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Designer fuels for aviation

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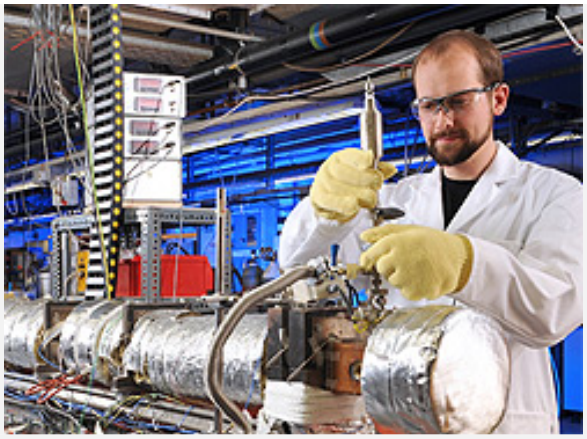


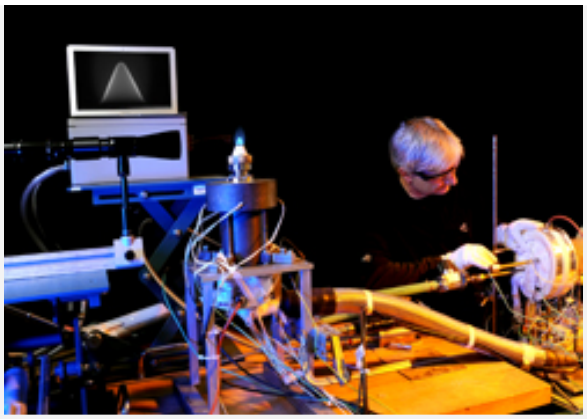
Research into new fuels

DLR conducts research into synthetic alternatives for kerosene

Designer fuels based on coal, natural gas and sustainable biomass could, in the future, replace kerosene in aviation. In the search for alternatives to crude oil, the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) has been conducting research into new synthetic fuels for aviation for several years. Current results show that the future fuels may even be superior to kerosene with regard to environmental friendliness and engine reliability.

"It is the common objective of all research partners from industry and academia to not only replace conventional oil-based kerosene, but also to replace it with a better fuel in the long term: a 'designer kerosene' for the sustainable, environmentally-friendly aviation of tomorrow," said Prof. Manfred Aigner, Director of the DLR Institute of Combustion Technology in Stuttgart. "In developing alternative fuels for air transport, we are working on optimising and modelling these new alternative fuels so that that they represent significant progress with regard to the environment and the technical reliability of engines," Aigner adds.

Gas to Liquid (GtL) in use

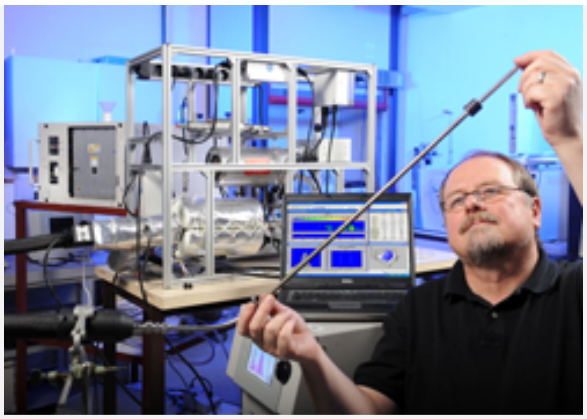


High-pressure burner at the Institute of Combustion Technology

The synthetic Gas to Liquid (GtL) fuel has already been tested successfully. It is manufactured using the 'Fischer-Tropsch process' invented in the 1920s in Germany. During this process, natural gas is first transformed into synthetic gas by adding oxygen and steam, and then transformed into liquid hydrocarbons. The first scheduled commercial flight using a 50 percent blend of GtL and kerosene took place during October 2009 in collaboration with Shell, Rolls-Royce and Qatar Airways. DLR researchers see great potential in GtL. It represents an important bridge to the long-term aim of using biofuels - alternative, biomass-based fuels. Both GtL and CtL (Coal to Liquid, a synthetic fuel based on coal), are produced using the same process (Fischer-Tropsch), which can also be used for the production of BtL (Biomass to Liquid). The newly acquired knowledge can thus be transferred to the development of high-performance biofuels.

Smoke emissions significantly reduced

That the introduction of GtL would be more than just a step towards independence from crude oil was something the researchers at the Institute of Combustion Technology had already established. Current measurements show that the carbon black content of GtL fuels is significantly lower than conventional kerosene. For a blend of GtL and kerosene, this means that the polluting emissions fall as the amount of GtL in the fuel rises - improving the air quality for people in the vicinity of airports.



Analysis of the polluting emissions of new fuels

This is but one aspect of the comprehensive research into new fuels at DLR. "The combustion process in an aircraft gas turbine is the sum of many different individual processes. One of them, for example, is the oxidation of the fuel. In order to analyse this process in isolation, we began by determining the most important combustion characteristics using our test facilities, such as a high-pressure burner or a shock tube system," Aigner explains. For instance, the speed at which the fuel reacts to release its energy – or combusts – is measured. "With these performance data we then 'feed' our simulation tools to create a model for the complete reaction process of the fuel."

The goal is to 'put together' the fuel of the future in a targeted design process using the models in such a way that an new fuel is created – one that is optimum with regard to technical suitability, reduced pollution and chemical and physical characteristics. Forecasts put the use of the new fuels within reach: "A gradual introduction can be expected over the next ten years, initially as a blend of GtL or CtL and conventional kerosene. In this way, we are already making a start on countering the problem of the

depletion of resources. By 2030 we anticipate that biomass-based fuels will largely have replaced kerosene. This will enable carbon-neutral aviation," Manfred Aigner says.

Background

For more than 30 years, the DLR Institute of Combustion Technology in Stuttgart has been conducting research into the challenges of combustion technology in the power plant, aviation and transport fields. For about ten years, a team of some 20 researchers from various departments of the institute has been working on the subject of alternatives fuels in aviation, above all in large long-term projects in cooperation with partners in industry and other research institutions. In the EU SWAFEA (**S**ustainable **W**ay for **A**lternative **F**uels and **E**nergy for **A**viation) study, the DLR combustion researchers and their partners have been investigating the feasibility and effect of the deployment of alternative fuels in aviation. In the EU ALFA-BIRD project, they are working on a roadmap for alternative aviation fuels in order to promote the use of new fuels in aviation. The development of design tools for a biomass-based energy supply is the focus of the DEDEBIO project. Research projects for the further development of GtL fuels are currently underway in cooperation with industry - for example with Shell, Rolls Royce, the Qatar Science & Technology Park technology centre and Texas A&M University Qatar.

Building on these results, industry is developing new engine combustion chambers for the alternative fuels. The new combustion chambers are then tested at DLR, in the unique, specially developed high-pressure test facilities of the Institute of Propulsion Technology in Cologne-Porz.

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