finding a halon alternative

No matter what advances are to come, one thing is clear: businesses will continue to turn to clean agents when they need to protect critical equipment and irreplaceable items. ■ **ANN FREESTONE**

MOST BUSINESS OWNERS WHO want to avoid downtime take steps to protect critical business operations from fire damage. Until the early 1990s, that often meant installing halon systems to protect essential equipment, such as mainframe computers and telecommunication switches, or essential areas, such as computer rooms, web-hosting facilities, and uninterrupted power-supply rooms. Halon systems were also used to protect art collections and historical archives, as well as airplanes and ships. Because halon is a gaseous, "clean" extinguishing agent, it provided a high level of property protection with very little secondary damage, and low toxicity.

In 1994, however, ratification of the Montréal Protocol changed everything. Halons were out, and a mad dash to develop alternatives began.

Since 1994, one halocarbon—FM-200—and one inert gas—Inergen—have emerged as the leading halon replacements in the United States, surviving the Underwriters Laboratory testing and listing process, complying with U.S. Environmental Protection Agency (EPA) regulations and *Clean Air Act* requirements, and meeting acceptable toxicity levels so that no one exposed to them in the short term would be harmed.

"With all these hurdles to jump over, these two agents reached the finish line before the others. Some tripped, fell down, and never got up," says Jeff Harrington, president of Harrington Group, Inc. in Duluth, Georgia and chair of the technical committee on halon alternative protection options.

Today, says Harrington, industries that used to rely on halon rely instead on halocarbons and inert gases. Like halon, these new clean agents extinguish fires by interrupting the flaming process chemically and reducing the fire's oxygen content. And like halon, they can be used to protect "anything of high value and anything critical for the business to make money," according to Steve Waters, president of Fireline Corporation in Baltimore, Maryland.

Unlike halon, however, they don't contribute to the destruction of the Earth's ozone layer because they don't contain chlorofluorocarbons.

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Halon's fall

From the 1960s through the 1980s, halon 1301 was the extinguishing agent of choice for many companies. Made of low-toxicity, chemically stable compounds, "halon was moderately expensive," says Harrington, "but it wasn't prohibitively expensive, so it enjoyed about a 20-year commercial availability and became accepted by insurance authorities, fire marshals, end-users, and designers."

Unfortunately, halon, pound for pound, is more likely to destroy the planet's ozone layer than the refrigerants found in a car's air conditioner. To comply with the Montréal Protocol, which was created in 1987 and has been signed by 157 nations, U.S. companies stopped manufacturing halon in the 1990s in developed countries, and began developing environmentally acceptable clean agents.

According to NFPA 2001, *Clean Agent Fire Extinguishing Systems,* the primary components of halocarbon agents are fluorine, chlorine, bromine, or iodine. Inert gas agents could contain helium, neon, argon, or nitrogen, or blends of inert gases that may contain carbon dioxide as a component. FM-200 is the commonly used name of the synthetic halocarbon agent HFC-227ea, while Inergen is a blend of nitrogen, argon, and carbon dioxide. Ansul Incorporated in Marinette, Wisconsin, has sole rights to Inergen in the U.S., and Great Lakes Chemical Corporation in Eldorado, Arkansas, manufactures HFC-227ea as FM-200. DuPont also sells HFC-227ea under the name FE-227.

"FE-227 is also known as FM-200. It is the exact same compound, but we're a second supplier," says NFPA 2001 committee member Howard Hammel, a senior technical service chemist for DuPont.

DuPont also manufactures FE-36 for use in extinguishers. FM-200, FE-227, and Inergen vaporize too quickly to be used in such devices.

"FE-36 is a streaming agent for portables or local applications," says Hammel. "Rather than pushing out a gas, it's a liquid."

In addition, DuPont sells the halocarbon FE-13 which can "go to lower temperatures and is used in Antarctica, the North Slope of Alaska, and anywhere it's very cold," says Hammel. He notes another clean agent from DuPont, FE-25, is used to protect aircraft electronics and grain elevators.

According to NFPA 2001 committee member Paul Rivers, a 3M product development specialist, "FM-200 is probably the 800-pound gorilla in the marketplace, and Inergen is pretty substantial." Waters of Fireline adds that FM-200 and Inergen represent 99 percent of his sales.

