CH_3OH/NH_3: A Possible Green Energy

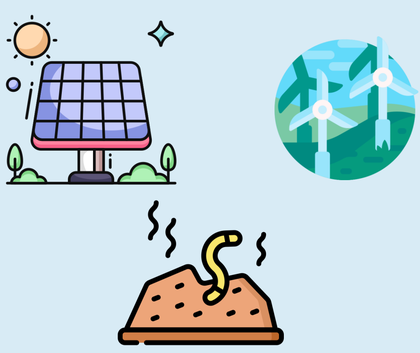
Adrián Ruiz-Gutierrez, Irene de Diego, María U. Alzueta

Departamento de Ingeniería Química y Tecnologías del Medio Ambiente
Universidad Zaragoza

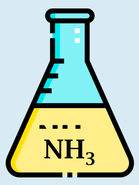
Jornada de Jóvenes Investigadores del I3A

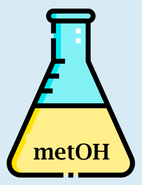
Instituto de Investigación en Ingeniería de Aragón (I3A)
Dept. of Chemical and Environmental Engineering
Universidad de Zaragoza, Mariano Esquillor s/n, 50018, Zaragoza, España
E—mail: adrian.ruiz@unizar.es

Introduction



Power to Fuel





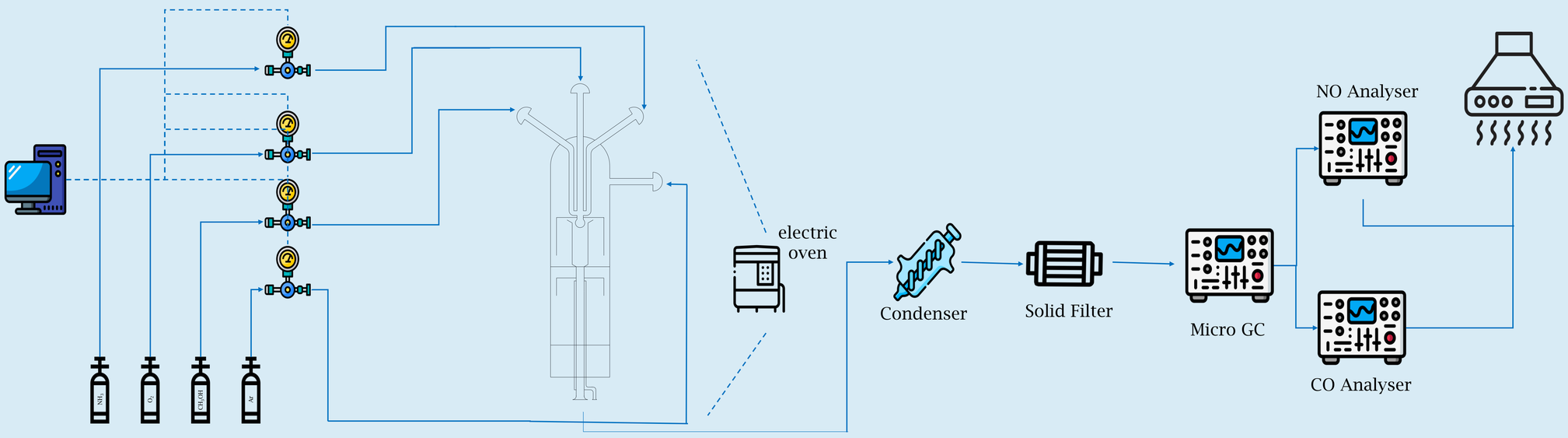
Pure NH_3 combustion

- High ignition temperature.
- Low flammability.
- Possible NO_X emissions.

CH_3OH/NH_3 combustion

- Better ignition temperature.
- Low NO_X emissions.
- No soot emissions.

Methodology



- ✓ NH_3 = 500 ppm
- ✓ CH_3OH = 500 ppm
- ✓ λ = 0-2
- ✓ T = 875 – 1425 K
- ✓ $T_r(s) = 190/T(K)$

