Ammonia Combustion Technology Group Meeting
September 5, 2023 1:00 pm EST - 3:00 pm EST

Original agenda:

1. Introductory remarks (1:00 pm EST)
2. Stanford Presentation by Matthias Ihme (1:10 pm EST)
3. Stanford Q&A (1:30 pm EST)
4. UCF Presentation by Gihun Kim (1:40 pm EST)
5. UCF Q&A (2:00 pm EST)
6. Open discussion (2:10 pm EST)
7. Closing remarks (by 2:55 pm EST)

Meeting notes:

Stanford porous media burner (PMB) - Matthias Ihme

- Presentation
    - Demonstrated first porous media burner for pure NH3 combustion
        - NO, NH3, H2 emissions and stability maps
    - 0D and 1D simulations
- Q&A
    - Thomas Sattelmayer - Operating conditions & material compatibility
        - Cannot operate PMB beyond ~1.4 equivalence ratio, but see reduction of NOx at rich conditions
        - Not addressing N2O emissions currently
    - Robert Steele - pressure?
        - All experiments at atmospheric pressure
    - Mark Freeman - concerns about long-term survival of materials?
        - Some degradation of ceramic materials. Does not affect combustion performance. But suspect some surface oxidation with ammonia. Have not seen too much of concern so far though.
    - Sireesha A - do you have to start with H2?
        - Operate with a mixture of H2/air or CH4/air to preheat the media and then switch to fuel of interest. Typically takes a few minutes to start up with staged ignition.
    - Sireesha A - how hot is preheat?
        - Ammonia above cracking temperature in preheat zone. See slide 12.
    - How long are experiments run?
        - Run to steady-state - temperature does not change by 10K over one minute.
        - Some unsteady conditions with intermittent flashback.
    - Michael Duesing - question about scaling up
        - With larger burners, problems with uniformity. Instead make smaller modular burners.
    - Mark Freeman - could degradation of porous media be harmful to downstream turbines?
        - Potentially yes
    - Nathan Weiland - how about radial uniformity?

        - Do not have radial measurements at this time, but some results indicate good temperature uniformity.
    - Luis - impact of pressure and temperature on durability of material
        - Previous experience operating up to 20 bar with heptane and found that it did not affect durability.

UCF, Flame Speed Measurements of Ammonia-Hydrogen Mixtures - Gihun Kim

- Presentation
    - Laminar burning velocity measurements with spherically expanding flames
    - Results at atmospheric pressure
    - Plans for measurements at 10 atm
- Q&A
    - Clint Bedick - do you expect stratification with H2?
        - They have homogeneous premixing and only 5 minutes in sphere before initiating experiment.

Closing remarks and open discussion

- Any interest in CH4/NH3 blends?
    - Robert Steele - Need to keep on the table probably because current industry uses NG and will likely not jump straight to NH3/H2 blends. Look at work currently being conducted by IHI.
- What approaches are being used for liquid ammonia delivery for “large” research-scale high pressure applications? Lessons learned? Advice?

    Major difficulties exist. May have relevant presentations in November on this issue.

    - Thomas Sattelmayer - Look at the work being done in marine applications.