By Tyler Aebersold, 11-15-03

The Future of Clean Agent Fire Protection

Introduction

Fike Corporation has introduced the newest and *coolest* clean agent fire suppression system the Fire Protection industry has been waiting for since Halon 1301 production was banned in January 1994. This new system is ECARO-25™. Fike Corporation and DuPont™ Company formed a strategic alliance to provide a clean agent system that provides many of the benefits the market became accustomed to with Halon 1301. With the exception that today's new product has a zero ozone depletion factor. The reasons for using ECARO-25, versus other Halon 1301 alternatives, are compelling.

Fike ECARO-25 Clean Agent System

ECARO-25 is a clean agent fire suppression system marketed worldwide by Fike Corporation. ECARO-25 utilizes HFC-125 as the fire-extinguishing agent. ECARO-25 was first introduced to market as a Halon replacement system only. Initially, ECARO-25 was an acronym for Extinguishing Clean Agent Retrofit Option. Fike has since released ECARO-25 for new system installations as well as continuing to promote it for Halon 1301 replacement projects.

In 2002, Fike introduced ECARO-25 into the European market as a Halon 1301 replacement system to satisfy the need to comply with the regulatory ban on installed Halon 1301 systems. With the success of ECARO-25 in Europe, Fike then released ECARO-25 into the United States market for the replacement of Halon 1301 systems as well. The United States government currently has no legislation requiring replacement of installed Halon systems, nor do they regulate the use of recycled Halon 1301, as is done in Europe. However many U.S. companies are proactively replacing their Halon 1301 due to its ozone depletion factor. In addition, many European subsidiaries exist in the U.S. and have issued global corporate mandates to remove Halon 1301 systems from service. The features and benefits of ECARO-25 are now available worldwide for the design and installation of new clean agent systems as well as for Halon replacement projects.

As a fire-extinguishing agent, HFC-125 is referred to by its commercial trademark FE-25™, a trademark of DuPont™. HFC-125 is a hydrofluorocarbon and its chemical name is Pentafluoroethane. It is addressed in NFPA 2001 and listed in ISO 14520. HFC-125 is a clean agent fire extinguishant that has a zero ozone-depletion potential (ODP) and is an environmentally preferred alternative to Halon and Halon alternatives. HFC-125 is also listed on the EPA Significant New Alternatives Policy Program (SNAP) List as an acceptable Halon 1301 product.

Valuable Asset Fire Protection. What's the Right Choice?

ECARO-25, together with Fike's rapid detection and control equipment, provides the superior level of protection necessary for high-value assets and businesses that can't afford business interruption, downtime or loss in revenue as a result of a fire. HFC-125 extinguishes fires at the molecular level, without reducing the oxygen supply of the protected space. It

extinguishes fires by absorbing heat and interrupting the combustion reaction so a fire cannot sustain itself. Fires are quickly detected and extinguished before damage from smoke or flames can occur. Because oxygen levels are not effected by ECARO-25 (HFC-125), it poses no threat to people, even those present at the time of discharge.

Unlike traditional water-based sprinkler systems, the clean agent used in an ECARO-25 system is non-conductive, non-corrosive, and leaves no residue, so it will not damage high-value assets or electrical components or pose a clean up problem. Relying on water-based systems for fire protection will meet your primary objective, which is to protect life and physical property. However, it will not protect the continuity of business or your information. Due to the speed of detection and suppression of a water-based system, a fire has more time to develop and grow. The damage caused by a developed fire in terms of smoke and combustion pollutants can be substantial. A water-based system can cause substantial water damage as well. Water can cause electrical surge and shock damage to sensitive equipment. A water-based system can do as much physical damage from water as a fire, especially to high-value electronic equipment, document, and assets. Recovering from a fire condition where a water-based system is relied upon is time-consuming and translates into a significant business interruption.

HFC-125 Historical Use in Fire Protection

The physical properties of HFC-125 were and continue to be the closest match to those of Halon 1301, which is the reason why it was the leading candidate for the replacement of Halon 1301 in 1992. However, as is the case with most science-based areas, technology continues to improve, and with technology improvement comes improved understanding and decisions. Since 1992, there has been a significant amount of work targeted at understanding the appropriate limitations around the use of fire extinguishants. Improved methods to establish fire extinguishing concentration levels for Class-A hazards (computer rooms, data center, etc.) also emerged. These improvements and new technologies re-energized the development work for HFC-125.

➧ *Fire Extinguishing Testing Method*

In 1992, the industry utilized Class-B values only per UL1058 to establish minimum extinguishing concentrations. The UL1058 test method determined the extinguishing concentration by testing the agent against the Class-B fuel n-heptane only. When has anyone ever encountered Class-B flammable liquid fires in a computer or telecommunication room? The extinguishing concentration for HFC-125 was measured at 8.7% v/v and the LOAEL, or maximum concentration for occupied spaces, was 10.0% v/v. Adding the safety factor to the extinguishing concentration, as required by NFPA and ISO, did not permit HFC-125 systems to be used in occupied spaces without lockout devices. With this limitation, the market migrated to other products such as HFC-227ea, commonly referred to as Heptafluoropropane and marketed as FE-227™ by DuPont™.

The industry agreed that using heptane to model the protection of computer rooms, data centers, etc. was forcing end-users to use more extinguishing agent than is truly necessary, therefore establishing that Class-B extinguishing concentration levels are excessive in the extinguishing concentrations required for Class-A fire applications. As a result, the industry agreed on the new Class-A fire test, UL2166, (also known as a plastics test) to measure the extinguishing concentration of the various clean agent alternatives.

