BURNERS, COMBUSTION AND HEAT TRANSFER

(673) - (*) - A FAST THERMAL NON-EQUILIBRIUM EULERIAN-EULERIAN NUMERICAL SIMULATION METHODOLOGY OF A PULVERIZED FUEL COMBUSTOR

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A fast thermal non-equilibrium Eulerian-Eulerian three-dimensional combustion and radiative heat transfer model is used for application in a pulverized fuel combustor. It eliminates the need to explicitly track the fuel particles in a Lagrangian frame of reference, thereby significantly reducing the computation time required. The homogenized Eulerian solid-phase model employs a species-transport approach to track gas constituent distribution inside the computational domain and solves scalar fields for the pseudo particle mass, energy and radiation interactions. Therefore, it effectively captures the heat transfer between the particle phase and the continuous phase. The validity of the modelling approach is demonstrated via application to a 2.4 MW(th) lab-scale swirl pulverized-fuel burner operating at full load. The results of the new model are compared to both measured data and that of a detailed numerical model using the conventional Eulerian-Lagrangian frame of reference. The proposed model captures the total wall heat flux distribution of the combustor with relative errors between 0.5% and 5%. The ability to capture the fluid flow and heat transfer phenomena at lower loads is also demonstrated, which is an important requirement for studying flexible operation of pulverized-fuel power plants. A computational speed enhancement of between 50% and 60% is achieved for various load cases. The proposed approach therefore fulfils the need for a fast, yet sufficiently accurate three-dimensional CFD modelling methodology to generate large databases of results for surrogate model development.

Palavras-chave : Computaional fluid dynamics, Solid fuel combustion, Eulerian-Eulerian