Numerical study of a laminar jet diffusion flame

Pedro H. Konzen
phak@mat.ufrgs.br

Álvaro L. De Bortoli
dbortoli@mat.ufrgs.br

Mark Thompson
thompson@mat.ufrgs.br

UFRGS-Graduate Program in Applied Mathematics-PPGMAp
Bento Gonalves 9500, P.O. Box 15080, Porto Alegre-RS, Brasil

ABSTRACT

Combustion of liquids, solids and gases is responsible for about 80% of the energy produced in the world. Probably, this process will maintain its importance for many decades. The increasing expectation for high efficiency and low fuel consuption turns the combustion a field of study in rapidly expansion [1, 3].
Combustion is a multidisciplinary field of study. It involves the description of chemical reaction (rate of fuel consuption and pollutant formation), mass transfer of the chemical species (molecular diffusion, convection and turbulent transport), heat transfer by chemical reactions (conduction, convection and radiative heat transfer) and flow field that is influenced by combustion [1, 2].
The goal of this work is the numerical study of a laminar jet diffusion flame. The model describes a process of molecular mixture with an one step, irreversible, exothermic chemical reaction between two species F (fuel) and O (oxidizer). These species react and yield a product P following the scheme $v_F F + v_O O \rightarrow v_P P + heat$, where v_F, v_O and v_P are the stoichiometric coefficients. The reaction is considered of first order for each reacting specie and the specific reaction rate follows the Arrhenius kinetic [2, 3].
Considering the incompressible regime, several results were obtained. Programs based on the finite difference (FDM) and on the finite element (FEM) methods were developed: the last with linear triangular elements, linear rectangular elements and quadratic rectangular elements [4]. A direct comparasion of the results showed that equivalent results were obtained for both FEM and FDM.
Now our objective is the numerical study of compressible combustion flows. We are developing codes based on the FDM and the FEM. It will permit a comparison between the two techniques in laminar flames problems.

References

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