Wet Chemical Fire Extinguishing Agent and Delivery Systems

by Deputy Assistant Chief Ronald R. Spadafora

The National Association of Fire Equipment Distributors (NAFED) and Underwriters Laboratories Inc. (UL) were two leading fire protection organizations responsible for evaluating dry chemical agent and fire extinguishing applications. Their research, in conjunction with the work performed by the National Fire Protection Association (NFPA), led to the eventual replacement of this fire suppression material with wet chemical agent technology within the food processing and cooking environment.

Pre-engineered dry chemical suppression systems for the protection of commercial cooking equipment, plenums and ducts were developed in the 1960s. The NAFED was established in 1963 with the mission of improving technical competence in this area. Tests conducted by this Chicago-based organization in 1978 and again in 1988 revealed a steady decline in dry chemical agent efficiency during the 10-year period. This downturn was partly attributed to the change in the methods of preparing food and the replacement of traditional commercial cooking equipment (deep-fat fryers, grilles, griddles and broilers) with new-age, energy-efficient equipment.

Also during the 1960s, UL developed a series of fire tests for dry chemical systems designed to duplicate the potential fire hazard. The analysis established a standard for type of extinguishing agent, fire detection system, piping, nozzle coverage, manual activation, etc. Tests conducted during this time merely simulated fires in commercial cooking appliances. Actual cooking equipment was not used. As commercial cooking operations, appliances and supplies changed over the years, UL recognized the necessity for a new set of standards for extinguishing agents, as well as pre-engineered systems.

Need for new technology

The use of vegetable oils, with lower fat and cholesterol content, now have replaced animal fats in the frying and processing of foods. Compared to vegetable oils, animal fats contain high amounts of fatty acids. Dry chemical agent is alkaline in make-up. When it is discharged over fatty acids, it forms a saponification blanket. This soap layer helps to seal off the burning material from ambient oxygen and smothers the fire.

Vegetable oils have significantly lower levels of fatty acids and, therefore, saponification is limited. This greatly reduces the effectiveness of dry chemical extinguishing agent. Vegetable oils also have a higher auto-ignition temperature (685 degrees Fahrenheit and above) than most animal fats (550-600 degrees Fahrenheit) and, therefore, have a higher smoke generation point, making them more suitable for high temperature frying applications. Fires involving these oils burn hotter and are more difficult to extinguish. These higher temperatures also will quickly break down any soap blanket that does get established.

Energy-efficient cooking appliances are highly insulated to reduce fuel consumption and maintain vegetable oils at high temperatures. This equipment stays hotter for longer periods of time, making it more difficult to secure against re-flash.

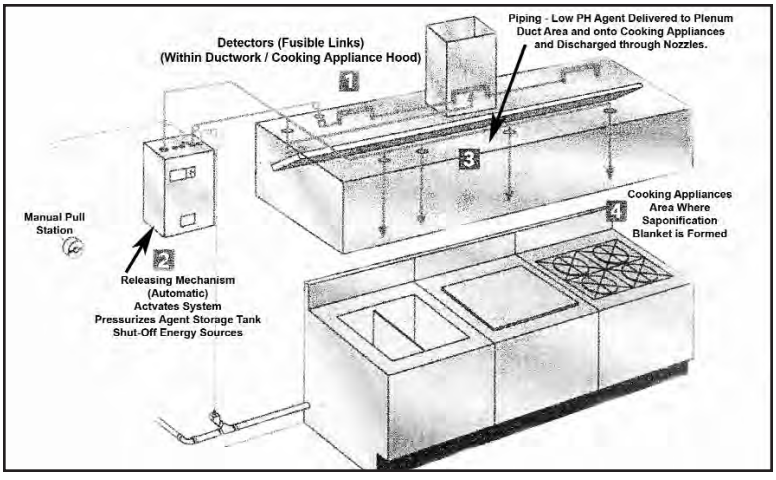
Wet chemical extinguishing agent

Wet chemical extinguishing agent was developed for the suppression of kitchen fires involving cooking oils, fats, lards and greases (Class K combustibles). It is a specially formulated, premixed aqueous (40 to 60 percent water by weight, depending on the manufacturer) solution of inorganic salts (potassium acetate, carbonate or citrate). This agent provides quick flame extinguishment by cooling combustibles below their ignition temperature, displacement of oxygen and vapor suppression by forming a soapy foam blanket (saponification) over the burning material. This foam blanket forms a crust over the hazard, inhibiting oxygen from reacting with the flaming substances.

