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Information of Contribution

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Title	Modelling of turbulent premixed swirl flames for 70/30 vol% NH3/H2 fuel-air mixtures
Track	MS 12. Spread of ammonia combustion research - Role of numerical simulation -
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Abstract

Accurate prediction of ammonia turbulent combustion emissions is crucial for the further development of combustion systems. Fuel-air mixtures with a 70/30 vol% NH_3/H_2 ratio were numerically investigated for a premixed burner setup with a fixed power of 10kW.
RANS calculations were performed with Reynolds stress transport using a complex chemistry and species transport model with respect to thermal and mixture averaged diffusion. Turbulence-chemistry interaction was modelled using the Eddy Dissipation Concept with Stagni and Nakamura kinetic reaction mechanisms.
The numerical results were evaluated in terms of flame shape, flame stability and emissions, with a focus on the NO, N_2O and NO_2 shares in the flue gases and the unburned NH_3 prediction capabilities of the model.
Qualitative and quantitative agreement was achieved within the equivalence ratio (ϕ) range of 0.8-1.2, while the relative error of the NO predictions did not exceed 3.5% with respect to the uncertainty of the experimental results.
Gradients of NH_3 and NO shares in the flue gases for the modelled turbulent flames were found to be shifted towards stoichiometric conditions compared to the same mixture and mechanism for a burner-stabilised stagnation 1D flame outcome. A significant overprediction of NO emission was expected for very lean mixtures $\phi = 0.6$, as deviations can be related to the simplification of fine structure reaction fractions commonly used in the EDC model.
Despite its limitations in the very lean conditions, the model correctly predicted a decrease in NO concentration in the flue gases, associated with a rapid increase in N_2O emission.

Keywords

CFD; ammonia; complex chemistry; swirl flame