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THERMAL STABILITY OF ALTERNATIVE JET FUELS

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The recent increase of the crude oil price, the depletion of this fossil resource and the worrying environmental situation lead the Nations to rethink their energy policy and thus to turn to alternative fuels. For mainly safety reasons, the introduction of alternative fuels in civil aviation will be possible only after a long process of studies and certifications. Moreover, as aircraft brought into service today will fly for 30 years, the alternative fuels chosen must be compatible with current engines. Thus, all the physicochemical characteristics of the alternative fuels have to be evaluated in order to determine if they are compatible or not with the jet fuel specifications. The thermal stability of the fuel is a critical property. In modern aircraft, on board fuel is used not only for propulsion but also as primary coolant. Thus, in fuel system and injection devices, the fuel temperature can increase significantly. This thermal stress conjugated with the presence of dissolved oxygen can lead to the formation of gums and solids. These deposits can cause fouling of nozzles and heat exchangers.

The goal of this work is to study the thermal stability of alternative fuels. Five fuels from several origins have been chosen. They are: synthetic fuel coming from Fischer-Tropsch process (representative of future BtL (Biomass to Liquid) fuels) and blends X/Jet A-1 where X could be vegetable oils (coprah, palm), heavy alcohol, and FAME. The results are compared with these of the Jet A-1 used as reference.

The tests are carried out with a back surge device at 185°C. In order to exacerbate the oxidation reactions, a continuous air flow (100 mL/min) is added to the liquid. During a 72 hour test, regular samplings of the liquid and gaseous phases are carried out. They are characterized by GC, GC/MS, HPLC and IR spectroscopy.

As expected, the stability towards oxidation is different from one fuel to another. For example, after 72 hours of test, solid particles are observed in the case of the blend palm oil/Jet A-1 but are not with the BTL. In some cases, gases like H_2, CO_2 and light hydrocarbons are detected. Nevertheless, oxidized products such as alcohols, ketones and carboxylic acids are formed in all the fuels.