Measurements and numerical study of laminar burning velocities of iso-butanol and ethanol blends

F. Rau[a*], S. Hartl[b], S. Voss[a], C. Hasse[b], D. Trimis[a]

[a]*TU Bergakademie Freiberg, Institute of Thermal Engineering, Freiberg, Germany*
[b]*TU Bergakademie Freiberg, Department of Energy Process Engineering and Chemical Engineering, Freiberg, Germany*

e-mail:* ***florian.rau@iwtt.tu-freiberg.de*

The reduction of emissions from the traffic sector is of great priority as they account for about 23% of the world's total energy-related GHG emissions [1]. The substitution of conventional fuels with biogenic ones like ethanol and butanol is regarded as a one of the most promising mitigation strategies. Alcohols can be easily blended with gasoline in mixtures that have a high octane number and a high calorific value. Thus, the currently established method to use biogenic fuels is by creating blends with gasoline, in proportions that depend mainly on local market restrictions. In order to improve the acceptance in the automotive sector and to increase the number of applications for such fuels, a more precise characterization of their combustion properties is essential.

In this work in progress, laminar burning velocities for iso-octane/ethanol and iso-octane/iso-butanol blends are measured for combustion with air, using the Heat Flux method. The aim of the work is to investigate the influence of alcohol addition in these blends, see Figure 1. The conventional Heat Flux burner test-rig configuration has been adapted so as to include a fuel conditioning system and to have an automated measurement procedure. In order to minimize pre-reactions in the fuel conditioning pathway a direct evaporator unit is used. The measurements are taken for variations of the equivalence ratio at constant atmospheric pressure and mixture temperatures that range from 298 K to 373 K.

Numerical calculations are also performed using a 1D model and different available reaction mechanisms, suitable for modeling iso-octane, ethanol and iso-butanol oxidation chemistry. The performance of the different kinetic schemes is evaluated against the obtained experimental data.

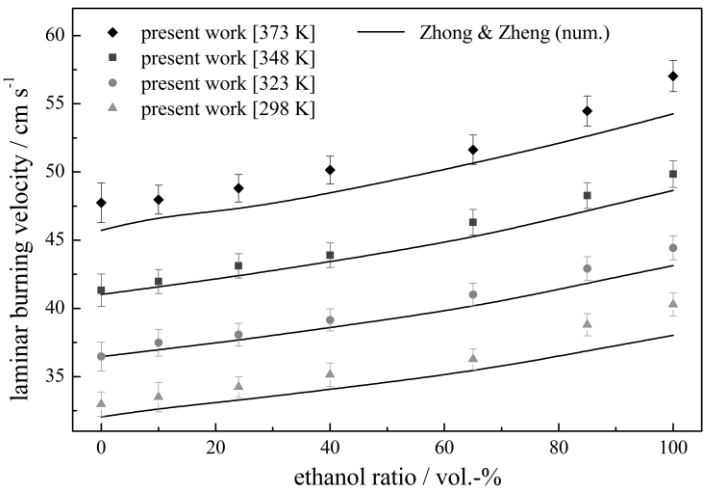

Figure 1 - Laminar burning velocities of ethanol/iso-octane blends for different mixture temperature

[1] IPCC Fourth Asessment Report: Climate Change 2007. Working Group III Report "Mitigation of Climate Change"

[2] B.-J. Zhong, D. Zheng, Combust. Sci. And Tech. 185 (2013) 627 – 644