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Watermist Techno

Watermist technology was once seen as a niche product for special industrial risks, but today, says Ruediger Kopp, it is widely accepted as an alternative to sprinklers and gaseous extinguishing systems.

By Rüdiger Kopp (Dipl.-Ing.)

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When watermist technology was "rediscovered" in the 1980s, it was seen mainly as a niche product for special industrial risks, such as protection of turbines, generators and other pieces of machinery. Today, however, watermist is accepted widely as a viable and effective alternative to gaseous extinguishing systems. In the marine industry, its benefits have been transferred from machinery space protection to accommodation areas where, traditionally, conventional sprinkler systems have been used.

Indeed, marine applications were the first where standards for testing, approval and installation of watermist systems were developed. The IMO (International Maritime Organisation) standards for machinery spaces and accommodation areas have been a good basis also for land-based applications, and still are used as a reference for the definition of fire scenarios in land-based watermist standards.

Watermist technology now has a firm place in the fire protection system market, with applications spanning from the protection of machinery containing fuels and lubricants, to cable tunnels, within the food industry, hotels, archives, museum, high-rise buildings, hospitals, laboratories, hotels and heritage buildings. Its use is also becoming widespread in the automotive and power generation sectors, for the protection of test cells, paint areas, hydraulic risks, generators, turbines and storage facilities. In the past few years, sophisticated and innovative fire protection solutions have been developed based on watermist technology that ensure highest possible level of safety where, previously, no appropriate solution was available.

Standards and fire tests

Since watermist combines the fire fighting effect of both conventional gaseous suppression and water sprinkler systems, it can neither be designed nor approved based on the standards applying to "conventional" systems. In their place, there are now a number of standards that apply specifically to the design and approval of watermist systems.

Among these, those that are most referenced internationally are: the IMO standards; NFPA 750 (Standard on Water Mist Fire Protection Systems); ANSI FM 5560 (American National Standard for Water Mist Systems) from Factory Mutual; and the European CEN TS 14972 (Fixed firefighting systems. Watermist systems. Design and installation). Based on these international standards, national guidelines and standards are under development, or have already been published by organisations such as VdS in Germany, APSAD in France and BSI in the UK.

All standards have in common that for watermist technology the required nozzle type, droplet distribution, flow rate, nozzle spacing and discharge time have to be individually determined by carrying out application-related, full scale fire tests to provide optimum protection of the respective risk. Transfer or extrapolation of design criteria from one application to another, or basing the system designs on calculation models, is not possible. In past years, numerous full scale fire tests have been carried out at independent fire

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research institutes and laboratories that have lead to broad acceptance of watermist systems as alternative to conventional systems.

Hamburg Philharmonic Orchestra Hall

Special buildings and architecturally challenging environments require sophisticated tailor-made solutions to fulfil their fire safety needs. The integration of an automatic fire fighting system into the Elbphilharmonie Philharmonic Concert Hall in Hamburg, Germany was one such challenge. It is a typical example of where watermist technology has delivered an innovative fire protection solution that provides efficient cooling, low water consumption, minimal potential water damage, and straightforward installation due to small pipework and small water storage requirement.

A conventional sprinkler system could not be used due to the height of the area and the potential water damage that would result from system activation. Similarly, a gaseous fire suppression system could also not be used due to the evacuation time required by the audience. So, it was decided to develop an innovative fire protection concept, based on high-pressure watermist technology; a concept that was verified in full scale fire tests that determined the system design parameters.

Since the fire load in the concert hall is concentrated in the floor and seating area, the firefighting agent preferably needed be focused in this area. So, instead of attempting to contend with the concert hall height of 25 metres, it was decided that a floor integrated system would be most appropriate solution. Rapid activation of the system after fire detection would further increase the safety level, so the fire detection and the firefighting systems were jointly evaluated.

Full scale fire tests were carried out with fire loads and test scenarios derived from standards such as CEN TS 14972, and the fire test results were evaluated by independent fire consultants and a certification body – HHP and DEKRA – to confirm that the concept met all of the safety requirements.

A zoned deluge, high pressure watermist system was installed, triggered by a linear heat detection system integrated into the floor area. In standby condition, special nozzles are covered with lids and incorporated into the floor areas between the seats to meet the demanding requirements of the architects and acoustics engineers of the building. Three adjacent areas can be discharged simultaneously to cover the worst fire condition.

