The state of the art of water mist technology

Ragnar Wighus, SINTEF, Norway

Topics covered in this presentation:

- Fire statistics
- Acceptance of watermist
- New applications
- Standardisation
- Development
- IWMA's role

Fire statistics:

- Economy Watch: In USA:
- Fire contributes to the maximum number of deaths occurring in America due to natural disasters.
- Eight out of ten fire deaths take place at home.
- A residential fire takes place after every 77 seconds.
- The major reason for a residential fire is unattended cooking.

- Trend: To see fire as vulnerability for the society (Wildland fires, earthquaque, tsunami, storms, terrorism)

Economic cost: 1% of Gross Domestic Product in developed countries

Over the centuries, our understanding of fire has changed and progressed. Instead of being just an elemental force, modern science has lead us to understand fire as a chemical process of combustion, to investigate the varied contexts and conditions in which combustion will and does occur, and to invent ways and means of averting or dealing with its incidence. Fire no longer holds the same pervasive mythological and mystical connotations it once did, and modern economies and societies now accept fire as one of many risks to life and property which must be managed. Widespread multi-risk property and casualty insurance, improved fire protection services and activities, stricter construction and building codes, more extensive safety standards for products and materials, and more sensitive urban and environmental planning have all helped to reduce the danger and damage of uncontrolled fire. Still, the scale, scope and intensity of fire as vulnerability remains great, leading the WFSC in the 1980s to estimate the economic cost of fire at around 1 per cent of gross domestic product in developed countries—an estimate which remains widely accepted to the present day.

Total cost in USA is estimated to 2.5% of Gross Domestic Product when including:

Direct fire losses

Indirect fire losses

Insurance coverage

Fire departments and volunteer fire fighters

Fire protection of buildings and constructions

This means that investment in watermist systems can make a big difference

Cost of Direct Fire Losses—Table 1

Table 1: ***Adjusted direct losses*** (in millions, except for Japan—billions)

Country	Currency	Direct Losses 2007	2008	2009		Cost as percentage of GDP 2007-2009	
Singapore	$S	110	110	115		0.04	
Slovenia	SIT					0.07	[2002-2004]
Australia †	$AUS	**905**	**1,000**	945		0.08	
Czech Republic	Kč	2,450	3,700	2,450		0.08	
Spain ‡	€		910			0.08	[2008]
Poland	zl	**900**	1,450	1,150		0.09	
United States	$US	16,500	17,500	14,000		0.11	
Japan	¥	600	**615**	605		0.12	
New Zealand	$NZ	180	240			0.12	[2007-2008]
Germany	€	2,950	2,850	3,050		0.12	
United Kingdom	£	1,700	**1,950**	1,800		0.13	
Finland	€	315	305	295		0.17	
Netherlands	€	900	1,050	925		0.17	
Sweden	kr	5,400	5,950	5,550		0.18	
Denmark	kr	4,050				0.20	[2005-2007]
France	€	3,400	4,550			0.20	
Italy	€	2,500	3,150	3,750		0.20	
Norway	kr					0.22	[2003-2005]

† Australian data is calculated from figures provided in the *Report on Government Services 2012* and may be influenced by specific methodological features of that publication.

‡ Spanish figures rely upon internal WFSC estimates derived from Spanish insurance data and have not had adjustments applied; consequently, this data should be regarded with caution.

NOTE: Fire losses include explosion losses following fire, but exclude explosion losses where no fire occurs (for example, some acts of terrorism)

Cost of Indirect Fire Losses—Table 2

Table 2: Average percentage of GDP (2007-2009)

