HOW INDOOR CLIMATE AFFECTS PRODUCTION

The importance of air humidity and temperature for manufacturing

condair systems

PRODUCTION AND CLIMATE

OPTIMUM HUMIDITY AND TEMPERATURE

For plant, people and production materials

Across a wide range of highly diversified manufacturing segments, an optimum indoor climate is a key factor for ensuring standardised production and quality control, and guaranteeing value. People also benefit from a high-quality indoor climate: a number of recent studies have confirmed its positive effect on employee health and productivity.

The standardisation of production processes is also highly dependent on the room climate in the workplace. An optimum, controlled indoor climate is possible only if air humidity, temperature and radiant heat are prevented from having a negative effect on the items being manufactured, and cannot affect the properties of materials or have an impact on machine processes.

Humidity

Without proper instruments, however, determining the right level of humidity is difficult – which is why it is often overlooked as a factor in production. If air is too dry, changes in materials or electrostatic charges can cause production downtime and additional costs. Processes involving hygroscopic materials such as paper, paperboard, wood or textile fibres are especially sensitive to these issues. From microelectronics to the food industry, many different kinds of manufacturing businesses can benefit from the standardised quality offered by a constant, optimum level of humidity and rapid, trouble-free production.

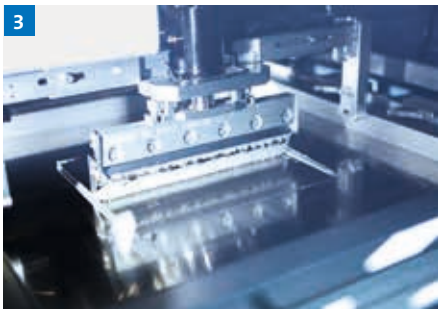
Temperature

As with humidity, temperature is also an important process parameter at many stages within manufacturing. Frequently, certain maximum values must not be exceeded whilst processing materials in order to preserve the desired characteristics of the final products. Machinery generates waste heat and high energy costs due to the cooling units needed to handle these thermal loads. Air that is too warm also has a direct effect on humidity: as temperatures rise, relative humidity drops, resulting in a string of negative consequences for materials and processes.

Productivity and health

Productivity and climatic comfort go hand in hand in the workplace: these were the findings of a recent UK study[1)] that investigated the influence of temperature and humidity on performance in the workplace over a two-year period. According to the study, companies can expect to see positive effects for their employees with a good climate: fewer absences, higher-quality products, better productivity, and improved employee loyalty and creativity. Humidity also has a direct effect on employee health: air that is too dry typically leads to irritation of the mucous membranes, respiratory infections and eye complaints.

[1)] BCO: Whole Life Performance Plus Study (2018), www.wlpplus.com



How indoor climate affects production

Dry air is no accident

Dry indoor air doesn't simply occur on its own but results from the interaction of absolute water content, temperature and air changes. In production, problems arise frequently in the winter months, and in the transitional seasons of spring and autumn. Avoiding dry air requires knowledge of the underlying physical conditions and enables preventive action to be taken as a quality assurance measure.

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When assessing room climate, the various interactions between temperature, absolute and relative humidity, and air changes must all be accounted for. The term **absolute humidity** describes the actual quantity of water in the air, in the form of water vapour. The **relative humidity** (r.h.) describes the amount of water contained in the air compared to the maximum possible amount of water that can be absorbed – and is the key metric for assessing humidity. This 'saturation percentage' of water vapour in the air is always regulated by air temperature: warm air can absorb a greater amount of water than cold air. Air will always attempt to absorb water in the form of water vapour until saturation.

Production facilities in winter

If a production room were to be hermetically sealed off from the air outdoors, absolute humidity would initially remain constant. If the **temperature** in this room were to be increased by heating the room or as a result of waste heat, relative humidity would drop, because the air is now warmer and so can absorb more water vapour than is available in this sealed room. When windows or doors are opened in the winter for ventilation, the inside air becomes even drier. The same effect is seen when fresh air is continuously drawn into the room by a ventilation system and the 'old' air is extracted from the room (**air change**). The colder the outside air, the lower its capacity to absorb water. This is why the air in winter is usually very dry. If this cold, dry outside air is allowed to enter the production room, relative humidity will drop rapidly as this air is heated up. The air tries to restore the equilibrium, and therefore attempts to become saturated by drawing moisture from materials, components and human bodies in the room.

