Evaluation of combustion behavior of renewable jet fuel in a combustor rig: influence of HEFA and its blends on flame stability and emissions compared to aviation kerosene

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ABSTRACT

The Aviation sector is going through complex challenges as a consequence of global emission reduction goals, drop-in fuels usage by 2020, operation costs, competition between regions, new alternative technologies, etc. Particularly, EU RED targets require EU Member States to include a global 10% of renewable energy in all transport sector. Therefore, considerable research has taken place to find new alternatives through advanced fuels and blended mixtures that cannot only provide the required power and reliability that commercial airlines need, but also allow a reduction in harmful emissions.

Thus, this work focuses on the combustion characteristics of a renewable alternative aviation fuel produced by hydrotreating processes (HEFA) and adopted for test flights by the EU FP7 ITAKA program. The renewable jet fuel is produced from non-edible vegetable oils, mainly composed by aliphatic hydrocarbons and regulated by ASTM D7566 (blended up to 50%v/v of Jet A-1) according to ASTM D4054 specifications. This work focuses on the experimental characterization of the combustion behavior of several mixtures, i.e. pure HEFA, blends at 20% and 50% volume with Jet A-1. The selected batches of fuel were tested and compared with traditional aviation kerosene by detailed investigation of flame stability and emissions characteristics at atmospheric and medium pressurized conditions. Chemiluminescence profiles together with combustion results provided fundamental characterization of the fuel and its implications when used in gas turbine systems. Results using pure HEFA showed better response than when utilizing traditional fuel through more stable flame patterns, lower emissions and homogeneous OH* production regimes.

The results provide relevant data for CFD simulation codes through the recognition of species formation, emissions and stability patterns. Moreover, this work created an opportunity to start a collaboration network between GTRC and CREAR/RE-CORD to carry out future developments.

Keywords: *Jet fuel, HEFA, HRJ, combustion, GHGs, hydro-treatment, gas-turbine, emissions, chemiluminescence.*

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