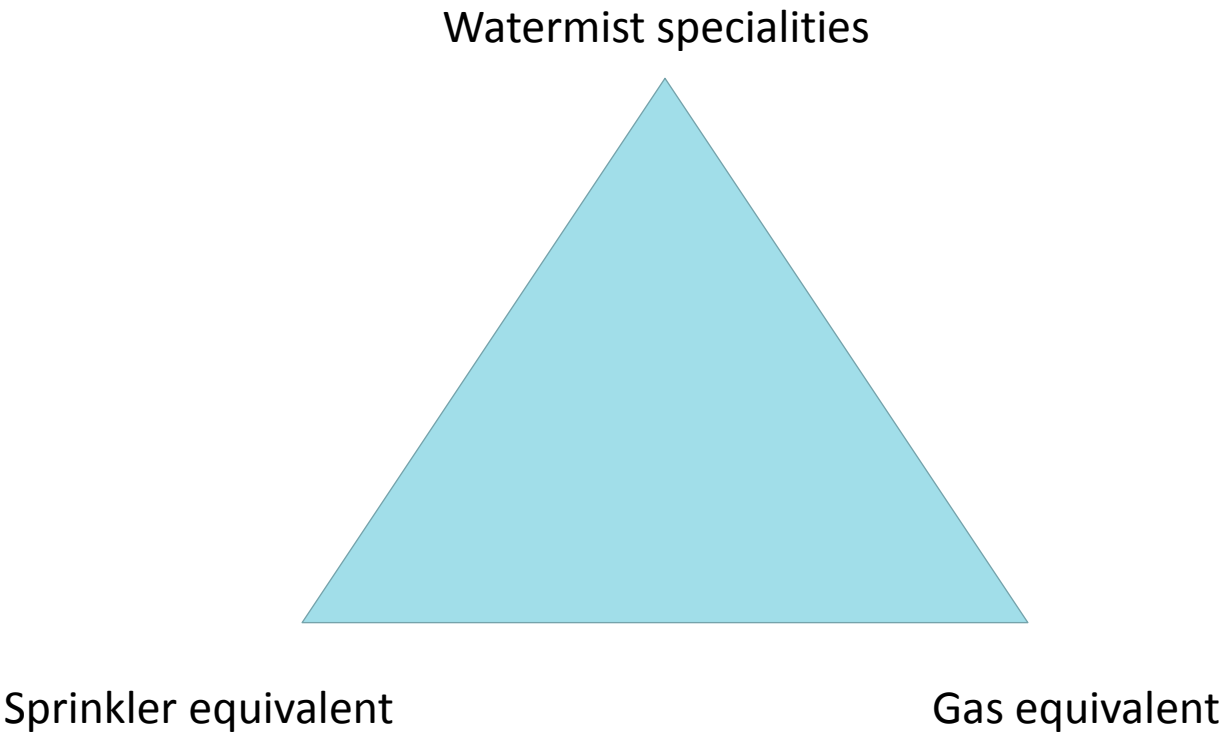
Country	Cost as percentage of GDP *2007-2009*	
Norway	0.002	[2003-2005]
Czech Republic	0.005	[2000-2002]
Japan †	0.006	
New Zealand	0.007	[2004]
United States	0.007	
Sweden	0.009	
Finland	0.010	
France	0.010	[2005-2007]
United Kingdom	0.010	
Germany	0.014	
Italy	0.014	[1993-1994]
Slovenia	0.021	[2002-2004]
Netherlands	0.027	[1995-1996]
Denmark	0.029	[1993-1995]

† The Japanese data does not take adjustments into account and should be compared to other figures cautiously.
NOTE: This table must be regarded with severe reservations—the figures are produced on widely varying bases and some differences appear too large for credibility.

Acceptance

- Even though there is a general scepticism against the "new" technology, there is a common acceptance that watermist fire protection systems have demonstrated their value in assisting the protection of life and property in industrial and commercial applications for many years.
- A correctly designed, installed and properly maintained watermist fire suppression system can detect, suppress and control a fire at an early stage of development, and activate an alarm. Operation of the system will rapidly reduce the rate of production of heat and smoke, allowing more time for the occupants to escape to safety or be rescued.
- The fire suppression leads to substantial reductions of material damage, and will normally constrict the fire damage to the near vicinity of the outbreak area.
- The basic concept of acceptance of watermist systems is that the performance is documented by relevant fire tests
- A bi-product of watermist tests is that other active fire protection systems (sprinkler) performance has been documented (equivalency testing)

Some types of watermist applications:



Applications:

- Much of the work with standards has been concentrated on equivalent systems, like the sprinkler equivalent systems and the replacement of Halon systems
- Some applications based on successful testing are:
  - Turbine enclosure protection
  - Protection of heritage buildings, museums, libraries and collections
  - Road and rail tunnels
  - Aircraft and hangar protection
  - Industrial fryers (deep fat fryers)
  - Local liquid fire sources

Standardization

- We have obtained a god basis for standardizing watermist systems and its use internationally for the marine sector.
- Standardization for the land-based sector in Europe has not reached this stage, and the national standardization bodies still are developing special standards for the design, installation and maintenance of watermist systems.
- In US the national standards have developed quite extensively. Both the NFPA, UL and FM have developed standards for certain applications.
- In Oceania, New Zealand has developed their own standard, as well as Australia.
- In Asia, US standards are mostly used, but some attempts to make national standards can not be disregarded.

Possible new applications:

- Flashover protection in large spaces (fire control, fire suppression rather than complete extinguishment of fires)
- Zoned protection of large spaces (marine, larger machinery spaces, also to general applications)

- These applications lacks specific standards for approval and acceptance.

Standardization

- International:
  - IMO: Well established for machinery spaces an pump rooms, Cabin and corrridors, public spaces, storage, taxfree shops
- Europe:
  - CEN, VdS, National standards: Many initiatives, partly conflicting standards
- USA:
  - NFPA, UL, FM: Quite uniform approach
- Other regions:
  - Australia and New Zealand: Established standards
  - Middle east: Uses mostly NFPA or other US standards
  - China: Developing own(?)

