



The "Rebirth" of Water Mist Fire-Fighting Technology

By M. Ecke
General Manager
Member: IWMA

(The article will be published in the January/February issue of the ifp-magazine. It is for those members who have not subscribed to ifp-magazine)

The last ten years have seen considerable advancement in the commercial application of water mist fire suppression systems throughout the fire safety industry. This is, however, only the beginning of a market development initiative that will lead to a much higher presence of water mist fire suppression systems in the future. The undisputed environmental advantages embodied by water mist systems will contribute to its continued success as an alternative to traditional chemical fire extinguishing agents, such as Halon 1301 which will be completely phased out in the foreseeable future. Due to these efforts to phase out Halon very soon, the fire safety community has revived the water mist technology which had been almost forgotten for decades. The regularly attested efficient fire fighting qualities of water mist accounts for its use in an increasing number of fire protection applications.

The creation of IWMA

A significant recent development is the creation of a forum, which is open to corporations, institutes and individuals, concerned with issues related to the water mist industry. This forum, the International Water Mist Association, comprised of water mist system manufacturers, nozzle manufacturers, research establishments and independent fire safety consultants has been established to support the ongoing evolution of water mist technology. Following an initial consultation period, the IWMA opened a permanent office in Germany at the beginning of last year. Although most of the founding members resided in Germany, the Association began to widen its basis by making manufacturers, research establishments and individuals aware of its existence. The current membership is truly international and includes representatives from 19 different countries.

The multi-national makeup of the IWMA membership is a crucial fact which reflects the increasing need to respond to an ongoing globalization in all aspects of water mist technology. Hence, IWMA is able to offer a platform for people dealing with water mist applications throughout the world. The foundation stone has been laid for the IWMA to serve as a medium for informed discussions relating to this efficient and environmentally friendly fire-fighting method.

IWMA is not able yet to speak for the entire water mist community, although the Association believes that a growing number of corporations and institutions will recognize the advantages of this forum which will help to raise the importance of water mist technology significantly. An essential part of the IWMA's remit is the advancement of knowledge concerning water mist. As a panel of experts, the Scientific Council is intended to be a center of knowledge concentration as well as knowledge creation.



Moreover, the support of the further development of general design rules will be a crucial task in the coming months and years. At present, end users are often hesitant to install a water mist system, usually due to the absence of relevant regulations in their countries. This situation is improving however and in the USA for example, the NFPA has established a good basis concerning the installation of water mist fire protection systems with the release of the NFPA 750 - 2000 edition. In addition, Factory Mutual Research will soon issue a new water mist system approval standard and the CEN group is currently developing a European standard; however, there is still much work to be done in this important area.

The International Water Mist Association has been set up as an independent body to which questions relating to the use of water mist may be addressed; typical discussion topics might include the understanding and interpretation of guidelines as well as the technology in general such as the suitability of water mist for certain applications, the limits of those systems, minimum requirements and so on.

It should also be stressed that the IWMA is not a commercial competitor to other organizations with a business interest in water mist technology. On the contrary, the IWMA is a specialized international association which will work closely together with other existing and well-known organizations in this specialized fire protection field.

International Water Mist Conference 2001

One of the first major events to be organized by the IWMA is the International Water Mist Conference 2001 scheduled for 4 – 6 April in Vienna, Austria. This conference will be held in cooperation with independent member institutions who will provide scientific support for the Symposium.

The Association's web page (www.iwma.net) offers all necessary information regarding this symposium. The IWMA office can also be contacted for the information and registration package.

The symposium will provide a good opportunity for fire safety experts, representatives of interested corporations and governmental authorities as well as potential end users to extend their knowledge about water mist technology for fire fighting.

Existing guidelines and regulations currently under development will be discussed in Vienna; there will also be presentations focussing on some relatively new applications for water mist systems. The annual member meeting of the International Water Mist Association will also take place during the conference week, on the 4 April 2001 in Vienna, Austria.

Those interested in any aspect of water mist technology and the aims of this forum are invited to join the Association and, thus, to support the work of the IWMA.

Smoke Scrubbing

By J. R. Mawhinney

Chair: NFPA 750 Water Mist Committee

Member: IWMA Scientific Council

Hughes Associates, Inc., Baltimore, MD USA

The article by Dr. Gerd Muehlenbruch, "New Concept for Tunnel Safety" is very interesting. I agree fully with the general conclusion that the water mist system will make fire fighting in the tunnel much easier, and less dangerous than the alternative (no fixed system). I am more than a little concerned, however, about Dr. Muehlenbruch's statements that the the water mist "washes out" the dangerous gases CO, CO₂ HCN and soot. It is my opinion, based on testing, that the threat to life that smoke presents is not significantly mitigated by passing it through a screen of water mist.