This protection concept for concert halls resulted in a safe and architecturally satisfying solution; one that was successfully integrated into the overall fire safety strategy of the building and approved by the regulatory authorities.

Eurotunnel protection

The Channel Tunnel Rail Link under the English Channel links Calais in France and Folkestone in England and is used by around 16 million passengers each year. Up to 450 train journeys are made through the tunnel every day, including the high-speed Eurostar passenger trains and the Eurotunnel car and truck shuttles. After truck fires in 1996 and 2008, Eurotunnel, the operating company, decided to reinforce the already high fire safety standards.

To achieve this, a special fire protection concept was developed based on the establishment of four separate firefighting sections within the tunnel, in which a fire on a train could be fought quickly and effectively. Due to the significantly larger potential fire load that trucks represent, these so called "safe" stations are primarily to protect truck shuttles.

The decision to incorporate a firefighting system inside the tunnel was based on the recommendation of an expert group that had carried out a quantitative risk assessment and a cost-benefit analysis. High pressure watermist was chosen due to its high cooling potential that helps to create a safe environment for passengers, staff and vehicles within the tunnel. The watermist system potentially contributes significantly towards reducing the intensity of a fire, and the heat absorption supports the successful evacuation of people, particularly during the first critical phase of a tunnel fire.

During a lengthy test program with the fire and rescue service, it was established that, even with heat release rates of more than 200 MW, the watermist system facilitates the fire brigade's rescue efforts and allows for effective control of the fire and rapid extinguishing.

The tunnels are fitted with four times 29 deluge fire fighting sections, each 30 metres long and independently controllable. Only open nozzles are used in order to provide full flow rates for every activated section, so maximising the effect of watermist from the beginning of the system's activation. IFP

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Protecting the

Karlstejn Castle

Historic buildings come in all shapes and sizes; they can be stone, brick or timber-built; surrounded by near-impenetrable jungle or alongside a vehicle-clogged highway; some are so old they almost defy dating. But they have one thing in common . . . they are irreplaceable. IFP editor, Graham Collins argues the case for better fire protection.

By Graham Collins

The scale of the problem of protecting historic buildings spread across the globe is daunting. In England alone there are 400,000 Grade I and Grade II listed heritage buildings; worldwide, the tally must run into tens of thousands, and a very significant proportion are considered to be "at risk" in one form or another. Some are threatened by a chronic lack of care, others by the tramping feet of too many visitors; vandalism, war, terrorism, climatic change and simply the passage of the centuries have also added to the toll.

In many cases, man's ingenuity, commitment and sheer hard work has brought historic buildings back from the brink of oblivion. Sadly though, fire is a threat from which it is often – particularly with highly-combustible buildings – impossible to recreate anything more than a sterile replica of the original. Of course, the technology does exist to safeguard these structures from the ravages of fire; the same cannot however be said for every nation's willingness or ability to devote the necessary funds to the task. In too many countries around the world, fire protection comes down to little more than sheer optimism that a fire will not occur and the watchful eyes of those working in or living near the building.

While the range of historic buildings is diverse, construction methods also vary greatly. By definition, the vast majority were constructed before any fire safety codes or standards were even considered; they frequently feature a labyrinth of dead-end corridors and concealed chambers, and escape routes were never part of the original designer's thinking. Compartmentation is often non-existent.

With the exception of some religious buildings, none were designed for the purpose for which they are now used. Castles, for example, were designed to keep enemies out; they were never built to accommodate thousands of transient visitors. Take, for example the Kinkaku-ji temple or Golden Pavilion in Kyoto. Today it is one of the most visited buildings in Japan, but was built for the exclusive use of the ruling shogun in the 14th

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century. Ironically, perhaps, it is one of the "facsimile" historic buildings, as the original was burnt to the ground in 1950. Even those buildings, such as temples, that were designed to be accessible to the public, were not conceived to contend with the hoards that today regularly stroll though.

The scope for passive fire protection is obviously very limited, as the introduction of conventional fire doors and partitions can have a disastrous affect on a building's character and historic interest. The task of protecting the structure itself, its contents, staff and visitors is, therefore, best tackled by implementing appropriate active fire protection measured, coupled with risk assessment and the development of a strategic approach to fire safety.

The scope for passive fire protection is obviously very limited in historic buildings, so the task of protecting the structure itself, its contents, staff and visitors is best tackled by implementing appropriate active fire protection measures, coupled with risk assessment and the development of a strategic approach to fire safety.