Overseas standards:

- **AS 4587-1999**
  Water mist fire protection systems - System design, installation and commissioning

Example of use of analytical design:

4.3.2.2 The impact of an automatic fire suppression system

If there is an automatic extinguishing system, the fire load in the relevant fire compartment can be reduced.

General recommendations:

Consideration can be given to the impact of an automatic fire suppression system according to BBR 5:252 by the design fire load being reduced to 60% of its original value.

Example of use of analytical design:

3.4.5 The impact of an automatic fire suppression system

General recommendations:

The effect of an automatic fire suppression system can be considered as indicated below. For other types of extinguishing systems not listed below, a specific assessment should be carried out.

If the heat release development upon activation of an automatic water sprinkler system or residential sprinklers is no more than 5.0 MW, heat release can be reduced as follows:

- After the sprinkler activation, heat release is kept constant for 1 minute.

- Then the heat release reduces to 1/3 of the release at the time of activation. This reduction occurs during the ensuing minute.

- Heat release is then kept constant at this level.

If the fire's heat release at sprinkler activation is greater than 5.0 MW, the heat release should be assumed to be constant after sprinkler activation.

Suggested Swedish recommendation for analytical design of fire protection for buildings

Table 7 Level of critical impact in the analysis of evacuation safety

Criterion	Level
1. Smoke layer level above floor	Lowest 1.6+0.1 × room height
2. Visibility, 2.0 m above floor	10.0 m in areas > 100 m^2 5.0 m in areas < 100 m^2 The criterion can also be applied to situations where queue formation occurs at an early stage at the location where the queue develops.
3. Heat dose	max. 60 kJ/m^2 above energy from a radiation level of 1 kW/m^2
4. Temperature	max. 80°C
5. Heat radiation	max. 2.5 kW/m^2 or
6. Toxicity, 2.0 m above floor	Carbon monoxide concentration (CO) < 2000 ppm Carbon dioxide concentration (CO_2) < 5 % Oxygen concentration (O_2) > 15 %

Residential sprinkler standards and equivalent watermist systems

- Important application, both due to the frequency of residential fires and the life threat of these fires
- Nordic initiative: Fixed firefighting systems has to be installed in all new buildings with a certain number of occupants and escape possibilities (in practice: Where an elevator must be installed, fixed firefighting systems also shall be installed)
- A suggested addition to INSTA 900 is recently released:
- **Residential sprinkler systems – Part 3: Watermist systems equivalent to residential sprinklers**
- Requirements and test methods for alternative water based fire fighting systems equivalent to residential sprinkler systems as required in INSTA 900-1 and 2

TYPICAL FIRE SOURCE IN RESIDENTIAL SPRINKLER TESTS (Simulated furniture)

Development

- Watermist was launched as alternatives to existing firefighting systems in marine applications, IMO FTP Code:
  - Revised guidelines for approval of sprinkler systems equivalent to that referred to in SOLAS regulation II-2/12 (resolution A.800(19))
  - Alternative arrangements for halon fire-extinguishing systems in machinery spaces and pump-rooms (MSC/Circ.668, as amended by MSC/Circ.728)

- Watermist is introduced by several insurance-based approval bodies (VdS, UL, FM)

Focus in standardization work:

- I think that another possible solution to succeed in the land-based market would be to work with a standard for deluge systems, not the sprinkler-equivalent nozzles released one by one.
- Systems covering zones of a space, released by smoke/flame or gas detection are at present treated by the standard for Water Spraying Systems (NFPA 15), using massive amounts of water (5-10, even 20 litres/m^2 min).

BRANZ (Building Research Association of New Zealand) has collected reference tests with water-based fire suppression systems:

- Accommodation
- Kitchen/cooking
- Office
- Heritage and Libraries
- Electronic equipment
- Entertainment
- Factory/ Machinery
- Generic compartment

IWMA's role

- Be the voice of the watermist industry in a much more coordinated way than today
- Launch and coordinate scientifically based test protocols where it is lacking
- By conferences and seminars world-wide spread the knowledge about watermist technology to the advisers and end users

Conclusions:

- Common acceptance of watermist systems is achieved in many parts of the world
- Due to the differences between systems, no prescriptive standards have been written.
- Still there is a lack of knowledge of how systems can be documented and accepted by Authorities Having Jurisdiction
- IWMA has been instrumental in the work to revise the present CEN TS 14972
- IWMA has restructured its organization, moved office to Hamburg and will be more visible and professional
- Many of the large international manufacturers of firefighting equipment have developed watermist systems or acquired existing watermist producers
- In the future, IWMA should be the leading voice to open for acceptance of watermist systems in applications where its peculiarity is important, rather than eqiuvalency with other firefighting systems