1 Publishable summary

Fuel cells for power generation and additional purposes on-board aircraft have a promising potential to contribute to making aircraft “greener” and thus to "greening of air transport” which is a superior goal of European policy of climate change.

GreenAir is addressing one of the key problems for fuel cell application aboard an aircraft - the generation of Hydrogen for on-board fuel cell power units from Jet fuel (Kerosene Jet A-1) which will be the aeronautic fuel for the next decades.

While “mainstream“ fuel processors (e.g. autothermal reforming) have been intensely investigated already, GreenAir is focusing on two novel and unconventional methods plus a supporting technology to overcome some hurdles of “mainstream” reforming technologies:

- For **Partial Dehydrogenation (PDh)** kerosene is taken from the fuel tank, and some hydrogen is stripped off the hydrocarbon molecules and delivered to the fuel cells. The depleted kerosene is sent back to the fuel tank or directly to the engines.
- **Plasma Assisted Fuel Processing (PAF**), will convert the fuel totally in its reformer to reformate and generate a hydrogen-rich gas (containing some nitrogen) from it by subsequent shift conversion and preferential oxidation of CO. No depleted fuel will be pumped back to the tank.
- **Fractionation** is the attempt to extract compounds favourable for reforming out of the kerosene by thermal treatment and separation. For example, if hydrocarbon species can be extracted that do not contain sulfur, or only very little, the catalyst challenge for PDh would be mitigated substantially. So this supporting technology is also a means to minimize risk.

Physical and chemical fundamentals of partial dehydrogenation have been studied using a surrogate model fluid containing well known species to represent the different types (linear, cyclic etc.) in kerosene enabling an interpretation of test results. Catalysts have been developed and activity has been proven on the surrogate as well as on desulfurized kerosene in short term test so far. Next steps will look at increasing the sulphur tolerance of the catalyst, avoidance of coke formation and in particular at durability overall several hundred hours which is pending.
A 1 kW system has been designed on this base, using also modelling tools and is under realisation.

A new design has been developed for a microwave reformer block, enabling increase in the kerosene flow while operating at higher temperature so that the microwave energy waste could be reduced. The overall optimisation of the microwave system has been supported by both modelling and experimental testing. Further to this, a new sub-system is being developed so as to enable heat recovery from the exhaust system.
A 5 kW system has been designed; its components are realised and integration is starting.

Several fractionation concepts have been studied and showed that it was difficult to select with this approach molecules better adapted to partial dehydrogenation. However, a fractionation based on rectification showed interesting results in reducing the sulphur content and has been retained for the next steps of the project as an complementary approach to achieve sulphur tolerance at the system level.

Beyond this, aircraft integration principles have been elaborated and representative tests have been defined, which will take place in the second project half.

Widespread dissemination via a website, publications and conference contributions and a special Forum will be ensured. Training and education of young scientists is foreseen. GreenAir combines 13 beneficiaries from 7 European countries which are from aircraft and fuel cell related industry as well as institutes and SMEs excelling in fuel cell and catalysis R&D. It will establish links to the JTIs (“CLEANSKY” and “Fuel Cells and Hydrogen”) to maximize synergies.
Website: www.greenair-fp7.eu