

AEROTOXIC SYNDROME

AVIATION'S BEST-KEPT SECRET

It is high time that the aviation industry acknowledge the insidious problem of toxic oil fumes leaking into aircraft cabins and adopt technical solutions before more aircrew and passengers suffer severe long-term damage to their health.

Hands up if you have ever got off an airliner feeling unexplainably...ill? Many people experience "jet lag" after flying across time zones, which makes sense, and adjustment can take several days. But what about the many who feel seriously ill for days, weeks, months and even years after a short-haul "fume event" flight?

I enjoyed extremely good health until 1989 when, as a new BAe 146 pilot, I suddenly developed Alzheimer's-type symptoms of failing memory, speech difficulties and trouble with thought-processing, which left me feeling permanently intoxicated. As I was on permanent night-flying duties, I logically put these symptoms down to the anti-social hours and I kept quiet for fear of losing my job. For 10 years previously, all over the world I had flown "dangerous" low-flying crop-spraying and aerial fire-fighting aircraft as well as the venerable DC-3 Dakota—all of which I flew at low altitude where one breathes normal, unpressurised air. Not unreasonably, I wished to get into a "safer" form of flying.

In 2005, by which time I had become a Training Captain on the BAe 146 but was now day-flying, my memory was appalling and I knew that I was a hazard not only to myself but to my passengers. In August 2004, I had "failed safe" by walking off a BAe 146 just prior to take-off for a difficult approach into Salzburg airport, Austria, as I was convinced that I was about to kill not only myself but all of my passengers. I finally stopped flying in early 2006 at 49 years of age, confused as to how my excellent health had progressively failed over a 16-year period, leaving me a "zombie-like vegetable".

I would be diagnosed by aviation specialist doctors in early 2006 as suffering from "chronic stress", but 12 months later I knew without any doubt whatsoever that I had actually been "chronically poisoned" by repeatedly breathing visible oil fumes in the BAe 146. Like so many others around the world, I would soon unfortunately discover "the best-kept secret in aviation" and a major cause of mysterious, undiagnosed ill health, mainly in aircrew but also in airline passengers who can become equally adversely affected from just one bad flight.

by Captain John Hoyte © 2009

Chairman
BM Aerotoxic Association
London, WCIN 3XX, UK

Email:
info@aerotoxic.org
Website:
<http://www.aerotoxic.org>

A dangerous design flaw

In October 1999, three international scientists proposed the term Aerotoxic Syndrome to describe the serious neurological ill health that results from breathing toxic cabin air from airliners.

How could the air become toxic? Surely at 35,000 feet the air is less dense, but how could it be poisonous?

When jet aircraft first flew in the late 1950s, the engineers knew that they had to provide compressed air in airliners to support life at high altitudes and so they designed mechanical compressors which did the job well. All of the early jet airliners such as the DC-8 and Boeing 707 used this separately compressed air.

But in the early 1960s, the accountants looked for cheaper, simpler ways to provide that air. It was realised that all jet engines have vast amounts of compressed air available from the forward section of the engine, before the fuel is added and burned.

It wasn't long before they were taking this hot, high-pressure air and piping it into the cabin. They would call it "bleed air", as it was "bled off" the jet engine compressor section.

At the time, many engineers warned that if the bleed air should become contaminated with oil from within the engine or hydraulic fluid, then everybody in the jet aeroplane would not be breathing pure air but a contaminated mixture of air and...oil.

However, the risk was thought negligible, such that bleed air quickly became the only way to get compressed air into the cabin of each and every aircraft since that period, including turboprop aircraft where a jet engine drives a propeller.

The first bleed-air jets were the Boeing 727 and the McDonnell Douglas DC-9, but it would be 36 years before Boeing would suddenly decide, in 1999, not to use bleed air in future designs. It would build a new type of jet: the Boeing 787 Dreamliner. This jet would also be made from composite materials and have a relatively higher cabin pressure.

