CFD Modeling of Water Mist Systems for Suppressing Shielded fires in Enclosures Using FDS

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BIO: Azad Hamzehpour is a PhD student at the Polytechnic University of Turin in Italy. He is working on the experimental and numerical analyses of water mist systems for enclosure and tunnel fires applications. He has been performing several tests on the performance of the water mist systems on suppressing shielded fires in enclosures and tunnels and conducting CFD models using FDS.

Abstract

Despite the fact that in the recent years, many researchers and engineers have been working on the fire-related topics and the firefighting systems, there are still unknowns in this field due to the fire phenomenon complexity. Due to the high cost of real scale experimental tests and engineering constraints, several numerical methods have been developed in recent years to simulate fire dynamics and water mist systems. Fire Dynamics Simulator is a powerful tool to solve Navier-Stokes equations numerically. In this work, different fire scenarios in confined spaces and shielded fires are analyzed using FDS CFD tool. In addition, the performance of the water-based firefighting systems is assessed to find out the capability of such systems to control or extinguish the fire. This study will also help to better understand the fire behavior and the effectiveness of water-based fire suppression systems. The shielded fires representing the car top or train or shelves in real fire scenarios will be studied. The interaction between the water droplets and the shielded fire plume is of importance while investigating the fires as the chance of reaching droplets directly to the fire is low in real scenarios. The obtained results will be carefully discussed in the paper and the evaluation of the water mist systems with different characteristics will be presented. The evolution of the temperature and the effect of the fire location will be also discussed. The results show that the capability of water mist system to extinguish the shielded fire is dependent on the distance between the nozzle and the obstacle and also the size and the location of the obstacle and the droplet size distribution of the water mist systems. The authors would recommend researchers and engineers to perform more tests and simulations to investigate other available commercial water mist systems in case of shielded fires and to analyze the fire extinguishing mechanisms.

KEYWORD: water mist systems, diesel pool fires, enclosure fires, shielded fires, fire dynamics simulator