ASSESMENT TOOLS OF MIXING FOR TWO COAXIAL SWIRLING JETS

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Abstract The aim of this paper is the assessment of the mixing in confined non-reacting coaxial swirling jets. The benchmark is that of Roback and Johnson [1]. The swirl on the annular jet is responsible of an inner recirculation zone on the test chamber. A model to measure the mixing is used on the paper. This system is of interest in the design of simple burners, where two or more streams should be mixed in the shortest length and mixing conditions strongly affect the behaviour of the combustion processes.

NUMERICAL MODEL

Despite the simple geometrical set-up of one swirler and two coaxial nozzles discharging to a test chamber, the flow pattern is characterized by an Inner Recirculation Zone (IRZ) and an Outer Recirculation Zone (ORZ). The high shear region between both recirculation zones is where mixture occurs. The Reynolds number is 2400 on the test chamber,. The swirler produces an annular jet with Swirl number the unity.

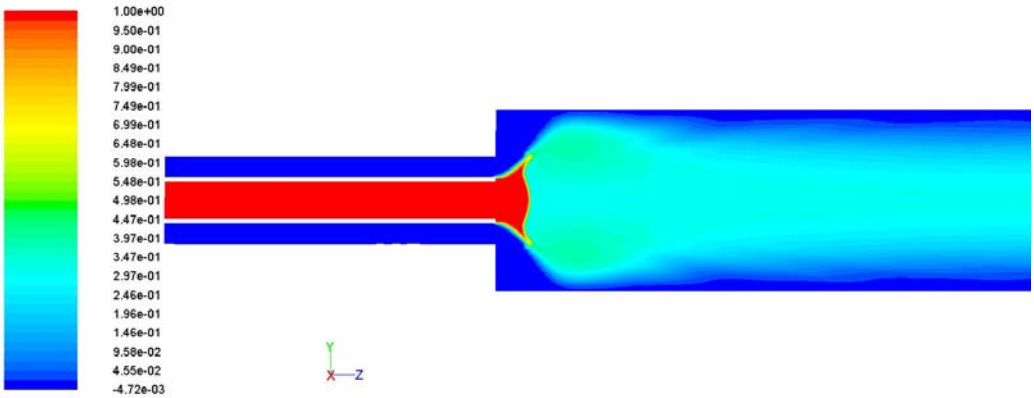

Figure 1. Passive Scalar of the central jet (Slice x=0).

The model solves the conservation equations using RANS approaches. Once the convergence is achieved, additional conservation equations are solved for a passive scalar (figure 1) and its concentration variance contributions on different stages such as inertial-convective, viscous-convective and viscous-diffusive dissipation [2]. The mixing time, that controls the source time of the different contributions to the total concentration variance, has been established for fluids with Schmidt number near to one. Finally, the intensity of segregation is defined as the concentration variance made non-dimensional with the variance of a completely segregated mixture. Besides, the age of the fluid is calculated to characterise the residence time on the recirculation zones.

RESULTS

The segregation intensity is defined so that it is equal to one when the fluid components are not mixed, whereas it has value zero when mixing is perfect. Figure 2 let identify the region of mixing that corresponds with that of high shear.

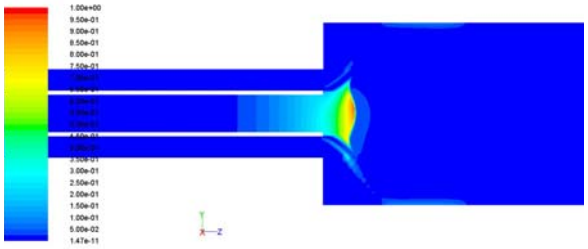

Figure 2. Segregation Intensity of the mixing model (Slice x=0)

CONCLUSIONS

A mixing model for Schmidt numbers near unity has been performed after the field flow was simulated. The intensity of segregation calculated from the variance of a passive scalar let measure the quality of the mixing in the shear region between the recirculation zones.

Acknowledgment

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References

[1] Roback R., Johnson B.V. Mass and momentum turbulent transport experiments with confined swirling coaxial jets, *NASA CR-168252*, 1983

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