But Boeing would never be able to admit that it had ditched

bleed air, as it continued to build bleed-air aircraft. Obviously it would take many, many years for a complete change of technology. This was a double bind for Boeing. Meanwhile, Airbus denies any problem and continues, some say foolishly, down the bleed-air route.

One fact of airline flying is that while you are sitting comfortably at 35,000 feet, the actual cabin pressure is at about 8,000 feet—or as if you are sitting on the top of a small mountain. Most people will know that this "lack of air", although bearable, is a compromise and that, ideally, the cabin air pressure should be at or near sea level. If this were so, it would take a massively strong aeroplane hull to contain the sea level pressure at high altitude and this would be "uneconomic". However, the Boeing 787 has a more comfortable cabin pressure of only 6,000 feet—a definite selling point, but only for those "in the know".

A little-mentioned but fundamental fact that Boeing prefers to keep quiet about is that the bleed air in a 787 will only be used for melting ice on the wings. The actual cabin air will be provided by an old style of air pump, driven not by mechanical pumps but by modern electric air pumps. But not surprisingly, Boeing is dismissive of this "insignificant" fact, which should now

be understood as an obvious "about-face" innovation. Boeing prefers to publicise the fuel economy, which many members of the public can readily relate to, and to invent likely reasons to deny any truth for the real reason... Unsurprisingly, there was no public reference to the real reason for dumping bleed air on the occasion of the B 787's inaugural flight on 15 December 2009.

Bleed air and fume events

So what exactly would Boeing prefer the public not to know about? Since 1963, there has been an ongoing debate as to how clean the bleed air is. Boeing itself admits that in abnormal situations, mainly when oil seals "rarely" fail, the engine oil can contaminate the air. This leads it to claim that the air is "generally safe in normal operations". But what about abnormal operations—the every-other-day occasions? What Boeing does not acknowledge readily is that oil seals do

not always fail suddenly but often fail slowly over many hours, leaking oil into the air.

The fact is that bleed air and oil are allowed to mix due to:

- a basic design feature which deliberately allows small amounts of oil to pass through oil seals to provide lubrication;
- the fact that jet engine oil seals prefer a constant-temperature environment to perform "normally" and tend to leak when warming up or cooling down;

What Boeing does not acknowledge readily is that oil seals do not always fail suddenly but often fail slowly over many hours, leaking oil into the air.

• the fact that when power changes are made, such as on take-off or at the top of descent when an incredible number of revolutions are suddenly increased or decreased, there are differing tolerances within the jet and the potential for oil to leak.

There are a number of basic facts which now must be presented. There will always be a few minor differences, but the following facts are known:

- aircrew and passengers generally breathe the same air; if the pilot is sick, so will the passengers be sick;
- all jet aircraft use bleed air: turboprops, Air Force One, corporate jets;
- the chemicals in the jet engine oil are extremely toxic, especially since an organophosphate (OP) is added to make the engines last longer and provide fire-retardant properties.

So what are organophosphate chemicals? They were developed during World War II by the Germans, specifically to do harm to human nervous systems. They have since been used in pesticides, e.g., in sheep dip—hence the dreadful neurological illnesses affecting many sheep farmers in the UK during the 1980s and 1990s. Gulf War military personnel were also exposed to OPs and became mysteriously ill.

It is known that chronic exposure to OPs can go on to change personalities and character, affect relationships and moods, and devastate lives. Does any of this sound familiar?

How many passengers are aware of OPs—especially tricresyl phosphate, or TCP—being in the engine oil of passenger jets? Well, if the oil stayed in the engines there wouldn't be a problem, but all too often OPs end up in the brains of aircrew and passengers.

Is there a problem? Well, some aircraft are more prone to a "fume event"—when the air and oil mix—than others, and the BAe 146 is by far the worst offender, closely followed by the Boeing 757, but really any Airbus, Boeing, Embraer and Fokker jet can and does suffer from this basic design flaw.