I recently made measurements of the 'scrubbing effect' of water mist as part of the following study, funded by the US Navy.

Mawhinney, J. R.; DiNenno, P. J., (Hughes Associates Inc.), Williams, F. W. (Navy Technology Center for Safety and Survivability), "Water Mist Flashover Suppression and Boundary Cooling System for Integration with DC-ARM: Volume 1: Summary of Testing," *NRL/MR/6180—99-8400*, September 30, 1999.

In that study my measurements did not show a significant reduction in soot content of smoke due to water mist. In fact if the fire is hot enough there is condensed steam mixed with the soot, which increases Optical Density measurements, hence reduces visibility. Also, as Dr. M. notes, the stratification is lost, so that smoke descends to the floor level, destroying the "smoke free layer" and reducing visibility at floor level. To remove enough soot from smoke to improve visibility, as in an industrial scrubber for stack emissions, much effort must be paid to the mixing length and plating out of wash water. Design of such industrial scrubbers involves controlling mixing efficiencies to a greater extent than can be achieved by spraying water mist into a cloud of smoke.

With respect to removal of hazardous gases, there is no evidence that water mist removes insoluble gases such as CO, and even though CO₂ is theoretically soluble, simply passing the gases through a screen of mist does not provide ideal conditions for dissolution of the CO₂. Most of the CO₂ remains as a gas. Even highly soluble HCl from burning plastics is not rendered harmless by the water mist. Also if the gases are vitiated of oxygen, washing the gases through water mist does not add oxygen. It is not a safe conclusion that smoke is breathable after having passed through a curtain of water mist.

The MGM Grand Hotel Fire in the early 1980's in Las Vegas, USA illustrates my point. About 80 people died from smoke in that fire. The smoke was drawn by fans from the fire area through a vertical ventilation duct, into the large roof-top air filtration units. The "smoke" was filtered to the extent that it had no soot. It was then pumped back into the ventilation system throughout the rest of the hotel. People died of CO poisoning in rooms and corridors far from the fire - from absolutely clean smoke. There was no soot to stain the walls, or even to warn the people that "smoke" was filtering into their hotel rooms. The smoke was cooled, soot was removed, but it was as deadly as ever.

In 1993 I examined the benefits of using water sprays to cool shielded fires to mitigate smoke conditions in a study funded by ASHRAE (reference below).

Mawhinney, J.R.; Tamura, G.T., "The effect of automatic sprinkler protection on smoke control systems." *ASHRAE Transactions* pp. 1-47. *In Proceedings to the ASHRAE Annual Meeting*, New Orleans, January, 1994, NRCC 36866 (IRC-P-3412).

In that study, I concluded that the benefits of using water sprays to mitigate smoke hazards can be attributed to:

1. reduction in the smoke generation rate due to suppression of the fire
2. reduction in buoyancy of the smoke due to cooling - with reduced buoyancy, the smoke does not spread at the same rate as when it is hot.
3. reduction in the temperature of the smoke, decreasing its threat to life, and the threat of spread of fire.

The water sprays did not improve visibility in the stairwells - visibility was 0 meters. CO concentrations of 3000 ppm were measured.

I agree with Dr. Muehlenbruch that the cooled smoke will present a less stressful condition for fire fighters than the alternative. Fire fighters are equipped with breathing apparatus. However, one should be cautious in claiming that the "air is breathable". This is a dangerous assumption for civilians trying to evacuate, and equally as dangerous for fire fighters if they approached a tunnel fire without breathing apparatus, on the mistaken assumption that the smoke was being cleansed by the water mist system.



Revision of the IMO Guideline MSC/Circ. 668/728

Information by the board

Corporate/Institutional Members, Board and Council Members of IWMA as well as a representative of the U.S. Coast Guard have met on 17 January at the head offices of Germanischer Lloyd in Hamburg, Germany, in order to start the revision of the IMO guideline MSC/Circ. 668/728. The attendees of this meeting have decided to continue the revision work within an IWMA work group.

The minutes of the first meeting will be available in week 12. The next meeting concerning this subject is scheduled for the conference week at the beginning of April. The venue for the meeting will be the conference hotel also.

