cci ZEITUNG

* LEADING SPECIALIST PUBLICATION FOR THE VENTILATION, CLIMATE CONTROL AND COOLING INDUSTRY (LüKK®)

Sonderdruck aus cci Zeitung

Juli 2015

08
15

Air humidification — a never-ending story: After the editors of cci Zeitung presented controversial opinions regarding two studies in the March 2015 issue of cci Zeitung on the purpose of air humidification, Dr. Walter Hugentobler shares his views on air humidification from a physician's point of view.

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„Our noses are our air handling unit!"

A medical doctor's opinion on air-humidification: useful or not? — by Dr.med. Walter Hugentobler

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Dryness and dust exposure are two sides of the same coin.

People spend more than 90 percent of their life in closed and ever more airtight interiors. Construction physics and building systems dictate indoor climate and air quality. Knowledge and know-how about climate control according to set targets are available offering freedom of choice. This freedom is not shared by airways, skin, and eyes, nor by the building users. They must provide every drop of humidity not supplied by climate control technology. Under any climatic condition, airways have to supply the lung alveoli with one hundred percent humidified air! Nose, mouth, throat, and bronchia must compete with the merciless, thirsty air that strives for saturation. The air picks up humidity wherever it is available and whatever its manifestation. Since humans often are the only source of humidity in working environments (and for part of the day in residential areas) people thus become their own humidifiers. We should realize that 'human humidifiers' fairly rapidly reach a threshold where complaints and illnesses start to occur. What does it mean if the humidity in a large office building does not exceed 20 or 30 percent? It simply means that nose, throat, and bronchia of everyone present are challenged up to the point of potential decompensation!

The drier the air, the more dust it contains. In heating season, dryness and dust combined strain the ability of the respiratory tract for air-conditioning and dust clearing to its limits and beyond. Our indoor climate is a challenge to the airways often exceeding the burden of the outdoor climate.

Over decades, in all independent surveys 30-40 % of building users agree with the statement that 'the air is too dry'. Is their request for better humidification a simple demand for comfort? The answer by informed and concerned doctors is a clear: no! There are no sound arguments supporting a humidity of below 40 % in terms of appropriateness or even advantages — but there are numerous, documented negative health effects.

The majority of people have a poor and delayed perception of the degree of dryness. Therefore, the persons affected cannot directly link dryness to their complaints and health status. The fact is that most people consider the devastating health effects of dry winter air as unavoidable and do not see the connection. Year after year during the heating season, most of us catch at least a cold once and we are regularly affected by flu epidemics. Chronic respiratory tract diseases (nasal allergies, asthma, chronic obstructive pulmonary disease and sinus problems) worsen and become more frequent. Today nobody asks about a possible connection — wrongly so – and to the disadvantage of our health.

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The efficiency of healthy noses

We can survive the huge fluctuations in outside humidity and temperatures because we all carry around our own, efficient climate control unit: our nose. Its task is the cleaning and climatisation (humidifying and heating) of the air we inhale. It is frequently claimed that our nose can cope with the demands of the dry and dusty winter air. This is true for those of us whose nose functions perfectly and at an optimal level — about two thirds of the population. Abnormally shaped noses and especially blocked noses cannot supply optimal climatisation since complete or partial conversion to mouth breathing is required. Nasal congestion and nasal dryness are the two most common nasal complaints. They do not just affect allergic people (rhinitis and asthma, 20–40 % of the population) but all those with damaged nasal mucosa (e.g. due to recurrent infections); smokers and senior citizens are equally affected. For these persons, dry, heated air means additional stress they cannot avoid at workplaces, in public buildings and shopping centers. Their mucosa gets more and more damaged and susceptible to infections. As allergies have become steadily more frequent and interior spaces increasingly dry over the past fifty years, these issues are expected to become more and more important in the future.

Which indoor climate is desirable during the heating season?

Building codes require a minimum indoor humidity of 30 % relative humidity (r.h.). This limit is often justified by suggesting that "similar values occur outdoors and are therefore not unnaturally low". The comparison of hourly averages (relative humidity at indoor temperature range of 20 to 24 °C) in our moderate climate reveals only a few percent of values below 30 % r.h. The median daily values are consistently over 50 % r.h., even in dry regions, areas with dry winds (Föhn) and in the mountains! The absolute amount of humidity in indoor air is therefore clearly below that of outdoor air in wintertime!

Why is this?

'How and when is humidification actually useful and when is it indispensable?' the editors of cci Zeitung asked in the March 2015 edition, which was published before trade fair ISH/Aircontec in March. The editors presented two new studies on humidification which came to differing conclusions. Discussions regarding these studies were sparked by ISH and are still continuing.

To recap: Alongside a current Fraunhofer study which underlines the benefits of humidification, an analysis by Kurt Hildebrand, Professor of Building Technology at the University of Lucerne, Department of Engineering and Architecture, addressed the question of whether it was useful just to increase comfort by humidifying the air in indoor spaces. In cci Zeitung's July 2015 issue, the editors published extensive reactions from readers to this controversy. Another specialist also had his say in this edition: Dr. Walter Hugentobler, who wrote about air humidification from a physician's point of view. In the next issue, there was an expert contribution from Professor Emeritus Klaus Fitzner, who put forward the argument from a technical sciences viewpoint.

‘Air humidification in winter is unnecessary’ — consequences of this attitude

The statement that dryness results solely in “comfort-related side effects” is simply not true. Maximum release of humidity by the human body is affecting several organ systems (airways, eyes, skin, brain, kidneys and blood), and signs of dehydration are detectable and measurable in all these organs. The best-known and reliably reproducible effects are those on the eyes and skin. Negative effects on brain performance are well documented. Aviation literature is full of papers on the dangerous consequences of dehydration on pilots’ vision, their level of responsiveness and their decision-making process. Deterioration in intellectual performance of office workers and students was documented frequently.

