Ventilation Systems:

A Terrorist Target of Opportunity or the First Line of Defense?

By Master Sergeant Arthur S. Hughes

Bioterrorism is a national concern. Ways to defeat intentional releases of agents and/or neutralize them are always under investigation. But adapting existing technologies could be as effective—in cost and in mission operation—as the expense, research, and development required for a new defensive system.

Scenario

It is late June, and the temperature is around 80 degrees. The armory on Second Street is being used for a local fundraiser, and the parking lot is about 75 percent full. People are coming and going in the public areas of the compound. There is public access to many cylinders of compressed gas (full and spent), including those used by vendors.

A few cylinders labeled "compressed gas" are located in an area near a building air-return vent, but they do not draw any attention. They have been intentionally mislabeled by a terrorist and actually contain a biological agent. At the appropriate time, the cylinders are opened to unleash a biological agent on the local population.

As the air-handling equipment moves large volumes of air throughout the building, 150 to 200 people are exposed to the agent. Since the symptoms do not appear for a few days, mild cases spread the agent (through contact with infected persons or clothing) to others who were not at the event.

When a terrorist attack occurs at a government establishment, the populace loses faith that the procedures in place will protect them in an emergency situation. Fear in the populace equals a terrorist victory.

To understand how this could happen and how future attacks can be prevented, it is necessary to understand the setup and function of the basic heating, ventilation, and air-conditioning (HVAC) system. The purpose of an HVAC system is to move, recirculate, and refresh large amounts of air in buildings with limited ventilation. The HVAC system was designed to alleviate sick building syndrome but, in recent years, it has become a weapon to combat the Global War on Terrorism.

UVGI Module

HVAC systems condition and recirculate most of the returned air. The remaining air is discharged outside to reduce odors and the level of carbon dioxide in the building. The recirculated air is then mixed with fresh, outside air and sent throughout the building. Since the recirculated air does not always return to the same area it was taken from, the entire building becomes contaminated.

For the most part, air intake units are placed on the roofs of buildings, and mechanical rooms are usually out of public access areas. But the problem is the air-return vents. They are in every room (and it is not uncommon to see several in the same room). Filter units are usually not the high-efficiency, particulate air (HEPA) type. They are usually little better than the standard house filter. This scenario could have been turned around with a few inexpensive precautions added to the filtration system. The use of a HEPA filter in the air-return system significantly reduces the amount of circulating agent. HEPA filters remove 99.9 percent of particulate 0.3 micrometer or larger.

HEPA filter technology was developed over 60 years ago for the Manhattan Project.[1] This technology is still used today to capture pollen, dust, mold, and chemicals suspended in the air. The addition of an ultraviolet, germicidal irradiation (UVGI) system (the next step forward in filtration) would have prevented the spread of contamination even if the HEPA filter failed (possibly because of incorrect fitting or improper or missed maintenance).

UVGI is widely used in the scientific and health care fields. Engineers are mostly familiar with placing UVGIs in laboratories, not in HVAC systems for large buildings. But UVGIs work just the same in small- or large-scale operations and can be a formidable weapon in the biological-defense arsenal.

Ultraviolet, Germicidal Irradiation System

UVGI is produced by mercury vapor lights operating in a range called the *germicidal ultraviolet C (UVC)* bandwidth of the electromagnetic spectrum at the specific wavelength of 253.7 nanometers. Many airborne respiratory agents are susceptible to inactivation by levitating light at this wavelength.

UVGI penetrates the cell membrane of the agent and chemically causes a change to the deoxyribonucleic acid (DNA). This change renders the organism incapable of reproduction. Unable to reproduce, the agent/organism becomes ineffective and incapable of infecting personnel in a building under attack.

The system also produces hydroxyls (a subgroup of the oxide group). Hydroxyls have a charge of minus 1. The chemicals that hydroxyls form are the opposite of acids (also known as caustics or alkalis). Examples are sodium hydroxide and potassium hydroxide. The negative charge causes them to readily combine with other molecules and form new, heavier compounds. These compounds then drop out of the circulating air and into a collection pan for disposal.

The Combined System

Our public buildings are vulnerable to inside attacks by terrorists using air-return systems. Returns are located in every room, and they cannot be constantly guarded or shut down. The circulating air is redistributed throughout the building, making it impossible to isolate one section. Using a combination of HEPA filters, diligent maintenance, and UVGI technology in HVAC systems will reduce the vulnerability for attacks on buildings. And the UVGI system requires very little main-tenance, which encourages greater compliance.

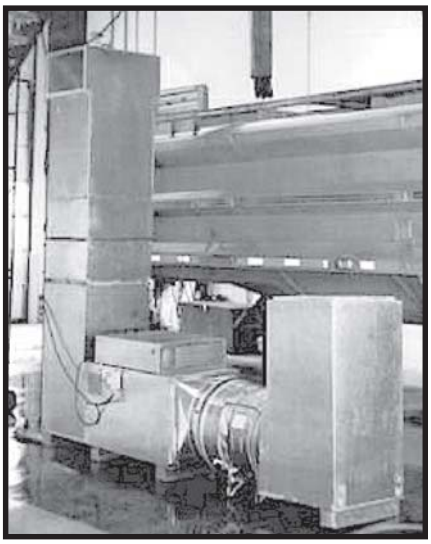
Studies

The British medical journal, *Lancet*, published an article in 2003 which concluded that the installation of UVGI systems in offices in North America could resolve work-related symptoms, caused by microbial organisms found in HVAC systems, in about 4 million employees.[2]

Westside Test and Balance, Incorporated, conducted simultaneous comparative studies on two HVAC air-handling units (AHUs).[3] Both studies showed an increase in the amount of coverage and a decrease in the energy usage. The net result was a more efficient and cost-effective operation. Since these systems are specifically designed for each application, they can be adapted for field use in areas such as collective shelters, field hospitals, and command and control centers.

Conclusion

Open societies, by their very nature, will always be vulnerable to attack by extremists. However, we can take reasonable precautions to limit the outcome of these actions. Upgrading HVAC systems with HEPA filters and UVGI technologies would be the most cost-effective, take the least time to implement, and be the best resource-consuming and effective avenue of approach. Preparedness for a biological attack can save lives, improve the overall health of the work force, save resources, preserve employee sick time, and reduce lost productivity time.



UVGI installed in HVAC system

Endnotes:

[1]The Manhattan Project was the code name for the U.S. government's secret project that was established before World War II and culminated in the development of the nuclear bomb.

[2]D. Menzies et al., "Effect of Ultraviolet Germicidal Lights Installed in Office Ventilation Systems on Workers' Health and Well-Being: Double-Blind Multiple Crossover Trial," *Lancet*, Vol. 362, Issue 9398, 29 November 2003, pp. 1785–1791.

[3]Westside Test and Balance, Incorporated; 7193 Douglas Boulevard; Suite 203; Douglasville, Georgia.

Reference:

Camden County Courier Post, New Jersey.

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