The key word is, of course, "appropriate", as conventional detectors and exposed wiring would be deemed to be defacing many historic buildings. This has led to a fairly widespread use of detection and suppression technology that either does not add any intrusive visual impact or damage the very building – aesthetically or structurally – it has been installed to protect.

Video detection for 14th century Czech chapel

One such example is the Chapel of the Holy Cross situated inside the world-famous Karlstejn Castle in the Czech Republic, which was founded in 1348 by the Bohemian King and Holy Roman Emperor. It is one of the most famous and most frequently visited castles in the Czech Republic. The installation of an advanced FireVu CCTV camera-based video smoke detection system from D-Tec is protecting the Chapel, where magnificent panel paintings make it a structure of major international importance.

The installation is designed to deliver a swift, around-the-clock, response to any fire related incidents without impacting negatively on the unique aesthetics of the Chapel. In this particular instance, the authorities at Karlstejn Castle ruled out the option of installing an aspirated system, as it would involve extensive tubing to draw in air. After surveying the Chapel, it was decided what was required was a single FireVu black-and-white, day/night CCTV camera. To minimise any visual impact this was positioned at the entrance window of the Chapel, where a climate control unit was already positioned. The result was no additional unsightly cabling, and the FireVu networked Digital Video Recorder was fitted elsewhere, out of sight of visitors to the Chapel.

FireVu has the potential to offer 24-hour remote monitoring of fire incidents, with alarm

Grafschafter Castle

and associated video images distributed to an unlimited number of locations for review. In addition, as all alarm events are recorded on the system's Digital Video Recorder, they can be readily accessed for pre and post-event analysis. Testing and diagnosis of the installation can also be carried out remotely.

Early warning at China's forbidden cities

Two projects where the decision was taken to opt for aspirating solutions were at the world-renowned Forbidden City in Beijing and at the identically named Forbidden City in Shenyang, capital of north-eastern China's Liaoning Province, where VESDA technology is now providing early warning smoke detection to avoid the potential destruction of irreplaceable treasures of China's cultural heritage. Today, only a handful of original palaces remain, and both Forbidden Cities have been ravaged by fire several times in the past few centuries.

Constructed predominantly from wood that has dried for centuries, these buildings are an extremely high fire risk. Their construction is often intricate and highly detailed, with timber beams supporting the heavy tiled roof. This forms an enclosed environment where it is difficult for smoke and heat to escape, and where a fire has the potential to cause the building to collapse and be totally lost to future generations. This can all happen in a very short period of time, making it essential that fires are detected early.

The contents of the buildings are also frequently highly combustible, with wooden furniture, curtains and drapes, and painted screens. Old electrical wiring, degraded insulation, inappropriate use of electrical appliances and burning candles all increase the risk of a fire.

The VESDA systems were installed with the detection points concealed within the buildings – positioned in pockets in the ceiling or below ceiling level in buildings with very high ceilings. Even if smoke is diluted by a draught blowing through the

buildings, it will be detected and an alarm raised. Adjustable alarm levels allow the elimination of nuisance alarms, which is particularly important in these public areas to prevent unnecessary panic among visitors. In total, 26 VESDA units were installed in Shenyang Forbidden City, while 23 are safeguarding the Forbidden City in Beijing. A further 108 units will be installed in the Beijing palace in several phases by 2014.

The pipe network that takes air samples to the detector is installed on top of the ceiling beams. Unobtrusive capillary tubes are then attached to draw air samples into the pipes and back to the detector that, along with the associated electronics is hidden from public view in a control room.

Sign of the Hall of Supreme Harmony

Watermist protection for German castle

Grafschafter Castle in Moers, Germany, is a major tourist attraction. Built in 1200, it now houses the Museum Grafschafter, which focuses on the cultural history of the Lower Rhine. It contains many pieces of priceless original furniture. It has recently undergone a complete refurbishment of the electrical installation and the installation of a fire detection and fire fighting system. Due to the wooden floors and the value and scarcity of exhibits, conventional sprinkler technology was considered not to be an option.

Instead, a Fogtec automatic high pressure watermist system has been installed. In addition to limiting the water damage in the event of system activation, other considerations in favour of the Fogtec solution included the very restricted space for pipe, pump and water storage. The pump water break tank was installed in a small ten-square-metre room, and a total of 160 glass-bulb nozzles protect the castle's six floors. The lightness of the small-bore pipes limited the weight imposed on the ceilings and walls that vary greatly in their stability. IFP