Tips for prevention

1. Temperature
Check regularly and ensure optimal configuration of ventilation and air conditioning systems.

2. Waste heat from machinery
Reduce or dissipate where possible.

3. Doors and windows
Keep closed wherever possible.

4. Air changes
Keep air changes to the necessary minimum.

5. Active humidification
Deploy to ensure an optimum level of humidity throughout the year.

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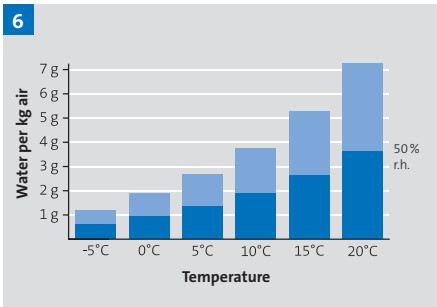

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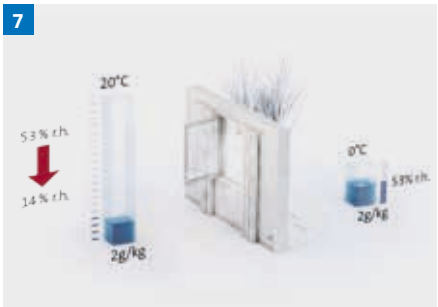

Production and climate

1 Climate control increases productivity
2 Dry air disrupts production processes
3 High temperatures affect soldering
4 Dry air is unhealthy
5 Humidifiers create an optimum climate
6 Warm air can absorb more moisture
7 Dry air in winter

Boosting quality – cutting costs

Paper, paperboard, wood, textile fibres, leather and many foods are hygroscopic materials that are very sensitive to problems caused by dry air. Drying out, deformation, cracking and lack of elasticity or adhesion can endanger quality and disrupt the manufacturing process. If relative humidity is high enough, it can also bind dust in the air, so as to improve bonding and coating processes.

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Hygroscopic materials have the capacity to absorb or release moisture from or into the air. The degree (if any) to which this occurs depends on the material's equilibrium moisture content, the relative humidity and the ambient air temperature.

Equilibrium moisture content

Many organic materials seek to achieve equilibrium between their absolute moisture content and the air in their environment. This equilibrium moisture content is then reached once the material neither absorbs nor releases moisture from or into room air. Depending on its individual constituents, the absolute humidity of a hygroscopic material is typically in a state of equilibrium at a relative humidity of 40 % to 70 %.

Material changes

If differences between the equilibrium moisture content and the relative humidity are too large, then the properties of the material will change as it gains or loses moisture. In many industries, this can lead to difficulties on the production line and an increase in rejects: deformation, warping, superficial cracking, a lack of elasticity and reduced tear strength are some of the problems most commonly observed.

Dust binding

For industrial applications that produce significant dust emissions, increasing humidity is an effective measure for meeting the required limit values, improving process flows and protecting employees from the adverse health effects of fine particulates.

Higher air humidity cleans dust from the air while reducing dust deposits on machinery and components. A thin film of water surrounds the dust particles and makes them heavier, so dust spends less time suspended in the air, falls to the ground more quickly and is not then swept back up into the air.

Bonding and coating

Many bonding and coating processes require an optimum indoor climate in order to ensure trouble-free processes and perfect results. Air that is too dry and too warm affects curing while also reducing the mechanical strength of glues and adhesives. For coating work, optimum humidity protects against uneven or excessively rapid drying – and related effects such as the formation of bubbles or streaking.

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4 **Recommended relative humidity**

Print shops	**45 %–60 %**
Woodworking	**55 %–60 %**
Textiles (natural)	**65 %–90 %**
Textiles (synthetic)	**65 %–70 %**
Packaging	**45 %–60 %**
Leatherworking	**65 %–70 %**
Offices	**45 %–60 %**
Electronics industry	**50 %–55 %**

How indoor climate affects production

ESD protection with optimum humidity

Protecting against electrostatic charge build-up and discharge is a basic and essential activity in the manufacturing industry. For electronic assemblies and sensitive semiconductors, even discharges as low as 30 volts can cause damage and defects. Electrostatically charged materials also create problems with machine feeding and can result in production downtime.

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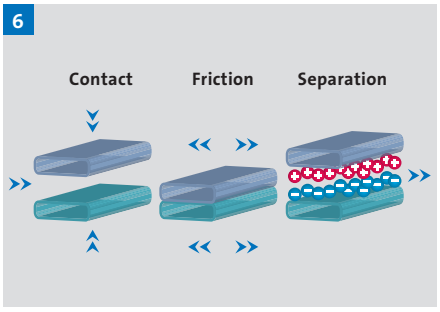
Electrostatic charges are produced when static electricity is created between two surfaces, which are then separated. This can happen at any workplace in a production unit and can result from touching a machine or be generated within machinery. When two surfaces with different conductivity come into contact, electrons flow from one material to the other. As a result, the surfaces become charged either negatively or positively. For materials with excellent conductivity, the charge is fully equalised immediately after separation. Poorly conductive or insulating materials, on the other hand, retain their new charge states, which can reach several thousands of volts when the distance is increased. Uncontrolled discharges can damage sensitive components whilst materials that stick together electrostatically like films and plastics can cause machine downtime and rejections.

