Supercooled water threat to aircraft fuel systems

Research on cloud formation led scientists to help aircraft engineers understand how droplets of 'supercooled' water in jet fuel can cause ice to form in aircraft engines.

Though rare, ice can cause major problems if it forms inside aircraft fuel lines: it is thought to have been responsible for the almost simultaneous failure of both engines on a Boeing 777 that crash-landed at Heathrow airport in 2008.

Partners:
Airbus, Asymptote Ltd, Leeds University

The collaboration

Analyses of the incident at Heathrow, and others like it, pointed to ice building up inside fuel lines and suddenly being released, blocking the fuel supply to the aircraft engine.

But atmospheric scientist Dr Ben Murray at the University of Leeds realised his work on ice formation in the atmosphere could shed new light on this process. The incident analysis assumed that water in the engines would freeze at 0°C, but Murray had determined that water droplets in the atmosphere can remain liquid as low as about -36°C. Above this temperature the water must come into contact with a suitable surface to trigger ice formation.

Working with ice-crystallisation specialists Asymptote Ltd, Murray used his own atmospheric research equipment to cool samples of jet fuel into which they had submerged micron-sized water droplets. They demonstrated that the water behaved the same in the fuel – ice crystals only started to form spontaneously below -36°C.

This means that, instead of ice sticking together, the engine problems could have begun when supercooled water droplets came into contact with solid surfaces in the aircraft's fuel system, instantly

freezing and resulting in a build-up of ice that could have restricted the flow of fuel.

Murray hosted a meeting in Leeds with Asymptote Ltd and Airbus to talk about the problem. Though not enough on its own to explain the engine failures, the research has important implications for aviation safety. Dr Joseph Lam of Airbus Operations Ltd says, 'The discussion with Ben and his colleagues has educated us and provided us with new leads and research directions. Ben's work draws us to the field of atmospheric science which we have not actively pursued before.'

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