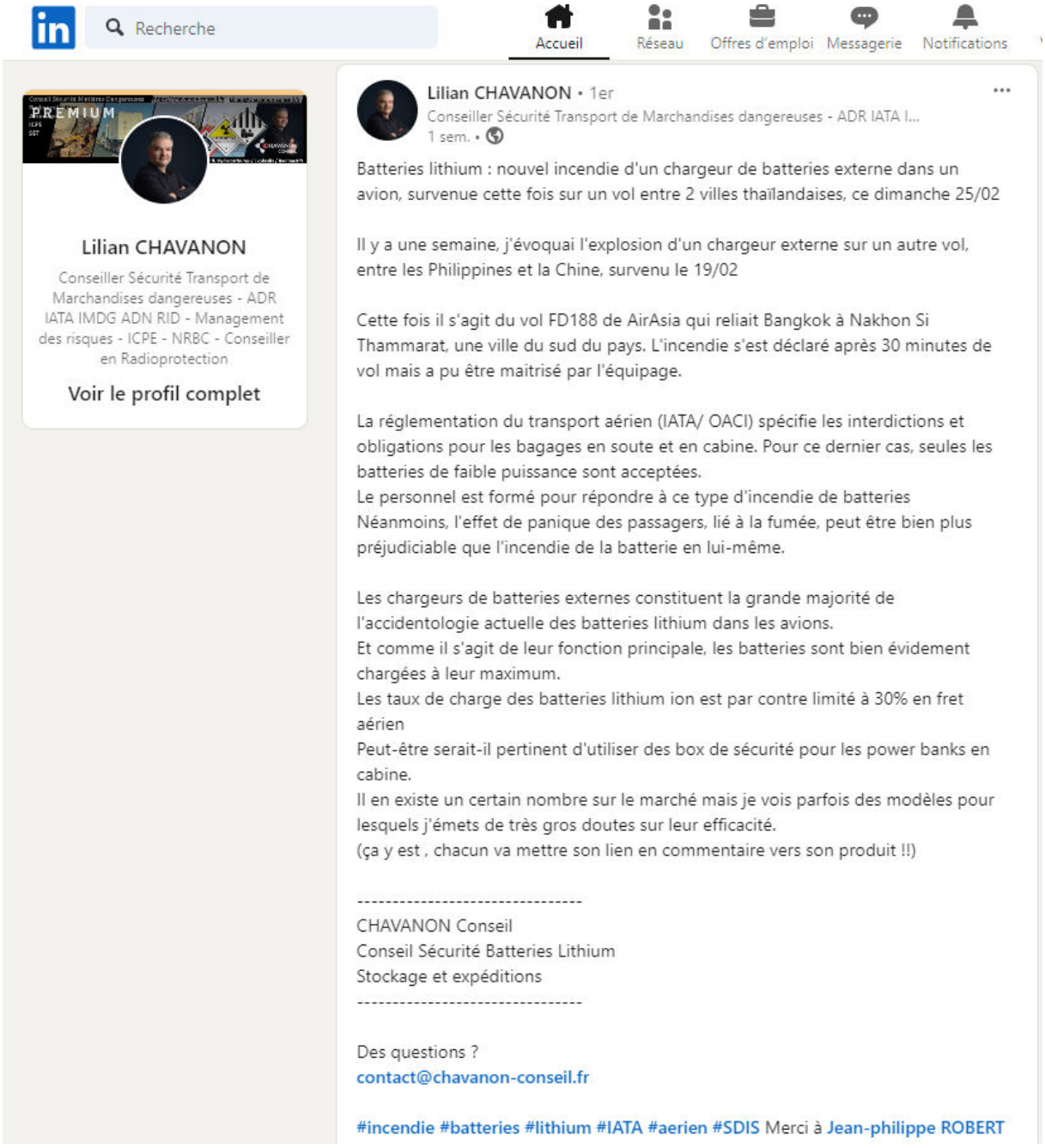
Li-ion Technology and Commercial Aviation Security

Foreword, the purpose of this short article is not to denigrate an emerging technology, to find "hazardous" alternatives that can put airlines in competition with disgruntled customers or simply to ban the use of this technology inside commercial aircraft altogether but to provide only a hypothesis and possibly warn about a potential **accentuated triggering** factorby the fact that these batteries travel by plane.

Note: Only Li-ion batteries with NMC (Nickel / Manganese / Cobalt) cathode will be mentioned because the most commonly used batteries currently concern, for example, mobile phone batteries, power banks (external chargers) and laptop batteries. That is to say, those with the highest energy density and used by a wide audience on a global scale.

