Advantages of Modern Fire Suppression Systems

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Application Background:

Analysis of several commercial kitchen fires suggests that conventional, spring-powered, wet chemical fire suppression systems are no match for detecting and suppressing fires caused by solid fuel cooking. For solid fuel cooking, the villain is creosote, which is formed from the condensed, unburned vapors from burning wood. Creosote has a surprisingly low flash point of vapors, about 160-190°F, and an auto-ignition temperature varying from the 400's to 800's F, depending on conditions.

Surprisingly, an analysis of fire reports shows that conventional systems often perform poorly in fires *not* related to solid fuel cooking. The irony of this situation is that modern fire suppression systems, with electronic detection, operation, monitoring, and communications, with water and surfactant suppression, have incremental costs lower than the typical costs of wet chemical cleanup, system reset, repair of damages, and lost sales, with conventional systems.

Conventional systems depend on pairs of fusible links to detect fires, whereby sufficient heat will fuse (melt) and allow the links to separate and actuate the systems; but even if they do, there is a limited amount of suppression agent, which is discharged for only about one minute, assuming all other parts of the system work properly.

Fusible link detection is a century-old technology, requiring persistent heat to fuse (melt) the solder holding the links together. Deep fat fryer fires have been a usual target for suppression systems, and persistent heat is generally available above burning fry vats. The same is not true for fires that start in other appliances and locations – especially for creosote and grease fires that ignite in ducts above the customary locations of fusible links over appliances and and/or in duct entrances.

Because creosote is formed by the condensation of unburned wood vapors, it tends to condense in upper duct locations where the temperature is lower. Notably, fusible links are rarely mounted in upper ducts for two reasons: potential interference with duct cleaning, and manufacturer instructions that preclude mounting the links more than 20 feet from release assemblies. Fortunately, advanced systems can be mounted in upper ducts.

There are several other issues with conventional fire suppression systems:

- Nearly 30 components and sequential actions must be set up and function properly for conventional systems to actuate and properly disperse suppressant.
- Fires can move upward in hoods and ducts faster than fusible link detectors can absorb enough heat to separate and actuate systems. For example, fire moving in an exhaust stream at 1500 feet per minute travels 25 feet per second.
- As such, a heat sensor located near the termination of the duct is imperative to detect fires originating in the duct system.
- Fusible links coated with grease and/or creosote can delay or preclude actuation.
- Conventional fixed-tank systems discharge wet chemical suppressant for only about one minute, making them unavailable in case of fire re-ignition.
- The amount of fire suppressant is limited to what is stored in the fixed tank, and though multiple tanks can be added for long hoods, the dispersion time remains about one minute.
- Though conventional fire suppression systems can shut off gas and electricity to appliances, there is no means of automatically turning off solid fuel fires.
- Conventional systems are unmonitored, except for a small "Armed" flag visible in systems cabinets, and required technician checks and tests every six months. One supplier has an optional warning if the gas cylinder is not properly installed in the release assembly, but this feature does not verify that the cylinder is new and unused.

Advanced Electronic Fire Suppression Systems:

Advanced fire suppression systems include electronic detection, operation, local and remote monitoring, and electric backup. The detectors can actuate at a set temperature or from the rate of temperature rise. The suppression agent is unlimited building or sprinkler system water, and timers are available to limit water quantities. A surfactant (low-sudsing detergent) product is injected into the suppression water to reduce water surface tension to "make water wetter" and more easily coat fire surfaces, including grease and creosote deposits in filters, hood plenums, and exhaust ducts and fans.

Unlike conventional systems, with showerhead type nozzles, advanced, electronically operated systems use misting nozzles to disperse a shielding mist of water droplets. Enhanced by surfactant, the mist provides a thermal blanket to limit surface temperatures to 212°F (at sea level). In addition, the water mist droplets absorb heat from the fire and vaporize, expanding more than 1000 times, to displace oxygen and further suppress combustion. With no means of shutting off solid fuel fire, these features are especially important. The accompanying table compares key features of conventional and advanced systems.

Comparison of Features for Conventional and Advanced Fire Suppression Systems:

FEATURE	CONVENTIONAL SYSTEM	ADVANCED SYSTEM
Detector type	Fusible links and cable release	Electronic fire detectors
Detection mode(s)	Rated temperature	Rated temperature and rate of temperature rise
Compensation	None	Rate compensated to offset temperature lag
Detector locations	Over appliances, and/or in duct entrances	Duct entrances and optionally, upper duct locations
Duct Fire Protection	Limited distance in ducts, by manufacturer instructions	No restrictions for mounting in ducts
Suppressant discharge coverage	Appliance-specific or overlapping	Overlapping coverage standard
Required detector replacement	Every six months, by certified service technician	Only if monitoring reveals need or problem
Suppression agent	Low pH liquid and foaming agent	Water and surfactant
Nozzle type	“shower head”	Misting, to aid vaporization and displace oxygen
Suppressant quantity	Fixed by size and number of tanks	Unlimited water with added surfactant*
Suppressant discharge time	About one minute	Per timer, such as minimum of 15 minutes
Power	Cocked	Electric, with battery backup
Monitoring	Small “armed” flag in cabinet, and Service Technician every six months	Continuous 24/7 monitoring and every six months by technician
Fault annunciation	None	Local, building management system, and network devices
Automatic hood plenum and lower duct cleaning	None, except for water wash hoods	Optional: daily at closing, with hot water and surfactant
Automatic hood cleaning agent	Water and detergent, as specified	Hot water with and surfactant injection
Communications	Fire alarm enunciation	Fire alarm, system warnings to building management systems, and Internet connection

*Note: surfactant available for about 40 min. with full tank, or about 20 min. at 50% alarm level

