

OVERVIEW OF MODERN WATERMIST SYSTEMS



My personal journey with watermist systems dates back to the early 2000s when I was still working within Finnish academia. At that time, several Finnish and Danish companies were developing water hydraulic products as eco-friendly and fire-safe

alternatives to oil hydraulic products. As a by-product, components for high-pressure watermist systems were also being developed.

My actual involvement in the watermist industry began soon after my academic career and post-graduate degree and has now continued for 20

years. Being deeply involved in the technology through the International Water Mist Association (IWMA), working within industry, standardisation committees, and participating in various research projects, I can confidently say that I know the technology inside and out. Currently, my daily work consists primarily of other fire safety engineering tasks, but I remain passionate about watermist technology. It uses pure water to tackle many different kinds of fires in a noble and efficient manner and is eco-friendly, making it even more appealing in today's changing world. This article will focus on the current state and future insights of watermist systems rather than their history.

WHAT IS MODERN WATERMIST TECHNOLOGY?

Modern watermist technology is a sophisticated evolution of the systems developed three decades ago. While the fundamental principles have remained consistent, advancements have significantly broadened the scope of applications, approvals and validation processes. Here is a closer look at what defines modern watermist systems in my opinion:

- **Enhanced application range:** Modern watermist systems have expanded far beyond their initial applications. They are now employed in a wide variety of environments, including commercial and residential buildings, industrial facilities, marine and transportation infrastructure. The technology's versatility allows it to address a diverse array of fire risks, including new and emerging hazards. Many of the applications are traditionally protected with sprinkler or gaseous systems, further demonstrating how adaptable mist technology is in working alongside these established methods.
- **Increased validation and approvals:** Over the years, watermist systems have undergone extensive validation through experimental fire tests. This rigorous testing has established their effectiveness across various scenarios and led to the development of comprehensive standards and approvals.

- **Response to new risks:** The rapid pace of change in the world has introduced new fire risks and challenges. Modern watermist technology is practised at adapting to these. The industry is accustomed to carrying out fire tests, enabling quick responses to new or evolving risks. Mist systems are well-known in typical applications performed with performance-based fire-safety design methods. Recent advancements have addressed fire-safety issues related to cross-laminated timber (CLT) structures, tunnel protection, lithium-ion battery applications, power generation, air hangars, data centres, various industrial risks and complex steel and glass structures. Watermist systems have proven to be highly effective in mitigating these new risks, demonstrating their ability to provide innovative solutions.
- **Continued technological evolution:** While the core principles of watermist technology have not changed, ongoing improvements in system design, nozzle technology and control mechanisms have enhanced their performance and efficiency. These advancements ensure that watermist systems remain at the forefront of fire-protection technology. In summary, modern watermist technology represents a blend of well-established principles and innovations. Although the fundamental concepts have been around for decades, the technology's evolution has been marked by increased application versatility, rigorous validation and a proactive approach to addressing new fire risks. This dynamic nature of watermist systems allows them to remain a vital and effective tool in modern fire protection.

WHAT ARE PHYSICAL FUNDAMENTALS OF WATERMIST TECHNOLOGY?

Modern watermist firefighting systems are founded on several key principles that collectively enhance their efficiency and effectiveness in extinguishing fires. These principles include the cooling effect, oxygen displacement and radiant heat attenuation. Understanding these principles is essential to appreciating how watermist technology operates and why it is an increasingly popular choice for fire protection.

COOLING EFFECT

One of the most significant advantages of watermist systems is their ability to maximise the cooling effect of water. Traditional sprinkler systems produce larger droplets, which are particularly effective on fuel surfaces but not as efficient in heat absorption or blocking radiant heat as the finer droplets produced by watermist



Elbphilharmonie Hamburg, a super modern high architectural concert hall, featuring a typical watermist application with performance-based design. (IFAB)

systems. The smaller droplets created by watermist systems work in a more three-dimensional manner, filling the protected volume and dramatically increasing the surface area of the water exposed to the fire.

This increase in surface area allows the water to absorb heat more efficiently and rapidly, reducing the temperature of the surrounding air and cooling the flames. This rapid cooling effect helps to lower the overall temperature of the fire, slowing down the combustion process and aiding in extinguishing the flames more quickly and effectively. The small droplets can penetrate even complex fire geometries and are suitable for flammable liquid or grease fires.