➧ ***Allowable Exposure Times for Halocarbon Agents***

The second factor involved NFPA and ISO incorporating the use of a US EPA sponsored Physiologically Based PharmacoKinetic (PBPK) model to determine allowable human exposure limits for Halocarbon agents (FE-25 ™, FE-227™, FM-200®, FE-36™). The PBPK model provides a more accurate assessment of the length of time that a person can be exposed to a chemical, whereas in the past this wasn't a consideration with gaseous Halon alternatives.

Prior to the PBPK model, the human exposure rules were based exclusively on visual observations during exposure testing of the various halocarbon agents using laboratory animals as test subjects. The results of the animal exposure testing were translated directly into exposure definitions NOAEL (no observed adverse effect level) and LOAEL (lowest observed adverse effect level). These agent-in-air concentration limits, without regard to exposure times, were the basis for regulating which agents were suitable for use in occupied spaces and which agents were not. (1) The PBPK method found HFC-125 to be safe for occupied spaces up to 11.5% by volume.

ECARO-25 vs. HFC-227ea

The Fire Protection industry's most widely accepted alternative to Halon 1301 systems has been HFC-227ea (FE-227™ or FM-200®). Unfortunately, with HFC-227ea systems, many of the benefits the industry had with Halon 1301 were lost. The larger negative factors of HFC-227ea are its slower, heavier flow characteristics, greater agent quantity in volume and most importantly the overall cost of the system. Looking back, if we would have known then what we know now with respect to realistic Class-A fire testing and the use of PBPK modeling, HFC-227ea might not have never become as commercially successful clean agent product, and HFC-125 would had been the leading Halon alternative. This is primarily due to the many advantages ECARO-25 (HFC-125) have over HFC-227ea systems in regards to superior flow characteristics, agent quantity, environmental impact and other design aspects that make it a more superior clean agent fire extinguishant and system.

➧ ***Agent Quantity***

Per cubic foot, ECARO-25 requires 20% less agent than HFC-227ea. The minimum design concentration for ECARO-25 is 8.0% v/v and for HFC-227ea it is 7.0%, which would appear to the untrained that more agent would be required when utilizing ECARO-25. This isn't so! Due to the reduced vapor density of HFC-125, you need 20% less agent, per cubic foot, as compared to HFC-227ea. Additionally, because of its reduced vapor pressure it flows quicker and easier than HFC-227ea. One pound of HFC-125 will expand to protect 36 cubic feet, whereas one pound HFC-227ea will only expand to protect 29 cubic feet. The reduction in the quantity of agent together with its superior flow characteristics will also reduce the flow rate (lb./sec), thus allowing smaller diameter pipe to be utilized with ECARO-25 installations.

➧ ***Agent Flow***

ECARO-25 demonstrates the closest physical property match to Halon 1301 in terms of flow characteristics and vapor pressure. Some gases have a higher natural vapour pressure than others. ECARO-25 has a vapor pressure of 195 psi @ 70° F, which is very close to Halon 1301's natural vapor pressure of 199 psi @ 70° F. By comparison, the natural vapour pressure of HFC-227ea (FE-227™ or FM-200®) is 66 psi @ 70° F, which is much lower than that of Halon 1301 or ECARO-25. Because ECARO-25 has the same superior flow

characteristics that Halon does, it can easily flow in the same pipe network without major changes and still comply with all NFPA design and delivery criteria. HFC-227ea with its slower, heavier flow characteristics requires the installation of a totally new pipe network, usually with larger pipe than a Halon or ECARO-25 system. HFC-227ea systems also had greater limits in regards to the distance storage cylinders could be located for new installations because of its heavier flow characteristics.

➧ ***Agent Hold Time***

The design concentration, or minimum calculated quantity of clean agent, must remain in the protected space for a specified period of time to extinguish a fire, and guidelines on this practice can be referred to in Appendix C of the National Fire Protection Association 2001 Standard. The industry norm is to hold the agent concentration within the protected space for a minimum of 10 minutes, which can be a challenging accomplishment, especially for smaller volumes. ECARO-25 presents a ~19% agent retention/hold-time advantage over HFC-227ea. The lower vapor density of HFC-125 helps inhibit the separation of mixed (agent/air) gases. The lower vapor density also allows for a faster mixing with the air in the enclosure upon discharge. The only zero ODP halocarbon clean agent alternative that has a better mixing rate is DuPont™ FE-13, again because of the vapor density.

➧ ***Environmental Impact***

HFC-125 is an environmentally preferred alternative to Halon 1301. Unlike Halon, HFC-125 does not contain chlorine or bromine and therefore has a zero ozone-depletion potential (ODP). Like many fluorine-based gases, HFC-125 has minor global warming potential (GWP). The global warming potential for HFC-125 is 2,800, based on a 100-year time horizon relative to CO_2. This is one of the lowest for the chemical agents commercially available, and slightly below HFC-227ea. The overall environmental impact is minimized by improved detection technology that reduces unwanted emissions into the environment. Factoring the agents minimum design concentrations and the GWP values together, the overall environmental impact of HFC-125 is 23% less than HFC-227ea and 46% less than Halon 1301.

Summary

In 2001, Fike and DuPont™ formed a strategic alliance to better serve the fire protection industry and set out to develop a superior clean agent fire suppression system that is both more cost-effective and, asset & people safe. ECARO-25 is the culmination of this effort and it is evident from the features and benefits presented here that ECARO-25 is the ***Future of Clean Agent Fire Protection.*** Fike's UL listed and FM approved ECARO-25 System is available worldwide, allowing the fire protection industry to return to many of the benefits that Halon 1301 originally offered.

References:

(1) HARC News "The Use of Pharmacokinetics and the Physiologically-Based Pharmacokinetic (PBPK) Model to Determine Allowable Exposure Times For Halocarbon Agents in the NFA 2001 Standard", March 2001.