Quality assurance

Uncontrolled discharges are caused both by human operators as well as equipment and machinery such as soldering tips, pick-and-place machines or packaging. As components become smaller and more powerful, they are increasingly susceptible to damage even at low voltages. A more serious problem than the costs of identifiable total failures of semiconductors are the undetectable faults that occur despite quality assurance, which can cause damage later on and shorten the lifespan of the final product. In such cases, controlling humidity throughout the year makes an ESD protection plan even more effective.

No discharge without a charge build-up

For comprehensive ESD protection, electrostatic build-up must be avoided whenever possible and a system for defined, controlled discharging must be provided. This is where optimum air humidity offers two key benefits. At a relative humidity of between 40 % and 60 %, a natural, conductive moisture film forms on the materials. This makes even poorly-conductive surfaces and insulators more conductive. In the case of frictional contact with subsequent separation, this ensures charges are fully equalised between materials without creating destructive electrostatic charge build-up. This level of humidity also increases air conductivity, so that electrical charges can be dissipated into the atmosphere without causing damage, materials that stick together or dusts to be swept up into the air.



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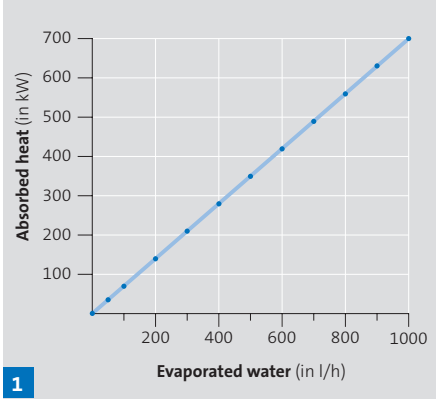
Materials and electrostatics

1 Wood splits in dry air
2 Yarns become less elastic
3 Dust suppression with humidification
4 Selection of optimum humidity levels
5 Humidity protects against static electricity
6 Static electricity is caused by friction
7 Electrostatic charge build-up on paper

Climate promotes well-being

High temperatures in production are a source of stress for people, production materials and plant. However, effective cooling of production facilities requires powerful units that have high energy costs. Additional air humidification can reduce the costs for using air-conditioning systems many times over, while also increasing comfort levels for people and plant.



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Temperature is a key process parameter at many different stages in production. For soldering and bonding, for example, the temperature of the processed materials must not exceed certain maximum values. Indoor air that is too warm also has a direct effect on humidity: as the temperature rises, relative humidity drops, with all of the associated negative consequences for quality control (see fig. 2). Last but not least, high temperatures are also stressful for employees.

Evaporative cooling

Climate control in production facilities requires plenty of cooling capacity, resulting in high energy costs. With the right design and technology, the deployment of additional humidification can reduce the costs of air-conditioning plant or simply reduce room temperatures independently of an existing system. The reason is the adiabatic cooling effect that occurs when cold water is sprayed into room air without causing droplets: the complete absorption of the micro-fine, atomised water particles by the air causes heat to be drawn from the room. The principle of adiabatic evaporative cooling results in extremely cost-effective lowering of the room temperature: 100 l of water from a high-pressure humidification system absorbs around 70 kW of heat while consuming only 0.6 kW of energy, and can achieve an average reduction in room temperature of between 2 °C and 5 °C.

A fresher room climate

An added benefit of direct room air humidification is the pleasant freshness of the indoor climate. The extremely fine, almost invisible atomisation of the water directly within the room ensures fast, immediate moisture absorption into the air. The result is a pleasantly fresh and revitalising room climate with beneficial effects for the skin, respiratory system and the body as a whole. This relieves stress and increases the sense of well-being in the workplace. Additionally, a high level of humidity cleans the air of dust particles and fine dust. At an optimum level of humidity – between 40 % and 60 % – dust particles fall to the ground faster, thereby reducing the risk of inhalation.

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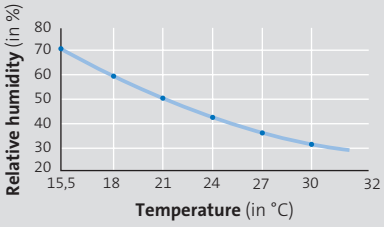

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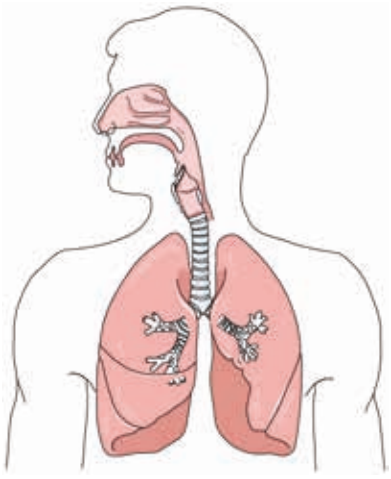
How indoor climate affects production

People in focus

Well-being in the workplace is one of the most important prerequisites for having motivated and productive staff. This is in large part connected to the room climate and humidity, in particular: air that is too dry is not only perceived as unpleasant, but also manifests in physical symptoms such as irritation of the mucous membranes, nose bleeds and eye problems.