How often do fume events happen? By now you will understand that there are two sides to the argument, but only one can be right. Members of the public are stuck in the middle, amazed at the genuinely "safe" reputation of flying but maybe having the sneaking suspicion that their "jet lag" is not entirely due to changing time zones, for it can kick in badly a few days *after* a fume-event flight. Many pilots know that minor fume events happen on each and every flight.

On a BAe 146, there is a small auxiliary power unit (APU) jet engine at the rear of the aircraft which is used primarily on the ground to provide electrical power and warm or cool air in the cabin. Often when this small jet engine is started from cold, the whole aircraft fills with a visible blue haze of oil fumes which lasts for around 10 minutes.

Breathing organophosphate fumes in a confined space is arguably much more hazardous than breathing in tobacco smoke, and scientists agree that a cocktail of chemicals working together synergistically is collectively many times more dangerous than any chemical in isolation.

The UK Mandatory Occurrence Reporting Scheme for June and July 2009 shows a fume event being recorded on average every second day. A quick calculation shows that 180 fume events multiplied by the number of passengers—on average, 100 per flight—and immediately one has 18,000 passengers per year being exposed to toxic chemicals. It has been suggested that only around four per cent of fume events are reported; pilots hate extra paperwork.

University College London calculated in 2006 that 196,000 UK passengers are exposed to toxic gas each

year. These people present their symptoms to their GPs, who have no pigeonhole for OP poisoning. Why? The UK government decreed years ago that it is all just too difficult, and does not even mention the possibility to doctors who are frequently presented with evidence from their patients and the Internet telling a different story.

Meanwhile, the UK government thinks that fume events happen in one in 2,000 flights (although the UK Committee on Toxicity reckons it's one in 100 flights from pilot reports). That doesn't sound too bad, except that with 1,200,000 flights in total annually, this is 600 flights per year. The numbers are almost immaterial. The fact is that fume events can and do happen—much more frequently than anybody can imagine. As a comparison, how many airliners end up landing in the water? Well,

the answer is two survivable accidents in around 50 years, and yet every passenger has an expensive life-jacket under their seat (even for flights over land), just in case.

Fumes and filters

Would a passenger recognise a fume event? What are the tell-tale signs?

In aviation, there are many different smells. Jet exhaust fumes on the ground from an aircraft taxiing ahead is a classic example of fuel fumes, but not oil fumes. There are oven fumes from when ovens get too hot. There are electric fumes when electrical components get too hot and melt. Then there are oil fumes from the bleed-air lines.

Most people would imagine that the oil components would be filtered out, but the incredible fact is that bleed-air lines are not filtered—except, as one lawyer has darkly noted, by the passengers' lungs.

There are filters in the actual aircraft, but not in the bleed-air lines. The aircraft manufacturers helpfully put these filters inside the aircraft to filter the air, but only the air which is already in the aircraft.

Oil fumes have been described as smelling like "a wet dog", "the inside of trainers" or "vomit". The fumes can also be visible and are often reported in aircraft such as the BAe 146 as a visible blue haze.

It must be known that breathing any visible oil fumes is likely to be extremely hazardous due to the concentration of chemicals, and many aircrew have become seriously ill from repeatedly breathing these fumes—more or less as an occupational hazard. Most people would agree that a whiff of fumes for a few minutes might not cause serious ill health, but when

It must be known that breathing any visible oil fumes is likely to be extremely hazardous due to the concentration of chemicals, and many aircrew have become seriously ill from repeatedly breathing these fumes...

one is repeatedly breathing fumes for many thousands of hours, just like smoking, one will be killed slowly.

There are other almost unbelievable facts.

Once one has accepted that toxic fumes may be a problem, might it not be a good idea to have toxic fume detectors on board an airliner, along with all the electronic entertainment systems which appear to be so vital these days?

