Contaminated Air TIME TO ACT?

BY SUSAN MICHAELIS

Many people within the airline industry continue to suggest that cockpit/cabin fumes events involving synthetic jet engine oils and hydraulic fluids are rare, perceive them as a nuisance rather than as a threat and therefore discount them as an aviation safety issue. This perception is not supported by the evidence. Others argue that more scientific data are required, but, in fact, a wide range of well-documented sources clearly shows that it is more likely than not that there is a connection between air contaminants and health effects.

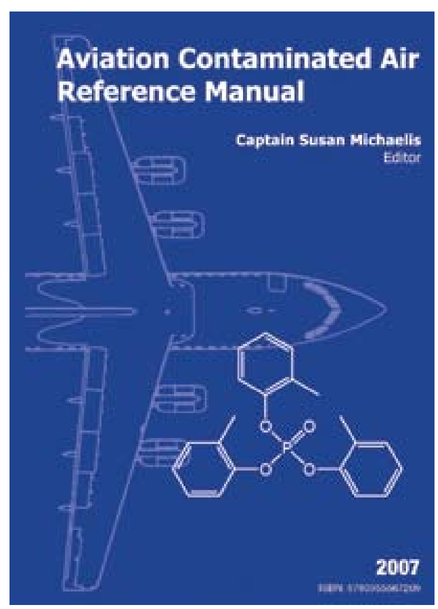
Fumes events were recognized as not being rare back in the 1970s and in the early 1980s. In 2006, the U.S. Federal Aviation Administration (FAA) expressed serious concerns that U.S. airlines were failing to report all "smoke/fumes in the cockpit/cabin" events; as such, the industry cannot truly know the scale of this problem.[1] Previous recognition that they are significantly under-reported has been supported by the Australian Senate, the Australian Transport Safety Bureau, the Royal Australian Air Force (RAAF) and the Global Cabin Air Quality Executive (GCAQE), a nonprofit advocacy group representing the interests of more than 500,000 aviation workers globally. In March 2008, the GCAQE called for a public inquiry into failures by the U.K. government, including the Civil Aviation Authority (CAA), to deal with these matters effectively.

Aviation oils and fluids typically contain hazardous substances that become toxic when heated.[2] Among those of most concern are an organophosphate anti-wear and fire-retardant compound called tricresyl phosphate (TCP), a neurotoxin, and an anti-oxidant compound called phenyl-alpha-naphthylamine, a skin sensitizer. The health hazards of inhaling their aerosols, vapors, mists, fumes or byproducts via the environmental control system (ECS) have been recognized since the 1950s.

The first published case of aircrew incapacitation in flight — involving disturbances in mental and neuromuscular functions caused by inhalation exposure to aerosolized or vaporized oil — was reported in 1977.[3] That paper stated, "Further investigation into the potential hazards from inhalation of synthetic oil fumes that are generated by these circumstances is definitely warranted." To date, adequate research has not occurred.

In addition to aircraft systems failures and inadequate maintenance practices, a major reason for this contamination is actually a seal design problem. The Civil Aviation Safety Authority of Australia advised the 1999 Australian Senate inquiry into British Aerospace BAe 146 cabin air quality that "all aircraft from time to time suffer fumes within the aircraft. … That is a feature of the basic design of air-conditioning systems in aircraft, being bleed air from engines." British Aerospace advised then that BAe 146 seals may be less efficient during transient engine operations or during warm-up to operating temperatures, and that improvements in seal design were under way and would increase efficiency.

Many state that when the aircraft is functioning properly, there should be no problem with air quality. However, any time air quality causes irritation and discomfort, this is typically a breach of civil aviation regulations. The



majority of cabin air quality monitoring studies have been undertaken during normal flight operations, and their results cannot be applied to oil/fluid fumes events. While many past cabin air monitoring reports have stated that all contaminant levels found were below government-set standards for occupational exposures, these "standards" in fact do not exist because occupational hygiene values applied on the ground should not be applied at altitude. A further concern is that most of these studies used inappropriate methods and monitored for gases and vapors, rather than mists and particulates, and therefore significantly underestimated the exposure effects.[4]

The 1999 Braathens Malmö Aviation BAe 146 incident in Sweden is a prime example whereby there was a known oil leak and in which more than 90 contaminants, including TCP, were identified in subsequent tests. The crew were severely incapacitated, yet the Swedish Accident Investigation Board (SHK) report stated that all contaminants were below government and industry standards. Further, this and other reports failed to look at the potential additive and synergistic effects of such exposures.

More recently, 85 percent of samples from swabs wiped against surfaces in aircraft cabins — on three continents and a range of aircraft types — came back from laboratory analysis positive for TCP. Further, TCP has been found on pilots' trousers and in their blood following in-flight exposure to contaminated air. Current cabin air monitoring by the FAA-funded Occupational Health Research Consortium in Aviation (OHRCA)[5] and research undertaken for the U.K. Department for Transport both have detected TCP in cabin air.

Both short-term and long-term health effects are being reported by aircrew as well as passengers, and this is well documented. Various reports show that TCP has been detected in cockpits and cabins through studies undertaken by numerous organizations including Honeywell, the RAAF, airlines and the CAA. The RAAF recently suggested that the term "aerotoxic syndrome" become internationally recognized to represent a cluster of neurological, neuropsychological, respiratory, immune, gastrointestinal, chemical sensitivity and irritant effects, among others.

Long-term neurotoxicity has been reported, and blood serum tests for neuronal and glial cell autoantibodies — signs of neurological autoimmune disorders — have indicated neuronal cell death in pilots tested. Research also has shown that the additive in jet engine oils can under-regulate and over-regulate gene expression.[6]

As it does not use bleed air, the Boeing 787's design concept appears to be a future solution. However, ECSs using bleed air are going to be in operation for many years, and available evidence clearly shows that a precautionary approach must be taken now, including bleed air filters on all current aircraft to protect crews and passengers. Additional solutions could be implemented, such as installing contaminant-detection systems, selecting less toxic oils/fluids and conducting appropriate epidemiological studies.

The *Aviation Contaminated Air Reference Manual* compiled, edited and published by the author in 2007, provides most of the documentation for this article and covers issues that require attention.[7] The head of research at the RAAF Institute of Aviation Medicine called the manual a "ground-breaking and seminal work" and noted that there has been a "widespread prevalence of denial of the existence of the problem, particularly among the aircraft operators and aviation regulators." ●

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Notes

1. FAA. "Guidance for Smoke/Fumes in the Cockpit/Cabin." *Flight Standards Information Bulletin for Airworthiness (FSAW)* no. FSAW 06-05A. Amended May 19, 2006.
2. Winder, Chris. "Chemistry and Toxicology of Mobil Jet Oil II." Presentation to the Australian and International Pilots Association, November 2007.
3. Montgomery, Mark R.; Wier, G. Thomas; Zieve, Franklin J.; Anders, M.W. "Human Intoxication Following Inhalation Exposure to Synthetic Jet Lubricating Oil." *Clinical Toxicology.* Volume 11 (November 1977): 423–426.
4. Winder. "Air Monitoring Studies for Aircraft Cabin Contamination." *Current Topics in Toxicology.* Volume 3 (2006): 33–48.
5. The Web site is <www.ohrca.org>.
6. Furlong, Clement E. "Biomarkers of Exposure to TCP." Presentation to the *Flight International* Crew Management Conference, Brussels, Belgium, October 2007. The U.S. National Cancer Institute defines gene expression as "the process by which a gene gets turned on in a cell to make [ribonucleic acid] and proteins."
7. The Web site is <www.susanmichaelis.com>.

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