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NUMERICAL SOLUTION OF LBL SPECTRAL RADIATION OF A N-HEPTANE POOL FIRE

Hadi Bordbar[1*], Simo Hostikka[1]

[1]Department of Civil Engineering, Aalto University, Finland.

ABSTRACT. The spectral characteristics of radiation coming from a pool fire flame are numerically obtained. The case study is a 2m n-heptane pool fire located in the bottom of a 4m×4m×5m rectangular domain. Transient heat and mass transfer of the system was solved using CFD code Fire Dynamic Simulator (FDS) with LES of turbulence and a two-step combustion reaction. The time averaged solution data of gas compositions, soot concentration and temperature along a line in the system were collected. Using the time averaged CFD data, two different one-dimensional models assuming parallel plate conditions and a line of sight solution were built to study the spectral radiative intensity observed outside the flame. The high-resolution LBL spectral absorption profiles of combustion gases together with a spectral model for soot absorption coefficient were used in spectral solution of thermal radiation along the line for both assumptions of parallel plates (using DO method) and line of the sight conditions. The spectral radiation profile reaching an imaginary sensor is qualitatively compared with the recently published experimental data of Kerosene large pool fires. The modelling results revealed the strong absorption effect of cold atmospheric gases while the emission peak of hot CO2 at ~2200cm^{-1} in fire is still quite distinguishable from the spectral profile of hot blackbody even at 23 meters away from the center of the flame. This emission peak can be therefore used for detection of the fire. Using the scaled CFD data for smaller pools showed that the difference between the spectral profiles of the fire and those of hot blackbodies is larger for smaller pools. It means that the detection of smaller fires using the spectral radiation characteristics is easier than that of larger fires where strong effect of soot emission caused more blackbody-like behavior.