Heat Pump Drying

Reliable, Fast and Gentle Drying

Reliable drying of complex geometries using low temperatures to maintain product integrity while saving energy and carbon emission – a heat pump dryer met all these requirements of a manufacturer of oxygenators. A view on an alternative technology.

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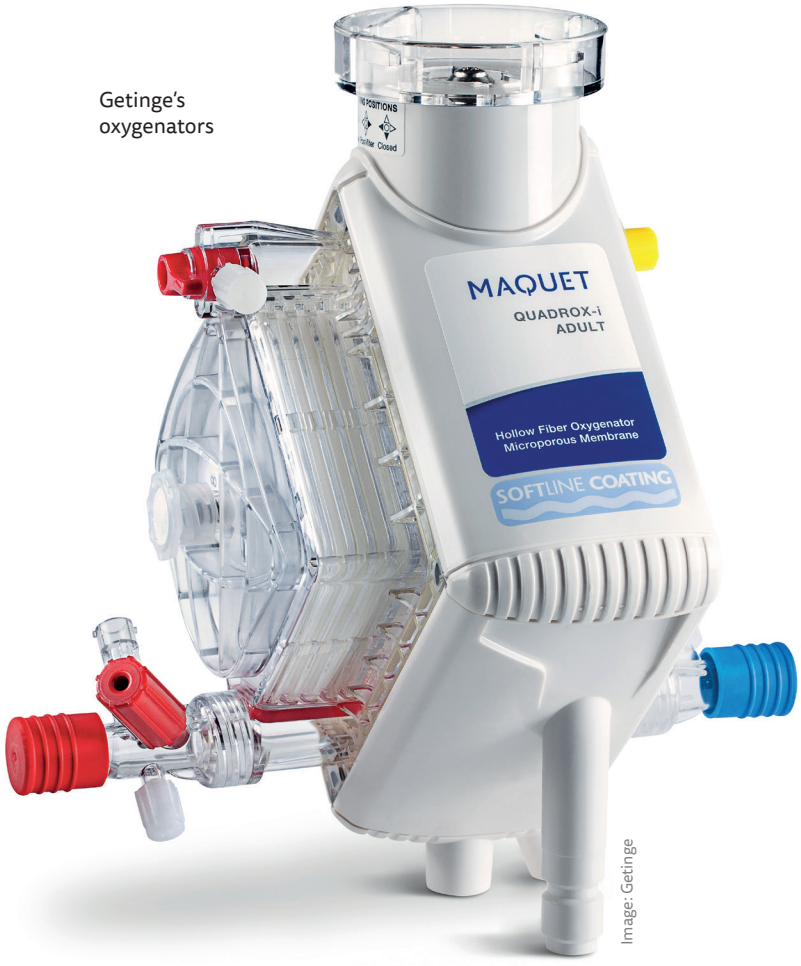
Getinge, a globally operating manufacturer of medical devices, produces oxygenators at their Hechingen, Germany, site. These highly complex products are used for gas exchange and organ perfusion to support patients suffering from severe heart and/or lung failure. There are various configurations for use with patients of different ages from newly born to adults. Oxygenators are made of plastic with special fabrics inside. These fabrics are coated and require subsequent complete drying. It goes without saying that such manufacturing processes must be perfect. There is no compromising quality. This applies to the last operation, namely drying, too.



Getinge's oxygenators

Image: Getinge

Drying system manufacturer Harter of Stiefenhofen, Germany, developed their heat pump based condensation drying method more than 30 years ago. The company has realised more than 2,000 drying projects ever since, by their own account. "We have been expanding our knowledge in these projects and gained much expertise," reports Reinhold Specht, managing owner of Harter. "This expertise has also been employed on our pharma and medical activities for many years."

Harter had developed drying solutions for special applications in other companies located in the wider area around Hechingen and was recommended to Getinge. Helder Neto, their Production Process Development Engineer, reports: "Our previous dryer used compressed air and dry air for processing, required much manpower, and had become prohibitive in terms of energy and cost. We also wished to shorten the drying period to raise our efficiency."

So, they were in search of a state-of-the-art process to meet both quality and energy requirements. "We didn't know heat pump drying at that time, and have now found a proper technology partner in Harter."

