PRODUCT GAS ANALYSIS OF LAMINAR PREMIXED AMMONIA-METHANE FLAMES IN STAGNATION FLOWS

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1. OVERVIEW

- The addition of ammonia to hydrocarbon fuels promotes lower greenhouse gas emissions. However, more detailed information on the effect of ammonia fuel fraction, E_{NH3} on these gases is required.
- An experimental product gas study of premixed laminar CH_4/NH_3/air stagnation stabilised flames was conducted.

2. METHODOLOGY

- The dual gas dilution method [1] was used for calculating emissions values and uncertainties.
- Fully premixed NH_3/CH_4/air fuel mixtures were employed at room temperature and pressure.
- The stagnation plate burner was regulated through oil plate temperature control and thermocouples inserted inside of the stagnation plate.
- Two concentrations of Ar+CO_2 dilution gases were used for each experimental condition.

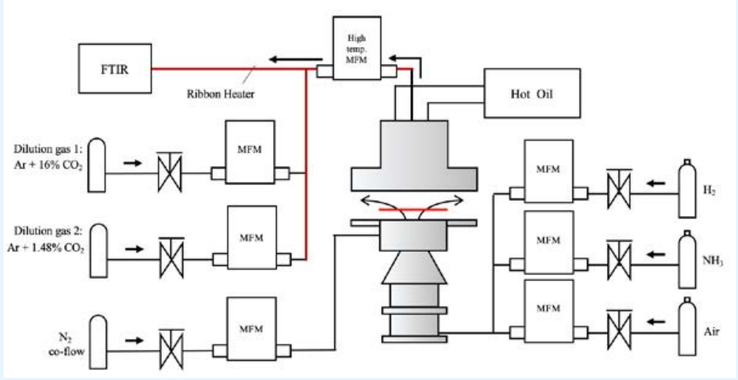

Fig.1 - Experimental diagram of burner and gas lines

3. RESULTS AND SUMMARY

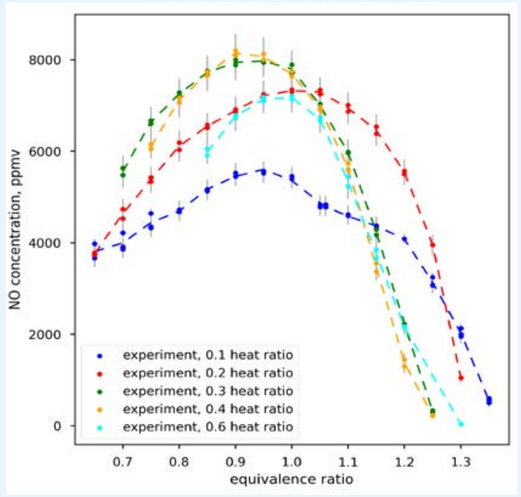

Fig 2 - Experimental NO profiles

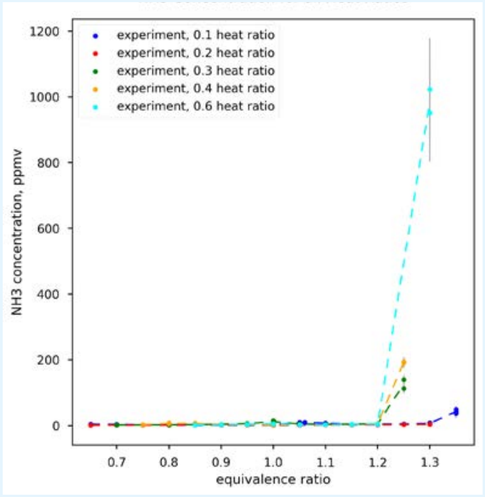

Fig 3 - Experimental NH_3 profiles

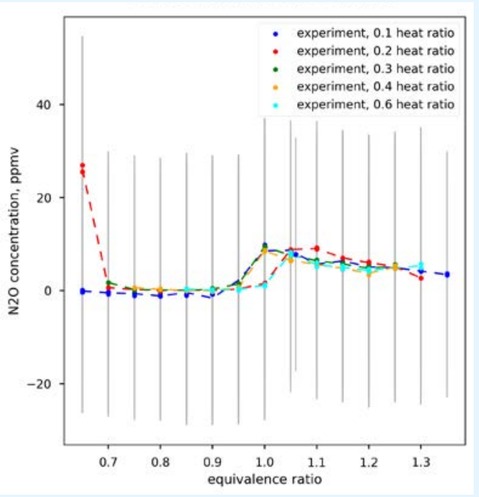

Fig 4 - Experimental N_2O profiles

- The highest NO emissions were at E_{NH3} = 0.3 to 0.4 near stoichiometry.
- NH_3 emissions moved to the rich region as methane concentration was increased.
- N_2O emissions moved to the lean region as methane concentration was increased with peaks below 0.7 and at 1.0 equivalence ratios.
- Considering these factors, the optimal condition for low emissions was found to be between 1.35 to 1.20 equivalence ratio for E_{NH3} = 0.1 to 0.6 respectively.

5. REFERENCES

1. HAYAKAWA, A., HIRANO, Y., ICHIKAWA, A., MATSUO, K., KUDO, T., & KOBAYASHI, H. (2020). Novel dilution sampling method for gas analysis with a low sampling rate. Mechanical Engineering Journal, 7(2), 19–193. https://doi.org/10.1299/mej.19-00193

6. AKNOWLEDGEMENTS

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