MYSTAIRE®
Science. Safety. Solutions.

ISOLA™

The next generation in filtered fume enclosure safety

There is a growing need for laboratory control systems that address safety, energy use, and cost concerns. With increasingly stringent environmental and regulatory guidelines, it is clear that safety is of great importance and therefore cannot be compromised.

Many common laboratory procedures result in the generation of hazardous fumes. When operated properly, filtered fume enclosures can control gases, fumes, and powders, and can prevent inhalation of highly toxic substances, including carcinogens. In the past, it was often acceptable to conduct scientific experiments with volatile chemicals and toxins on an open bench without containment. Regulations now state, however, that such experiments must be conducted within an environment that will ensure efficient and safe fume containment.

The latest ductless filtered fume enclosures address these needs directly, and are a vital resource in the safe and effective operation of modern industrial, educational, hospital, forensic, and pharmaceutical scientific laboratories.

Air Velocity

For hazardous fume containment, there must be sufficient and uniform air velocity, or "face velocity", across the sash of the enclosure. If this velocity is too low, it may not be sufficient to overcome competing airflow caused by the movement or position of the operator in front of the enclosure. If the face velocity is too high, it can lead to a "roll effect". This occurs when entering air causes a vortex, sending air across the work surface, up the back, and along the top of the enclosure. This air then becomes trapped, potentially leading to a dangerous escalation of contaminant levels. In some instances, the contaminated air can "roll out" of the enclosure into the operator's breathing zone, endangering the operator and other laboratory occupants. Not only does the roll effect have serious safety consequences, it can also disturb delicate operations and experimental results - potentially jeopardizing years of research.

Digital control technology

A variable air volume system within a laboratory must have a fast and responsive control system to provide effective fume containment. The majority of existing filtered fume enclosure systems use analog control technology. These systems do not have the flexibility to respond to dynamic changes in fume enclosure and laboratory conditions, and thereby threaten the reliability of a rapid emergency response. To address these concerns, ductless filtered enclosure manufacturers have engineered the use of digital control systems.

The advanced monitoring system on the ISOLA™ filtered chemical workstation, the EverSafe™ III Touch Controller (Figure 1), has the benefit of state-of-the-art digital sensor technology, providing highly accurate and instantaneous readings. The system continuously monitors and digitally displays the face velocity, ensuring that working conditions are safe. Sophisticated sensors determine any chemical breakthrough based on the type of solvent used within the enclosure. Visual and audible alarms alert operators when airflow falls below the industry recommended standard of 80 fpm -- indicating, for example, an inoperative blower or loss of efficiency due to blocked filters. A second alarm sounds if filters are approaching saturation -- allowing for replacement well before exposure limits are reached.

Additional safety features include a digital display, which shows the filter type in use and the correct application for the filter; a bar graph, to indicate filter saturation levels; and a time display, to track the duration that the filter has been in use relative to the maximum time allowance (Figure 2).

Carbon filtration

Carbon filtration systems combine the highest level of operator safety, while protecting the lab environment from potentially harmful fumes. The systems are based on re-circulatory technology using carbon filtration to adsorb and capture harmful and toxic fumes. Upon passing through a series of filters, clean air is recirculated back into the work environment rather than vented outside – with the additional benefit of reducing atmospheric pollution. There is also an added cost benefit when using ductless enclosures, since there is no loss of actively heated or cooled air from the lab environment.

Different types of research incur different risks and containment requirements. In this regard, effective capture and filtration systems also help to make the laboratory environment safer from airborne particulates and contaminants. Ductless filtered fume enclosures are designed to accommodate a variety of filters that can capture a broad range of fumes and airborne particulates. In order to ensure proper filtration, it is important to match the filter medium to the contaminants to be contained.

A comprehensive range of high-efficiency filters has been developed for use with the ISOLA™ filtered chemical workstations. Contaminated air is drawn through a three-stage filter system (pre-filter, main carbon filter, and safety filter) for maximum fume adsorption. The pre-filter is electrostatically charged and removes particulates down to 0.5 microns in size, thereby protecting the main filters from contaminants (Figure 3)). A back-up safety filter offers additional protection. Safety is guaranteed by meeting and exceeding all requirements of OSHA and ANZI Z9.5 standards.

High-capacity carbon filtration

High-capacity activated carbon and specially treated carbon filters are also available for the containment of fumes and vapors in the most demanding applications. Although activated carbon can be manufactured from a variety of raw materials, only activated carbon derived from high-grade coconut shell is used in the ISOLA™ filtered chemical workstations.

High-temperature steam activation of coconut shell carbon leads to a slow and controlled destruction of the solid carbon mass, producing millions of pores. It is the micro-porous nature of this carbon product that ensures an extremely large internal adsorption surface. This steam-activated carbon is effective in adsorbing most commonly found organic compounds from the air including: aliphatic and aromatic hydrocarbons, solvents, organic acids, aldehydes and ketones, alcohols, esters, and many halogen and nitrogen compounds.

Some substances are not physically adsorbed by activated carbon, such as lower molecular weight compounds and inorganic gases. To address this, special impregnated chemisorptive carbon filters are recommended for treatment of chemically reactive gases. These treated carbon filters combine a chemical reaction with the carbon's adsorptive activity, thereby breaking down compounds into their individual elements for easy adsorption. In essence, the addition of impregnates, such as a neutralizing or oxidizing agent, enhances the rate and effectiveness of adsorption. Even compounds with low adsorption ratings, such as: ammonia, hydrogen sulfide, inorganic acid vapors, radioactive iodine, mercury vapors, and formaldehyde, can be effectively trapped and rendered harmless by means of the chemisorptive carbon filters. In addition, there are specialized filters for sulfur compounds, where the activated carbon is impregnated with sodium sulfate to enhance chemical adsorption.

HEPA Filters

While standard filtered fume enclosure applications, such as containment of acid spills or protection from harmful fumes, require both pre-filter and carbon filtration, high-efficiency particulate air (HEPA) filters are also available for specified cleanroom applications. Originally developed by the military for nuclear particle filtration, HEPA filters are specially designed air cleaning devices that demonstrate filtration efficiencies of 99.97%, for removal of particles ≥ 0.3 microns in diameter. Used in combination with pre-filters, HEPA filters are an effective way to capture particulates in: smoke, dust, fingerprinting powders, asbestos, mold spores, bacteria, and other pathogens and high-risk cleanroom substances. The Mystaire® portfolio of products combines active carbon filters with HEPA filters, enabling users to combine effective hazard containment with demanding cleanroom requirements.

Conclusion

To summarize, when deciding upon a suitable filtered fume enclosure for the laboratory, each of the factors discussed should be considered. A well-designed ductless filtered fume enclosure will provide a safe and effective means of containing a wide range of fumes and applicable powders and particulates. The overall benefit is operator safety, environmental protection, and improvements in the overall function and efficiency of the laboratory.