Many will be shocked to know that apart from the smoke detectors in the toilets, there are no detectors in the bleed-air lines. If and when toxic air gets through, it is up to the pilots, cabin crew or passengers to smell it with their noses and raise a stink, and then up to the pilots to try to isolate the faulty bleed-air line, which on a four-engine aircraft takes time as each engine supplies bleed air.

What about protection from the fumes? Well, worry not, because the pilots and cabin crew have oxygen masks which they must put on, although it is incredible how many pilots prefer to breathe the fumes, totally ignorant of their toxic properties. I did it for 16 years.

But what about the passengers? Surely they have their own drop-down oxygen supply (with the thoughtful addition of extra masks)? Actually, this system is only for use in an emergency descent when the pressurisation suddenly fails and the airliner

must be descended rapidly to 10,000 feet. In any case, this oxygen is mixed with contaminated ambient air and only lasts for 20 minutes. This leaves the passengers without any protection at all from exposure to toxic fume events. Simple activated-carbon face masks offer some protection.

The effect of toxic fumes on a pregnant woman and her growing foetus can only be imagined. The fumes have been recorded as doing permanent damage to many unlucky people; yet, as fume events are still seen as "non-events" by regulators and airlines, most people will be affected but never know it.

Breathhtaking silence on health effects

So why is aerotoxic syndrome not accepted? It shouldn't be too surprising to know that industry has a habit of working together on certain issues and having vested interests. It could be argued that the aircraft industry starts the problem by designing a flawed system where oil and air can mix. But who is to blame? The engine manufacturer? The airframe manufacturer? The oil industry? The seal manufacturer? The health industry? Definitely not the airlines, although they too are party to the cover-up.

Many people must know of the dire effects from breathing oil fumes repeatedly. However, breathing these fumes only seems to affect around 30 per cent of people very badly. It doesn't kill these people, it only *half kills* them.

Meanwhile, authorities such as the UK Civil Aviation Authority (CAA) and the US Federal Aviation Administration (FAA) are there to protect the airlines, so, despite all the overwhelming evidence, they still consider breathing oil fumes as not causing any long-term ill health and for there to be no evidence for these deleterious effects.

The medical system is skilled at misdiagnosing the symptoms of OP poisoning, which have been known for around 100 years: chronic fatigue, memory problems, muscle twitches, respiratory problems, speech difficulties and many other neurological problems associated with damage to the central nervous system. Frequent

misdiagnoses are of chronic "stress", a "virus" or just "not known", and incorrect treatments using antidepressants and antibiotics just go to complete the circle of deceit and keep the medical industry's wheels turning around and around.

Pilots and cabin crew are in a particular "no win" situation. They are often lured into a glamorous, globetrotting job which has its attractions of respect and skill, but soon most crew often find the reality

somewhat different. Many aircrew start flying and do a few years before retiring...exhausted. This is the deal; and once they leave their jobs, their health is deliberately never followed up, which perpetuates the scam.

As aircrew, they usually have above-average fitness on starting flying but they quickly become like "zombies", "vegetables" or "permanently intoxicated". The pattern is that they continue for as long as possible, usually unknowingly, going "part-time" to try to limit the exposure before "failing safe" and being led up the garden path by a medical system which deliberately goes out of its way to test their blood—usually with the result that, if it's red, it's okay! If more complex tests were done, not only on the blood but also on the fat reserves (where the toxins are stored), these would show a cocktail of toxic chemicals.

It shouldn't take too much ingenuity to prove exposure to OPs in aircrew and passengers in a "modern-day" jet aeroplane. Within months, there could be a routine blood test which not only showed exposure but also told the owner of the blood the exact time of exposure. So, would any similarity between serious ill health and the time of flying then be purely coincidental? The airlines' and authorities' answer to

The medical system is skilled at misdiagnosing the symptoms of OP poisoning, which have been known for around 100 years...

this issue is to prefer not to even talk about it, as if silence will make it go away. It is called denial.