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As with office environments, the right level of 'thermal comfort' in the workplace is also very important in manufacturing: long production lines, high machine densities and very large amounts of waste heat from machinery often cause climatic stress. High temperatures above the recommended 20 °C to 22 °C and the resulting humidity levels of less than 30 % have an impact on employee satisfaction and productivity. The consequences are increased metabolic and circulatory stress, and reduced physical endurance. Other physical ailments occur if the air is also dry, which adversely impact health and, in a worst-case scenario, may cause actual employee absences.

Irritation of mucous membranes

The mucous membranes of the respiratory tract (nose, bronchial tubes and lungs) are sensitive to persistently dry air. If the protective layer of mucus dries out or its thickness is reduced, dusts, fine particulates and allergens can penetrate unimpeded and irritate these membranes. Common symptoms include inflammation of the throat, hoarseness, coughing and compulsive swallowing. The vocal apparatus also suffers as a result of insufficiently moistened mucous membranes, which can lead to a loss of the voice in severe cases. Nosebleeds are a frequent symptom of nasal mucous membranes irritated by dry air.

A weakened immune system

Air that is too dry also affects the self-cleaning function of the mucous membranes and thus the human immune response. At a relative humidity of less than 30 %, the mucous membranes of the respiratory tract can no longer transport pathogenic microorganisms out of the body. Studies also show that excessively low humidity sharply increases the risk of contracting an infection, due to the extended lifespan of viruses and the time they spend suspended in the air.

Eye problems

Manual production steps, soldering by hand, and visual inspections all involve highly strenuous work for the eyes. Air that is too dry causes the evaporation of the fluid in the tear film, which protects the conjunctiva from environmental effects. In extreme cases, the tear film can even rupture. Common symptoms are swollen eyelids, red eyes, a stinging sensation in the eyes and inflammation. This reduces the ability to concentrate as well as productivity. Staring at monitors and microscopes for hours on end also makes things worse.

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Health and well-being

1 Humidification absorbs heat
2 Temperature and relative humidity
3 High temperatures make work difficult
4 High-pressure nozzle humidifier
5 Humidity protects mucous membranes
6 Fewer respiratory infections
7 A severe strain on the eyes

HUMIDIFICATION TECHNOLOGY

AN OVERVIEW OF POTENTIAL SYSTEMS

One goal, multiple options

A wide range of systems and technologies are deployed in manufacturing to ensure an adequate level of humidity. The technology that is used and whether direct or indirect humidification is deployed depends on the structural conditions, as well as the user requirements in terms of energy consumption, maintenance and humidification output.

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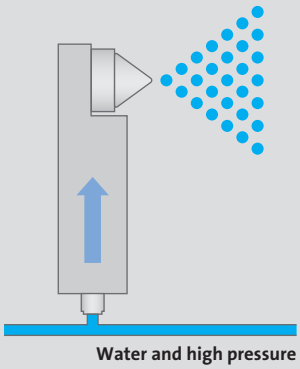

In general, we can distinguish between two basic principles in humidification: direct and indirect humidification. With a direct room air humidification system, separate humidification units are installed directly in the room and also clearly visible. With indirect humidification, moisture is added to the air in the innards of a centralised air-conditioning system or unit and fed into the production facilities by a system of ducts and outlets. Both of these basic principles are applied in manufacturing. The simple, flexible installation of direct room air humidification makes this solution particularly attractive for retrofitting existing buildings.

Technologies

The technologies available today for use in direct room humidification systems vary in terms of their energy consumption, maintenance costs and humidification capacity. With **evaporators**, a fan is used to draw in room air, which is then passed over a moist evaporator mat. The humidification process takes place by evaporation on the surface of the evaporator mat. While these kinds of humidifiers require very little electricity to run, humidification performance is also low, and there is a high risk of bacterial growth without thorough cleaning and inspection. **Steam-based** humidifiers generate steam in a heatproof plastic or stainless steel cylinder, in which the humidifier water is heated up to 100 °C. Steam humidifiers are hygienic, since microbes and bacteria are reliably killed off by this process. For electrode- and resistor-based steam humidifiers, energy consumption is very high, and the service life of the steam cylinder is limited due to limescale. With **atomisers**, water is broken into a spray of tiny water droplets. A fan then propels the aerosols so generated into the room air, where they are absorbed immediately. Atomisers are available with ultrasonic oscillators and compressed air or high-pressure nozzles. Atomisers can humidify large interior spaces while consuming very little energy. Atomisers typically require a water treatment plant capable of producing sterile, demineralised water.

