Computational Fluid Dynamics Simulation of Fire Whirl Using Methanol Fuel

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ABSTRACT

A fire whirl is usually a very complex combustion phenomenon with dangerous consequences through increase of spotting fire, huge fire intensity, inconsistent spread rate, undetectable direction, and wind damage. But currently, there is lacking of understanding on the characteristics of fire whirls by using hydrocarbon fuels. Therefore, the objectives of this study is mainly based on analyze and determine the characteristics of fire whirl by using computational fluid dynamics (CFD) simulation with methanol acting as a fuel supplement. A methodology of SIMPLE algorithm is used to solve the momentum conservation equation, fuel species conservation equation, oxidizer species conservation equation and energy conservation equation to obtains the unknown variable of temperature (T), density (ρ), axial velocity (v_z), radial velocity (v_r), angular velocity (v_z), fuel mass fraction (Y_f) and oxygen mass fraction (Y_o) inside the predetermined boundary conditions of the numerical solution. The results from the simulation shows that the forming of fire whirl can be categorize into 3 stages correspondingly is the ignition stage, developing stage and stable stage. The results shown in the simulation is then compared to the laboratory experiment. Moreover, it is found that the simulations has correctly predicts the flame height of fire whirl before doing laboratory experiment. Besides this, the simulations has also predicts the external physical characteristics of fire whirls and unforeseen phenomenon. Discussions of the study are mainly prepared to discuss and explain the phenomenon in the simulations. Moreover, there is a discovered of a new finding on the fire whirl is it has been further deliberated and prove in this study. Then finally a conclusion and future recommendations have been made based on the results and discussion in the study. A well-functioning CFD simulation of fire whirl with methanol fuel using FORTRAN code 95 (shown in *Appendix A*) is created.