JETSCREEN Program, Impact of fuel composition on aeronautic emissions: Laboratory experiments

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Introduction

Aviation is actually one of the strongest growing transport sectors, and this trend is predicted to continue. Therefore, there is a big concern linked to the impact of aviation emissions both in climate and air quality. Among the different options available, the aviation industry has identified the development of new fuels as one of the major tools to tackle its emissions. Currently there are five biofuel production pathways technically certified and 16 more certifications are in preparation (Mawhood et al. 2016). In this frame, The JETSCREEN project aims to develop an optimization platform enabling the integration of distributed design tools and experimental based validations to assess the risks and benefits of alternative fuels. The proposed platform will contribute to optimize alternative fuels in terms of achieving the maximal energy density and lowest pollutant emissions.

Methods

During JETSCREEN project, tests at different scales, from laboratory to combustor rig, will be performed. In this work we present the test done using a Combustion Aerosol STandard (CAST) Generator (Fig. 1) especially designed to work with liquid fuel (Jing et al. 2003). Compared to the standard gas CAST this unit adds a nebulizer to produce liquid fuel droplets that are ignited by the existing propane flame. Thanks to the low fuel consumption of this CAST generator, it is extremely useful when a preliminary performance test is needed for large number of fuels.

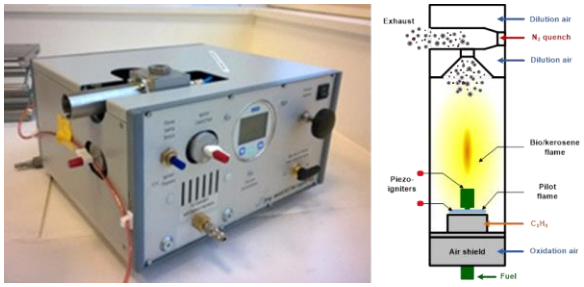

Figure 1. CAST used in this work (left) and a schematic representation of CAST working principle (right)

In this work, we have studied up to 15 different fuels, including: JetA-1, Synthetic Paraffinic Kerosene (SPK), Alcohol to Jet (AtJ), AtJ/JetA-1 and HEFA/JetA-1 blends and different JetA-1 in terms of sulphur and/or aromatics content.

We have used the measurement line depicted in Fig. 2 to characterize the emissions from different fuels.

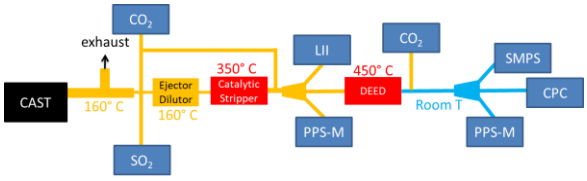

Figure 2. Scheme of the sampling line for Jetscreen tests

We have measured CO_2 and SO_2 concentrations. CO_2 was used as well to calculate the dilution done along the line. We have measured soot mass by means of Laser Induced Incandescence (LII, Artium Inc.), particle number was measured using a Pegasor Particle Sensor type M (PPS-M, Pegasor Oy.) and a Condensation Particle Counter (CPC, Grimm GmbH.). Finally, particle size distribution was measured using a Scanning Mobility Particle Sizer (SMPS) using either a CPC or a Faraday Cup Electrometer as detector (Grimm GmbH). For each fuel, we have studied different fuel to air ratios, from lean to rich combustion. In addition to the on-line characterization, samples have been taken for chemical characterization by different off-line mass spectrometry techniques.

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Jing, L. (2003) *7th ETH Conference on Nanoparticle Measurement*, ETH Hönggerberg, Zürich.

Mawhood, R., et al., (2016) *Biofuels, Bioprod. Bioref.* 10, 462-484.