

Ammonia Combustion Technical Working Group Meeting #7
May 7, 2024

- Introductory remarks
- KIER presentation, Hookyung Lee
 - R&D experiences for NH₃ combustion in KIER
 - Fundamental staging-combustion behavior
 - Planned 7.1% power generation by 2036
 - 100 kW NH₃ co-firing CFB system
 - 10 MW NH₃ co-firing system
 - Initial research with 2-stage, globally lean, swirl burner
 - Co-firing with pulverized coal particles
 - Staging radially instead of axially
 - Increased flame length as %NH₃ increased
 - Can reduce NO_x by staging but may come with increased CO and NH₃ emissions
 - Proper NH₃ staging can induce selective non-catalytic reduction
- KIER Q&A
 - Clint Bedick: Is co-firing seen as transitional or longer term?
 - Ultimate goal is to make 100% NH₃ fired boiler
 - By 2027, will demonstrate 20% co-firing in 1,000 MW power plant
 - Assaad Masri: Did you have to modify burner design to increase %NH₃?
 - Poor stability with original burner; changed nozzle type
 - Clint Bedick: How is fuel staging achieved?
 - In the co-fired boiler situation, there is no axial staging, so ammonia staging done radially
- U Sydney presentation, Assaad Masri
 - Turbulent combustion of ammonia at USYD
 - Fundamental turbulent combustion studies with NH₃ & H₂ blends
 - Turbulent autoignition
 - Small amounts of H₂ addition can dramatically enhance stability and reduce ignition delay time
 - Mixed mode combustion
 - Reduced stability limits with NH₃ addition
- U Sydney Q&A
 - Wesley Boyette: What pressure for the KAUST work?
 - Atmospheric pressure
 - Wesley Boyette: How does O₂ content change in vitiated coflow experiment?
 - It does change as the equivalence ratio changes; off the top-of-the-head maybe by 7% in going from 1000 K to 1700 K
 - Clint Bedick: Flashback concerns in the inhomogeneous inlets burner?
 - It is a concern with very high H₂ content mixtures
 - Lulin Jiang: How will you keep NH₃ as liquid at atmospheric pressure?
 - One idea would be to siphon as liquid from the bottle and then sustain with heat control - probably will go with this one
 - Or could get ammonia as vapor and then pressurize to liquify
 - In Australia, cannot get pressurized NH₃ cylinders
 - Cristian Avila: Will you stay at atmospheric pressure

- Replicate what Kobayashi group has done - build up to 10 MPa and inject at atmospheric pressure
 - Will stay at atmospheric pressure
- Clint Bedick: Imaging of N species in which burners?
 - Stick with autoignition and inhomogeneous inlets burners for now, maybe other burners in the future
- Open discussion
- Closing remarks