For some time now, many incidents of Li-ion batteries have been reported by some airlines, especially during the flight phase.
For the sake of brevity, I will only mention the latest one known as the incident of February 25, 2024 on AirAsia flight FD188 connecting two cities in Thailand where an external charger caught fire in mid-flight in the cabin, fortunately without serious consequences for all passengers.
Of course, the flight crew is trained in this type of situation, but let's not forget that we are talking about the start of a fire in a high-altitude aircraft, in a confined space with the release of toxic gases (even if the air is constantly renewed by pressurization) but also an understandable panic movement on the part of the passengers.
Needless to say, a larger fire at high altitudes and in the middle of an ocean could take a more dramatic turn...

See LinkedIn post by Mr Lilian Chavanon concerning the latest incident on February 28, 2024: https://www.linkedin.com/posts/lilian-chavanon_incendie-batteries-lithium-activity-7168512409932873728-lY1f/?utm_source=share&utm_medium=member_desktop



As I have been involved in this issue for some time outside of my professional capacity, a serious avenue immediately caught my attention and it would be relevant to explore it in order to rule it out or not from an increased risk.

This track or hypothesis is that of the pressure difference (which we will call △P) that prevails in a pressurized aircraft cabin at cruising altitude.

As a reminder :

"The air inside the plane is completely renewed every two or three minutes, making it even cleaner than the air in your home or office.

Pressurization systems are designed to maintain cabin pressure between **0.81 and 0.75 atm** at cruising altitude. On a typical flight, when the aircraft climbs to 10,000 meters, the interior of the cabin corresponds to an altitude between 1,800 and 2,400 meters.

You may be wondering at this point, " *Why not keep the cabin at 1 atm in order to simulate sea level pressure ?* " I am not sure The aircraft must be designed to withstand differential **pressure**, which is the difference between the air pressure inside and outside the aircraft. Exceeding the differential pressure limit is what causes a balloon to burst when it is over-inflated."

Source

This is easily verifiable by anyone who owns, for example, a watch with a pressure sensor:

On the ground, under a normal pressure of about 1 atm (1015 hectopascals/hPa), a defective Li-ion battery whose origin may be a manufacturing defect, shock, etc. can go completely unnoticed during the entire life of use of the latter, even "borderline".

Here are a few examples of defective batteries that you can't see without dismantling them at a pressure of 1 atm :

Swollen Portable Li-ion Phone Batteries

Crédits : www.netcost-security.fr
lcdstore.fr

Faulty and swollen Li-ion batteries on a laptop
(Credit: www.assistancepc.fr)

A faulty Li-ion battery in a mobile phone that spontaneously catches fire.
Credit
As you can see, with such defective batteries on the ground below 1015 hPa, losing 200 to 250 hPa in an airplane cabin can be the "coup de grace" for the latter.
This △P is anything but insignificant and can exert a significant mechanical action on an already defective battery. It should be noted that this mechanical action can be so intense that it is even experienced by many passengers themselves, with pain in their eardrums or even in their teeth when these variations △ in P occur suddenly.

In conclusion, a recurrence and an increase in these incidents could occur in the very near future with the increasing number of passengers and therefore users of this technology subject to physical constraints, in particular differences in pressures inherent to aeronautics and therefore to commercial flights.

If this hypothesis were to be confirmed by experimental tests on the ground, the recommendation would be to put these batteries in small waterproof boxes under a pressure of 1 atm for the duration of the flight, which would be a lesser evil regarding a complete ban.

Another recommendation, much less restrictive for airlines and which would perhaps be a less expensive alternative, would also be to replace (or add) certain fire extinguishers for so-called "classic" fires with fire extinguishers specific to Li-ion battery fires.
The latter contain Vermiculite which is a 100% natural mineral in dispersion and aqueous form with respectively 17% Vermiculite and 83% water. This mixture is also called "AVD" for Aqueous Vermiculite Dispersion.
This AVD is "non-flammable, chemically and physically inert. It only emits steam when exposed to high temperatures, says Eric Hentgès. In addition, this natural mineral is non-toxic to people, property and the environment. This exempts it from the REACH regulation. It should be added that once dispersed, the AVD is not a conductor of electricity. »
Source

L'article est unique et a été rédigé par un bénévole expert de chez ADESS, ayant une grande expertise dans sa thématique de prédilection. Il a accumulé une expérience professionnelle significative et des diplômes qui lui sont associés.

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