OXYGEN DISPLACEMENT

In addition to their cooling effect, watermist systems also leverage the principle of oxygen displacement to combat fires. When the fine droplets of water are introduced into the fire zone, they evaporate rapidly due to the heat. This rapid evaporation process expands the volume 1,680 times, which displaces the oxygen in the immediate vicinity of the fire.

Oxygen is a critical component of the fire triangle, along with heat and fuel. By displacing oxygen, watermist systems effectively starve the fire of one of its essential elements, thereby inhibiting the combustion process. This dual-action approach of cooling the fire and displacing oxygen makes watermist systems highly effective in controlling and extinguishing fires.

BLOCKING RADIANT HEAT

Radiant heat is a significant factor in the spread of fires, as it can preheat surrounding materials, making them more susceptible to ignition. Watermist systems provide effective protection from radiant heat through the blocking properties of the fine water droplets. When watermist droplets are dispersed into a fire, they create a mist curtain that absorbs and scatters the radiant heat energy. This mist curtain acts as a barrier, reducing the intensity of the radiant heat that can reach other areas. By blocking (limiting) radiant heat, watermist systems help to prevent the fire from spreading to adjacent areas and materials, thereby containing the fire and protecting the surrounding environment.

WHY MODERN WATERMIST IS GAINING POPULARITY?

The principles of watermist systems have been known for over 100 years, but their popularity has risen gradually, particularly over the past 20 years. This increase in popularity can be attributed to several factors, including physical fundamentals, technical benefits and environmental considerations. While the physical fundamentals have been covered previously, the following will address the technical benefits and environmental aspects.

TECHNICAL BENEFITS

Watermist systems offer technical benefits that increase their popularity in many applications:

- **Ease and speed of installation:** Watermist systems are relatively easy and quick to install compared to traditional fire-suppression systems. This is due to the smaller components, such as pipes and tanks, that are required. Nozzle spacing is also typically much larger for mist systems.
- **Retrofitting:** These systems can be easily retrofitted into existing buildings, including those with high architectural significance or heritage status, as the components are typically very small.
- **No compartmentation required:** Unlike many gaseous systems, watermist systems do not require compartmentation. They can be activated immediately, which helps to limit damage in sensitive areas such as data centres.
- **Distribution and penetration:** Due to the small size of the droplets, watermist is well distributed and fills many nooks and crevices within seconds of activation. It can be carried by air flow, allowing it to control or extinguish even concealed fires.
- **Smoke control:** Watermist efficiently cools the smoke layer, preventing the hot gas layer from contributing to further fire spread. It also helps to clean out some of the smoke particles, improving visibility and reducing smoke inhalation risks.
- **Human safety:** Watermist is harmless to humans, making it safe for use in occupied spaces.
- **Minimal water damage:** The disposal of fire water is easy due to the small amount of water used, resulting in less water damage to property.

ENVIRONMENTAL ASPECTS

Watermist systems offer significant environmental benefits that contribute to their growing popularity as eco-friendly technology:

- **Reduced water consumption:** Watermist systems use notably less water compared to traditional sprinkler systems. This not only minimizes consequential water damage but also reduces downtime for businesses after a fire event.
- **No ozone depletion or global warming:** Watermist systems do not contribute to ozone depletion or global warming. Unlike some fire-suppression systems that use chemical agents, watermist relies solely on water, making it a more environmentally responsible choice.
- **Non-toxic and simple disposal:** Watermist systems do not produce toxic by-products when applied to a fire. Additionally, they do not require complex decommissioning procedures, simplifying the clean-up and disposal process. This ensures that watermist systems are safe for both humans and the environment.

WHAT IS HINDERING MODERN WATERMIST TECHNOLOGY?

Despite the increasing popularity of modern watermist systems and their numerous advantages, several factors have historically hindered their broader adoption and development. Understanding these challenges is important to appreciating both the progress made and the areas where further advancements are needed. Here are some of the key obstacles that I find most relevant:

