Information sheet – Online seminar 2/10 **Task 66: Recent progress in SAF research**

Process parameters and desirable end-use properties

This information sheet provides a brief overview on the topic of the second workshop of the IEA AMF Task 66 free online seminar series on recent progress in Sustainable Aviation Fuels (SAF) research. This workshop highlights research activities in the field of adjusting process parameters to obtain desirable end-use properties.

Introduction

Commercial aircrafts typically fly with the fossil kerosene types Jet A (primarily used in US) and Jet A-1 (most used worldwide). Main difference between these two fuels is the freezing point. The lower freezing point makes Jet A-1 more suitable for colder climates and long-distance flights. Additionally, Jet A-1 typically contains a static dissipator additive to reduce static discharge and the risk of electro-static ignition. The properties of both fuels are specified under ASTM D1655 “Standard Specification for Aviation Turbine Fuels”. The chemical composition of the fuels varies depending on the hydrocarbons from which they are refined, thus the specifications are focused on fuel properties, such as thermal stability and combustion properties. Additionally, the standard specifies maximum amounts of sulphur, potassium hydroxide and aromatics.

Jet fuel certification

ASTM International (American Society for Testing and Materials) certifies equipment and materials, with a strong focus on safety. In that course they provide minimum fuel property requirements for Jet A/A-1 to be met in order to be used in a commercial airplane. ASTM D1655 is the global base for jet fuel quality specifications.

For SAF production pathways complying with ASTM D7566 “Standard Specifications for Aviation Turbine Fuel Containing Synthesized Hydrocarbons” is crucial. All potential new jet fuels must undergo a strict procedure and excessive testing to be included in ASTM D7566 as an annex. Each annex provides a maximum blending ratio (blend of fossil jet fuel and a sustainable blending component). The blend can then be certified according to D7566 and receive a D1655 certification, making it fully Jet A/A-1 compliant (drop-in) and ready to use in existing jet fuel infrastructure and airplanes.

Technical specifications

Aviation fuel specifications define the physical and chemical properties of aviation fuels to ensure safe and reliable engine operation. These specifications cover aspects like kinematic viscosity, density, freeze, flash and boiling point, total aromatics, derived cetane number, and surface tension. The fuel specifications for SAF pathways are listed in the corresponding D7566 annex. The specifications are based on those for fossil fuels, but are stricter, especially if they are to be used unblended.

Process parameters and fuel properties

In order to meet the requirements of ASTM, the required fuel properties – which are directly related to the performance of aircraft engines – must be fulfilled by carefully setting production process parameters.

The chemical composition of SAF can vary depending on the production pathway, feedstock and process parameters, but it generally consists of cycloalkanes, iso-alkanes, n-alkanes and aromatics. The proportion of these fuel components as well as refining methods like hydrocracking or additives impact the final fuel properties. Fuel properties, such as energy content and combustion quality are paramount for powering the aircraft, whereas properties like fuel stability, volatility and lubricity ensure reliable fuel handling. Density and heating value influence fuel consumption and engine performance and the flash point is a crucial safety factor.

Demonstration plants are built and measurements and simulations are carried out to deepen knowledge of the ideal fuel properties and their interactions. One example are aromatics, which are primarily relevant for the swelling of the seals, but also influence energy density and the cetane number, which in turn has an impact on proper engine operation.

The relationship between process parameters and fuel properties is crucial for ensuring efficient, reliable, and environmentally responsible aviation.

References

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