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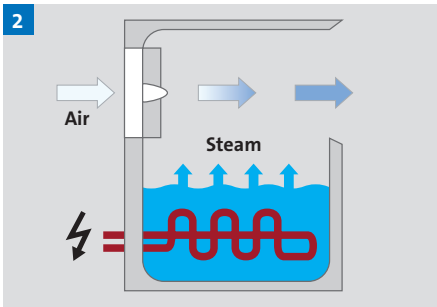

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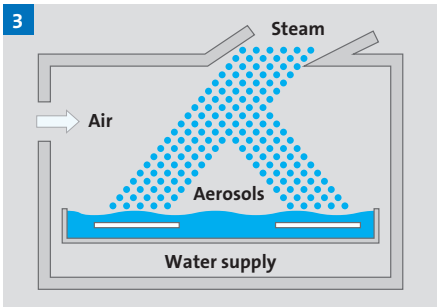

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How indoor climate affects production

HUMIDIFICATION TECHNOLOGY

AN OVERVIEW OF POTENTIAL SYSTEMS

High-pressure air humidification

In recent years, many companies have replaced steam and compressed-air atomisers with high-pressure nozzle systems. These systems use a high-pressure pump and special nozzles to atomise the water into a fine mist directly in the room as part of a virtually silent process. Energy consumption is also only a fraction of typical values for nozzles powered by compressed air or steam humidifiers. The adiabatic cooling effect of cold water evaporation also creates a pleasant indoor climate. This adiabatic cooling effect can have a positively effect on the use of an air-conditioning system. For each kilogram of water that evaporates per hour in the air as a result of nozzle humidification, a cooling capacity of 700 W can be achieved. To ensure operation is hygienic and trouble-free, only ultrapure, demineralised water is used – provided by a reverse osmosis plant that is integrated into the humidification system.

Direct or indirect?

There is no one-size-fits-all answer to the question of whether the required level of humidity can be better provided indirectly by the ventilation and air conditioning system or by a direct room air humidification system. Depending on local conditions and the requirements of building users, a combination of indirect and direct humidification may also be advisable, with the indirect humidification system providing basic humidification while the direct air humidification provides additional, 'spot humidification' in defined areas. The key advantage of direct room humidification is its targeted and individual management of moisture. Production areas used for different kinds of work and with varying humidification requirements – warehouses, labs, clean rooms and assembly units – can be humidified precisely according to demand. For specialised machinery and applications, spot humidification for areas of materials can also be implemented, to ensure higher levels of humidification as needed.

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Ideal for retrofitting

Structural conditions must also be considered when answering the question of whether humidification should be indirect or direct. In many older production buildings, installing an indirect humidification system is possible only with extensive construction work and financial outlay, because air-conditioning ducts are either unavailable or inadequately sized. For a retrofit, direct room air humidification is therefore the simpler and much more affordable solution for most applications in manufacturing. Even the necessary maintenance work can be implemented with less effort due to improved accessibility to the humidifiers and water-carrying systems.

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Humidification technology

1. High-pressure nozzle humidifiers
2. Steam humidifiers
3. Ultrasonic humidifiers
4. High-pressure system for ceiling installation
5. Direct room humidification
6. Energy-efficient: high-pressure nozzle systems
7. Targeted spot/material humidification

DIRECT ROOM HUMIDIFICATION

A STATE-OF-THE-ART SYSTEM

High-pressure humidification

Direct room humidification with high-pressure technology is now regarded as state of the art for many industrial applications. Ease of installation, reliable controls, low energy costs and good maintenance access are some of the features that also make the case for using high-pressure direct room humidification for manufacturing industries.


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With direct room air humidification, the humidifiers are installed directly in the production building or in the room to be humidified instead of centrally in the air-conditioning system (HVAC). Attached to the wall or ceiling, the small humidifier units spray a micro-fine fog as required, which is immediately absorbed into the air and distributed evenly through the room. The extremely fine atomisation with a droplet size of less than 15 µm is achieved by high-pressure technology that forces the water through the high-performance nozzles at a working pressure of 85 bar. Compared with steam or compressed-air systems, the energy consumption of the high-pressure pump is a very low 700 W.

Simple installation

By separating ventilation and air-conditioning processes from water atomisation, the systems can be deployed independently of an air conditioning system with minimal installation effort. Specialised, high-pressure hoses no thicker than a finger plus the necessary power and control cables provide the connection between the centralised water treatment plant and the local humidifiers. This simple, adaptable installation makes direct room air humidification particularly appealing for a retrofitting project.

