3M

Technical Brief

Novec™ 1230
Fire Protection Fluid

Thermal Decomposition Considerations with 3M™ Novec™ 1230 Fire Protection Fluid

Fires involving valuable and critical assets can be hazardous to people, damage property and interfere with the continuity of critical operations and processes. Even small fires produce combustion byproducts that, left unchecked, can potentially have deleterious consequences. In addition to the combustion products due to the fire, one would expect that fluorine containing extinguishing agents like Novec 1230 fluid which interact with a flame front, will thermally decompose. The magnitude of thermal decomposition production resulting from the interaction of a halocarbon agent with a flame front is dependent upon three key factors that influence the time to extinguish. They are the fire size-to-enclosure volume ratio, the agent volumetric concentration, and the discharge time[1].

The thermal decomposition products (TDPs) of fluorine containing agents of particular interest are the acid gas hydrogen halides (HX) and carbonyl halides (COX_2). Studies have shown that acid-gas production by in-kind physically acting halocarbons is significantly more than that of the chemically acting halon 1301[1]. While that is true, fire suppression systems using Novec 1230 fluid have been developed to detect and extinguish fires at their incipient stage, minimizing acid gas production. Couple that with the proven effectiveness of Novec 1230 fluid in quickly extinguishing the small fire, and TDPs are prevented from significantly adding to the potential hazards created by the combustion products already present from the fire itself. Studies conducted using Novec 1230 fluid have determined that the concentrations of TDPs during a given fire are comparable to what is produced by other fluorinated halon alternatives currently in use.[2] Fortunately, human detection of thermal decomposition products at even low concentrations will result in the evacuation of a room well before any toxic threshold is reached.

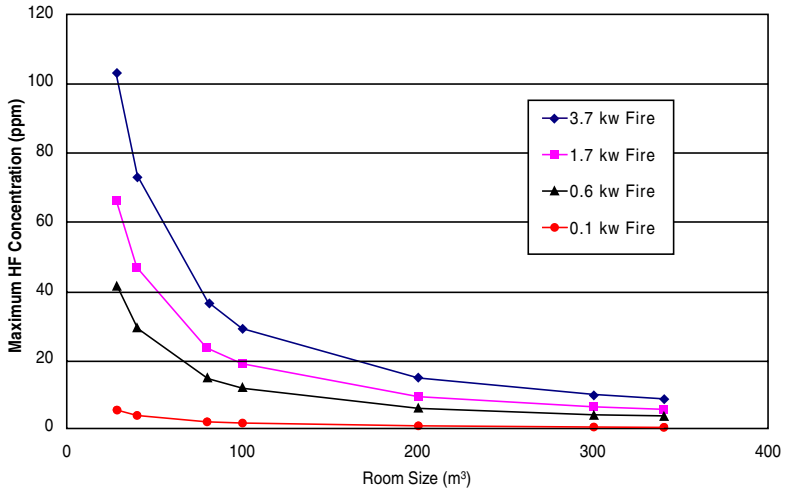

Figure 1:
Effect of room size on HF production[1] Novec 1230 fluid at 4.9% v/v concentration.

Well over 90% of applications involving the use of halocarbons, like Novec 1230 fluid, concern the protection of Class A assets, including those related to computer and telecommunication facilities. Continuity of operation is paramount, and those types of assets, typically involving electronic switches and circuit boards, cannot tolerate even a relatively modest fire. System design, therefore, must be such that fire size is kept to a minimum.

Large-scale approval tests conducted by 3M have involved Class A plastic fuels or Class B "telltale" can fire sizes up to 24kW. The maximum small-scale fire size tested at 3M is 3.7 kW, similar to the typical fire size for a circuit board in a data center or telecommunications switch. These type of fires are on the order of 3 to 5 kW, according to industry experts[3]. Such hazards typically result in fire sizes less than 10 kW at detection; fires of this magnitude are representative of fire conditions in real-life scenarios. Also, consider that for systems in the telecommunication industry, the need to detect fire sizes of 1 kW, considered a small loss potential, is often desired[4] and easily achieved[5].

Figure 1 on the previous page illustrates the magnitude of TDP for a "normal" sized room. It can be used as a tool such that the TDP can actually be predicted for a given room size. A system is then engineered to limit TDP below hazardous levels through effective design. For example, to maintain HF concentrations at an acceptable level in a 28 m^3 (1000 ft^3) room (small switch enclosure), fire detection should occur before reaching 3.7 kW in size.