Inergen is usually the agent of choice if the user prefers a non-chemical agent, has the necessary square footage for the large number of cylinders in which Inergen is stored, or is protecting multiple hazards with one system, says Waters. It's difficult to protect multiple hazards with a single FM-200 system because the agent has poor flowing characteristics so the system's pipe runs must be limited. Another possible reason, says Harrington, is that Ansul will replace Inergen free of charge if the system accidentally discharges.

Harrington says those choosing FM-200 typically do so because it generally costs less to install than Inergen and storing it takes less space. If the system accidentally discharges, however, it can be costly to replace the lost FM-200.

A technician adjusts a sprinkler that's part of a 3M facility that tests its new clean agent: Novec 1230.

PHOTOGRAPH: COURTESY OF 3M

Harrington has designed gaseous suppression systems for clients and provides an example of a company that's chosen Inergen.

"We have a client in Atlanta that's taken a stand on environmental issues," he says. "We helped this company evaluate the alternatives, and they chose Inergen because they perceived it was more environmentally friendly. It contains naturally occurring substances, while FM-200 is all man-made substances."

Sedrick Holden, on the other hand, turned to FM-200 to protect GramTel U.S.A., a Web server and Web hosting facility in Southbend, Indiana, of which he is general manager. The reason: his company would have had to buy 15 cylinders of Inergen to get the same amount of agent found in two cylinders of FM-200.

"There was a space requirement for Inergen," explains Holden. "We didn't want to take valuable real estate within our property to designate a large amount of space for just the cylinders for one room. We wanted the cylinders to be in the same room" as the equipment the system was protecting.

According to Waters, both FM-200 and Inergen extinguish fires rapidly, but not as rapidly as halon.

"In my opinion, they're not as good as halon in the speed of extinguishment, but they're environmentally safe, which is a major factor in this day and age," he says.

FM-200, Inergen, and other halon alternatives are included in the EPA's acceptable Significant New Alternatives Policy (SNAP) program. The goal of this program is to promote alternatives that reduce risks to people and the environment.

Before it adds a product to the SNAP list, the EPA examines its environmental properties and toxicity levels to make sure they're acceptable. If they are, the EPA approves the product for use in occupied areas, unoccupied areas, or both. FM-200 and Inergen are among the agents that have acceptable toxicity levels for use in occupied areas, which is why, according to Phil DiNenno, president of Hughes Associates, Inc., in Baltimore, so many companies have turned to them.

The environmental issue surrounding clean agents has become so important that a 3M study conducted to determine the attributes companies wanted in a clean agent revealed that environmental issues, not fire-suppression performance, topped the list.

"The top two things we consistently heard no matter who we talked to—end-users, manufacturers, OEMs, or distributors—were that it had to be non-ozone-depleting and it had to be a non-global-warmer," says Rivers. "We kept hearing that over and over. On a list of 10, fire performance was down at 4 or 5."

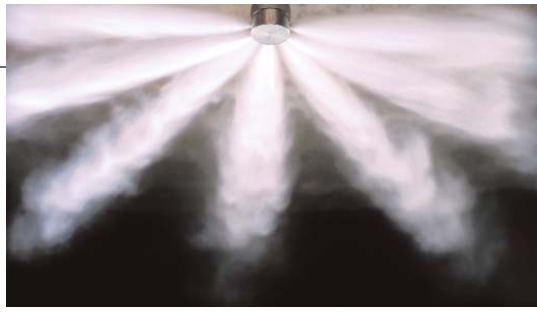
There's no doubt that halocarbons and inert gases are better for the environment than halon, but which clean agent is environmentally better? During the past decade, says DiNenno, the industry has debated the relative long-term environmental effects of both halocarbons and inert gases. One side says inert gases should be used instead of halocarbons because inert gases have no global warming potential while halocarbons have medium to high potential. The other points out that the total environmental impact of inert gases, not just their impact on global warming, must be taken into account.

"Inert gases have no ozone-depletion potential and no global warming potential per se," says DiNenno, "but when I say zero, that's only the gas itself. Global warming is a life-cycle issue. People are asking about the total life-cycle environmental impact."

For example, more steel is used to make the high-pressure steel cylinders in which inert gases are stored than is used to make halocarbon containers, which means additional energy is needed in their manufacture, storage, and transportation.

"The choice should be looked at from a life-cycle standpoint," DiNenno says. And that makes selecting a clean agent more complicated than it might first seem—so complicated, in fact, that many users leave the choice to market forces. Instead of looking at their protection needs and deciding which agent best suits them, they buy a system from the distributor that's captured the market in their area.

