



Importance of aircraft cabin humidity

– from a scientific point of view

The moisture in the air we breathe is essential to life, as our respiratory system would collapse without humidity in the air. Aircraft cabin air is extremely dry. An aircraft is by far the most dehydrating environment on earth.

But there is a solution for the humidity problem.

WHITE PAPER

CTT Systems
Optimizing humidity in aircraft

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Introduction

Humidification

Everybody agrees – that humidity is vital to human wellbeing. The moisture in the air we breathe is essential to life, as our respiratory system would collapse without humidity in the air. Aircraft cabin air is extremely dry. An aircraft is by far the most dehydrating environment on earth.

Healthy, well-rested, alert pilots are a safe crew, yet a cockpit in flight is probably one of the driest places on earth. CTT Systems Humidifier Onboard Flight Deck helps pilots reduce fatigue and recover faster.

Humidity questions we answer

- What is the humidity threshold for good health and well-being?
- At what humidity levels will our immune system still function and protect us?
- At what humidity levels is our natural virus and bacterial defense system still effective?
- At what humidity do we start to feel discomfort and unease?

It was proved that a 1 percent decrease in relative humidity was associated with a 7-8 percent increase in cases of COVID-19 infections.

*Michael P. Ward, Shuang Xiao, Zhijie Zhang
University of Sydney and Fudan University*

Introduction

The scientific perspective

Esteemed scientists from diverse specializations contribute their perspectives on the importance of humidity, delineating its effects on our immune system and overall well-being. The group of scientists giving their perspectives on the topic include Professor Bertil Forsberg, environmental medicine at Umeå University and Professor Magnus Svartengren, occupational and environmental medicine at Uppsala University.

It also includes Lidia Morawska, director of the International Laboratory for Air Quality and Health in Australia and professor of atmospheric aerosol science at Queensland University of Technology. All the scientists have been interviewed directly by CTT Systems for this text. Additionally, the text will refer to studies conducted by several other scientists and the reference list also gives suggestions for further reading.

The most important factor

Relative humidity

The centerpiece of this discourse is Relative Humidity (RH). The text delves into various scientific perspectives on the critical importance of humidity in aircraft cabin air. In the absence of humidifying systems like the Humidifier Onboard from CTT Systems, the cabin air remains not only excessively dry but also detrimental to human health and organ functionality.

New insights: The literature reveals a high prevalence of fatigue and sleepiness among cabin crew and pilots, which was associated with environmental conditions, accentuating the importance of managing cabin humidity.¹²

Facts

World Health Organization

The World Health Organization declares that the humidity in aircraft cabin air is as low as below 20 percent, compared to over 30 percent humidity in the indoor air of a home¹. A research paper conducted by Martin B. Hocking and Harold D. Foster², declares the typical RH level in aircraft cabins for flights longer than one hour as low as below 10 percent. In long-haul flights, it can even drop to lower than 5 percent.

Facts

Good indoor environment

Based on several scientific studies and discussions with recognized experts on indoor air environments, all included in this paper, one can conclude that a good indoor environment with a temperature of 23°C requires a humidity above 20 percent relative humidity for human health and well-being.

The results of several studies also suggest and point out the relationship between insufficient humidity and the transmission of infections, such as COVID-19. One study has investigated the effect of humidification systems in aircraft, with the results that such systems and the increased humidity they cause, indeed bring passengers and crew members better comfort.

New insights: Recent studies have underscored the significant role of Relative Humidity (RH) in the persistence of airborne coronavirus infectivity and the transmission of infections. The research highlights the role of humidity in modulating the transmission and survival of airborne pathogens, and how low humidity is a major complaint among passengers and crew, often associated with various health-related symptoms.^{9,10,11}

Facts

Respiratory system

The extensive alveoli surface within human lungs, along with the daily in-and-out flow of 15 kg air per person, underscores the pivotal role of good air quality in quality of life. The complex mix of constituents in aircraft cabin air, including Ultrafine Particles (UFP), ozone, Volatile Organic Compounds (VOC), and external CO₂ emissions, presents a unique challenge.

