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# DESIGN AND TEST OF NON-UNIFORM SPRAY SWIRL INJECTORS AND ITS APPLICATIONS IN INJECTION PLATE DESIGN

**Abstract**

Modifications of injector geometry are proposed to obtain a variety of different non uniform mass flow distributions. Although in general a uniform distribution is preferred, the possibility of modulating the spray to different regions of the combustion chamber can be advantageous especially in near wall injectors and other specific applications like minimizing NOx emissions in gas turbines. In this work the cases of the conventional tangential swirl atomizer, n-planar sheet spray, n-shell spray and n-tilted exit are explored with analytical modelling of its spray's geometry and mass flow distribution. Specifically for the tilted exit modification, relations are established to exemplify and support applications in rocket engine's injection plates for near wall injectors as a way of creating a film cooling effect with bipropellant injectors, optimizing its protection effect and minimizing the near wall mixture ratio gradient. Another possibility is the application on the entirety of the injection plate in a way of fine-tuning mass flow and mixture ratios within the entire combustion chamber and possibly assisting the fulfilment of geometric constraints of injector placement within the injection plate. Furthermore, experimental data on the tilted exit injectors are displayed and analysed with respect to its effect in total mass flow and its non-uniform mass flow characteristics, confirming its capabilities of directing the mass flow in the intended region, without substantial divergence from the analytical model.