Modern air humidifiers – low-maintenance, cost-effective and hygienic

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In their speeches this year, the factory managers in the Industrieverband Garne-Gewebe-Technische Textilien (IVGT - a German association of manufacturers and suppliers of yarn, cloth and technical textiles) presented and discussed evaluation criteria and cost-related issues for different air humidifiers.

Increased elasticity and breaking strength of fibres and yarns
The current state of knowledge shows that optimal relative air humidity is a decisive factor in processing hygroscopic fibres and yarns such as wool, cotton and linen. If relative air humidity is lower than the optimal sensible humidity of the material during production, there is an increased risk of yarn breaks or production failures - if relative humidity is too low, the materials lose their elasticity and breaking strength. For example, it has been proven that an increase in relative humidity from 60 to 70% increases the elasticity of cotton products by more than 15% (source: Institute of Textile Technology, USA). As regards yarn breaks, it has also been shown that an increase in relative humidity from 53 to 68% reduces the number of warp thread breaks by 31%. In addition, electrostatic charges caused by excessively low relative air humidity can impair the material flow during production. In particular, fully-synthetic fibres such as nylon acquire electrostatic charges if the environment is too dry. Because the fibres cannot conduct electricity, like electrical charges which arise when fibres are rubbed against each other during production cannot discharge. The fibres with like charges repel each other and this makes it difficult for the machine to form a smooth, homogenous fabric.

By way of digression:
what is air humidity?

1. Absolute air humidity (a.h.)
   Absolute air humidity is the entire water quantity contained in a specific air volume in the form of water vapour (e.g. 8 g/m^3).
2. Relative air humidity (r.h.)
   Relative air humidity (e.g. 55 % a.h.) is the water quantity contained in a specific air volume (a.h.) in relation to the maximum water quantity which this air volume can absorb at a specific air temperature. The "percentage saturation" of the air with water vapour is influenced by the air temperature: hot air can absorb a larger quantity of water vapour than cold air. This means that, if absolute air humidity remains constant and the room temperature rises (e.g. waste heat from the machine), relative humidity falls. Relative air humidity is the decisive factor in evaluating the humidity of a room.

Ensuring optimal air humidity has become increasingly important in many companies in the textile industry in the past. Many companies have replaced older machines with more modern ones. Due to their higher production speeds, these new machines are much more sensitive to deviations in air humidity than their predecessors. An increase in waste heat from the machine and the need for more air renewal rates also have a negative effect on relative air humidity.

Air humidifiers – a comparison
In order to ensure optimal relative air humidity, companies can now choose from a wide range of systems and technologies. In general, air humidifiers are designed in accordance with one of two basic principles. In direct room humidification (a), air humidifiers are installed and operated in the room to be humidified. In indirect humidification (b), the air is humidified in the chambers of a ventilation (conditioning) system and directed into the working rooms via channels and vent openings. Steam, ultrasound or nozzle systems are used in both systems. Air cleaners are often used in the textile industry as well. These are also installed in the ventilation/air-conditioning channel.

1) Hygiene and cleanliness
In order to ensure as much health protection as possible, particular importance is attached to cleaning and maintenance tasks. Due to the open tank, ultrasound atomisers and air cleaners should be treated with extreme care here. Organic dusts (e.g. cotton fibres, dirt, size abrasion) and impurities can enter the tanks freely. This makes the tanks an ideal breeding ground for fungi, germs and bacteria. It is therefore absolutely essential to clean the tanks thoroughly on a regular basis. However, companies can only specify regulated cleaning intervals, appoint people with binding responsibilities and set up an attestable verification procedure if they have the necessary personnel and can cover the extra costs incurred.

2) Maintenance and performance
The ongoing operating costs are also influenced by the necessary service and maintenance tasks. For example, the life span of ultrasound ceramic oscillators is normally very limited unless they are operated with fully desalinated water. The function principle also limits the capability and life span of the steam humidifiers - minerals and suspended matters accumulate over time on the bottom of the device or on the electrodes and heating devices and reduce the capability of the humidifiers considerably. Where ventilators and air conditioners (especially older ones) are fitted with air cleaners, adding biocides and oxidants to the humidification water is not only a dubious procedure on health grounds but also because of the considerable costs it incurs.

3) Energy consumption
From an energy and cost perspective, steam humidifiers are the most expensive of all the systems under comparison. Electrically heated steam humidifiers use approx. ten times as much electricity as cold atomisers. This has a clear negative effect on the cost-benefit ratio. Steam humidifiers also cause unnecessary additional heating of the room due to "vapourisation".

