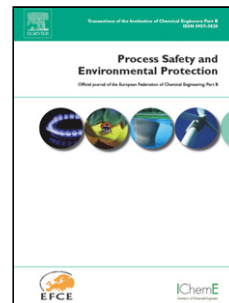


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Swirl Stability and Emission Characteristics of CO-enriched Syngas/Air Flame in a Premixed Swirl Burner

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Highlights

- CO-enriched syngas flames are less stable with higher lean blowout limit.
- Blowout limit increases with increasing CH₄ fraction in CO-rich syngases.
- CO₂-diluted syngases show increased blowout equivalence ratio due to reduced reactivity.
- Pure CO syngas emits high level of CO and NO_x in fuel-lean and fuel-rich region respectively.
- Increasing CO₂ dilution in CO-rich syngases reduced NO_x emissions for mixtures with $\phi \geq 1$.

Abstract

There is significant variation in the composition of synthesis gas derived from biomass, coal or waste. The inconsistency of syngas constituents poses challenges and requires thorough characterisation prior to use as alternative fuel in practical combustion system. The present study investigates the combustion and emission characteristics of CO-enriched syngases by using an atmospheric premixed swirl flame burner. High (CO/H₂=3) and moderate (CO/H₂=1.2) CO-enriched syngases were fully premixed with air and diluents of CH₄ and CO₂ prior to ignition at the burner outlet. Direct flame imaging shows that moderate CO-enriched syngas produces less luminous flames than high CO-rich syngas, signifying less tendency to form soot. Moderate CO-rich syngases show more compact flames with higher intensity owing to higher H₂ contents. The blowout test shows that higher CO content syngases result in lean blowout at higher equivalence ratios, posing stability issues. High fractions of unreactive CO₂ and reactive CH₄ in syngases results in higher lean blowout limit. Emissions wise, high CO-rich syngases show evidently less NO_x emissions as compared to baseline pure CO flames at increasing equivalence ratios. Moderate CO-rich flame

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