The right kind of water

The water treatment is also important for the quality and hygiene of air humidification. Untreated water is not suitable for air humidification. This is because of the large number of substances in water: bacteria, microbes, suspended particles, salts and other minerals can pose a serious threat to human health, and to the proper function of machinery. For clean rooms in particular, as well as the pharmaceutical and electronics industries, the water must be treated so that no additional dust enters the production rooms. This requires multi-stage water treatment, which first cleans the water, disinfects it and completely removes all minerals.

Straight to the point

The required relative humidity is controlled via digital control systems which permanently monitor the climatic situation in the rooms and ensure a constant humidity level. The humidifiers are activated with pinpoint accuracy as soon as the setpoint is fallen short of. As individually defined humidification zones (halls or partial areas) are specified for direct room air humidification, it is possible to use different setpoints for rooms that are used for different purposes.


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Maintenance is a must!

Air humidification systems are only as good as their underlying service and maintenance concept. Even if the water used appears clean and clear, substances in the water can still pose risks to the employees' health and to operational safety. Hygienic standards and systems with automated maintenance intervals reliably eliminate all risks.

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Typically, reverse osmosis plant is used for the hygienic treatment of the water to be used in humidification systems. Despite optimal pre-treatment of tap water water with softener and filtration stages, undesirable deposits can still form on reverse osmosis membranes and other key components within a humidification system. These are not only capable of seriously compromising the performance and service life of the plant, but also – and above all – present a serious risk to human health. Routine inspections, maintenance, disinfection and the replacement of heavily worn system components are therefore absolutely essential for the safe and hygienic operation of humidification plant.

Safety first

In order to prevent contamination of water-bearing elements and to prevent the uncontrolled propagation of micro-organisms, comprehensive hygiene measures are necessary to comply with microbiological limits. As a rule, pumps membranes, UV-C lamps and other critical components should be serviced every six months. If the upper limits of germ contamination are exceeded, the inspection intervals must be halved until it can be permanently ascertained that the air humidification systems are in a safe state.

Microbiological limit values of the humidifier water according to the current state of the art

1) Legionella	<100 CFU/100 ml
2) Total colony count	<150 CFU/100 ml

CFU = Colony-forming unit, variable for quantification of microorganisms

Standards and certificates

Modular systems that are replaced in fixed time intervals and sent to the manufacturer for maintenance are advantageous. With these automated maintenance programmes, users do not have to worry about hygienic measures and can rest assured that they are always operating a functionally safe and hygienic air humidification system. Details of the hygiene standards of the various humidification systems can be obtained from national and international certificates issued by independent testing labs, and from manufacturers' maintenance and service programmes. VDI [1)] Standard 6022 Part 6 defines the best available technology for direct room humidification systems.

[1)] Association of German Engineers

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High pressure, hygiene and maintenance

1 Constant humidity in production
2 Easy to retrofit in any facility
3 Digital control
4 Multi-stage water treatment
5 Microbes and bacteria must be avoided
6 Routine maintenance
7 Maintenance of mobile systems at the manufacturer

CASE STUDY

VOLKSWAGEN COMMERCIAL VEHICLES, HANOVER, GERMANY

Humidification and cooling

The Volkswagen plant in Hanover is the main plant of Volkswagen Commercial Vehicles, an independent brand within the Volkswagen Group. Volkswagen Commercial Vehicles has used a direct room humidification system in its production facilities for heat exchangers since 2012. Around 600 employees enjoy the optimised air quality, which also ensures greater health and comfort in the workplace.


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Covering a total area of 120 hectares and with a workforce of over 14,000 employees, Volkswagen's Hanover plant it also the largest production facility for the transporter and Amarok segments. The heat exchanger business unit produces more than eight million coolers for the European market every year. "That means we produce up to 30,000 coolers every day here in Hanover," explains Stefan Diskau, who is responsible for heat exchanger planning at Volkswagen.

High thermal loads and dry air

The indoor climate in production is significantly influenced by the furnaces, where the soldering process can attain temperatures of around 600 °C. Despite a sophisticated system of insulation and air conduits, the heating of indoor air cannot be entirely prevented. For the 600-strong workforce in the production facility, the soldering furnaces create high levels of heat stress and dry air in the workplace. "In 2012 we were looking for a way to make the work stations of our employees ergonomically better. Particularly in the warmer working areas, we wanted to lower the temperature, bind dust in the air and provide a more pleasant working environment," says Diskau, summarising the previous situation.

Direct in-room humidification

Volkswagen became aware of the topic of humidification while researching suitable options for greater cooling, dust binding and comfort in its heat exchanger production facilities. "The best solution in our case was to use direct, in-room spot humidification systems capable of creating an individual room climate," explains Stefan Diskau. The carmaker chose to deploy a Draabe TurboFogNeo high-pressure humidification system, certified by the DGUV (German Social Accident Insurance Association). This direct room humidification system first treats the water to remove microbes and minerals, and then uses a high-pressure pump to transport the water directly to the humidifiers located in the production facilities – independently of the existing centralised air-conditioning system. Humidity is kept constant throughout the year by digital controllers in the production facilities: these only activate the humidifiers when humidity drops below predefined minimum setpoints.


