Microbes: Aviation’s Worst Passenger

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Microbes have been an unwanted yet ever-present stowaway onboard aircraft. The recent COVID-19 pandemic immediately springs to mind, where lockdowns and travel restrictions left aircraft grounded and devastated the aviation industry. Global air traffic dropped by 66% and 58% in 2020 and 2021 respectively when comparing to pre covid levels, causing an economic loss of USD 390 Billion combined [1]. Our national carrier Singapore Airlines saw passenger traffic fall by 98% at the peak of the pandemic, forcing it to make difficult operational decisions [2]. These include retiring aircraft early as well as repurposing passenger aircraft for cargo by loading cargo in the overhead compartments and on passenger seats [3]. Beyond the threat of travel restrictions due to infectious diseases, how else have microbes impacted the aviation industry? What if I told you that these microbes could cause engine flameouts, or an entire fuselage to be written off? Obviously, I’m slightly exaggerating here, but moving on, I’ll be talking about the ways microbes have impacted day to day operations in the aviation world.

As alluded to earlier, the COVID-19 pandemic decimated the aviation industry, but with the pandemic now over, the industry has been eager to take onboard the lessons learnt to improve passenger confidence in hygiene standards in airports and aircraft, as well as hopefully minimise the impact of the next pandemic. Numerous airlines have committed to continuing cleaning protocols initiated during the COVID-19 pandemic, whereby aircraft are cleaned and disinfected after each flight [4]. Surfaces such as windows, seats, in-flight entertainment systems, tray tables and more are cleaned, a 15-minute process while the aircraft is serviced on the ground [4]. Although this comes at both an extra monetary and time cost, these airlines deem this to be worth it in the name of passenger quality service. Monitoring the efficacy of these cleaning protocols is SKYTRAX, “an international air transport rating organisation that classifies airlines and airports by the quality of product and staff service standards [5]”. In 2022, SKYTRAX introduced a new category called the “Hygiene Safety Rating” which validates the necessary cleaning and hygiene standards of airlines and airports through inspections and evaluations by their hygiene inspection teams [6]. This rating could then influence travelers’ decision making when choosing which airline to fly by or airport to transit through, incentivising them to maintain these cleanliness standards as they provide additional value against their competitors. Last year, these awards went to Tokyo Haneda, Singapore Changi and Doha Hamad as the world's cleanest airports, alongside ANA, Asiana and Qatar airlines as world's cleanest airlines [4]. With how airports and aircraft see a large volume of people packed in close proximity to one another for extended periods of time, it can become a hotbed for infectious diseases to be transmitted, and I think we can all appreciate the extra attention given to hygiene standards in air travel post pandemic.

My next point will be on microbes' impact on aviation maintenance. Jet fuel faces many different forms of contamination which adversely affect the fuel quality, however microbial contamination is perceived as the most dangerous. Although jet fuel is initially sterile when it is produced, microorganisms will inevitably enter the fuel and the fuel tanks through the environment. The presence of fuel and water within the tanks provide microbes with an excellent environment to thrive in, and even more so in hot and humid environments like Singapore's tropical climate. Microbes such as fungi, bacteria and yeast are able to break down the fuel hydrocarbons and grow in mass to become solid debris within the fuel tanks, resulting in fuel gauge malfunctions or fuel system clogging, dangerous scenarios to have in flight [7]. The predominantly found microbe in jet fuel is a fungus called Hormoconis resinae (H.res) and is also the most damaging one according to the International Air Transport Association (IATA). This is due to H.res being capable of producing a considerable amount of biomass to block fuel filters along with its stubbornness after attaching itself to the walls of the fuel tanks, even when the tank has been drained [7]. Should an aircraft spend a prolonged stretch of time on the ground (think of the pandemic), engineers must be aware of the threat of microbial growth and take the appropriate mitigation measures before engines are turned on as the biomass can then circulate within the system. There are 2 aspects of managing the contamination: preventive and curative treatment. Preventive treatment involves frequent draining of fuel tanks and testing, to catch microbial growth at the earliest stage to reduce the economic and time costs of remedying it. Should there be microbial growth detected, then either the tank surfaces should be deep cleaned, or a biocide treatment can be applied [7].