Water Mist Fire Protection Systems Gain Momentum

By Richard P. Ferron

*Member: IWMA Scientific Council
Factory Mutual Research*

Water mist fire protection systems gained acceptance just a few years ago as a replacement in many applications for halon gas, which is now banned by most countries worldwide. The surprisingly effective fire fighting qualities of water mist have led to its use in a rapidly growing number of challenging fire protection applications, including oil platforms, gas turbine enclosures, hotels, trains, ships, and antiheroes manufacturing environments. At Factory Mutual Research, an affiliate of commercial and industrial property insurer FM Global, the combined efforts of engineering and research disciplines have enabled the company to keep up with the demand on the part of water mist system manufacturers for an increasing number of approved water mist applications. In fact, no other testing laboratory in the world offers more water mist application testing than Factory Mutual Research. In addition, the company is continually developing new application tests to help expand the use of water mist fire protection systems into new areas. In an effort to make it easier for manufacturers to develop new water mist systems, understand Factory Mutual Research performance tests, and communicate more effectively with local authorities having jurisdiction (AHJs), Factory Mutual Research will soon issue a comprehensive new water mist system approval standard (Class 5560). The new standard will simplify and clarify the approval process by combining in one document all of the current component tests required for water mist system approval, as well as all the fire performance approval requirements currently used by Factory Mutual Research to test complete water mist systems for various applications. "We're taking our best shot with this new standard at covering all of the water mist system components we currently approve," explains Rich Ferron, P.E. senior engineer with the Factory Mutual Research Hydraulics Section based in West Glocester, Rhode Island, USA.

"We're sure that once this standard is out, someone will find components that we missed or that should be included, and that's okay. We plan to update this standard annually or whenever necessary. We believe this is an excellent starting point.



A Growing List of Applications

The following is a list of current applications for which Factory Mutual Research will evaluate and approve water mist fire protection systems. Manufacturers seeking an approval for their water mist system must satisfy the appropriate Factory Mutual Research Fire Performance Approval Requirements pertaining to that application, in addition to passing component testing. The list, wherever possible, includes an example of the application and other relevant details.

Combustion Turbine Enclosures

Examples: Esso, Shell, and BP all use Factory Mutual Research – Approved water mist systems on all platforms in the North sea to protect turbines, turbine drivers, and other critical equipment. In conducting their own tests of water mist systems, Esso was able to extinguish large crude oil and propane gas fires in less than 10 seconds, using less than 2,5 gallons (10 liters) of water. Enclosure volumes covered by this standard include:

Up to 80 m³ - extinguishment is the goal

Up to 260 m³ - extinguishment is the goal

Exceeding 260 m³ - suppression or extinguishment is the goal.

Machinery Enclosures

Volumes and protection goals are the same as for turbine enclosures.

Industrial Oil Cookers

Used in the food processing industry for deep-frying. "Fires in large industrial oil cookers have in large property damage losses," Ferron says. "Water mist may be an excellent solution for these applications because it extinguishes the fire quickly and prevents reignition by cooling the oil and the surrounding metal portions of the equipment. A manufacturer is currently being evaluated for the first Approval for this application."

Light Hazard Occupancies

Office space and living areas; also may include corridors and common areas. Examples: Marriott Hotel in London; Channel trains using the Channel Tunnel; and the 73,000-ton (65,700 metric ton) Sovereign of the Seas, one of the world's largest cruise ships. Fire control is typically the goal in this Approval category.

Special Hazard Machinery Enclosures. Volumes and goals are the same as for turbine enclosures. Examples: engine test cells and machinery spaces that include minimal storage of flammable liquids similar to n-heptane.

Wet bench and other processing equipment

An example would be a computer chip manufacturing bench where the slightest contamination from fire could shutdown the process and cost millions. Flame and heat detectors are used with nozzles over the workbench and in the plenum. Rapid extinguishment is imperative in this application.

In many cases, end users and manufacturers were initially reluctant to trust new water mist technology. However after successful field tests and with the added pressure of regulatory changes, water mist systems were gradually accepted.

Today, water mist is not only an acceptable Fire prevention alternative, but, in many applications the best system for the job. "it is interesting to note that, at one time turbine manufacturers would not allow water near their equipment for fear it might warp hot casting," Ferron explains, "Today, several combustion turbine manufacturers and many end users specify water mist fire protection for combustion turbine installations. You may have to actually request another type of fire protection system if you do not want water mist."



A Steady Stream of New Application

Along with the current Factory Mutual Research fire Performance Approval Requirements, the company is researching and developing tests for many new water mist applications. In many new cases, manufacturers of water mist systems suggest ideas for new applications. Other application ideas are suggested by Factory Mutual Research field engineers and by FM Global insured's.

"The development of water mist testing and performance requirements at Factory Mutual Research is driven by the requests of manufactures and by our own needs," Ferron explains. "For Instance, in flammable liquid storage, which is one of the new applications we're Investigating, we agonized that we have a lot of insured's by chemical storage areas, even janitorial supply storage, that need special protection. Water mist may be ideal because of cooling run-off, and ventilation issues. We believe this will be a very big market for water mist systems." The following are additional applications for which water mist Fire Performance Approval Requirements are under development at Factory Mutual Research.

