Experimental Investigation of Laminar Flame Speeds for Medium Calorific Gas With Various Amounts of Hydrogen and Carbon Monoxide Content at Gas Turbine Temperatures

Itis expected that, in the future, gas turbines will beoperated on gaseous fuels currently unutilized. The ability to predictthe range of feasible fuels, and the extent to whichexisting turbines must be modified to accommodate these fuels, restson the nature of these fuels in the combustion environment.Understanding the combustion behavior is aided by investigation of syngasesof similar composition. As part of an ongoing project atthe Lund University Departments of Thermal Power Engineering and CombustionPhysics, to investigate syngases in gas turbine combustion, the laminarflame speed of five syngases (see table) have been measured.The syngases examined are of two groups. The first gasgroup (A), contains blends of H_2, CO and CH_4, withhigh hydrogen content. The group A gases exhibit a maximumflame speed at an equivalence ratio of approximately 1.4, anda flame speed roughly four times that of methane. Thesecond gas group (B) contains mixtures of CH_4 and H_2diluted with CO_2. Group B gases exhibit maximum flame speedat an equivalence ratio of 1, and flame speeds about3/4 that of methane. A long tube Bunsen-type burner wasused and the conical flame was visualized by Schlieren imaging.The flame speeds were measured for a range of equivalenceratios using a constrained cone half-angle method. The equivalence ratiofor measurements ranged from stable lean combustion to rich combustionfor room temperature (25°C) and an elevated temperature representative ofa gas turbine at full load (270°C). The experimental procedurewas verified by methane laminar flame speed measurement; and, experimentalresults were compared against numerical simulations based on GRI 3.0,Hoyerman and San Diego chemical kinetic mechanisms using the DARSv2.02 combustion modeler. On examination, all measured laminar flame speedsat room temperature were higher than values predicted by theaforementioned chemical kinetic mechanisms, with the exception of group Agases, which were lower than predicted.

Author Name:
Ivan R. Sigfrid
Ronald Whiddon
Robert Collin
Jens Klingmann
Conference Location:
Glasgow, UK

Pages:
173-181
Conference Date:

Monday, June 14, 2010
Paper Reference:
GT2010-22275
Volume:
2: Combustion, Fuels and Emissions, Parts A and B
ISBN:
978-0-7918-4397-0
DOI:
http://dx.doi.org/10.1115/GT2010-22275
Conference Name:
ASME Turbo Expo 2010: Power for Land, Sea, and Air (GT2010)