Key issue — air quality

Air quality is defined by the quality and quantity of particles and its humidity content. The water content of air is, in this context, the most important physical parameter. Humidity has a direct impact on nearly all processes related to invisible, microscopic, floating particles in air. Some everyday effects are well known and easily understandable by everybody. The colloquial expression ‘dry as dust’ sums up the most important effect of dryness: the association with high dust levels. In relation to a surface, “dust-dry” means that dryness has reached the point where dust particles cannot stick to the surface anymore. In other words dryness promotes a long ‘float time’ and a high “resuspension rate” for dust particles. Both strain our airways.

The air we breathe is an aerosol

From a physical perspective, the air we breathe is a mixture of gases, solid and droplet-shaped particles and moisture. This type of mixture is called an aerosol. From a health point of view, most particles are air contaminants and many pose a serious risk to our health. Building users have no choice: they must breathe in whatever is there.
The aerosol mixture is invisible to the naked eye, although even fresh, clean sea air contains about a thousand million particles per cubic meter. Depending on their size, the fine and coarse dust and droplet-shaped aerosols can float in the air for hours. They are whirled around by thermal and forced convection, dispersed, diluted, and transported to the outside. In any given room, the majority of dust particles is not floating in the air but sticking to surfaces. The dynamic distribution of particles between surfaces and the air is significantly affected by humidity and convection.

Water: aerosols “glue”

What is the significance of humidity in this dynamic interplay of forces? Humidity supports all effects that remove dust from the air and make it adhere to surfaces and thus reducing resuspension. These effects are well known, investigated and quantified in experiments. They also reflect our everyday experience. If we want to clean dusty surfaces, we spray them with water or at least wipe the dust off with a damp cloth. Otherwise, the whirled-up dust gets into our nose and airways and causes sneezing and coughing. The relieving effects of increased air humidity are well known to all those who are allergic to pollen. Higher humidity keeps pollen attached to flower heads and surfaces and prevents their passage into the air. Therefore, humidity allows allergic people to breathe easier, even in closed rooms. People allergic to animals and mites (‘dust allergies’) benefit in the same way. Higher humidity makes house dust (carrier of the allergens mentioned) stick to surfaces, and the concentration of allergens in the air decreases.

Scientific background

Water molecules, present in the air as water vapor, are wetting all surfaces. This process is called “condensation” and starts at very low humidity levels. The surface of airborne particles with diameters of more than 0.1 micrometer are equally wetted and become ‘condensation nuclei.’
Wetting provides the surfaces and airborne particles with the property of “stickiness”. Wet particles stick to each other (aggregation) and to surfaces much better then dry particles. We all know that fine powder sticks well to a wetted surface and that the powder can clump together (aggregate) if humidity rises further. In dry conditions, the powder can easily be blown away by airflow.

Air at room temperature, with a natural humidity level of 50 to 60 % r.h., has the following advantages over dry air with a humidity level of 20 to 30 % r.h.:

- The air feels fresher and more pleasant. We are fully in our thermal comfort zone and not in a transitional zone. Depending on the point of view, the transitional zone can be described as ‘still comfortable’ or ‘getting a little uncomfortable.’
- The perceived temperature is 1 to 2 degrees higher, which means that comfort can be achieved by setting the room temperature 1 to 2 degrees lower.
- Internal heat recovery is better with higher humidity. Human heat output changes from latent to sensitive.
- Smells become less intensive.
- Fewer unwanted electromagnetic currents are formed.
- Less water evaporates from valuable furniture, paintings, musical instruments, textiles, and books.

This means that they retain their value over a longer period of time.
– Flu viruses and cold viruses that make us suffer are killed within a matter of minutes.

Using arguments like "it's too expensive and energy-intensive" and "the risk of mold is too high" the advantages mentioned above are ignored when it comes to air climate in residential and working spaces. In the manufacturing sector however, these advantages are widely used to optimize processes and to reduce dust and odors. Humidity is indispensable where unwanted dust due to drilling, grinding, and milling has to be reduced. Even for the treatment of poisonous industrial fumes, humidity is essential.

Clean room technology as a model

In some respects, experience gained in clean room technology can be seen as a model for reaching targets in the building services industry. The basic idea of clean rooms is to achieve the least possible amount of airborne particles. Most clean rooms obtain this goal with humidity levels of 50 to 60 % r.h. and specially designed displacement ventilation.
Some chemical and pharmaceutical industries use special dry clean rooms for humidity-sensitive manufacturing processes. Facemasks are required for workers in these rooms. They serve as protection from dust exposure and reduce drying of the airways. Special antistatic skin-protection suits and frequently gloves are also required. Special rules are in place to regulate breaks, drinking patterns, and skin care. These workplaces are perfectly illustrating the fact that dryness is not harmless.

Contamination of interior spaces by building occupants

When no people are present and active in enclosed rooms, the so-called 'background concentration' of particles is measured, influenced by the quality of the outside air and by filters in the supply air. The worst contamination by harmful dust ('house dust') occurs when users of the internal space become active. Supply air filters cannot prevent this contamination! Various activities and unavoidable actions, such as walking about, opening and closing doors, cleaning and manual work increase the number of particles tenfold or up to a hundredfold. A higher level of humidity in the air has a preventive effect: it keeps some of the unwanted particles stuck to the surfaces where they can be disinfected, wiped off and thus disposed of.

Summary

The effects described have an impact on our everyday life and our workplaces and dwellings. Whereas in medicine, science and manufacturing industries the advantages of well-humidified air are widely used they are disregarded in our living spaces.
Air humidification offers a yet unused preventive potential. We should make the best of it. *