Fires Don’t Have Labels

by Tony McGuirk

Note to Readers: This article is a companion to the July 2014 *PM* magazine cover story “No Cause for Alarm – Sustainability in Fire Service Depends on Change."

The title of this article refers to my difficulties with the current thinking around fire extinguishers. Perhaps it’s just me, but even after 35 years of service in the fire and rescue service, I still find the whole issue of fire extinguishers and fire classification confusing.

More recently, I have reflected on why fire extinguishers are such a complicated and bureaucratic mess. I am a great believer in the role of history in creating complicated systems**.** The Romans had an important role in terms of our development of thinking about fire extinguishers.

It is generally agreed that the first professional fire service was put in place in AD 6, when the Roman Emperor Augustus levied a 4 percent tax on the sale of slaves. He used the proceeds to set up a new public fire-fighting force called the Vigiles, which was divided into seven cohorts, each consisting of 70 to 80 men commanded by a centurion, and each patrolling two of the city's regions.

Water was at the heart of Vigiles’ fire-fighting strategy and tactics. Every cohort was equipped with a sipho or fire engine, pulled by horses, and consisting of a large double-action pump that was partially submerged in a reservoir of water. The Vigiles had an expert in water called a Siphonarius, who operated the pump, and an Aquarius, who supervised the supply of water.

A major duty of the Vigiles was to enforce preventative measures against conflagrations. Adequate fire-fighting equipment was required in every home. The Digest of Justinian decreed that Vigiles are “ordered to remind everyone to have a supply of water ready in his upper room.”

While the Vigiles only had advising authority, their recommendations were often followed to avoid repercussions for negligence. Corporal punishment was the most common punishment for negligence according to the Digest of Justinia, “where persons have paid insufficient attention to their fire, the prefect . . . orders them to be beaten.”

Scientific Processes Win Favor

I believe the approach of the Romans teaches us two things about fire safety. First, that regulation, enforcement, and fire-safety standards have an important role to play in fire safety. Second, a

water extinguisher that can be quickly used by the person who discovers a fire is an excellent way to put out a fire.

Despite this somewhat simplistic approach, the fire extinguisher industry has adopted a more complicated and chemically based approach to fire extinguishers, turning the simple task of fighting a small fire into a relatively complicated and scientific task of applying the right chemical to change the process of combustion.

The first fire extinguisher on record was patented in England in 1723 by Ambrose Godfrey. In his book, "Account of the New Method of Extinguishing Fires" published in 1724, he described a process of extinguishing fires by using gunpowder and explosives to effectively blow out a fire.

A miniature wooden barrel was filled with fire-extinguishing material. Then gunpowder was inserted in a pewter sphere at the centre of the barrel, and fitted with a fuse, pipe, and guides to the top. When the fuse was fired, the explosion forced the fire upwards.

Whatever happened to a bucket of water? Given that the first fire extinguisher was developed by an apothecary, is it any wonder that the fire extinguishers of today have become increasingly focused on the process of combustion rather than the process of putting out the flames, or as American colleagues paraphrase, "putting the wet stuff on the red stuff."

Additional Chemical Inventions

This first fire extinguisher was followed by many other fire extinguisher models using various chemical reactions designed to produce propellants of various types to extinguish fires. The year 1818 witnessed the invention of the modern fire extinguisher by George William Manby, a British captain**.**

Subsequent fire extinguisher models included two versions of the soda-acid fire extinguisher. The next two fire extinguisher models would be a cartridge-operated fire extinguisher, developed in 1866, and the "petrolux" fire extinguisher, patented in 1881, which was designed for use on cars.

The year 1904 saw the arrival of the chemical foam fire extinguisher; 1910 brought carbon tetrachloride but because of the toxicity of carbon tetrachloride damaging the nervous system and internal organs, the use of the chemical was discontinued in the 1950s. Several chemicals followed, including chlorobromomethane and methyl bromide.

The carbon dioxide fire extinguisher was invented in the United States by the Walter Kidde Company in 1924.This type of fire extinguisher is still used today. It is an ozone-friendly, clean agent. Other fire extinguishers that were developed used dry chemicals. In the 1950s, small, dry-chemical fire extinguishers were developed for use in homes.

Back to Basics

The list goes on, but the brands and philosophy remain the same—a move toward a scientific approach rather than a simplistic approach. The fire extinguisher market has evolved to be about the chemical or other interruption of the process of combustion, rather than "putting the wet stuff on the red stuff." But what if we went back to basics? What would we need to go from the complicated fire extinguisher chart (see Figure 1) to something much more simple?

Surely, if we could make a fire extinguisher that could simply put the wet stuff on any classification of red stuff, then we would have some major benefits that would include these elements:

- Ease of training.
- Ease of understanding.
- Ease of use.
- Ease of maintenance.
- Cost effective.
- Environmentally sensitive.

The fire extinguisher products available up to this point in time have been extremely effective when used in the right circumstances. Such products, however, are:

- Expensive and sometimes difficult for end-users to understand.
- Require extensive training and can be frightening to use, especially in a domestic context, and they also require frequent maintenance.
- Damaging to the environment, in some cases.

The outcome has been the creation of a vast fire extinguisher industry that is in reality about the management of chemical processes rather than combustion. There seems to have been little disruptive innovation in the market for years, but perhaps things are now changing with a new type of water fire extinguisher coming to the market in the form of dry water mist extinguishers.

