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Thermal And Dynamic Study of Confluent Round Jet of Different Diameters

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ABSTRACT

The interaction between two axisymmetric jets of differentdiameters is examined in this study in order to perform a dynamic and thermal description. The various results of the three-dimensional configurations allowed to evaluate the influence of the velocities ratio and the temperature ratio on the flow structure resulting from the interaction inconvergence, merging and fully developed regions. Throughout this study the maximum heat exchange point was located for a given velocities ratio and for different temperature ratios of the two jets. In addition, we find thatthe velocities ratio affects the distribution of temperature particularly its thermal expansion rate. This study permitted us to propose correlations predicting both the velocities and temperature ratios of the two jets.

Introduction

Free jets have been widely studied for their various industrial and environmental applications. In order to improve their efficiency, the application of multiple jets has been the subject of a considerable number of studies. This configuration is encountered in several industrial applications such as: cooling systems, combustion anddispersion of pollutants. The objective of this contributionis to study of the interaction between the main jet and the secondary jet, in order to analyze the effect of the velocities ratio and the temperature ratio on the flow structure after the mixing.

Theoretical Study

The flow studied is fully turbulent and the fluid is Newtonian. The considered configuration consists of two aligned round jets. The calculations are performed using 3D-RANS modeling. The averaged equations for incompressible fluid, translate from the principles of conservation equations of the mass, momentum and energy, coupled with the equations of the turbulence model.

Results and Discussion

This study considers numerically several velocity ratios □ and several temperature ratios □T ranges. The two unequal jets are round of diameters D and d, parallel. For agiven strong jet velocity U0D, the weak-jet is varied such as: $0 \leq \lambda \leq 1$; where. For the thermal study, the strong jetis heated and the cold jet is varied from ambient temperature T0d to the strong jet temperature, corresponding to temperature ratio. The velocity contours and particle trajectories predicted by the k- Realizable model are shown in Figures 1, which describe the structureof the 3D flow produced by the interaction of the two jets.These contours show that the longitudinal velocitycomponent is always positive, which justifies the absence of a recirculation zone. Contrary to the cases of plane jet configurations that induce recirculation zones. These contours illustrate the interaction between the two jets andthe

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important curvature of the secondary jet towards the primary jet, due to the Coanda effect where a favorable pressure gradient is produced. We note that the two jets meet at a point called the confluence point. We also observe that for low velocities of the secondary jet, its deviation is more important towards the strong jet.

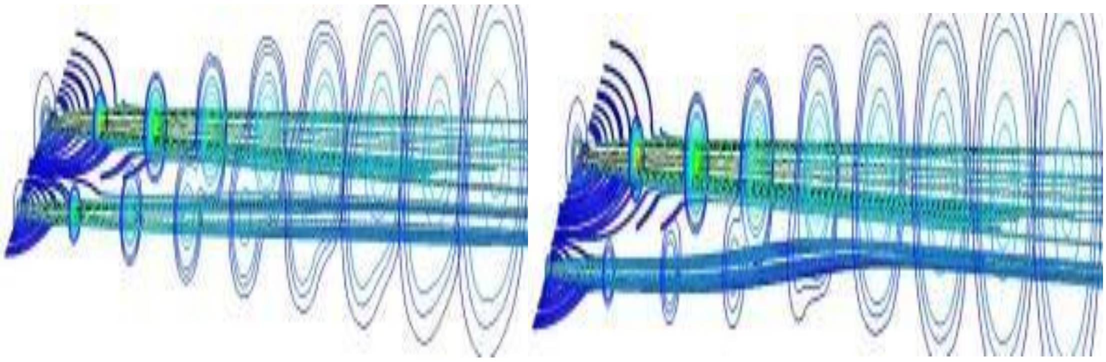

Figure 1: Trajectories of the particles of the interacting jets, and magnitude contours velocity

Figure 2 shows that the position of the maximum temperature of the jet (yTmax) varies linearly with the velocity ratio λ, for T between 0.88 and 1 and 0.25≤λ≤1. The slope of this line decreases when the velocity ratio decreases. yTmax is correlated from the speed and temperature ratios.

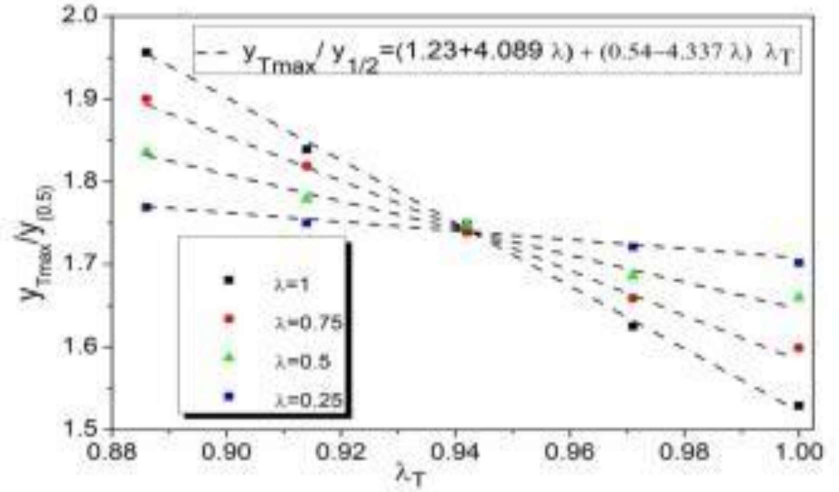

Figure 2: Position of temperature maxima.

Conclusion

Through this study the maximum heat exchange point was located for a given velocity ratio and for different temperature ratios of the two jets, the growth of the dynamic expansion rate with the increase in velocity. In addition, we note that the velocity ratio affects substantially all the quantities of the flow resulting from the interaction of the two jets, more particularly the temperature distribution, in particular its thermal expansion rate. Therefore, the effect of the secondary jet plays an effective role in the cooling of a strong jet

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