New insights: The in-cabin VOCs were found to influence passengers' perceptions and symptoms, with higher exposure to certain VOCs being a risk factor for eye irritation, headache, and fatigue among passengers.¹⁴

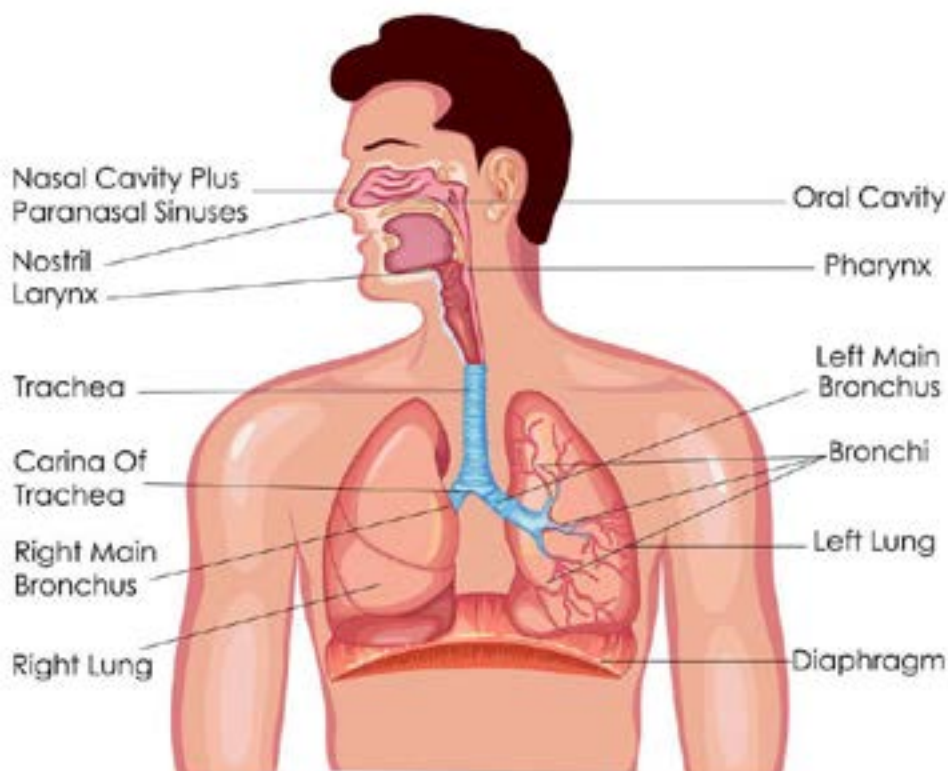


Illustration of the respiratory system

The importance of humidity

Health effects

The human immune system is built up by a network of proteins and cells, that defend us from infections.³ One important part of the complex system is our mucous membranes that cover the eye conjunctiva and various inner surfaces, such as the respiratory and digestive tracts. With mucous membranes lining our pharynx, larynx, trachea, bronchi and lungs, these areas are provided with both chemical and mechanical mechanisms for cleansing and protection against environmental toxic insults.⁴ By extension, the mucosal immune system plays a highly important part in protecting us from infections.

New insights: The modulation of humidity levels significantly impacts the mucosal membranes in our airways, which is crucial for maintaining the primary defense against airborne pathogens and potential infections.^{9,11}

Low humidity reduces the immune defense

For the mucosal membrane to be able to function with optimal capacity, it needs humidity. According to Bertil Forsberg, professor in environmental medicine at Umeå University, low humidity harms the mucous membranes in our airways which reduces the primary defense against airborne pathogens and potential infections.

New insights: RH appeared to play a significant role in the persistence of airborne coronavirus infectivity.⁹

The fact that many respiratory virus infections have a seasonal pattern – where they are much more common during winter – depends partly on the low humidity in the air during those months.