According to Mark Conroy, senior fire protection engineer at NFPA, the purchase of clean agents tends to follow a regional pattern. One section of the country leans toward Inergen, for instance, while another section of the country favors the use FM-200 when protecting operations. This can lead to a mismatch between occupancy needs and the system installed.



A clean agent, Novec 1230, is sprayed into the air at a 3M testing facility.

Technical aspects

Compared to the environmental issues surrounding halocarbons and inert gases, the technical issues involved in making clean agent extinguishing systems work are fairly straightforward.

In office settings, the most common type of extinguishing system in which halon substitutes are used is the total flooding system, according to Harrington. This type of system completely fills the enclosure in which it's installed with extinguishant.

"There are applications where you might have a computer enclosure inside a room. Instead of flooding the room," Harrington explains, "you'd put nozzles on top of the enclosure and dump the gas on the computer itself, so you didn't fill the room. There's some need for that, but it's a fringe need."

NFPA 2001 defines total flooding systems as consisting of "an agent supply and distribution network designed to achieve a total flooding condition in a hazard volume." The standard explains how to design, install, maintain, and operate such systems, addressing the agents themselves, storage, and distribution.

Both types of systems must be carefully designed and installed, not only to ensure they operate properly, and avoid health issues.

"When halocarbons extinguish a flaming fire, the flame in contact with the gas creates ions in air that are acidic," says Harrington. The chemical reaction between the flame and the gas produces hydrofluoric acid, which, under certain conditions and in significant amounts, can damage the lungs.

"The halocarbon system has to be designed and installed right to make sure you don't form excessive amounts of hydrofluoric acid," says DiNenno.

When inert gases are used, care must be taken to prevent the discharge of too much gas, too quickly which could blow the structure apart, according to DiNenno.

PHOTOGRAPH: COURTESY OF 3M

Relief venting is one solution. When the pressure in the room into which the system is discharged becomes too high, a spring-loaded damper in the wall opens a vent that releases gas, air, and smoke from the room.

Other issues, such as preventing an inert gas system from venting into an occupied area, must also be addressed.

Harrington says NFPA 2001 deals with the health issues of halocarbon and inert gases carefully, requiring pre-discharge alarms and time delays in both types of extinguishing systems.

"The detection system isn't supposed to dump gas as soon as it recognizes a fire. There's a delay. An alarm sounds first," says Harrington. At that point, people must start evacuating the area.

"The intent is when a discharge occurs, everyone will be out," says Harrington. "The EPA believes very strongly in system design that allows for evacuation so people aren't unnecessarily exposed to these chemicals."

Of course, notification to evacuate isn't possible without detection, which makes the building's detection system one of the most important technical aspects the user must address. Detection systems are also the key to preventing downtime, because they enable the system to suppress a fire when it's small. Detection systems are covered in NFPA 2001 and in NFPA 72, *National Fire Alarm Code®*.

"The success of a clean agent—putting out a fire the size of my pinky—is totally dependent on the detection system," says Harrington. "So we have this wonderful agent that can be discharged quickly and get inside cabinets, but if we don't discharge it when the fire is small, what good is it? If discharged when the fire is large, you might as well use automatic sprinklers.

"It comes down to the sensitivity of the detection system," he concludes. "If it's designed and installed correctly, a detection system can detect an overheating circuit board before it even ignites."

The standard

"In the last couple years," says DiNenno, "the EPA's relied more on NFPA 2001" to provide use restrictions from the standpoint of safety and efficacy, in accordance with federal rules that require U.S. government agencies to adopt standards developed by private standards-making organizations such as NFPA when such standards are available.

"NFPA 2001 is a minimum standard of acceptance for how a system should be designed and installed, for pipe thickness, flow rates, nozzle height—just about everything," he says. "If you follow NFPA 2001, the local authority will generally accept it."

The latest edition of NFPA 2001 will be presented to NFPA members for adoption in May 2003. The closing date for proposals was December 28, 2001, and the technical committee met in San Francisco last month to review the proposals.

No matter what advances are to come, one thing is clear: businesses will continue to turn to clean agents when they need to protect critical equipment and irreplaceable items and many companies will continue to rely on clean agent systems.

"You can't protect the actual piece of equipment that's the source of the fire," says Holden of GramTel U.S.A. "It's already damaged. But you can minimize the damage."