The Water Mist Extinguisher

Dry water mist is a relatively new development enabling a fire extinguisher to apply water droplets as small as 25 microns in diameter. A micron measures less than 0.001millimeters in diameter. Low pressure water mist and these extinguishers produce more than 22 billion droplets of water from 1 liter of water, giving them incredible fire extinguishing power.

The water mist droplets are so small they do not allow electricity transmission, which allows the extinguisher to be used on electrical fires. As the impact of the droplets is so miniscule, the extinguishers can be used on flammable liquids and the deadly F–Class fires—that is, fires involving cooking oils or fats—without the danger of a flashback to the user. The cooling effect of the water will also extinguish A-Class Fires—flammable textiles and such solids as wood, paper, trash, or anything else that leaves an ash.

When heat is applied to combustible material, the temperature of the material rises and free radicals begin to form. Free radicals and gases become airborne, and begin to bond with oxygen in the air. Once a sufficient amount of gas forms, it ignites, which is called pyrolysis.

The gases burn, generating heat and forming more free radicals and therefore, more gas. Free radicals are atoms or groups of atoms that have at least one unpaired electron and are therefore unstable and highly reactive. The extinguisher is activated, removing two of the three fire triangle elements.

Heat is removed by the mist droplets and the oxygen particles by the steam. The water mist fire extinguisher is not a chemical attack, and genuinely is about putting the wet stuff on the red stuff.

The fire is extinguished. Steam (inert) formed by the mist during extinguishing continues to evaporate, dissipating the heat and oxygen from the fire source, cooling the material to prevent re-ignition. There is little collateral damage after discharge.

As described previously, the mist turns to steam and evaporates, both preventing re-ignition from cooling and suffocating the fire while maintaining a specific density in the air to allow those in the vicinity to breathe normally. Water mist has these advantages over conventional methods:

- The extinguishers are safer to use as the agent is pure water with no additives and no fluorosurfactants (i.e., chemicals).
- Water mist extinguishers can reduce the risk of making mistakes by using the wrong extinguisher on different classes of fire. The versatility makes staff training much easier.
- The extinguishers are exceptional at clearing smoke and most people who are killed in fire-related incidents do so from inhaling smoke as they try to escape rather than actually being caught up in the fire.
- When the fire is being extinguished, the mist evaporates into steam, and any collateral damage is also completely removed. The use of water is more environmentally friendly than chemicals.

A Case Study: Castle Howard

To illustrate the point, I will use Castle Howard in Yorkshire, a county in Northern England, as a case study. Castle Howard is a magnificent 18th-century residence in the Howardian Hills, an area of outstanding natural beauty just 15 miles northeast of York.

It houses world-renowned art collections and is also a thriving rural estate with such traditional enterprises as farming and forestry. The profits generated from all estate businesses contribute towards the ongoing restoration and conservation of 200 listed buildings and monuments.

Currently, the house deploys a range of extinguishers, including foam, water, and Co2 combinations, but it will shortly be adopting a water mist extinguisher for standard use across the estate. Due to the high value and irreplaceable nature of antiques, water mist offers the least damaging option as in the event of an actuation the only product used is water.

It has been estimated that the estate will be able to drop its conventional extinguisher total from 180 to 100. This will be done over the next few years as existing extinguishers come to end-of-life usage and are replaced with water mist.

Although there is not a great savings in supply costs as 180 conventional is similar to 100 water mist, service costs will be more than halved. Staff fire-safety training will be easier and cheaper as it will be a one-extinguisher solution to tackle all fires, and staff will find this a lot less confusing (i.e., which extinguisher to use on what fire).

High value works of art and antiques will suffer much less damage and restoration costs if extinguishers are used in anger or by accident, cleanups will be far less labour intensive and expensive and far more environmentally safe. Water, foam, and powder on floors, carpets, tapestries, manuscripts, and books could ruin them. Water and foam going through floor boards will be devastating in some areas.

A Sensible Solution

Water mist extinguishers have a supersonic nozzle that disperses the microscopic, dry, water mist particles to suppress fires, and they can be used on just about every type of fire, including fat fires. The environmentally friendly mist, which is de-ionised water, means there is no residue, and the water mist also protects the user from heat.

Obvious uses are in kitchens where even a deep-fat fryer fire can be quickly dealt with, and it means cleanup is much easier. A powder or foam extinguisher even on a minor fire would leave a lot of mess. The lack of residue also makes these extinguishers popular in museums and heritage buildings, as illustrated by Castle Howard.

The water mist extinguisher will cope with any likely domestic fire, and there are no residual fumes that would harm children. Given the ease of use of these extinguishers, and the fact that no longer is there a risk of using the wrong type of extinguisher on a fire, perhaps it may be time to re-visit the "Get out, stay out" philosophy as we see more and more fire and rescue services reduce response as a result of savage government cuts.

Figure 1.

Fire Extinguisher Chart

Extinguisher		Type of Fire				
Colour	Type	Solids (wood, paper, cloth, etc)	Flammable Liquids	Flammable Gasses	Electrical Equipment	Cooking Oils & Fats
	Water	✓ Yes	✗ No	✗ No	✗ No	✗ No
	Foam	✓ Yes	✓ Yes	✗ No	✗ No	✓ Yes
	Dry Powder	✓ Yes	✓ Yes	✓ Yes	✓ Yes	✗ No
	Carbon Dioxide (CO2)	✗ No	✓ Yes	✗ No	✓ Yes	✓ Yes

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