Fire damage is contained within the general area of origin. The agent also cools the hot metal surfaces of cooking equipment to help prevent re-ignition of lingering combustible vapors. Post-fire cleanup is readily accomplished by flushing the area with water or steam. It will produce no toxic by-products. It is an irritant, however. If contact is made with the eyes or skin, flush with water for a minimum of 15 minutes.

Portable fire extinguishers

Wet chemical portable fire extinguishers also are known as Class K extinguishers. They are designed to be used in conjunction with pre-engineered kitchen wet chemical fire protection systems. Wet chemical agent used in portable fire extinguishers has been tested by UL standard 711 on electrically energized equipment using up to 100,000 volts to assure operator safety.



Commercial wet chemical fire extinguishing system.

In the event of a fire, the primary suppression system should be initiated first, via the manual pull station, if it has not automatically activated. The Class K portable fire extinguisher is required by the New York City Fire Code (enacted by Local Law 26 of 2008) to be provided within a 30-foot travel distance of commercial cooking equipment and cooking equipment involving vegetable or animal oils and fats.

When using the portable fire extinguisher, the application wand at the end of the discharge hose creates a fine mist that helps prevent grease splash and fire re-flash while cooling the cooking appliance. It also allows the user to apply the agent exactly where aimed from a safe distance (10 to 12 feet). Class K fire extinguishers are excellent for use on all cooking appliances, including solid-fuel char-broilers.

Standard size (1.5- to 2.5-gallon) extinguishers have a UL 2A : K rating. This means they also can be used on Class A materials (wood, paper, plastics, rubber) with the equivalent effectiveness of 2.5 gallons of water (1A approximates 1.25 gallons of water). Discharge time (corresponding to amount of agent) ranges between one and two minutes. The standard type portable fire extinguisher is a stainless-steel cylinder. Temperature range is from +40 to +120 degrees Fahrenheit. A black hexagon is the geometric symbol used to denote a wet chemical portable fire extinguisher and the pictogram (showing the type of fire the extinguisher is approved to fight) is a burning pan. They will be located on the shell of the container.

(Left) Portable (Class K) wet chemical fire extinguisher with unique wand applicator. (Above) Wall-mounted releasing mechanism and pressurized wet chemical cylinders. (Right) Class K (wet chemical agent) portable fire extinguisher pictogram.

UL-300 Standard

In the early 1980s, pre-engineered wet chemical extinguishing equipment was introduced. These new systems provided solutions to the problem of effectively extinguishing commercial kitchen fires. On November 21, 1994, UL adopted a new standard--Fire Testing of Fire Extinguishing Systems for Protection of Restaurant Cooking Areas (known as UL-300). Manufacturers of kitchen fire-suppression systems, wishing to sell UL-listed fire protection equipment after this date, had to re-submit their systems to UL for testing.

The UL-300 standard takes into consideration cooking appliance design, cooking agent ignition characteristics and "worst case scenario" fire simulations. These tests are more sophisticated since genuine cooking appliances are used. The procedures create a higher rate of heat release fire involving fryers, griddles, ranges, char-broilers (gas radiant, electric, lava rock) and woks that is more difficult to extinguish and secure against re-flash than previous tests. Only wet chemical systems have been able to meet the UL-300 standard. No dry chemical extinguishing systems have passed.