*Professor Bertil Forsberg
Umeå University*

The importance of humidity

Health effects

Risk of exposure to viruses and infectious diseases

Dry air, as in the aircraft cabin environment with RH dropping down to 5 to 20 percent, therefore increases the risk of exposure to viable virus particles and other airborne pollution – and consequently, infectious diseases. Additionally, Magnus Svartengren, professor in occupational and environmental medicine at Uppsala University, points out the fact that dry air also creates an environment where droplets remain airborne longer, and therefore possibly can transmit infections to a larger extent.

At the end of the respiratory system inside our lungs, there are air sacs called alveoli. Inside the alveoli there are macrophages, taking care of particles and other emissions. However, if there is too much exposure to pollution, the alveoli die, which enables viruses to easily pass the barrier. When the alveoli die it also starts producing hormones spreading to the blood system and causing potentially severe problems.

New insights: 71% of cabin crew believe their fatigue affected their safety-related performance, and 60% felt their roles in looking after passengers were compromised, both in service and safety.¹²

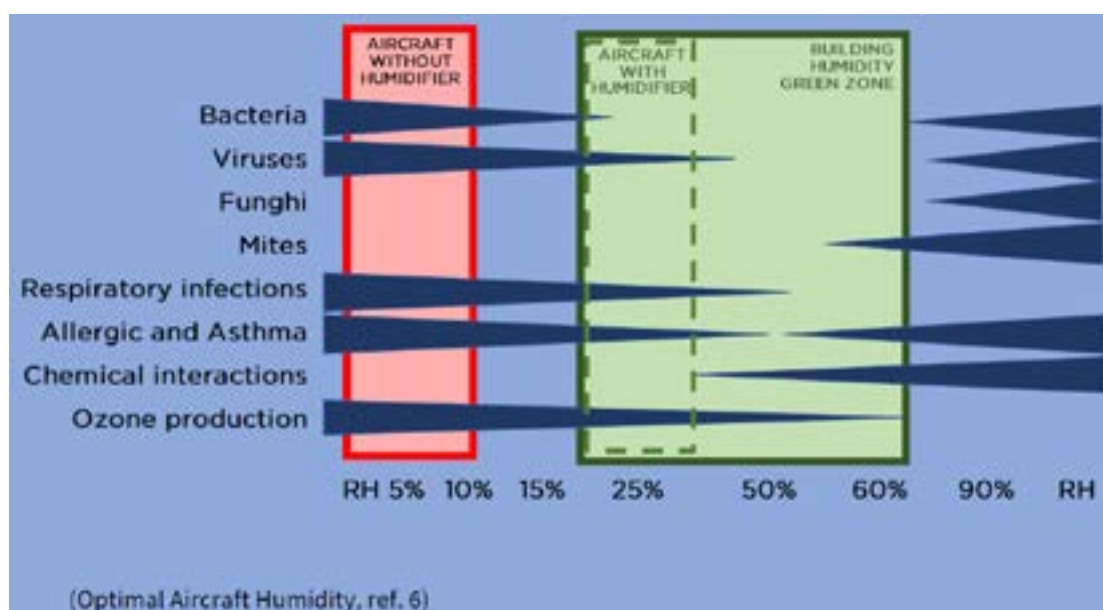


Illustration of the RH levels - without and with Humidifier Onboard

The importance of humidity

Health effects

Viruses are more infectious in dry environments

When comparing different indoor air qualities and levels of RH, studies show that a virus is five times more infectious in an environment with an RH level of 5 percent than in an environment with an RH percentage level of 25. However, if the levels of RH are as high as 45-65 percent, the lifetime of a virus in ambient air could be prolonged, according to a study conducted by Lidia Morawska.⁵

This calls for a controlled and therefore potentially optimal indoor air quality in aircraft, with a RH level equivalent to the green zone in the diagram on the page before, and with the amount of ozone and other emissions within a reasonable level.

