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A Quick Introduction to the Problem of Cabin Air Contamination

A) How can Cabin Air Contamination (CAC) be explained? Why should we be alert?
B) Where are the legal problems?
C) What can be done?

A) How can Cabin Air Contamination (CAC) be explained? Why should we be alert?

1.) **(Labyrinth) Seals** do not seal by design, but are built so that air can pass.
2.) Opened **bleed ducts** show oil deposits.
3.) Opened **air conditioning ducts** show oil deposits.
4.) **Wipe samples** from the cabin show chemical components than can be traced back to the oil.
5.) **Recirculation filters** show components than can be traced back to the oil.
6.) Hydro carbons (HC) are about two-fold in standard Pax A/C cabins compared to 787 (EASA).
7.) The additional HC can be explained by the pyrolized oil leaking past seals (my calculation). B787 is not free of HCs, because of e.g. new furniture and flame retardants.
8.) **"dirty socks smell"** comes from the base stock of the oil. The smell is an indication for oil products in the cabin.
9.) **CO** concentrations were measured in the cockpit/cabin (e.g. BAe 146).
CO concentrations were measured in the cabin in 74% of samples (Honeywell Patent 9902499).
CO is one substance in pyrolized oil.
This means: CO can be used as an easy to measure indicator for pyrolized oil in the cabin.
10.) There is a **"thinning effect"**, but instances (aircraft failure cases, e.g. documented on YouTube) show the cabin full of smoke. The "thinning effect" reduces a concentration, but concentration also depends on the source strength. If it is high enough, concentration is high (and the cabin full of smoke).
11.) ECS uses bleed air. **This design should NOT be used**, because of its potential danger to contaminate cabin air (**SAE documents**). Nevertheless, it has been done - problems surface now!
12.) People have shown symptoms (measured reactions compared to the average of the population) originating from same time and location (aircraft). This is no proof that the aircraft has caused the symptoms, but a very strong heuristic indicator. Degenerations of nerves of victims show same pattern as from TCP poisoning.
13.) A quick comparison may well show the "air in aircraft to be as good as in kindergartens", but we are not flooded with reports of kindergarten crews falling ill.

There is a very strong indication for a CAC problem in aviation.
Instead of applying a cautionary proactive attitude,
those responsible use too much effort to play things down.
We need a change of attitude to the cabin air problem!

B) Where are the legal problems?

1.) Missing sensors for air quality on board

CS-25.1309 (c) Information concerning unsafe system operating conditions must be provided to the crew to enable them to take appropriate corrective action

AMC-25.1309 c. Compliance with CS 25.1309(c).
(5) Even if operation or performance is unaffected or insignificantly affected at the time of failure, information to the crew is required if it is considered necessary for the crew to take any action or observe any precautions.

2.) Fail-Safe Design Concept violated with bleed air used for the cabin

AMC-25.1309 b. Fail-Safe Design Concept.
(2) The fail-safe design concept uses the following design principles:
(xi) Error-Tolerance that considers adverse effects of foreseeable errors during the aeroplane's design, test, manufacture, operation, and maintenance.

Known deficiencies (here: oil contamination of bleed air) are not allowed. The system has to be error-tolerant to yet UNKNOWN design errors that have to be envisaged because it is a known fact in life that errors do occur. The system's error-tolerance is compromized, if it has to cope with already known design errors that are not rectified out of negligence relying on the systems error-tolerance. This means: The fail-safe design concept is not applied here.

3.) Cabin air must be free from contamination

EASA 2017: CS 25.831 Ventilation
(a) Each passenger and crew compartment must be ventilated ... to enable crewmembers to perform their duties without undue discomfort or fatigue.
(b) Crew and passenger compartment air must be free from harmful or hazardous concentrations of gases or vapours.