The UL-300 standard was created and adopted in association with changes made by the NFPA in standard 17 (Dry Chemical Extinguishing Systems) and 17A (Wet Chemical Extinguishing Systems). The UL-300 standard, however, did not change plenum, hood and duct fire protection test requirements (NFPA standard 96), which still allows the use of dry chemical extinguishing systems.

Members are urged to review the following reference materials:

- "Commercial Cooking Facilities," Fire Safety, Inc., 2003 http://www.firesafetyinc.com/ccf.html
- "Dry Chemical Rangehood Fire Extinguishing Systems," *Fire Prevention Manual*, chapter 12, FPIB 42, Addendum 1, August 11, 2005
- "Meeting the New Standard For Commercial Cooking Fire Suppression," Fire Fighter Products, Inc., 2006 http://www.ffpsafety.com/ffp/ul_300_new_standard_.htm
- New York City Fire Code, July 1, 2008 http://www.nyc.gov/html/fdny/html/firecode/table_of_contents.shtml
- "Restaurant Kitchen Protection Systems Update," Fireline Corporation, 2006 http://www.fireline.com/fc_newsk.html
- September 2005: "Things You Should Know About Your Cafeteria Extinguishing Systems," Risk Logic, Inc., 2005 http://www.risklogic.com/Sep2005.html
- "UL-300 Standard Update," National Association of Fire Equipment Distributors, 2007 http://www.nafed.org/resources/library/UL300.cfm
- "Wet Chemical Systems-Restaurant Protection," Tyco International, 2007 http://tycoemea.com/English/Products/Extinguishing/wetchem.asp

Pre-engineered extinguishing systems

Wet chemical pre-engineered extinguishing systems are highly effective on fires in commercial cooking appliances. They also are used to protect restaurant ventilating equipment (hoods and ductwork). Pre-engineered systems automatically are activated by a fusible link detection system located within the ductwork or cooking appliance hood. Detectors trigger a spring-loaded, mechanical/pneumatic-type releasing mechanism that pressurizes (using inert gas) the wet chemical agent stainless-steel storage tanks. The tanks have a working pressure of 100 psi. The detectors also automatically shut off the appliance energy sources.

Systems can be remotely activated manually via a mechanical pull station. This pull station is designed to be installed along an egress route from the cooking area, a minimum of 10 feet and a maximum of 20 feet from the kitchen exhaust system. Suppression agent flows through system piping (black, chrome-plated, stainless steel), where it is discharged into the plenum, duct areas and onto cooking appliances.

Discharge nozzles--constructed of brass, stainless steel or a combination of both--are narrow (three-quarters to one inch in diameter) and must have metal or rubber blow-off caps to keep their tips free of grease build-up. They spray wet chemical agent in atomized droplets at a low velocity to avoid splattering burning oil/grease.

New York City ramifications

FDNY units on Building Inspection Safety Program (BISP) should be aware that on or after November 21, 1994, all new, pre-engineered commercial cooking equipment must conform to the UL-300 standard. Legacy systems must be re-installed or upgraded to conform to the UL-300 standard if the equipment no longer is protecting the type of hazard it originally was installed to protect. Existing dry chemical fire extinguishing systems may be

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Photo #13--Alimak power switch car.


Photo #14--Elevator controls.


Photo #17--Spring-loaded latch.


Photo #18--Open landing gate.

constant pressure on the button, lever or joystick in order for the elevator car to travel; releasing the control stick will stop the car. These manually controlled devices require the operator to bring the elevator car level with the building floor. (See Photos #21 and 22.)

Adhesive tape may be applied to the car and landing gate to assist the operator with lining up the car with the floor landing. Before moving the car, look for a mark in the elevator car at about five feet from the floor. (See Photo #23.)

Another car control does not require the operator to maintain constant pressure. With this type of control, the operator momentarily presses the lever in the direction of travel and releases. In order for the elevator car to stop at the desired floor, the operator is required to press the floor button. The floor button is a single button near the lever. The floor button is pressed one level below the landing where you want the car to stop. The elevator car self-levels. However, the operator must manually open the car gate to exit the elevator. (See Photo #24.)

