EXPERIMENTAL AND NUMERICAL STUDY OF THE COMBUSTION CHARACTERISTICS OF SAF COMPONENTS

M. V. Manna*, P. Sabia*, M. de Joannon*, R. Ragucci*
mariavirginia.manna@stems.cnr.it
**Institute of Sciences and Technologies for Sustainable Energy and Mobility (STEMS), National Research Council (CNR), Naples, Italy*

Abstract
The aviation industry is responsible for over 2% of global human-induced CO_2 emissions and 12% of CO_2 emissions within the transport sector. To reduce the carbon footprint of aviation, it is essential to develop renewable alternative fuels. Sustainable Aviation Fuels (SAFs) offer a promising solution by lowering reliance on fossil fuels and decreasing carbon emissions throughout their lifecycle. Despite meeting ASTM D7566 standards, SAF production processes yield fuels with different hydrocarbon compositions compared to fossil jet fuels, characterized by higher iso-paraffin content and nearly negligible aromatic concentration. Currently, blending SAF with fossil jet fuels is necessary to meet required standards. Understanding the combustion properties of SAFs is crucial to increase the blending limit to 100%. This study investigates the oxidation of different SAF components to characterize mixture reactivity and speciation under conditions relevant to aircraft applications. Experimental tests were conducted in a Jet Stirred Flow Reactor, varying preheating temperatures, while maintaining a fixed residence time (0.37s), equivalence ratio (0.8), and dilution level (97%). Different bath gases were used to analyze oxidation behavior under vitiated air conditions. Detailed kinetic mechanisms were employed to validate their predictive capabilities against experimental data. Results revealed notable differences among the components. Isooctane showed higher reactivity at low temperatures but reduced reactant conversion between 1000-1200K, indicating a “NTC-like” behavior. Conversely, decane exhibited greater reactivity within this temperature range. Methylcyclohexane and toluene ignited at higher temperatures. Additionally, CO_2 and H_2O were found to influence fuel oxidation behavior. Further experimental and numerical research is planned to examine the impact of fuel mixture composition on overall oxidation behavior, focusing on the high branched-hydrocarbon content typical of SAF compositions.

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