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Recent developments in the stabilization of swirl spray flames

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Abstract

In gas turbine combustion, the fuel is injected in liquid form and the subsequent atomisation and dispersion and the aerodynamic features of the combustor play a crucial role for its ignition, stability, and pollutant emissions. Recent work in fundamental and more applied aspects of swirling kerosene flames at the presenter's lab are reviewed, with emphasis on the key physical mechanisms and topics where future research is needed. The ignition process of simplified and complex geometrical configurations is discussed through low-order and detailed CFD simulations and experiments, showing the effects of convection, large-scale and small-scale diffusion, and spray characteristics. Similarly, the stabilisation of swirl spray flames is discussed through local and global extinction and how these can be predicted by CFD. Finally, the soot emitted by such flames is reviewed from the perspective of the Rich-Quench-Lean combustor concept through model burner experiments and associated modelling with LES and a sectional soot model. The presentation includes results from academic lab-scale geometries, but also from publicly-available realistic gas turbine combustors.

Keywords
Swirl spray flames, Combustion, Gas-turbine