Aviation industry dons 'shark skins' to save fuel

February 17 2013, by Etienne Balmer

Illustration. Germany's biggest airline Lufthansa announced earlier this month that two of its Airbus A340-300 jets would take part in trials starting this summer to test the properties of shark skin in flight. A new type of coating are being painted on to the fuselage and wing edges of the aircraft.

In its never-ending quest to develop more aerodynamic, more fuel-efficient aircraft, the aviation industry believes the ocean's oldest predator, the shark, could hold the key to cutting energy consumption.

Germany's biggest airline Lufthansa announced earlier this month that two of its Airbus A340-300 jets would take part in trials starting this summer to test the properties of shark skin in flight.

For the two-year trials, eight 10 by 10 centimetre (4 by 4 inch) patches of a new type of coating are being painted on to the fuselage and wing edges of the aircraft.

A new state-of-the-art varnish, developed by the Fraunhofer Institute for Manufacturing Technology and Advanced Materials (FAM) in Bremen, attempts to mimic the skins of fast-swimming sharks.

The skin of sharks is covered in tiny riblets that reduce turbulent vortices and the drag they cause, thereby diminishing surface resistance when moving at speed.

The phenomenon of the streamlined shark skin has been known for about 30 years and has fascinated research scientists in a wide range of fields, from military applications to aerospace and aeronautics and from naval construction to wind technology.

More recently, its use in sports such as swimming and athletics has brought the special properties of shark skin to much wider attention.

High-tech swimsuits were developed that enabled athletes to move ever faster through water, breaking one swimming record after the next until the suits were eventually banned as unfair in competition.

In the past, says Volkmar Stenzel, the project's head at the Fraunhofer Institute, sheets of plastic imitation shark skin were glued to the aircraft's exterior.

"But the foil had major disadvantages: it was rather heavy and the added

weight cancelled out the amount of fuel that could be saved," Stenzel said.

"Also, it was difficult to stick the foil to curved surfaces without creasing and wrinkling," he said.

Another problem was that aircraft have to be stripped of their paint and recoated every five years "and that was just not possible with these foils," the expert explained.

Thus, in collaboration with European aircraft maker Airbus and the DLR German Aerospace Center, scientists at the Fraunhofer Institute have developed a new technique to emboss the structures of shark skin into aircraft paints.

The idea is to make surfaces more aerodynamic and reduce fuel consumption by about one percent and lower operating costs.

The trials on Lufthansa jets represent the last phase before possible industrial application, said Denis Darracq, head of research and flight physics technology at Airbus.

"The expected results have been achieved in terms of performance. It's now a matter of measuring operational efficiency and durability," Darracq said.

"An airline must not have to clean its aircraft after every flight. The paint needs to last for several years," he said.

The engineer estimated that if an aircraft was covered by between 40-70 percent in the new paint, it can cut fuel consumption by around one percent for very little outlay.

And with high fuel prices and customers becoming increasingly sensitive to the environmental impact of flying, that would represent an "enormous benefit" for an airline, Darracq argued.

Nature is also the inspiration for another state-of-the-art technology that is already being used by the industry and may have wider applications.

The leaf of the lotus plant has a unique microstructure consisting of tiny bumps topped with tiny hairs that make the leaf highly water repellent.

Special surface coatings have been developed to mimic this effect and they are already used in the interior of the A380 to make it easier to clean.

But Airbus is also looking into whether such coatings can be used on the exterior of aircraft as well.

"De-icing is a real problem for planes and represents a substantial cost factor. If there were surfaces where water cannot collect, they wouldn't freeze over and that would represent a big step forward," said Darracq.

Airlines' growing interest could therefore help accelerate research in surface technologies "and these may be ready for industrial application in a number of years," the engineer said.