SAFE SCIENCE:
BE PROTECTED!
By Dr. Kenneth R. Roy*

Ventilation: Are science labs really supposed to smell?

I. So What is the Problem?

A chemistry teacher complained to the building principal about the quality of air in her laboratory. It seemed that no matter what type of experiment was done involving chemicals, the air was heavy and smelled. In fact, the biology teachers in the laboratories always joked about how they knew what was happening in the chemistry lab by the smell coming out of their air supply vents. In response to the chemistry teacher's concern, the principal simply noted that science labs are supposed to smell and he didn't believe there was any problem. Furthermore, the teacher was told to simply turn on the laboratory's only fume hood to help get rid of the smell in the lab.

Additional inquiries by the chemistry teacher and department head, determined that the ventilating system had been designed to recirculate air taken from the chemistry labs downstairs into the biology laboratories. Furthermore, a portion of the air from the biology laboratories was again recycled upstairs into the chemistry laboratories. The fume hood was designed to supply and evacuate only the air within it. As a result of these findings, the school district had to secure a town referendum for monies to rectify the ventilation problem.

Unfortunately, there are many true stories like this one with less favorable outcomes. However, this need not be! Science teachers and supervisors must become knowledgeable in the safety standards and then advocate for change by working with school administrators, boards of education, and parents.

II. What Are the Standards?

According to the National Fire Protection Association's standards (NFPA-45 section 6-2.1 - Standard on Fire Protection for Laboratories Using Chemicals ñ 1996 Edition) ventilation systems serving laboratories shall be designed to prevent chemicals originating from laboratory operations, from recirculating back into that laboratory or any other part(s) of the building. One reason this standard has been written is to prevent flammable or combustible concentrations of chemicals from reaching ignition sources and causing fires or explosions. It also prevents exposure of occupants to chemical fumes, which could effect health problems.

Relative to air supply systems, the standard requires that external fresh air intakes to be positioned in such a way as to avoid drawing in effluents of chemicals or products of combustion originating from the laboratory building or from other structures and devices (6-3.1). This section requires that air intake vents will not be located near building exhaust vents or chimneys.

Continuous ventilation is required for all laboratories and work areas where chemicals are present (NFPA-45, section 6-3.2). This section addresses continuous ventilation of the laboratory unit under negative pressure with respect to corridors and non-lab spaces. By definition (NFPA-45, section 1-4 definitions) (A) Laboratory Unit(s) is defined as, An enclosed space used for experiments or tests. A laboratory unit may include offices, laboratories, and other incidental contiguous rooms maintained for or used by laboratory personnel, and corridors within the unit (But typically egress corridors are not part of the lab unit). It can contain one or more separate laboratory work areas. It can also be an entire building!î This equates into a minimum ventilation rate of four room air changes per hour for unoccupied laboratories such as evenings, nights, weekends and holidays. Occupied laboratories generally operate at rates greater than eight room air changes per hour, depending on conditions of use.

III. What AboutLaboratory Hoods:

Just turn on the hood's directive from the principal is an unacceptable choice for the chemistry teacher, given its design limitations. The NFPA standard (NFPA-45) again addresses this situation. Laboratory hoods are designed to evacuate air within them. In addition, some laboratory hood systems are also specifically designed to evacuate the environmental air within the laboratory space. Such hoods function to accommodate the prescribed number of air exchanges for the laboratory space and generally require additional hoods or exhaust registers connected to the hood exhaust system..

Laboratory hoods are typically used to house experiments and/or procedures using flammable gases, toxic vapors or noxious odors. Generally, Prudent Practices for Handling Hazardous Chemicals in the Laboratory calls for 1 hood per 2 workers with 2.5 linear feet working space at the hood face. Uniform face velocity can be as low as 60-feet/min. Ideal velocity is 80-120 feet/min. Turbulence caused by velocities around 150 ft./min and greater cause spillage etc. NFPA Sections 6-2, 6-3, 6-4 addresses the following areas:

1. Hoods can not be relied on to provide explosion protection unless specifically engineered for that purpose. (6-2.2)
2. Performance of the hood must not be affected adversely by the location of air supply diffusion devices with in for the lab. (6-3.4)

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3. Air exhausted from lab hoods can not be re-circulated.
4. There must be sufficient hood face velocities and exhaust volumes to contain contaminants with in the hood and exhaust them safely out of the building. (6-4.5)
5. The hood must provide containment of hazards and protection for the user when chemicals are present in the hood. (6-4.5)
6. Lab hood exhaust must be discharged above the roof level in such a manner as to prevent any reentry of chemicals ñ effluents into the building. (6-4.10)
7. Laboratory hoods shall not be placed adjacent to a single means of laboratory egress.

Laboratory hoods and hood exhaust system must be inspected and tested a minimum of once a year.

Inspection is to include:

a. Visual inspection of physical condition;
b. Flow motion;
c. Low airflow/no airflow alarms;
d. Face velocity;
e. Verification of inward airflow over the entire face of the hood;
f. Check of alterations in work area (i.e. equipment and/or furniture location) that might alter hood exhaust operation (6-3.1)

Air supply, exhaust fumes, motor and related parts of the hood system must be inspected and documented at least once a year. (6-13.5.1)

10. When airflow detectors are not provided, or airflow-rate tests are not made, there must be a quarterly inspection of fan belts and replacement if frayed or broken. (6-13.5.2)

Use of ductless fume hoods is very lim ited compared to conventional laboratory fume hoods. According to the American National Standard for Laboratory Ventilation (ANSI/AIHA Z9.5-1992), Ductless fume hoods have limited application in the laboratory because of the wide variety of chemicals used in a laboratory. The absorption properties of the air filtration technique used in the ductless hood must be evaluated for each chemical.

The type of chemicals used or produced and, the frequency of use, dramatically limit the use of ductless fume hoods. The filtration media (e.g. activated charcoal) which captures contaminants and recycles air back into the laboratory air space is much less desirable and functional for general laboratory use. (Note that commentary on the use of the ductless fume hood can be found in NFPA-45, Appendix A6-4.1)

IV. What is the Bottom Line?

Science teachers need to determine if they have the appropriate ventilation prior to doing laboratory work. They also need to facilitate proper preventative maintenance for general laboratory and hood ventilation operation in concert with the building administrator or maintenance foreman. Alternatives such as microscale experiments or safety reactants need to be entertained when ventilation is inadequate.

Standards — be they OSHA, NFPA, ANSI, state or local codes are there to protect all occupants - both teachers and students. Know them and have them enforced for the health and safety of all persons in the building containing a laboratory.

Remember that adoption of NFPA Standards varies from state to state. Teachers and administrators should contact their local or state fire marshal's office, regional OSHA office or state safety official to secure copies of appropriate laws and enforceable standards.

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