- **Knowledge and expertise:** The relatively recent and continuously increasing adoption of watermist technology means that there is a limited pool of professionals with extensive experience and knowledge in this area. The specialised nature of the technology requires skilled engineers and technicians who understand the nuances of watermist systems, which can be a limiting factor in some regions. The IWMA has extensively educated and promoted knowledge related to watermist systems, helping to address this challenge.
- **Historical preference for sprinklers and gas systems:** Sprinkler systems and various gas-based fire-suppression methods have been industry standards for several decades. Sprinkler systems have been widely used since the early 20th century, while gas-based systems gained prominence from the mid-20th century onwards. They are well-established, with a long history of proven performance and extensive regulatory approval. The entrenched use of these older technologies can lead to resistance against adopting new methods, even when modern alternatives offer significant advantages. Although watermist systems are often considered a new technology, they have been around for nearly 30 years and hold almost 100% market share in many applications.
- **Costs:** The initial cost of watermist systems can be higher compared to traditional fire-suppression systems, such as sprinklers. This is due to the advanced technology and components required, such as pumps and specialised nozzles. For some organisations, the upfront investment can be a significant barrier, despite the long-term benefits and savings on water usage and potential damage. Additionally, indirect costs, such as those related to tank and sump sizes, drainage or disposal, are often not fully considered.
- **Attitude toward innovation:** The fire-protection industry is known for its conservative approach, often favouring established technologies over exploring new innovations. This cautious attitude can slow the acceptance and implementation of newer technologies, such as watermist systems. Many stakeholders may be



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hesitant to transition from proven systems to newer alternatives due to this reluctance. Furthermore, the conservatism of the fire-protection industry has also limited the influx of young engineers. I have observed that we rarely compete with more attractive industries, like the automotive or aviation sectors, to attract top-level young engineers. Additionally, other industries within the construction sector have demonstrated significantly more innovation compared to fire protection.

WHAT IS THE FUTURE OF MODERN WATERMIST TECHNOLOGY?

In my opinion, the trend of growth and expansion within the watermist industry is set to continue. The commercial value of this sector is already substantial, and the technology is being applied increasingly across a wide range of applications, thanks to its superior efficiency. Several factors will play a crucial role in this ongoing development:

- Even broader application scope: The watermist

industry will continue to be a leading innovator in fire protection. Emerging risks related to energy storage systems, data centres, car parks and the automotive industry have demonstrated the sector's ability to quickly develop sound and reliable solutions. Performance-based design is gaining traction, allowing for the development of application-specific best practices that further support the use of watermist systems. I have personally been involved in projects such as those for the Eurotunnel, a unique rail link, where we developed tailored solutions to address specific challenges.

- Environmental and sustainability focus: With an increasing emphasis on environmental sustainability, watermist systems will benefit from their eco-friendly attributes, and innovations in water recycling and conservation within these systems will enhance their environmental credentials. As environmental regulations tighten, watermist systems are likely to gain further recognition and support. Their reduced water usage and non-toxic nature align well with global sustainability goals, potentially leading to more favourable regulations

and incentives for their adoption.


- Standardisation: The standardisation of watermist systems is expected to advance, with new standards emerging for broader applications. The IWMA has developed a comprehensive matrix outlining all relevant watermist standards and applications, which is available on their website. This progress in standardisation will help facilitate wider adoption and ensure consistency in system performance.
- Increased market penetration: As watermist technology becomes an industry standard in various regions and applications, the resulting commercial momentum is likely to reduce costs. This will make watermist systems more accessible and attractive to a wider range of applications and markets.
- Education and training: Expanding education and training programmes for engineers, designers and installers will help address the expertise gap and promote broader adoption of watermist technology. Enhanced knowledge and skills in this area will contribute to more effective implementation and optimisation of watermist systems.
- Ongoing research: Continued investment in research and development is crucial for advancing watermist technology. This includes exploring new materials, testing novel applications and refining system performance to address emerging fire risks. Ongoing research will drive innovation and ensure

that watermist systems remain at the forefront of fire protection solutions.

CONCLUSIONS

Modern watermist technology has advanced significantly over the past 30 years, becoming both a well-established and commercially valuable technology. Its impact goes beyond mere commercial success, driving substantial innovations in fire protection.

Looking ahead, the watermist industry is set for continued growth. With ongoing advancements in design, expanding application scopes, and a stronger focus on sustainability and eco-friendliness, watermist technology will play an increasingly vital role in modern fire protection. As costs decrease and knowledge broadens, these systems will address both traditional and emerging fire-safety needs more effectively. Progress in technology, regulatory support and industry collaboration will be essential for overcoming current challenges and ensuring the technology's ongoing success. The IWMA plays a key role in this evolution.

I have been fortunate to closely follow the development of the watermist industry for over 20 years, which, like my own background, has deep roots in Europe and particularly the Nordic region. I look forward to seeing what the next 20 years will bring. 



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