POLLUTION ASPECTS

(606) - (*) - EXHAUST GAS RECIRCULATION (EGR) ANALYSIS OF A SWIRL-STABILIZED PULVERIZED COAL FLAME WITH FOCUS ON NOX RELEASE USING FPV-LES

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Massively parallel Large Eddy Simulations (LES) are performed to capture the combustion characteristics and the NO_x formation in the swirl-induced recirculation zones of the swirl-stabilized Brigham Young University (BYU) Burner Flow Reactor (BFR).

The swirl-stabilized combustion chamber of BYU is particularly suitable for investigating the formation of pollutants with respect to C- and N-compounds, since extensive experimental data is available. Furthermore, the burner allows a detailed investigation of the influence of exhaust gas recirculation (EGR) on pollutant formation due to its swirl-induced inner and outer recirculation zones.

The simulations are performed using the in-house LES tool PsiPhi, utilizing a flamelet/progress variable (FPV) approach to model the complex, reactive multiphase flow. Four manifolds are used to parameterize the thermochemical quantities consisting of two mixture fractions for 1) volatiles and 2) char burnout, 3) the total enthalpy and 4) a progress variable, defined by a linear combination of key product species mass fractions.

One dimensional, steady, non-premixed flamelets are calculated using the 1D flame solver FlameMaster by Pitsch to build the flame library for tabulation. A reduced CRECK mechanism with 120 species is used, which includes the formation mechanisms for prompt-NO_x, fuel-NO_x and thermal-NO_x, and enables the detailed analysis of the formation of important N-compounds, such as NO, NO_2, N_2O, HCN and NH_3.

Devolatilization as well as char burnout and radiation effects are considered in the LES. A qualitative and quantitative comparison with the experiment is performed first. Axial and radial profiles of major gas species are compared with the experimental data. This is followed by a detailed analysis of NO, NO_2, N_2O, HCN and NH_3 species in and outside the recirculation zones in the overall context of the flame structure.

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Palavras-chave : PCC, LES, FGM, FPV, NOx