Infection prevention

The previously mentioned research paper by Martin B. Hocking and Harold D. Foster also concluded that our immune system and its capability to defend us from virus and bacteria infections is in direct relation to the humidity in the air that we breathe.

In the paper, Hocking and Foster conclude that it therefore seems more likely that the higher incidence of colds reported by recent aircraft passengers, may be due to a decline in their ability to resist infections while flying. Our mucous membrane thickens when the air is dry and becomes less effective in beating viruses and bacteria. In turn, this enables more viruses and bacteria to cause respiratory tract infections. Good aircraft quality with appropriate levels of relative humidity could therefore help prevent infections.²

New insights: Past research that studied both pilots and cabin crew has found nearly 82% of participants have operated flights under the duress of fatigue.¹²

The importance of humidity

Health effects

Low humidity increases our susceptibility to infections

The evidence studied in the paper suggests that passengers of aircraft seem to develop colds with a higher frequency than normal, in the week after their exposure to aircraft cabin air. It also suggests that it is the low relative humidity that increases our susceptibility to infections, rather than a high viral load. However, to further ensure a scientific relation, an attempt to correlate transmissions of colds with the lengths of flights using the same humidity and airflow of outside air per person could provide further useful answers.²

New findings: Low humidity is a major complaint from passengers and crew members.¹¹

Humidity science

Additional studies

The effect of humidification systems on aircraft

Several scientific studies have been conducted to investigate the human perception of cabin air quality. Dan Norbäck, professor in occupational and environmental medicine at Uppsala University, has conducted one of them. His study aimed to investigate and evaluate the effect of air humidification systems in the aircraft cabin, with the conclusion that those are solutions that could bring better comfort to the crew and passengers, by increasing the RH. The study also concluded that the particle concentration in the air could be reduced.⁷

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Additional studies

Humidity and SARS-CoV-2 transmission

Another study, conducted in 2020 by Michael P. Ward, Shuang Xiao and Zhijie Zhang, focused on the correlation between humidity and transmission of SARS-CoV-2.⁸ It aimed to investigate the relationship between climatic factors, such as humidity, and cases of COVID-19 in different areas in New South Wales, Australia. The investigation took place during the southern hemisphere's summer and autumn of 2020, both in the exponential and declining phases of the epidemic.

The results pointed out humidity as a consistent climatic factor contributing to the transmission of the virus – while other climatic factors such as temperature, rainfall or wind speed showed no such connections. More specifically, it was proved that a 1 percent decrease in relative humidity was associated with a 7-8 percent increase in cases of COVID-19 infections. This negative relationship between cases and relative humidity was seen in both the exponential and the declining phases of the epidemic, once again proving the importance of humidity in the air that we breathe.⁸

Dry air, as in the aircraft cabin environment with RH dropping down to 5 to 20 percent, therefore increases the risk of exposure to viable virus particles and other airborne pollution – and consequently, infectious diseases.

*Professor Magnus Svartengren
Uppsala University*

The importance of humidity

Conclusion

In conclusion, the meticulous exploration of scientific narratives, enriched by fresh insights, affirms the indispensable role of humidity in safeguarding health and ensuring a pleasant aircraft environment.

CTT Systems Humidifier Onboard technology spearheads the industry towards health-centric innovations, setting new benchmarks in enhancing air quality, thereby redefining a gratifying flight experience.

Through relentless research and innovation, CTT Systems ventures to make each sky journey a hallmark of comfort, safety, and wellness, aligning with the broader public health imperatives.

**Welcome onboard a safe and healthy journey
- with Humidifier Onboard**

CTT Systems – Optimizing humidity in aircraft

The importance of humidity

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Thank you for taking the time to read

We hope you found it informative and helpful.

If you have any questions or would like to discuss your specific needs, please don't hesitate to contact us. We are here to help you optimize the humidity in your aircraft.

We look forward to hearing from you!

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