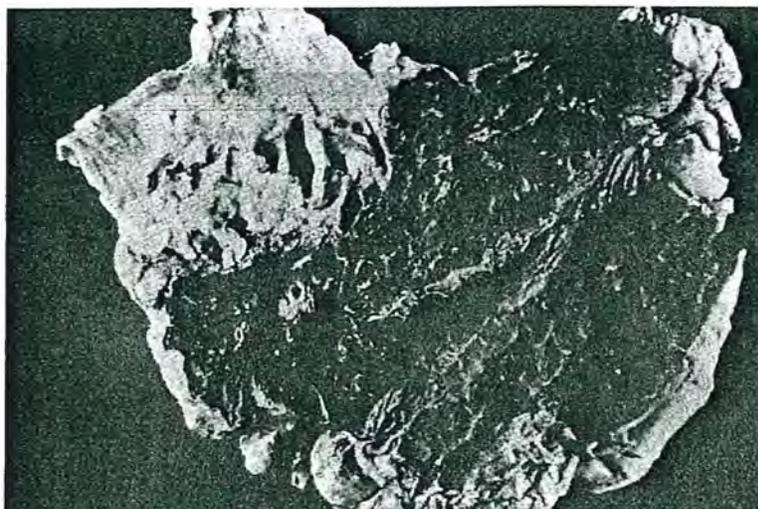
examples of isolation for small castings is fully automated pourers. Automated pouring systems are operated from a remote location, isolating the worker from the process altogether. In operations where hand-operated ladles are used and workers cannot be physically removed from the process, a hinged ladle cover can isolate fumes and reduce the risk of hazards from manual pouring. Because residual contaminants still may escape during manual pouring, supply air ducts should be installed directly overhead. As with large pouring jobs, close-fitting ventilation hoods also are necessary to protect employees throughout the foundry from potentially hazardous emissions.

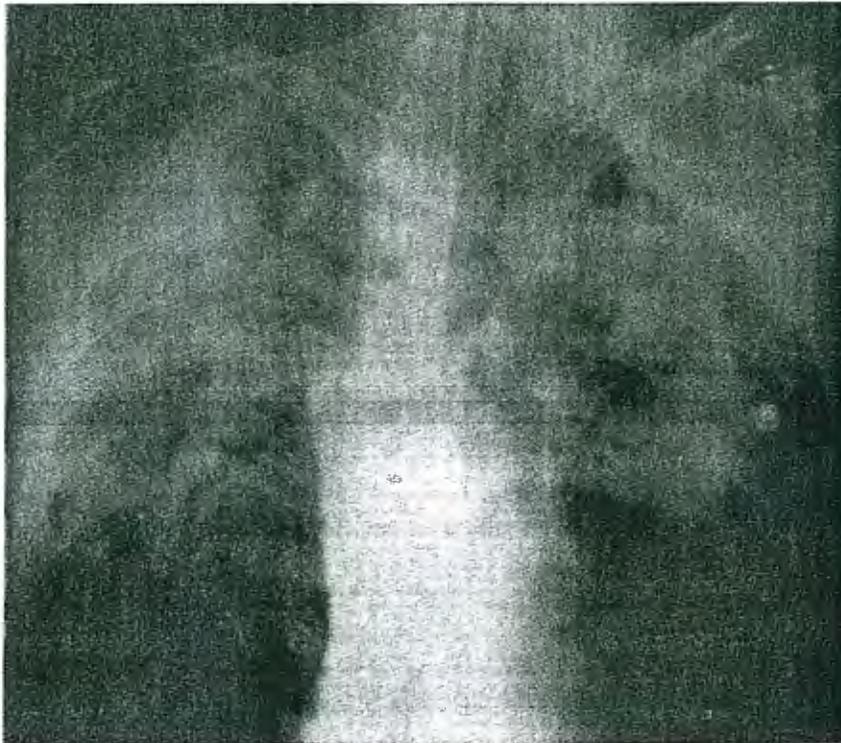
In addition to isolation by distance, some foundries practice isolation by limiting pouring to the end of the work day. After the metal is poured and begins to solidify, the heaviest emission period occurs when workers are absent.

Reducing Silica Exposure

Possibly the greatest threat to air quality in foundries is respirable crystalline silica, the primary constituent of molding sand. Substitutes for silica sand, such as olivine or zircon, do not cause scarring of lung tissue and are used in some foundries. Unfortunately, silica substitutes can be incompatible with the chemistries of some binder systems and are more expensive than silica molding sand. Thus, despite

Autopsied lung from a patient with silicosis.





Silicosis can be fatal if it seriously impairs respiratory function.

X-ray of lungs from a patient with silicosis.

significant health benefits of these substitutes, silica sand remains the most widely used type of molding material.

Silica exposure also can occur in the scrap yard from leftover metal from a foundry's own castings. Often encrusted with dry silica, leftover scrap releases silica into the air every time it is handled. One way to prevent exposure to silica during the handling of scrap material is to ensure that the operating areas — cabs, booths, platforms — for all scrap yard equipment are properly enclosed and supplied with fresh air.

Inside the foundry, dust control is a necessity for processes that involve contact with dry sand. These operations include shakeout, in which loose silica is shaken from castings by specialized machinery, and finishing, in which any silica residue is removed both manually and by machine. Shakeout machinery that is both enclosed (isolation) and ventilated during operation will greatly reduce exposure to airborne silica. In the finishing process, automated grinders remove the worker from the environment and are ideal for larger castings. In addition to inherent safety advantages, all automated finishing equipment can help increase output.

The risk of silica exposure usually is greatest in manual cleaning setups — a job that still is essential in most foundries. Solutions include use of a close-fitting hood that completely covers the point of dust generation (commonly used over grinding tables) and

hand tools, such as saws and chippers, that have their own properly designed tool mounted exhaust systems. Since these exhaust mechanisms are located on the active end of the tool itself, dust is captured almost instantly. In cases where the worker is particularly overexposed to silica, respirators must be worn. If respirators are needed to reduce exposure, the Occupational Safety and Health Administration requires a formal respirator program be established. When selecting respirators, consider only those models that have been certified to protect against silica inhalation by NIOSH.

The Bottom Line

Although every hazard control may not be appropriate for every foundry, the principles behind them can be practiced almost anywhere. The examples described in this article are vital to the creation of safety-conscious work environments. But they are not the only solutions. Continuous attention to the principles of ventilation and isolation has enabled many employers to meet new levels of worker protection.

For more information on ventilation and isolation in foundries, call NIOSH at (800) 356-4674 to request a copy of the video *Caution: Foundry at Work*. ■

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