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Health in the Arts

LASER-CUTTING-SAFETY 3D PRINTING

Ventilation of Toxic Substances



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This article will discuss the ventilation of toxic substances. Since health effects of chemicals occur at air concentrations well below the lower explosive limits of solvents and gases, if you ventilate to prevent adverse health effects, you are also preventing a buildup of vapors which could catch fire or explode.

There are two types of ventilation for toxic substances: dilution ventilation and local exhaust ventilation. Dilution ventilation involves bringing in clean air to dilute contaminated air, and then exhausting the diluted air to the outside via exhaust fans. Local exhaust ventilation, on the other hand, involves trapping the contaminants at their source before they get into the air being inhaled.

Dilution Ventilation

A classic example of dilution ventilation in an art studio is a window exhaust fan that removes the contaminated air from the room, and an open window that provides replacement or makeup air. The source of makeup air and the exhaust fan should be positioned so that clean air comes past the face of the artist, and contaminated air is pulled away from the artist's face.

Dilution ventilation should not be used to exhaust large amounts of toxic solvent vapors or for highly toxic solvent vapors because of the need for large amounts of makeup or replacement air to replace the air being exhausted. This makeup air has to be heated or cooled. Dilution ventilation should not be used for dusts or fumes because of the difficulty in calculating the amount of dilution air required. The exhausted air should be completely exhausted to the outside and not recirculated.

For solvents, the amount of exhaust ventilation required can be calculated by the procedure in Chapter 6 of Ventilation (see references). For example, if each student in a printmaking class of 20 uses 2 ounces (0.125 pints) of mineral spirits in cleaning intaglio inking slabs over a 3-hour class period, then the amount of dilution ventilation required would be:

total amt evaporated x dilution volume/pint x safety factor K /# minutes

$$= 20 \times .125 \text{ pts} \times 35,000 \text{ cu. ft/pint} \times 10 / 180 \text{ minutes}$$

$$= 4860 \text{ cfm}$$

where the dilution volume for mineral spirits is 35,000 cu. ft/pt and the safety factor K = 10.

Local Exhaust Ventilation

A local exhaust ventilation system consists of a hood to capture the contaminants, ducts to transport them to the outside, an exhaust fan to move the air, and (occasionally) air cleaners to remove particulates from the air. The only air cleaners I would recommend are filters in spray booths and dust collectors for woodworking machines.

Particular types of hoods are used for particular operations. Examples of typical local exhaust systems for art operations include canopy hoods over electric kilns, slot exhaust hoods for cleaning etching plates, enclosed hoods for acid etching, spray booths for spray painting and spray glazes, movable exhaust hoods for welding, and dust-collecting hoods for woodshops.

In many instances, either a slot exhaust hood or enclosed hood can provide adequate local exhaust ventilation. If practical, an enclosed hood uses a lower exhaust rate and therefore requires less makeup air. This can result in lowered energy costs for makeup air.

Some basic rules for operation of local exhaust systems are:

- Provide adequate makeup air to replace exhausted air.
- Enclose the process as much as possible to ensure effective capture of contaminants.
- Place the hood as close to the operation as possible.
- Have as few bends in the ducts as possible and make sure bends are gradual not sharp.
- Fans should be located outside so all ducts are under negative pressure.
- Do not recirculate any of the exhausted air.
- Make sure exhausted air cannot reenter the room.
- Provide regular maintenance.
- When exhausting flammable vapors in local exhaust systems, use spark-proof (aluminum) fan blades and place fan motors outside the air stream.

References:

Clark, N., Cutter, T. and McGrane, J: Ventilation, Nick Lyons Books, New York (1984) - Available from CSA for \$7.95 plus \$2.00 postage and handling.

Committee on Industrial Ventilation. Industrial Ventilation: A Manual of Practice. 20th ed., American Conference of Governmental Industrial Hygienists, East Lansing, MI (1988). Updated regularly.

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