

Modelling fire suppression by water sprays in CFD: a review of progresses and challenges

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BIO: Dr Siaka Dembele is an Associate Professor at Kingston University London, where he leads the Fire, Explosion and Fluid Dynamics research group. He has been actively involved in the development of models for water spray in fire protection for over 20 years. He has authored and co-authored about 80 scientific publications on fire modelling, fire protection issues and computational fluid dynamics. Siaka is a member of the Scientific Council of the IWMA.

Abstract

In the past decades, water mist technology has emerged as a viable alternative for fire suppression in many applications. Numerous application and experimental studies of water mist are available in the open literature. However the modelling and numerical simulations of water mist, which are both critical to the development of this emerging technology, have received relatively little attention. Computational Fluid Dynamics (CFD) simulations of spray atomization and water mist in fire suppression are crucial to the design of efficient spray nozzles, the prediction of the spray characteristics and for performance based fire engineering design.

The presentation aims to provide to the water mist community a state of the art review of the current modelling strategies for spray atomisation and the behaviour of the multiphase spray in a fire suppression environment. The review will cover the primary and secondary atomisation modelling strategies in Lagrangian and Eulerian frameworks, and the challenges in the context of water mist technology. Some progresses achieved in the development of numerical approaches will be highlighted. It is worth noting that advances in spray atomisation modelling were mainly achieved in the automotive industry in the context of diesel spray modelling. But in light of recent developments in the diesel industry, a decline in research for spray atomisation is likely and the talk also aims to highlight to the water mist industry the future research needs for water mist atomisation and fire suppression modelling with CFD. The speaker will also present some research studies in his research team at Kingston University London on spray atomisation predictions and some improvements in radiative heat transfer modelling strategies important for predicting water mist cooling effect in fires.

KEYWORD: Spray model, atomisation, CFD, review, multiphase flow, Lagrangian particles, Eulerian