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Project Thesis / Bachelor's Thesis

Experimental Investigation of Refrigerant Flammability

Because of their high global warming potential (GWP), hydrofluorocarbon refrigerants for heating and cooling applications are now systematically removed from the market. Low GWP replacements are available; however, they pose safety hazards due to flammability. Hence, a fundamental understanding of refrigerant combustion behavior is needed. In this regard, the laminar flame speed is a key property, which considers the combined effects of diffusivity, exothermicity, and reactivity. A robust and accurate method to determine the laminar flame speed is the closed vessel technique, wherein a homogeneous gas mixture is ignited centrally, and the spherical flame propagation is recorded.
A combined approach of the Schlieren method and Particle Image Velocimetry (PIV) is utilized in this work to investigate refrigerant combustion in a closed vessel. The Schlieren method (see Figure 1 left) is used to determine the flame radius rate of change $\dot{R}_\mathrm{f}$. PIV (see Figure 1 right) provides the flow velocity in the unburned mixture ahead of the flame front $V_\mathrm{f,u}$. The difference between these two quantities yields the laminar flame speed $S_\mathrm{L,u} = \dot{R}_\mathrm{f} - V_\mathrm{f,u}$.
In this thesis, experiments with Methane/Air mixtures as a combustible gas are performed to validate the experimental method. Then, the commonly used refrigerant
R-32 is burned in mixtures with air. The experimental data are post-processed with a MATLAB tool and the results are compared to laminar flame speed data in the literature.

Tasks:

- Literature survey of refrigerant laminar flame speed
- Perform Schlieren and PIV experiments with Methane and R-32
- Post-processing and analysis
- Writing the thesis

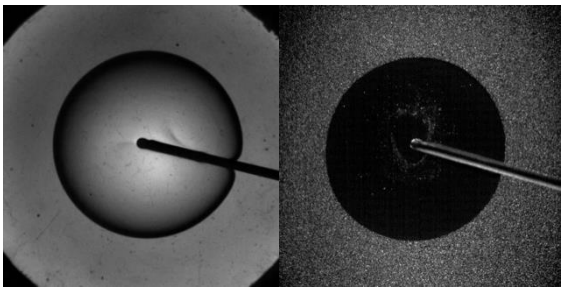

Figure 1: Visualization of a CH_4/air flame by Schlieren (left) and PIV (right).

Requirements:

- Interest in hands-on work
- Knowledge in thermodynamics, fluid mechanics and combustion desirable

The thesis can be combined with a student job.
For your application, please send a CV and your grade sheet to the contact below.

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