The work pattern of continual mix and match of different flights prevents many aircrew from identifying their common illness. And there is a total failure on the part of doctors to apply basic chemistry to a known practical issue.

There is also a "can do" or "right stuff" attitude among pilots, where mission completion is vital not only to their airline but also to their sense of job satisfaction. As professional pilots, curiously the only result we wish to see is safer flying and an end to the denial.

Airlines' duty of care

So, at the moment, there are two distinct features: the poisoning and the cover-up.

By now, though, we should realise that there *are* technical fixes that could be adopted:

- filter the bleed air;
- fit toxic fume detectors;
- remove OPs from jet engine oil.

It is high time that airline bosses be questioned about a basic duty of care to their aircrew and customers, if only to check that they understand the significance of the emerging, unstoppable science.

While the airline industry and authorities would obviously prefer the "slowly does it, incremental approach", in the meantime an enormous amount of ill health is being misdiagnosed and lives are being wrecked as a systems failure is allowed to go largely unchecked and airlines give no warnings as to the likely damage or risk which is now known to result from exposure.

Yet many aviation professors and doctors still doubt the pilots when they describe their symptoms. Even when they are invited to sit in a BAe 146 on the ground, breathing visible oil fumes, they claim that this would be "unethical".

There are now three ongoing court cases in the USA where both aircrew and passengers are suing Boeing for long-term ill health from aerotoxic syndrome.

The UK *Observer* newspaper first reported "zombie-like pilots and passengers" in 1999; but, meanwhile, the *Times* has yet to mention the subject even once, despite its being repeatedly debated in the British Houses of Parliament. While many people may be aware of the subject, few have the ability to understand the enormity of the issue and help press for technical solutions.

The BBC mentioned Aerotoxic Syndrome for the first

time ever on 24 September 2009, after conclusive proof from a doctor had established a link between serious ill health in pilots and breathing oil fumes. Quick as a flash, the establishment replied that this finding was not "peer reviewed".

In November 2007, the House of Lords Science and Technology Committee helpfully recommended that the chemicals in fume events be "urgently" identified. The BBC, following an interview on 15 September 2009, was able to establish that Cranfield University, which enjoys very close relations with BAe Systems and other highly ethical aerospace companies, would publish these urgent results in six months' time, by 15 March 2010. A convenient countdown clock, along with other unique, balanced evidence, can be found on the Aerotoxic

Association's website (www.aerotoxic.org) for the media to use as a handy peg for their next report.

However, it is feared that academics, who love the "never-ending research" approach, would prefer to take another 10 years to arrive at the precautionary conclusion that breathing oil fumes in a confined space on balance "may" be harmful.

The trouble is that acceptance of Aerotoxic Syndrome would run the risk of ruining the aerospace and medical industries. It would also expose many

research universities which are really fronts for denial and are very likely in the pockets of other related industries.

In 2007, frustrated by overwhelming evidence, silence, denial and lack of a job, I started the Aerotoxic Association so that other victims might be saved from the agony such as what I endured, particularly in mid-2005 immediately after I stopped flying. If one considers committing suicide, then

something has clearly gone very wrong.

When will aircrew and passengers be told the truth of what is in their abnormal, generally unsafe, cabin air? Suggested on 15 March 2010. ∞

The trouble is that acceptance of Aerotoxic Syndrome would run the risk of ruining the aerospace and medical industries. It would also expose many research universities...

About the Author:

Captain John Hoyte, a former commercial airline pilot and BAe 146 Training Captain, is Chairman of the Aerotoxic Association, a support group for sufferers of Aerotoxic Syndrome. Its website, <http://www.aerotoxic.org>, contains detailed information on the syndrome as well as news and articles, reports and evidence, testimonies from victims and more details of Captain Hoyte's story.

Captain Hoyte can be contacted at info@aerotoxic.org.