In The Hood

By: Vince McLeod - Published: November 3 2011

One focus of laboratory management is equipment, and a basic fixture in any laboratory is the chemical fume hood. We recently had an issue with a chemical hood that we think is a common occurrence, and we feel it is a good time to discuss chemical fume hood design and installation. Consider the following scenario:

A new building was constructed for research and included several chemical hoods. The hoods and ducts were selected based on feedback from principal investigators. However, after securing a new research grant, a PI shifted the focus of one of the labs toward concentrated hydrochloric acid digestion. It didn't take long before green slime began dripping down the back panel and forming a puddle in the back of the lab's hood. Shortly afterward, the hood stopped working altogether, and the call went into Environmental Health and Safety to investigate.

Obviously, we had a duct material compatibility issue. The acid fumes from the complete digestion work were eroding the stainless steel duct. Only fiberglass reinforced plastic (FRP) duct materials should be used for acid digestions. Unfortunately, the fix for this situation was expensive and required a completely new exhaust system for the hood. To help labs avoid this and other pitfalls related to chemical fume hoods, we are providing information on design and installation for chemical hoods.

General laboratory ventilation considerations

Before we get to the specifics for chemical fume hoods, there are a few basic ventilation rules that should be incorporated into all research labs where potentially toxic or hazardous chemicals are used. First, provide proper general ventilation. All labs should have mechanical supply and exhaust. The supply should use 100 percent outside air and be exhausted to the outside.1,2 In other words, neither the fume hood nor lab exhaust should be returned or recirculated. The general supply is not for protection from exposures but provides a continual supply of fresh outside air to prevent the buildup of fumes, vapors and particulates.

Second, keep chemical laboratories under negative pressure in relation to the adjacent non-laboratory rooms, offices and corridors.2 If there is a spill or release, the contaminates will keep from spreading into surrounding rooms and offices and, instead, will be exhausted outside. Generally, the airflow should be from low-hazard areas to highhazard areas. Proper pressurization is maintained by balancing the ventilation system.

A good rule of thumb is to provide make-up air equal to 90 percent of exhaust volume.1 However, pay attention to design of make-up air systems. They should be introduced so that air patterns and negative pressurization are maintained. Locate make-up supplies at the end of the lab opposite from the fume hood. Try to plan HVAC systems and hood exhausts so they complement rather than fight each other in regards to flow patterns.

A third recommendation is to provide at least six general ventilation air changes per hour for your chemical laboratory.1 This means the total volume of air in the lab is replaced six times every hour. In general, room air velocities should not exceed 50 feet per minute or 20 percent of the average face velocity around fume hoods. This minimizes interference with proper capture and hood operation.

Ventilation system ducting should also be scrutinized. Ducts should not contain any internal insulation. Use external insulation if needed. Using the right air velocity will preclude the need for acoustical insulation (see below).

Do not use air speeds too high for the duct size, and keep velocities at optimum levels. Air velocities should be high enough to prevent any condensation of liquid or condensable solids on the duct walls. The ACGIH recommends velocities from 1,000 to 2,000 feet per minute.3 All horizontal duct runs must slope at least one inch per ten feet downward to a suitable drain in the direction of airflow.

All ventilation should be ducted, and corridors and ceiling spaces should not be used for plenums. Fume hood exhaust ducts must be constructed entirely of noncombustible material. Any gaskets must be resistant to chemical degradation and fire.

Design location principles for fume hoods

Layout of the laboratory and location of the chemical fume hood is very important for optimum performance and minimal interference. Fume hoods must not be located near doorways or exits. Ten feet from any door or exit is recommended by the National Fire Protection Association. The reason is obvious. Should a fire or chemical release occur, the exit would be blocked.

Also, to the extent possible, locate fume hoods away from high-traffic areas, air supply diffusers, doors and windows. Any area that produces air currents or potential turbulence could affect the ability of the hood to capture and exhaust contaminates as designed.

Do not locate chemical fume hoods opposite workstations, desks, microscope benches or other areas where personnel spend significant time. As above, the reason should be obvious, as any incident in the hood could involve or injure anyone seated in front of the hood.

Ensure that there is an emergency eyewash and safety shower within ten seconds of every fume hood. This is a requirement wherever a worker could be exposed to corrosive, toxic or severely irritating substances.

One final recommendation is to make sure cabinets and equipment do not block or interfere with the fume hood opening or the laboratory's supply or exhaust vents. Very often we inspect labs and find things stored on top of cabinets or in front of hoods or vents, completely disrupting the air flow.

Maintaining fume hood performance

When we think about chemical fume hood performance, the first thing that comes to mind is face velocity. Granted this is important, but hitting a specific number should probably not be the primary focus. Although the OSHA Lab Standard (the OSHA standard for Occupational Exposure to Hazardous Chemicals in Laboratories, 29CFR1910.1450) does not specify procedures for safe hood operation, exhaust volumes or face velocities, it does contain this statement, albeit in the non-mandatory Appendix A: "Airflow into and within the hood should not be excessively turbulent; hood face velocity should be adequate (typically 60-100 lfm)".4

The generally accepted consensus is for face velocity to be around 100 feet per minute on average. We feel it is more important to provide an airflow indicator and routine performance certification or testing. The flow indicator should be located so it is easily viewed from the front of the hood. It could be a magnehelic gauge that shows inches of water and is marked for a corresponding 100 fpm, a digital FPM readout, both with audio and/or visual alarms, or a simple strip of yarn or Kimwipe®. The key is a visual indication that the hood is exhausting.

The next most critical part to maintaining hood performance is a regular check or testing of fume hood flows. Routinely checking the hood for adequate flow and velocity must be incorporated into your lab safety program. We recommend you post flow test results or performance checks directly on the hood and request a recheck if you suspect a problem.

Sources

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