Computer rooms

While computer managers have concerns about using water mist systems to protect computers due to the possible effect on sensitive computer cards and other electronics, many organizations have adopted water mist for use below raised computer room floors. With halon banned and CO 2 too dangerous for office environments, water mist is an increasingly popular substitute in sub floor applications where power and communications cables are accentuated. Control or suppression is the goal in this application.

Local applications

This category includes isolated applications of water mist to protect a specific area or device. This may include motors, transformers, oil filters, and stand-alone machinery. "Local applications is a very big market right now," notes Ferron. "We need to develop a standard for these types of applications. Manufacturers want it and our insured's will benefit from it Extinguishments is the goal.

Ordinary Hazard Occupancies

Examples include stockrooms, small warehouses, and other small storage areas. Fire control is the goal.

Flammable liquid storage areas

Found almost everywhere, including hospitals, colleges, research firms, manufacturers, and paint operations, may include chemicals, janitorial supplies, paints and lubricants.

Water mist has the potential to eliminate run-off problems and provide a tremendous cooling effect. Rapid extinguishments is the goal.

"By continuing to stress performance-based water mist fire testing, rather than prescriptive testing, we hope to allow many system designs and configurations to proliferate," Ferron stresses. "As long as new systems can meet our Approve and encourage new applications for water mist systems. While no single system can work for every situation, water mist has proven itself to be a flexible and powerful fire protection alternative. We believe water mist systems will continue to find widespread use in challenging situations.

System Approach

"We are the only Approval laboratory in the world today that tests the entire water mist system, not just the nozzle or other isolated component," Ferron notes, "we are in the property protection business. Our primary concern is system effectiveness and reliability, not isolated components. While we have work as part of a complete system.



We sit on the International Organization for Standardization (ISO) committee investigating water mist systems, and many of the delegates want ISO to take a systems approach to water mist. We plan to propose our completed water mist standard to the ISO committee, at least as a starting point for discussion.

Water Mist Benefits

What is all the fuss over water mist? What makes it so effective for so many different applications? How is it different from conventional sprinkler systems? The following are some of the critical benefits that water mist offers.

Replacement for halon and CO 2 in many applications

The first major use of water mist protection systems was on ships as a replacement for CO 2 and in response to regulatory requirements to provide sprinklers on passenger vessels. Water mist is environmentally benign and totally safe for occupied areas.

Safer than CO 2

There have been numerous instances of injuries and even deaths as a result of accidental CO 2 discharges during routine maintenance and other situations. Water mist is not only safe, but actually improves the livability of radiant heat by the many microscopic droplets.

Uses less water than conventional Sprinklers

This is a big benefit in many applications where run-off is a concern, such as “cut off” rooms containing paint or flammable chemicals. Water usage is critical in Europe where building owners must provide a collection area for all run-off.

Prevents reignition

Again, because of its cooling effect and room flooding ability, water mist systems are very good at preventing reignition, even of oil bath fire or other “pool” fires. In Factory Mutual Research tests, attempts to reignite fires with a torch were often impossible because the water mist put the torch out.

Works well against high heat release rate fires in enclosures when total “flooding” protection is used

For large fire in enclosures, the strong convection and high heat release rates are ideal for optimal water mist operation. In this application, the atomized droplets are drawn to the base of the fire and flash instantaneously to steam, expanding in volume by 1,700 times, thereby displacing oxygen required for combustion.

Works in partially ventilated areas

Unlike CO 2 or halon, water mist will work in areas where a door or vent has been left open. Gas-based extinguishing systems typically require a sealed area so that a gas concentration can be achieved to put out the fire.

Has some smoke-scrubbing qualities

Some smoke and toxic gases are absorbed by the atomized spray, and eventually settle with the water.

What’s the Down side?

There is currently no general design method recognized for water mist protection systems.



Doesn't do well on very small fires

Such as trash can fires; however, it will contain small fires in an equilibrium state and cool the room enough to allow extinguishments by fire fighters or facility personnel.

It's more expensive

While prices continue to fall with wider use, the fact remains that water mist systems tend to be somewhat more complicated and more expensive than conventional sprinkler systems.

It's new and many authorities having jurisdiction (AHJs) are uncertain how to evaluate water mist system

This situation is improving and the introduction of clear documentation, such as Factory Mutual Research's soon-to-be-released water mist Approval standard, will help manufactures and insured gain acceptance of water mist systems.

Typically requires greater water pressure than conventional sprinkler

While some water mist systems have been developed to operate at relatively low water pressure, most water mist systems require compressed gas or high-pressure pumps to create the atomized spray necessary for proper operation.

For additional information on the Factory Mutual Research Approval program for water mist systems and components, please visit www.fmglobal.com or contact Rich Ferron senior, engineer, Factory Mutual Research, E-Mail: richard.ferron@fmglobal.com

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