# Understanding of MILD Combustion Characteristics of $NH_3$/AIR Flames in $N_2$ and $H_2O$ (steam) Diluted Environment at Atmospheric Pressure

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KAUST Research Conference:
Hydrogen-Based Mobility and Power

## Introduction

Ammonia is gaining popularity as a carbon-free fuel; however large amount of NOx emission during its combustion poses a significant challenge [1].

In the present work, a chemical kinetic study is performed to study the MILD combustion characteristics of $NH_3$/air flames in the $N_2$ and $H_2O$ diluted atmosphere at oxygen concentrations, reactant temperatures, and pressure of 11-23%, 1300-1700K, and 1 atm.

## Numerical Methodology

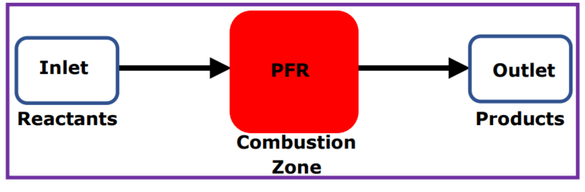
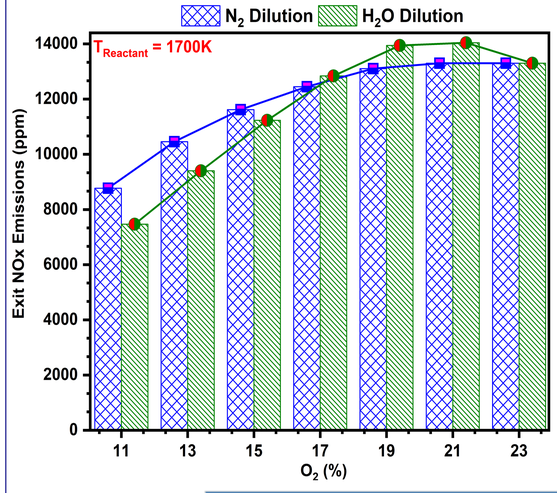
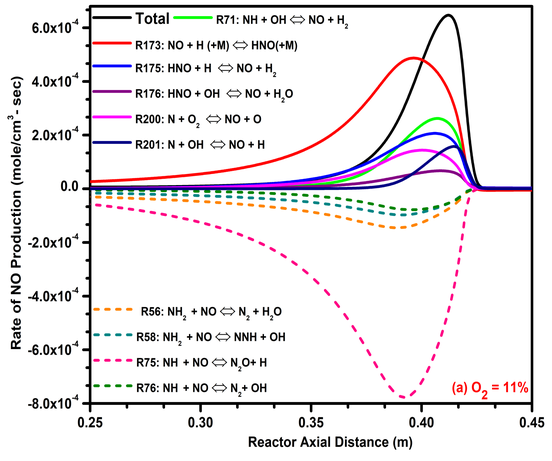


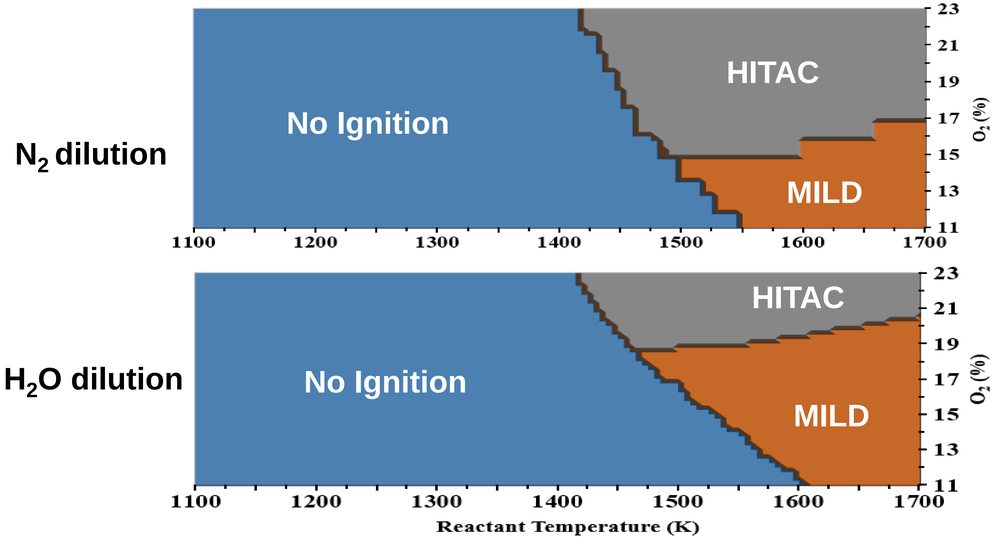

Fig. 1: Schematic representation of chemical reactor network

PFR dimensions: L = 1.4m, D = 0.01m. Stoichiometric mixture having combustor capacity of 5 kW. Reactor dimensions were based on the experimental study of Sabia et al.[2]. Singh et al. [3] $NH_3/H_2$/air mechanism having 32 species and 259 reactions is considered for the numerical simulations.

## Results




## Conclusions

- MILD combustion regimes are identified using Cavaliere & Joannon's [4] suggested conditions.
- The NOx emission is lesser in steam diluted flames than the nitrogen diluted flames.
- Exit NOx emissions from $N_2$-diluted flames begin to rise as the $O_2$ concentration rises from11-23 % (i.e., reduction in $N_2$ concentration). However, for steam diluted flames, the exit NOx increases up to the $O_2$ concentration of 21%, and after that, it starts decreasing.
- The broader NO-Ignition regime is observed for steam diluted flames compared to $N_2$ diluted.
- Steam diluted flames exhibit wider regimes of MILD combustion compared with $N_2$ diluted flames due to the lesser increase in peak temperature.
- Steam-diluted flames require a higher reactant temperature than $N_2$ diluted flames at a given $O_2$ concentration in order to achieve MILD combustion.

## References

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