Newer elevator controls may be computerized and require the operator to select the floor by pressing a numbered keypad. For example, if the 12th floor is the desired location, press 1 and 2. Then enter. The car will travel to the desired location. If any of the above procedures fails to get the car in operation, locate the contact number of the construction company and make notification.

Many sites attach a durable sign indicating floor number to the landing gate. (See Photos #25 and 26.) Other sites spray paint the floor number on a column in the building on each floor. The distance of the columns varies and the paint fades, possibly making identification difficult. While on drill or when conducting an inspection, request that a durable sign be installed on the landing gate. The durable sign is a much easier way of identifying the floor from the car and street with binoculars.

Safety considerations

Operating at a fire, the elevator must stop two floors below. Locate the stairs and standpipe. For a medical emergency, the car can be brought to that floor.

If an emergency (i.e., a medical problem or injured worker) occurs while an elevator operator is present, assign a Firefighter to ride with the operator unless the operator would be threatened by fire or smoke. Check for obstructions before moving the car. Workers may have left long pieces of material extending beyond the edge of the building or wind conditions may have moved building materials. Binoculars may be needed.

Rated load capacities and instructions shall be posted on the cars and platforms. Do *not* overload the car. When entering and exiting the car, remove power, using the power button in the car. An emergency stop switch shall be provided in the car and marked *stop*. During high-wind conditions, the hoist must not be used. Whenever the hoisting equipment is exposed to winds exceeding 35 mph, it shall be inspected and put in operable condition before reuse.

The Department of Buildings conducts a drop test every 90 days. It is an operational check of the safety of the hoist. A certificate with the date of the drop test is posted in the car. Outside hoists require more maintenance than the standard elevators.

The hoist requires oil and grease every 60 days because it is subjected to all types of weather. This maintenance is the responsibility of the company that erected the hoist.

Do not lean on the car gates while the car is traveling. The average speed of the car is between 90 to 150 feet per minute (fpm). The maximum speed is 300 fpm.

Gates protecting the entrances to the hoist shall be equipped with a latching device. Landing gates shall be not less than six feet, six inches high and shall be provided with mechanical locks, which cannot be operated from the landing side and shall be accessible only to persons in the car.

Overhead protective covering of two-inch planking, 3/4-inch plywood or other solid material of equivalent strength shall be provided on the top of every personnel hoist.

Firefighters operating in the car must have a working flashlight. They must wear helmets when in the construction site. The only requirement to operate the cars is that a competent person is knowledgeable in the operation of the hoist. No Certificate of

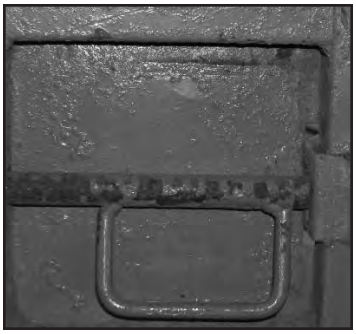
Photo #15--Landing gate.


Photo #16--Landing gate lock.


Photo #19--Gate switch.

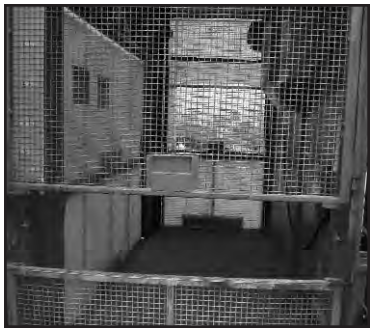
Photo #20--Bi-parting gate.

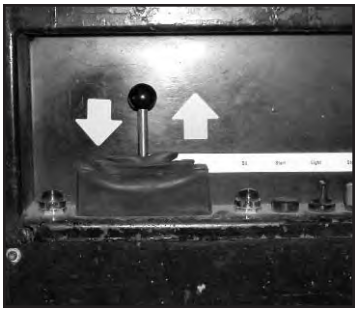

Photo #21--Elevator controls.

