TWO DIMENSIONAL MODELING OF THE HEAT RELEASED BY A DIFFUSION FLAME INSIDE A SCALE TUNNEL

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ABSTRACT. This work intends to study numerically the heat released by a diffusion flame inside a scale tunnel and to validate the numerical approach with experimental data. These results serve as an input to determine the effectiveness of an original system based on Double Stream-Twin Jets air curtains operating as fire protection systems in tunnels generating a confined space inside the tunnel [1, 2]. The fuel is ethylene, injected through a flat plate porous burner into the tunnel and burned in normal air conditions. In order to evaluate the heat released by the diffusion flame, several simulations were carried out using the Fire Dynamics Simulator (FDS). The model is based on an approximated expression of the Navier-Stokes equations where acoustic waves are filtered while still allowing large density and temperature changes (low Mach number approximation) [3]. Characteristic velocities and dimensions corresponding to this study preclude the use of the subgrid model included in this code, thus LES is used [3]. The Radiative Transfer Equation, in its non-scattering approximation, is solved through a wide band model. A narrow-band model that accounts for the two main combustion products, H_2O and CO_2, computes the absorption coefficients required for each wide band [3]. In order to obtain experimental data the heat released by radiation was measured on several points along the tunnel by a specific radiometer. Several two dimensional simulations were conducted, modifying the main parameters affecting the radiation model. These results exhibited the capability of FDS to predict the heat released by the diffusion flame. A deviation on the numerical evaluation of soot production leads to a small difference of the computational prediction [4]. However, this does not affect the potential of FDS to predict the height of the diffusion flame [5].

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