CO, CO2, ozone concentration limits are given, but not for other substances. This does not mean that other substances are allowed in any concentration (BFU 2014) "The BFU is of the opinion that a product [aircraft] which has received a type certificate by EASA should be designed in a way that neither crew nor passengers are harmed or become chronically ill." (BFU 2014)

4.) Bleed air is not tested to be fit for use in cabin as stated:

EASA 2018: CS-E 690 (b)
(b) Contamination Tests of Bleed Air for Cabin Pressurisation or Ventilation. The specifications of this paragraph (b) are applicable where it is desired to declare that compressor bleed air is suitable for direct use in an aircraft cabin pressurisation or ventilation system.
(1) Tests to determine the purity of the air supply must be made.
(2) An analysis of defects which could affect the purity of the bleed air must be prepared and where necessary the defects must be simulated and tests, as agreed by the Agency, must be made to establish the degree of contamination which is likely to occur.

Note:

- Airlines are unable to apply **manufacturer's maintenance procedures after a Cabin Air Contamination Event (CACE).** Cleaning of all air conditioning ducts (overnight) is impossible!
- **Engines are much longer (about 2-fold) under the wing** than 10 years ago. Contact seals show time dependant wear and are accepted to leak more than designed for.

C) What can be done?

We need to act, but note:
1.) Compressed air from a turbocompressor (DC-8, B707) is not the solution for today.
2.) A safe engine oil probably does not exist.
3.) Carbon recirculation filters only reduce the (TCP) concentration to about 60%.
4.) "Full filtration" (combined with recirc filtration) reduces the (TCP) concentration to about 18%.
5.) A bleed free architecture is needed to solve the problem.

What crew can do:
6.) Avoid potable water on board (on aircraft where potable water is pressurized with bleed air).
7.) Use a CO sensor for objective proof of a malfunction (CACE) on board.
8.) Cabin crew: Have a breathing mask in your luggage (for severe CACEs).
9.) Cockpit crew: Follow systematic trouble shooting in case of a CACE.
Be aware of the possibility to descent to 10000 ft and ventilate the cabin with outside air.

Delivered during a meeting at the German Parliament (Deutscher Bundestag)
Unter den Linden 71, 10117 Berlin
12 March 2019, 11:30

Björn Simon
Mitglied des Deutschen Bundestages

Gespräch Kontaminierte Kabinenluft

Dienstag, 12. März 2019, 11.30 Uhr, Deutscher Bundestag (UdL 71, Raum 223)

Teilnehmer Deutscher Bundestag

- Björn Simon MdB (CDU/CSU-Bundestagsfraktion, Mitglied Verkehrsausschuss und Umweltausschuss)
- Michael Donth MdB (CDU/CSU-Bundestagsfraktion, Mitglied Tourismusausschuss und Verkehrsausschuss)

Teilnehmer Bundesregierung

- Thomas Jarzombek MdB (Koordinator der Bundesregierung für Luft- und Raumfahrt)
- Dr. Joachim Eichhorn (Büro PSts Steffen Bilger, BMVI)
- Herr Johann Friedrich Colsmann (BMVI, Abteilungsleiter LF)
- Frau Kamala Schulz (BMVI, Referat LF18)
- Thomas Pantin (Luftfahrt-Bundesamt LBA)
- Herr Johann Reuß (Bundesstelle für Flugunfalluntersuchung BFU)

Teilnehmer Berufsverbände

- Ekaterini Bary-Schüller (Patienteninitiative P-CoC)
- Kerstin Konrad (Patienteninitiative P-CoC)
- Prof. Dieter Scholz (Hochschule für Angewandte Wissenschaften HAW Hamburg)

- Arie Adriaensen (Vereinigung Cockpit VC)
- Uwe Harter (Vereinigung Cockpit VC)
- Bastian Roet (Vereinigung Cockpit VC)

- Christoph Drescher (Unabhängige Flugbegleiter Organisation UFO)
- Sylvia Gassner (Unabhängige Flugbegleiter Organisation UFO)
- Herrn André John (Unabhängige Flugbegleiter Organisation UFO)

- Volker Nüsse (Vereinte Dienstleistungsgewerkschaft ver.di)