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

D. Giesel, DRAABE Industrietechnik GmbH, Hamburg/Germany

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.

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 on health grounds but also be- cause 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 m³) 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 titanium nozzles (Fig. 2). The very fine atomisation...
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 compression-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.

Yarn innovations for hosiery and knitted articles
J. Leitner, Lenzing AG, Lenzing/Austria

General trends
In past decades there was a distinct trend towards light-weight fabrics and this is still evident today. This applies equally to woven and knitted fabrics. Consumers reveal a marked preference for e.g. finer shirt fabrics made of yarns in the count range of between Nm 160/2 and Nm 280/2. Similar tendencies are also apparent when it comes to circular knitted fabrics where more yarns are being knitted to lingerie or tops in counts of between Nm 85/1 and Nm 100/1. Yarns of Nm 100/2 and finer are often used for high-quality golf clothing or sports shirts. To optimise the quality these plied yarns are frequently singed and mercerised.

Market potential of fine yarns
World-wide, about 3.2 million tons of combed cotton yarns are spun every year between Nm 85 and Nm 240. Of these around 1.8 million tons are accounted for by yarns in Nm 85 and approximately 0.9 million tons in Nm 100. In counts of between Nm 135 and Nm 240, a consumption of about 420,000 tons is anticipated. Fine yarns are mainly processed for end uses such as shirt fabrics and/or bed linen. For these two groups of products alone approx. 2.0 million tons of combed yarns are processed per annum. When it comes to lingerie, t-shirts and socks, the consumption per annum is anticipated to be 600,000 tons.

Development trends
To satisfy the consumers’ interest in light-weight knitted fabrics, different developments were launched by fiber manufacturers and subsequently by machine builders.

- Knitting machines with a fine and very fine gauge
As can be seen in the literature on this subject and is recognisable at fairs, machine constructors are currently working on the development of knitting machines with a very fine gauge e.g. the E 46 and even finer for single jersey area, or the E 32 for jaccard knitting machines. It can be assumed that these fine machine gauges contribute to the fact that the share of fine and very fine yarns processed for knitting will significantly increase in the future.

- Finer fibres including micro-fibres
Lenzing AG was one of the pioneers of this development and began to produce fibres with 1.3 dtex respectively in the micro-fibre count range at an early stage. As Fig. 2 shows the use of finer fibres makes it possible to clearly increase the limits for yarn counts in spinning. This is true of ring spinning and also in alternative spinning processes such as OE spinning. Lenzing currently produces Micro-Lycocell and Micro-Lycocell LF with 0.9 dtex/34 mm and Micro-Modal 1.0 dtex with cut lengths of 34 or 38 mm. Micro-Modal and Lycocell LF are predestined for fine knitwear due to their fibre properties.

- New (alternative) spinning methods
Recently existing technologies for the production of yarns have been modified and new processes have been developed and introduced. These processes can produce finer yarns which offer interesting product-specific advantages.

Requirements of very fine knitting machine gauges with regards to yarn quality
Fine machine gauges in knitting demand high-quality spun yarns. This means that spinners who supply yarns for very fine knits are challenged to use optimum raw materials. They will have to optimise their processes to be in a position to be able to supply yarns with the highest possible evenness, a low hairiness, with perfect splices and a decreased propensity to form fibre fly and fibre dust. When it comes to knitting machines with finer gauges factors like an optimum steaming of the yarns, a uniform treatment with wax and an extreme low tendency to create spirality become more important. The question of fibre fly in knitting machines when processing spun yarns and the problems which arise from this in knitting should also be taken into consideration. New testing processes might have to be developed and introduced in this connection to better characterise the quality of spun yarns.

Production of high-quality and very fine spun yarns
Ring and rotor spinning processes have been well established in practice for many years.