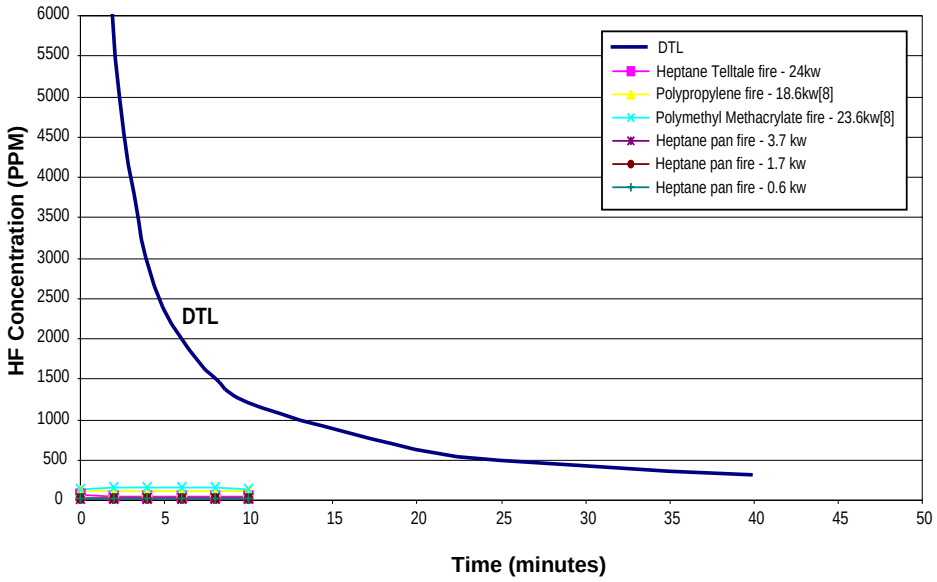

Figure 2: Time dependent HF concentrations related to toxicological endpoints

Figure 2 compares the level of HF measured during extinguishment of fires less than 25 kW.

In order to display the HF data in a manner consistent with Appendix A of the National Fire Protection Association NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems, Figure 2 also illustrates the dangerous toxic load (DTL) for humans based on analysis from Meldrum[6]. The DTL corresponds to exposure levels at which severe distress would be expected for all exposed personnel. This testing has shown levels of HF produced in the referenced fires, where 3M™ Novec™ 1230 Fire Protection Fluid is employed as the extinguishant, fall well below both the DTL curves.

Levels of HF produced from fires extinguished by Novec 1230 fluid are similar to those involving other physically acting halocarbon agents. Industry practice over the last decade has demonstrated that fire extinguishing systems using halogenated halon alternatives can be designed to minimize TDP formation and prevent adding to the potential toxic threat of a fire event (the hazards created by the combustion products of the fire).

Fire extinguishing system manufacturers recognize the importance of early detection, an optimum system discharge time and the appropriate design concentration for the specific protected space in minimizing thermal decomposition of an agent. Fire extinguishing systems using Novec 1230 fluid can be designed to perform optimally for the protection of personnel and sensitive assets. A properly designed and operating system will minimize generation of HF that would add to the potential hazard posed by a fire.

References

1. M.J. Peatross, *"A Review of Thermal Decomposition Product Testing of Halocarbon Fire Suppression Agents,"* Halon Options Technical Working Conference, Albuquerque, NM, 1998
2. B.D. Ditch, *"Thermal Decomposition Products Testing With 1,1,1,2,2,4,5,5,5 nonafluoro-4-trifluoromethyl pentan-3-one (C_6 F-ketone) During Fire Extinguishing,"* WPI Masters Thesis Paper, December 2001.
3. UL 2166, "Halocarbon Clean Agent Extinguishing System Units," ISBN 0-7629-0410-0, 22 March 2001
4. M.L. Robin, *"A Review of Thermal Decomposition Product Formation from Halocarbon Fire Suppression Agents: Suppression of Class A Fires,"* Halon Options Technical Working Conference, Albuquerque, NM, 1999
5. A.M. Leber, *"Early Warning Fire Detection,"* International CFC and Halon Alternatives Conference & Exhibition Conference Proceedings, Washington, DC, 1994
6. M. Meldrum, *"Toxicology of Substances in Relation to Major Hazards: Hydrogen Fluoride,"* Health and Safety Executive, ISBN 11 882100 8, 1993

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