PRESS RELEASE

Protection against wing icing

When ice builds-up on the wings of aircrafts, it drives up costs and impedes safety – and in the worst case scenario, could even cause an aircraft to crash. At the ILA Berlin Air Show from September 11-16, 2012, researchers of the Fraunhofer IFAM will demonstrate new ways to keep ice off of the aircraft's wings (Hall 3, Booth 3221).

Regardless of how fluffy and plush white clouds against a blue sky may appear from ground level, the conditions inside them are forbidding indeed: If aircrafts fly through these clouds, the low temperatures, combined with wind speed, can cause the rapid formation of ice sheets on the wings. This icing could have two serious consequences: First, the ice sheet may cause an up to 40 percent rise in the aircraft's aerodynamic drag; second, the aircraft becomes heavier and can lose up to 30 percent of its lift. Both conditions lead to a marked spike in fuel consumption, impede safety and – in the worst case scenario – the ice may even cause the aircraft to crash.

Aircraft manufacturers therefore must prevent icing. Various technologies can help with this. For example, by conducting the heat from the jet engines to the hollow spaces inside the wing leading edges, the wings can be de-iced during flight. Other manufacturers are integrating "rubber boots": basically, rubber mats that can be pumped up when needed and "blast" the ice from the wing surface. A major disadvantage of these technologies is the exorbitant energy requirement. Moreover, they cannot be combined with fiber composite materials – or only with great difficulty – but carbon fiber materials are increasingly being used in aircraft construction.

System solutions for de-icing

Paint/Lacquer Technology experts at the Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM in Bremen are working on system solutions for de-icing. Through an EU-funded project that is scheduled to begin in the autumn of 2012, they will engineer new technical solutions – besides de-icing through heat – for the mechanical removal of ice from the wings. "We will use innovative materials here, such as 'shape-memory materials'", explains Dr. Stephan Sell, scientist who specializes in paint/lacquer technology at Fraunhofer IFAM. What is so unusual – and special – about this approach? If the temperature changes, or if one applies an electrical current, then the material changes its volume. This way, scientists can blast the ice off of the wing surface. "We expect energy savings from this to reach up to 80 percent compared to conventional heating methods," Sell explains.

Editorial Notes
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At the same time, the scientists wanted to combine the active de-icing of the wings with new kinds of sensors. If the wings ice up, the sensors detect this condition through an optical system, and notify the crew. Previous techniques were based merely on indirect measurements. This integrated sensor system makes it possible to identify the icing in real time, and to monitor the success of the de-icing process in real time, too. The result is greater energy efficiency for the entire system, and a manifold increase to airline traffic safety.

Protection through anti-ice coatings

Where there is no water, there can be no ice. Therefore, researchers at Fraunhofer IFAM engineered coatings with anti-ice capabilities under the "CleanSky" program. Among other things, the hydrophobic, water-repellant coating should protect against runback ice, which forms from the melted ice coming from the wing leading edges. At the wing leading edges, once the heaters melt the ice back into water, it flows down to the lower part of the wing as melt water, where it freezes again and turns back into ice. "Our hydrophobic coatings are intended to ensure that water at the rear part of the wing flows off the wing instead of cleaving to it. We can achieve that by blending certain additives into the paint, such as fluorinated compounds," explains Stephan Sell. "The main challenge is figuring out how to produce water-repellant coatings so that they remain stable for several years – resisting the effects of UV radiation and high erosion stresses.

The areas of application for these new technologies are not limited to aviation. Icing is also a problem for ships, rail-based vehicles, cars, rolling doors, refrigeration aggregates and wind power farms. For example, iced rotor blades at the wind turbines cause the facility to produce substantially less power – in the worst case, the icing leads to irreparable damage. If parts of this ice drop off, they could even cause injury to people below.

The Fraunhofer IFAM researchers have a custom-built ice chamber at their disposal for testing anti-ice technologies. This lets them adjust conditions to a variety of realistic icing scenarios. For example, they can drop the ambient air temperature by up to -20° Celsius, blow wind through the test chamber at speeds of up to 70 meters a second, and simulate rain through a nozzle. This means the researchers can identify ice formation on surfaces, quantify the efficacy of de-icing processes and measure the adhesive strength of the ice. They can also use, for instance, individually produced models of wing profiles, with new anti-ice coatings, for testing purposes. One of these will be exhibited at the ILA Berlin Air Show (Hall 3, Booth 3221).

Further information about the Fraunhofer IFAM
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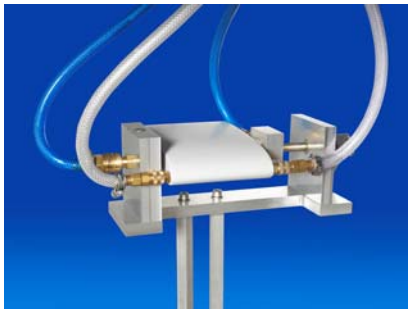

Photo caption
Test device developed at Fraunhofer IFAM for carrying out the runback ice test on wing sections (© Fraunhofer IFAM).

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