Another way microbes affect aircraft maintenance is in the form of corrosion termed as microbiologically influenced corrosion (MIC). Aluminium and its alloys are a key material used in aircraft construction, preferred for its high strength to weight ratio and corrosion resistance when compared to its ferrous counterparts. Unfortunately, at the same time, the elements that make the alloys leave them an easy target for microbial attachment followed by localised corrosion. Once attached, the microbes embed themselves in a biofilm which protects them from the environment and helps them to further propagate [8]. These biofilms formed could be very thin or reach a thickness of centimetres. Beneath the surface of the biofilms, microorganisms secrete organic acids that are metabolised by them, the effect of which is intensified whilst being under the biofilm surface [8]. The acids then react with the aluminium ions, causing the corrosion of the metal surface. This corrosion is localised, which leads to the surface having an uneven surface, compromising the overall structural integrity of the material, a catastrophic consequence to have on aircraft. So far, the industry has primarily been using biocides and deep cleaning to control the effects of MIC, but research has now been made on other methods to curb MIC. One example is the fabrication of super-hydrophobic aluminium surfaces, which would make it more difficult for microbes to attach to the surface and inhibit the subsequent formation of biofilms, hence reducing the corrosion of the surface [8].

To wrap it all up, the influence of microbes on aviation goes far deeper than mere disease outbreaks. In terms of an aircraft's airworthiness, microbes pose an equally significant challenge in contamination and corrosion. As such, the industry must be proactive and continually innovate solutions to mitigate these threats, ensuring that the skies remain safe and secure for all travelers.

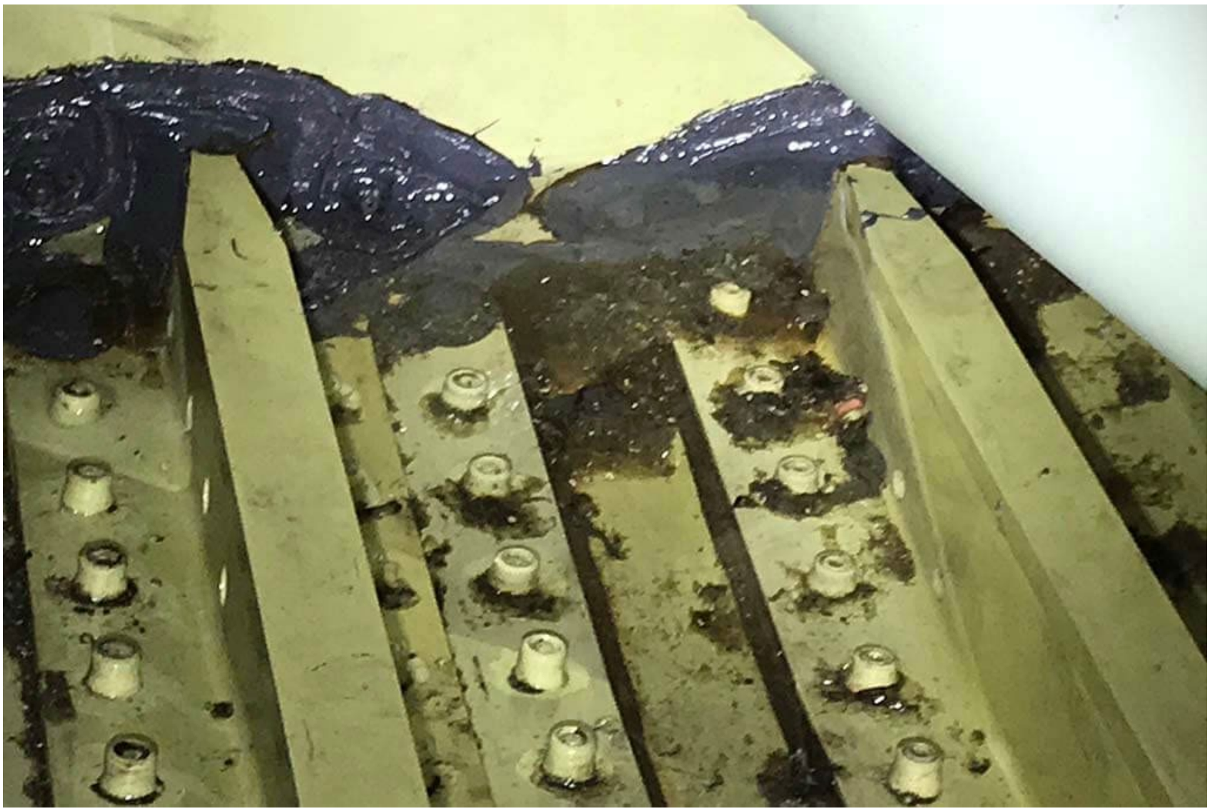
Figure 1: Microbial Contamination of Fuel Tanks [9]


Figure 2: MIC on Aircraft Fuel Tank Walls [10]

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