Enhanced performance and hygiene with nozzle humidification
Compressed air and high-pressure nozzle systems are superior to the above-mentioned systems when it comes to energy consumption, the amount of servicing required and the humidification capacity. Compressed air nozzle systems, in which the water is atomised using compressed air, are widely used. However, despite the advanced technology used here, these systems are not free from disadvantages either. In particular, the high compressed air consumption, and the energy and compressor servicing and maintenance costs this incurs generate high operating costs. Despite this, using compressed air technology for smaller rooms in particular (up to approx. 4,000 m^3) can prove very cost-effective. In recent years however, more and more industrial companies have switched over to high-pressure nozzle systems (Fig. 1) for air humidification. Draabe Industrietechnik GmbH (Germany) is one of the precursors of this technology. It supplies high-pressure systems worldwide both for direct room humidification as well as for installation in ventilation (conditioning) systems. In these systems, the water is atomised into microfine particles by means of a high-pressure pump (85 bar) and special titan nozzles (Fig. 2). The very fine atomisation

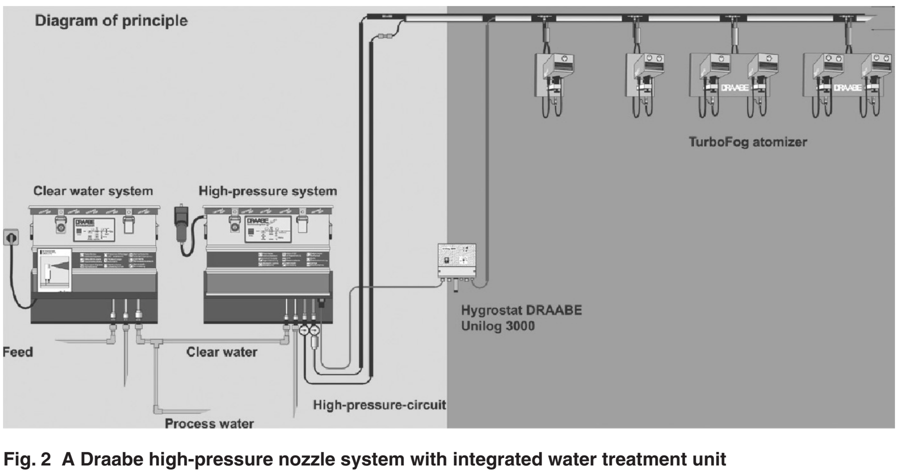

Fig. 2 A Draabe high-pressure nozzle system with integrated water treatment unit

ensures that the humidity is rapidly absorbed in the air. When used in ventilation (conditioning) systems (Fig. 3), the humidification chambers remain dry so that humid surfaces, germ formation and corrosion in the channel (all of which can have a considerable effect on hygiene) do not arise. In contrast with compressed-air operated systems, high-pressure nozzle systems only incur a fraction of the electricity costs even though the atomisers have a much larger humidification capacity (max. 32 kg/h). In Draabe systems, the water is guided through a closed circulation system. In order to ensure hygienic, reliable operation, only high-purity, sterilised and demineralised water is used. It is supplied via a reverse osmosis unit integrated into the system.

Indirect or direct humidification?

A universally applicable answer cannot be given to the question whether the required air humidity should be provided via the ventilation (conditioning) system or a direct room humidifier. Depending on the individual conditions in the place in question, a combination of indirect humidification - to ensure the basic humidity - and an additional direct (spot) humidity may be useful. One advantage of direct room humidification is that it can humidify only those specific areas which require humidification, e.g. production sections and machine areas which require high relative humidity can be humidified while other areas are factored out. In particular, direct room systems in which the various atomisers can be positioned individually and adjusted vertically and horizontally can adapt flexibly to suit the conditions in the room (e.g. machine closeness, suction holes, employees). One positive side-effect of direct humidification is also the adiabatic evaporation cooling. A humidification power of 100 kg/h supplies approx. 63 kW cooling capacity. Nor should the generally excellent serviceability of direct room systems be forgotten. By contrast, cleaning and servicing air humidifiers in ventilation (conditioning) systems is much more complicated. In order to reduce hygiene problems caused by channel humidification, filters should be connected in series to the humidification chambers in order to bond the dust and fibres. A closed water guidance system within the indoor air system, in combination with a drop-free high-pressure nozzle atomiser is highly recommended.

Renaissance of air humidification

The comparison of different humidification principles and systems which the factory managers made in their IVGT speeches this year showed that factories must always compare the cost of the different systems before deciding what system to invest in. In addition to the purchase costs, costs for energy, servicing, maintenance and commodities must also be taken into consideration. For *Kurt Miller*, member of the IVGT staff, a cost comparison is not, however, sufficient in itself: "The requirement profile of the application should be defined as accurately as possible in advance, and the costs, flexibility, serviceability and possible effects on the workplace/room climate should be discussed with the suppliers." Regardless of the manufacturer, no system can operate hygienically and problem-free without regular servicing and disinfection. In order to ensure low-cost, professional servicing, modular systems should be chosen over fixed, stationary systems as they can be sent back to the manufacturer for servicing (Fig. 4). "In contrast with the past, the systems on offer today are clearly much more advanced technologically, though the individual uses to which they can be put and the current cost considerations lead us to suspect that the future will see a "Renaissance in air humidification," states *Kurt Miller* to round off the information offered by the IVGT factory managers.

Fig. 1 Flexibly positionable high-pressure nozzle systems for direct room humidification can be adjusted to suit the individual conditions of the room.

Fig. 3 In ventilation (conditioning) systems, a drop-free high-pressure atomiser prevents germ formation and corrosion in the channel.

Fig. 4 Modular systems can be disassembled in no time at all to be sent back to the manufacturer for professional servicing.