WATER-MIST SYSTEMS FOR FIRE-PROTECTION OF SAUNAS

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Abstract
Saunas have become increasingly popular in the built environment (e.g., recreation centers, resorts). However, their structural components – timber benches – and the presence of fabric and chemicals represent an inherent fire hazard. High environmental temperatures, short circuits of electrical heaters and direct contact with incandescent materials may cause fires and even explosions, if the former are not effectively controlled and suppressed. Passive fire-protection systems are commonly combined with fixed, discharge-based ones; among these latter, water mist is a promising technology, especially if no sprinkler installation is already present.
An enclosed, real-scale facility was built and instrumented to evaluate control and suppression performance of a water-mist-based system against fires occurring in a sauna-like configuration. Typical timber benches (~ 43 kg) were used; a wood-crib fire accelerated by a heptane-pool fire was also employed to reproduce an electrical-heater failure. Two water-mist nozzles were installed at the ceiling height (2.4 m), each of which had a 12.96 m^2 area coverage. The discharge was operated at 100 bar. Various design and configuration parameters were varied: ignition-source location, presence of drywall boards and distance between benches and walls, distance between nozzles and walls, (natural) ventilation, initial room temperature (20 – 80 °C). Heat detectors were inserted to govern discharge activation upon a fixed threshold (180 s); the test chamber was equipped with K-type thermocouples and hot-plate thermometer to measure the heat-flux trend.
The system proved able to successfully control and contain the fire, as the bench damage ratio was kept below 5% throughout the whole experimental campaign. However, 2 instances of suppression without extinction occurred, one of which related to the supposed most challenging configuration (ventilated compartment, initial temperature > 80 °C and bigger nozzle-to-wall distance). Ignition-source location, wood-crib damage ratio and air-gap between benches and walls did not appear to impact on suppression performance.

Keywords: water mist, sauna, fire protection, control, suppression