FIRST ORDER EVALUATION OF COMBUSTION CHARACTERISTICS OF LCV FUELS FOR INDUSTRIAL BURNER DEVELOPMENT

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Energy recovery from low calorific value (LCV) gaseous fuels such as blast furnace gas (BFG), coke oven gas (COG) and many other industrial off-gases is often times economically beneficial to the process/plant. The composition of (LCV) fuels primarily depends on the industrial process as well as the variations in the process. Hence, there is wide variability in fuel compositions leading to significant variation in combustion characteristics. As a result, designing burners for LCV fuels becomes a challenge.

In addition to highly variable fuel compositions, the LCV fuels can have complex/hazardous components. It may be impractical and/or unsafe to replicate these fuel compositions in a laboratory environment for burner testing. In such cases, it is possible to synthesize a surrogate fuel that emulates physical properties such as mean molecular weight, density, LHV and Wobbe Index of the actual fuel. However, the surrogate fuel can have significantly different combustion characteristics compared to the real fuel.

In this study, we compare some of the critical parameters that impact flame stability between a surrogate fuel and real LCV fuel. Four essential combustion properties – adiabatic flame temperature, ignition delays, flame blow out and flame speeds were studied for each fuel. An open-source chemical kinetics program, CANTERA was used for combustion simulation with the detailed chemical kinetic models of GRI 3.0. Two typical BFGs, one with high CO concentration and another with high H2 concentration were chosen for this study and corresponding surrogate BFGs were synthesized. Results show that the surrogate blast furnace gases had lower adiabatic flame temperature compared to the actual industrial BFGs. The surrogate BFG compositions also showed longer ignition delay time, lower blow-off time and lower flame speed compared to the industrial blast furnace gases. This demonstrates that a burner designed for the surrogate BFG will perform well with actual industrial BFG in terms of flame stabilization.

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