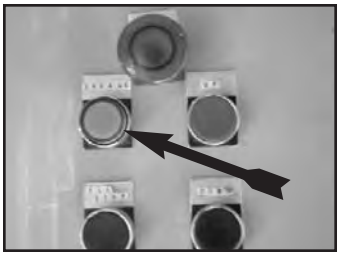

Photo #22--Inside controls at 2nd Avenue site. Note the constant pressure button (arrow).

Photo #25--Floor label.

Photo #26--The floor number (arrow) is spray-painted on the building.

Photo #23--Floor level mark.

Photo #24--Alimak car control.

Fitness is required.

Material hoists

There are base-mounted drum hoists designed to transport equipment and materials. These are referred to as winding drum machines. Controls are operated from an operator's station. These hoists are not used to transport Fire Department personnel. FDNY members do not operate these elevators. However, material hoists would be an asset in transporting Fire Department equipment. A construction worker should be recruited to operate the material hoist for FDNY members. Another option would be to use the hoist that carries people, but when loading equipment, bear in mind the weight capacity of the hoist.

This is not meant to be an all-encompassing instructional guide. When a hoist is located in your first-due area or administrative district, arrange for familiarization drills through the site safety or project manager. Saturdays are a good time to visit because there are fewer workers on-site and an FDNY visit will cause less disruption than during the week. Hoists are continually being erected at buildings under construction.

Note: *Special thanks to FF Michael A. Dragonetti, Stamford, Connecticut, Fire-Rescue Department, who assisted with this article. He is a nationally recognized instructor on "Handling Elevator Emergencies" and presented courses on this topic at the FDNY Technical Rescue School.*

About the Author...

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acceptable for non-commercial applications (social clubs), however, if installed in the original location, remain in compliance with the original listing and continue to offer fire protection for the original equipment without any changes. This exception would be very rare and should be referred to the Bureau of Fire Prevention, Rangehood Unit, for a determination.

In 2005, the Rangehood Unit began a campaign to have dry chemical fire extinguishing systems used in the protection of commercial cooking equipment upgraded to meet the UL-300 standard. Required servicing of existing dry chemical systems was not recognized by the Unit since parts for these type systems no longer were being built. Owners of commercial cooking establishments were directed to follow UL-300 guidelines in order to comply with all maintenance codes, as well as manufacturers' requirements.

The New York City Fire Code states: pre-engineered wet chemical fire extinguishing systems shall be tested in accordance with the UL-300 standard and listed and labeled for the intended application. It also declares that dry chemical fire extinguishing systems shall not be installed to protect commercial cooking equipment and exhaust systems. Specific-use fire protection systems for commercial cooking operations using carbon dioxide or foam/water extinguishing agent must be installed employing equipment and devices in accordance with reference standards NFPA 12 or 16, respectively.

Conclusion

The job description of the first responder is getting more complex daily. It is critical to keep abreast of current laws, codes and standards dealing with new fire-suppression strategies. A thorough understanding of wet chemical agent and advanced delivery systems is vital to the success and safety of all fire service personnel, whether extinguishing a food-on-the-stove fire or performing building inspection in a restaurant. Examine wet chemical fire-extinguishing equipment and application devices on your next visit to a commercial kitchen or food-processing facility. Familiarize yourself and ensure all members of your unit are knowledgeable in the key concepts of this new technology.

About the Author...

Deputy Assistant Chief Ronald R. Spadafora is a 31-year veteran of the FDNY. He is assigned to Operations as the Chief of Logistics. He holds a masters degree in criminal justice from LIU-C.W. Post Center, a BS degree in fire science from CUNY-John Jay College and a BA degree in health education from CUNY-Queens College. He is an Editorial Advisor and regular contributor to WNYF. *He teaches fire science at John Jay College as an adjunct lecturer and is the senior instructor for Fire Tech Promotions, Inc.*