Experimental Investigations of Lean Stability Limits of a Prototype Syngas Burner for Low Calorific Value Gases

Thelean stability limit of a prototype syngas burner is investigated.The burner is a three sector system, consisting of aseparate igniter, stabilizer and Main burner. The ignition sector, Rich-Pilot-Lean(RPL), can be operated with both rich or lean equivalencevalues, and serves to ignite the Pilot sector which stabilizesthe Main combustion sector. The RPL and Main sectors arefully premixed, while the Pilot sector is partially premixed. Thecomplexity of this burner design, especially the ability to varyequivalence ratios in all three sectors, allows for the burnerto be adapted to various gases and achieve optimal combustion.The gases examined are methane and a high H_2 modelsyngas (10% CH_4, 22.5% CO, 67.5% H_2). Both gases arecombusted at their original compositions and the syngas was alsodiluted with N_2 to a low calorific value fuel witha Wobbe index of 15 MJ/m^3. The syngas is atypical product of gasification of biomass or coal. Gasification ofbiomass can be considered to be CO_2 neutral. The leanstability limit is localized by lowering the equivalence ratio fromstable combustion until the limit is reached. To get acomparable blowout definition the CO emissions is measured using anon-dispersive infrared sensor analyzer. The stability limit is defined whenthe measured CO emissions exceed 200 ppm. The stability limitis measured for the 3 gas mixtures at atmospheric pressure.The RPL equivalence ratio is varied to investigate how thisaffected the lean blowout limit. A small decrease in stabilitylimit can be observed when increasing the RPL equivalence ratio.The experimental values are compared with values from a perfectlystirred reactor modeled (PSR), under burner conditions, using the GRI3.0 kinetic mechanism for methane and the San Diego mechanismfor the syngas fuels.

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