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How indoor climate affects production

Impressive maintenance options

A key factor in choosing to deploy the Draabe system was the attention to hygiene in the all-inclusive maintenance concept offered by manufacturer Condair Systems. “Initially, we had a lot of concerns about hygiene and operational safety,” Diskau remembers. “The full-service-package was impressive, however, and was ultimately the reason we chose a Draabe system.” Top performance and the microbe-free, ultrapure quality of the water in a humidification system can be achieved only by regular preventive maintenance and disinfection. Both the system-side water treatment and the high-pressure pump are therefore installed in portable small containers, which can simply be replaced in the event of maintenance. As a result, Volkswagen receives fully maintained and disinfected replacement units every six months. Technical improvements and innovations are also retrofitted automatically and free of charge. A technical specialist from the VDI [1] also visits Volkswagen once a year to confirm that the plant meets hygiene and operational safety standards while it is running. Since the Draabe system is certified to VDI 6022 Part 6, this on-site audit is all part of the manufacturer’s regular service model.

A good investment in health

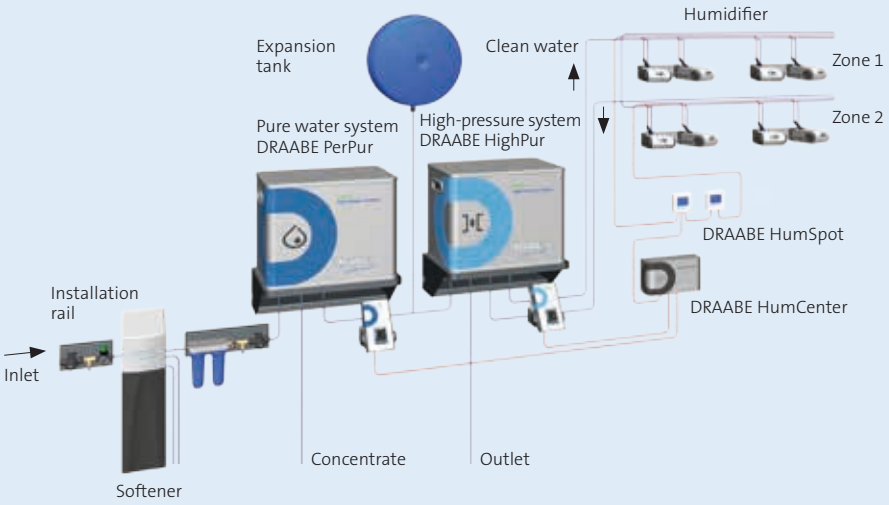
Since 2012, over 30 high-pressure humidifiers have provided spot humidification for the 11 production lines, which are spread out over a total of 30,000 m². For employees working with the soldering furnaces, this has created the perfect, healthy room climate that is noticeably fresher and protects the mucous membranes in the respiratory tract from drying out. Employee satisfaction has also significantly improved since then. “Based on this very positive experience, we have gradually equipped additional areas with these Draabe systems. Quite apart from optimising our machinery, it is always worth focusing more strongly on improving the working conditions for our employees,” reports Stefan Diskau.

Fact file

Humidification:	30 high-pressure humidifiers
Rooms:	total 30,000 m²
Required humidity:	40 % to 60 % relative humidity
In-service date:	2012

1) Association of German Engineers

System schematic



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Volkswagen Commercial Vehicles

1 Volkswagen plant in Hanover
2 Stefan Diskau, Heat Exchanger Planning
3 Brazing furnace for heat exchangers
4 Air humidification for automotive sector
5 Over 30 humidifiers now in use
6 Controlled humidity for production

CASE STUDY

DANNEMANN CIGAR FACTORY, LÜBBECKE, GERMANY

Quality for connoisseurs

The long-established international company Dannemann is Germany's market leader for cigarillos and cigars. More than 200 employees produce brands such as Moods and Al Capone at this 16,000 m² facility. To ensure optimum production process conditions, from the storage and processing of the tobacco to the automatic packaging of the final product, a Draabe humidification system controls the air humidity.

Fact file

Humidification:	64 high-pressure humidifiers
Rooms:	total 4,500 m²
Required humidity:	50 % to 70 % relative humidity
In-service date:	1996, multiple expansions to 2016

Founded over 140 years ago in Brazil, the company now operates in over 60 countries. Alongside the plant in Lübbecke, previously famous for its cigar factories, other production facilities are located in Gran Canaria, Honduras, Indonesia and Nicaragua.

