CHEMICAL USE IN BIOLOGICAL SAFETY CABINETS

A biological safety cabinet (BSC) can contain the most infectious pathogens. However, the BSC design determines its effectiveness. As a BSC user, it is important to understand there can be significant differences in installation engineering and airflow between certain models and to know the limitations of the BSC you are using.

ABOUT BSC DESIGN

BSCs use High Efficiency Particulate Air (HEPA) filters to capture particles, including biological agents, to protect work surfaces and to clean air, which is either re-circulated within the BSC or exhausted. HEPA filters capture particles well, but are poor at capturing volatile or vaporized chemicals (including radio-labeled chemicals). Such chemicals pass through the HEPA filters.

Many of the BSCs at the UW are designed to recirculate most of the filtered air within the BSC and to exhaust some of it to the room or to an exhaust duct. If the chemicals used in this type of BSC are flammable, contaminants in the air recirculated within the BSC could build up, potentially causing a fire or explosion in the BSC. Another concern is that recirculating toxic chemicals could potentially affect your research results. And if the cabinet design recirculates air into the room, there may be personnel exposure concerns.

Because of these concerns, **you need to know how much air is being recirculated within your BSC, and how much air (if any) is being discharged to your room.** A short description of BSC design follows, with additional information. A list of cabinets approved for use at the UW is on the EH&S website.

Class II A1 and A2 BSCs are designed to recirculate 70 percent of the HEPA-filtered air within the BSC and to discharge 30 percent either into the room or into a duct. The BSCs can be indirectly connected to the building's general exhaust system via a "thimble" or "canopy" connection (a small air gap designed to allow access to the HEPA filter). For these BSCs, a building fan shutdown or failure may go undetected, resulting in the flow of discharge air being pushed into your room or other rooms that are connected through the duct system.

Class II B1 BSCs are designed to recirculate 50 percent within the BSC and discharge the remainder into a duct. Class II B2 BSCs have an internal fan that cleans the air through a HEPA filter and discharges it all to an exhaust duct. Class II B BSCs are connected to a dedicated ventilation system that is independent of the building's ventilation system. Fan failure of a Class II B BSC will usually result in an alarm at the BSC.

CHEMICAL HAZARDS IN A BSC

Chemicals related to BSC use are those involved directly in the research (whether fed to the biological agent, produced by the agent, or not given to the agent but necessary for the research process) and those used to clean or disinfect the BSC. The two biggest concerns for a chemical in a BSC are the chemical's **flammability** and **toxicity**.

A buildup of flammable materials within a BSC may cause an internal fire or explosion. Toxic chemicals may reach room occupants if the BSC recirculates air to the room. Also, research agents and research results may suffer if toxic chemicals are being recirculated within the BSC.

The procedures used also affect potential risk. For example, a "nonvolatile" toxic chemical may be aerosolized. Another potentially risky process is the use of a Bunsen burner within the BSC. **The open flame disrupts air flow patterns** within the BSC, and there have been fires when a HEPA filter ignited, including here at UW.

A lesser concern involves gases, vapors or aerosolized chemicals that contact the HEPA filter and damage it to the point where it allows particles to leak through.

Chemicals that can damage filters, such as aerosolized acids, should not be used in a BSC. Because of these hazards, at least one BSC manufacturer posts a warning label that reads "Do Not Use Flammable, Toxic or Explosive Substances in this Cabinet."

EH&S also posts a warning label on BSCs known to recirculate to the room.

The Centers for Disease Control's Biosafety in Microbiological and Biomedical Laboratories (BMBL) publication indicates that:

- "No" volatile toxic chemicals should be used in Class II A1 BSCs;
- "Minute amounts" can be used in Class IIA2 and B1 BSCs; and
- "Small amounts" can be used in Class IIB2 BSCs.

CHEMICAL LIMITS IN A BSC

If a hazardous chemical is to be used in a BSC, its quantity must be limited. The most common toxic chemical used in a BSC is the decontaminant used to protect the research and researcher.

For example, alcohol may be used for decontamination. Theoretical calculations by EH&S show that for a typical four-foot BSC, 10 milliliters (ml) of 70 percent isopropyl or ethyl alcohol is not likely to present either a fire or explosion risk in the BSC or an exposure risk from vapors recirculated in the BSC or exhausted to the room. (Assuming there are no other alcohol applications or spills for at least 20 minutes and that it is appropriate to use a 3:1 safety factor to address the mixing of the vapors with recirculated air.)

Whenever possible, **use a chemical fume hood to handle and prepare hazardous chemicals for application.**

But if gaseous, vaporized or aerosolized chemicals must be generated in a BSC, you should **assure yourself that the quantity being generated will not cause a flammable or toxic risk.** EH&S can provide assistance with theoretical calculations.

While minimal use of alcohols as outlined above does not present a fire or explosion risk, alcohol as a disinfectant is discouraged by EH&S because the researcher must assure that the required contact time is achieved.

EH&S recommends using the following for disinfecting the surfaces of BSCs, depending on the agent to be controlled:

- Sodium hypochlorite (bleach)
- Iiodophors (Wescodyne)
- Phenolics (Hilphene, Vespene)
- Quaternary ammonium compounds(Conflikt, EndbacII)

Chemical decontaminant problems may include damage to stainless steel by sodium hypochlorite (bleach) if it is not rinsed off adequately, and decontaminant ineffectiveness on the agent, for example if the recommended contact time is not achieved.

You should select the decontaminant based on the agent, and as a minimum:

- Follow the manufacturer's instructions for disinfection.
- Use the correct concentration.
- Ensure the minimum contact time is achieved or exceeded.
- Be cognizant of hidden spaces that maybe reservoirs of the agent and difficult to disinfect.
- Limit the amount used, to minimize flammability and toxic risks.

Please refer to the UW Biosafety Manual for more information about decontaminants.

ADDITIONAL RESOURCES

Resources available on the EH&S website include:

- Steps to Purchase, Replace, Relocate or Remove a Biosafety Cabinet
- Biosafety Cabinet Purchase-Move Request form
- List of Approved Biological Safety Cabinets

For questions related to the purchase, relocation, installation, certification, or formaldehyde (complete) decontamination of a BSC, contact EH&S at labcheck@uw.edu or call 206.685.3993.

Visit the Biological Safety Cabinet page on the EH&S website for additional guidance.

Please contact the EH&S Lab Safety Team at labcheck@uw.edu or 206.685.3993 for more information.