Experimental + Simulation

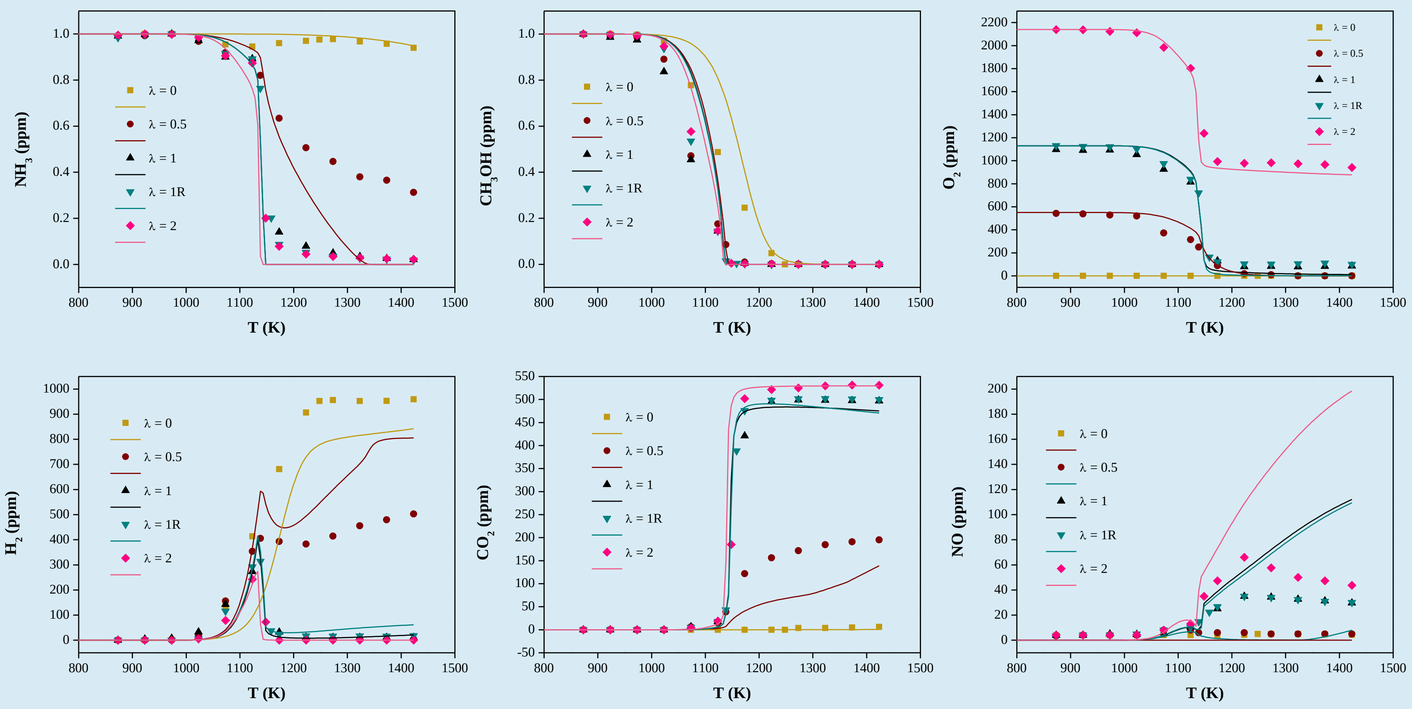


Figure 1. Concentration of different compounds as a function of temperature and excess oxygen ratio.

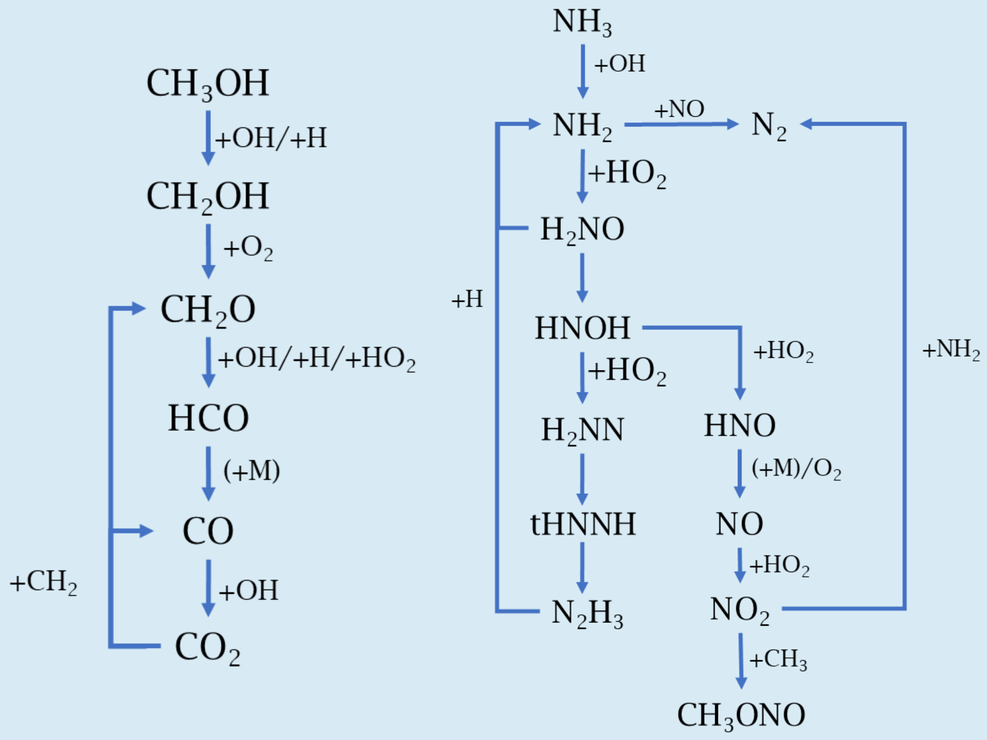


Figure 2. Reaction pathways of NH_3, and CH_3OH.

Conclusions

- ✓Improvement of ammonia ignition.
- ✓Good prediction bythe mechanism.
- ✓Low NO_x emissions.
- ✓Only one major interaction between CH_3OH and NH_3.
- ✓Fuel-lean condition causes oxidation of the compounds at lower temperatures.

References

[1] ABIÁN, M., BENÉS, M., de GOÑI, A., MUÑOZ, B., ALZUETA, M.U. Study of the oxidation of ammonia in a flow reactor. Experiments and kinetic modeling simulation. Fuel. 2021, 300.

[2] GLARBORG, P., MILLER, J. A., RUSCIC, B, KLIPPENSTEIN, S. J. Modeling nitrogen chemistry in combustion. Progress in Energy and Combustion Science 2018, 67, 31-68.

[3] MORGAN, E., MANWELL, J., MCGOWAN, J. Wind-powered ammonia fuel production for remote islands: A case study. Renewable Energy 2014, 72, 51–61. doi:10.1016/j.renene.2014.06.034

Acknowledgment

The authors express their gratitude to Projects TED2021-129557B-I00 financed by MCIN/AEI/10.13039/501100011033/FEDER and Project PID2021-12432OB-I00, and to Aragón Government (Ref. T22_23R), cofounded by FEDER "Construyendo Europa desde Aragón“and PRE2022-104181 grant funded by Ministry of Science and Innovation.