Quality assurance

Humidification has been an important part of quality assurance at Dannemann for over 20 years now and guarantees the specific humidity levels required by the company. "The right humidity is very important for our cigarillo production, to ensure the tobacco stays supple and can be processed into a high-quality product," explains Facility Manager Andreas Steinmann. Tobacco leaves, cut tobacco and paper are all hygroscopic materials that will release their moisture into the environment if the air is too dry. This can affect the qualities of the raw materials, which results in problems that include shrinkage, weight loss, flaking, peeling or tearing. The additional humidity guarantees standardised product quality with optimum inherent moisture in the cigarillo.

Humidification for any application

Over 60 humidifiers in five different device classes are in use at Dannemann, and are utilised to provide optimum humidification for warehouses, sprawling production areas and rooms with a very high machine density. "Over the last 20 years, we have slowly perfected our working processes with the Draabe system," Steinmann says. "All in all, the wide variety of units in use here at Dannemann means that we can always retrofit our systems in the various areas with the most appropriate and most recent technology." To ensure trouble-free, hygienic operation of its systems, Dannemann has the peace of mind offered by the all-inclusive maintenance concept from Condair Systems. As part of its full-service lease package, Dannemann is sent fully serviced and disinfected replacement containers every six months. All costs for hygiene inspections, disinfections, replacement parts or malfunction incidents are included in the full-service package. In addition, technical innovations and updates are retrofitted automatically, to ensure that the system in use is as modern and up-to-date as possible.


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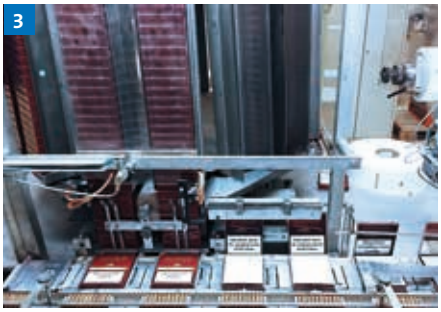
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How indoor climate affects production

Protected wood

The NorDan group is one of the leading manufacturers of wooden windows and doors. High-pressure air humidification ensures quality at all stages of production at the group's Wolsztyn site. The Polish site in Wolsztyn has been one of the NorDan Group's largest production facilities since 2006: over 200 employees produce 100,000 wooden windows there for Scandinavia and the United Kingdom each year.

Fact file

Humidification:	22 high-pressure humidifiers
Rooms:	total 10,000 m²
Required humidity:	50 % to 60 % relative humidity
In-service date:	2006, multiple expansions to 2016

High quality requirements apply at NorDan both for finished products and for the whole production process: top priority is given to energy efficiency, safety and environmental protection. "Stable processes and production conditions are enormously important for us. It is therefore essential to have constant, optimum humidity", explains the chief engineer, Maciej Sosiński.

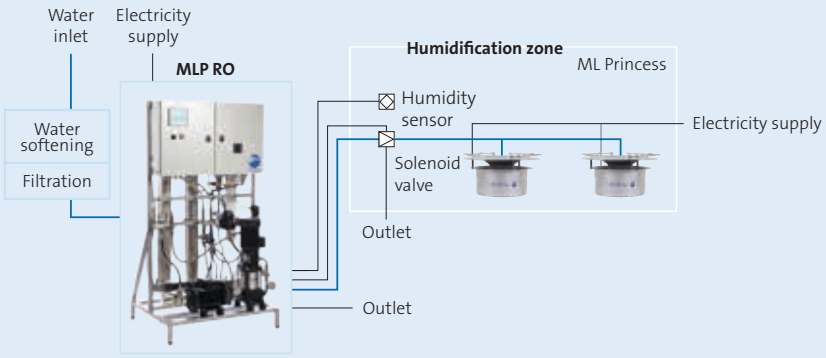
Repeatedly expanded

The high-pressure ML Princess system used is particularly well-suited to applications in large rooms involving large quantities of moisture. The system's low energy consumption and flexible expansion options were crucial for NorDan when it came to choosing the right system. Numerous expansions to the system now mean that the air is humidified in all production areas, from cutting and painting, through to final assembly and the warehouse. "We are very happy with the air humidification and will also use ML Princess again for future expansions", says Maciej Sosiński, delighted.

Humidity protects

NorDan uses a high-pressure air humidification system in order to ensure a relative humidity of between 50 % and 60 % throughout the year. This protects the window frames from drying out, and prevents damage due to distortion and cracking. It also protects the wood from veneers peeling off or frame corners coming loose and adhesion problems encountered when using water-soluble coatings.

System schematic



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Practical examples

1 Humidification in high-bay storage
2 Manual quality testing
3 Cigarillo production at Dannemann
4 Maciej Sosiński, Senior Engineer
5 ML Princess humidification system

HOW INDOOR CLIMATE AFFECTS PRODUCTION

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