Testing to find a solution

Testing in Harter's Test Center is always the most important stage on the way to developing an individual solution. Initially, an engineer subjects the products to tests for their drying properties, and determines the relevant drying parameters such as time, temperature, airflow rate and air speed. A major factor is air routeing which is critical for highly complex geometries as in the case of oxygenators. This way, the Test Center becomes a powerhouse

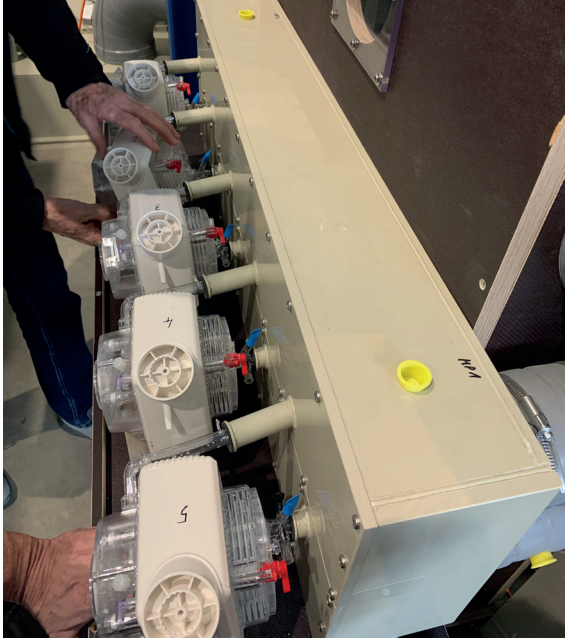


Image: Harter

The geometrically challenging oxygenators were dampened and subjected to tests in Harter's Test Center. Harter develops individual drying solutions in this way.

of ideas and the origin of a viable solution. "We were very curious to see if complete drying was feasible at all," reports Neto in retrospect. "And we were very impressed, at the same time, by the high effort that Harter invested at this early testing stage." As the portfolio of many manufacturers includes a large variety of products, the tests are always conducted on the product representing the "worst case". This way, the final solution will always be the one that will best dry the operator's entire portfolio.

Harter's heat pump drying is capable of drying within a defined temperature between 30 °C and 70 °C, as required for the specific product and process. Cooling and temperature equalisation stages, if desired, may be integrated easily. The latter was not required for this project.

The series of tests conducted demonstrated that (1) the airflow rate must not be too high, and (2) the specified 48 °C maximum temperature is basically sufficient.

The one thing that would tip the scales for the oxygenators was a product carrier to be developed to enable absolutely exact air routeing. Harter systems use extremely dry process air to quickly absorb any humi-dity present. "The feat to be accomplished is to direct the process air to the exact place where it is supposed to absorb humidity. We draw on our wealth of experience to accomplish this," explains Specht. The only way to make drying ultimately successful is to perfectly combine air dehumidification with air routeing. Harter developed a system design along these lines. It looks as follows today.

Efficient, ergonomic, energy-saving

Getinge has six drying systems in operation at their Hechingen site. They consist of a drying chamber and a heat pump module each. The heat pump module provides the necessary process air to the associated

Image: Getinge

40 oxygenators each are processed in six identical dryers to become completely dry within 120 minutes at 48 °C maximum.

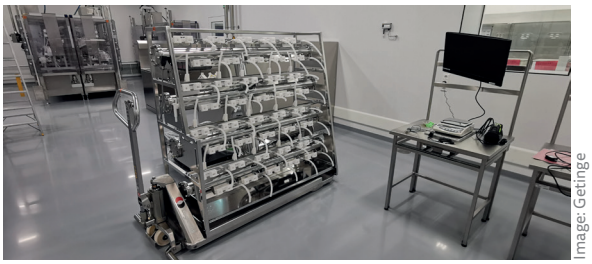


Image: Getinge

Two carts for mounting the oxygenators are associated with each dryer. These carts are special builds to accommodate the complex and different geometries.

chamber. The process air is passed through a HEPA filter before entering the drying chamber. Each dryer also has two associated special carts. The carts are made from stainless steel. They are purpose-developed for supporting and drying the oxygenators. "I am very proud of my engineers for designing a product carrier system that can actually accommodate all the product sizes," reports Specht.

40 coated oxygenators can be dried in each dryer, which totals 240 at a time. Each cart features a pan to collect the condensate and a scissor lift trolley required for handling, particularly to lift the rack for mounting and dismounting. This ensures compliance with cleanroom requirements and is easy on the worker's backs.

Following mounting, a worker moves the cart into the drying chamber. Docking to the dry air hook-up in the rear wall is automatic. The drying chamber is then closed manually, and the drying process started. Programmes for the various oxygenator types are recorded in a programmable logic controller. Initially, there is an electrical heater battery in operation. It is shut down once the desired temperature is reached. What used to take three hours is now obtained within only two hours – perfectly dry products. During this hour, the other cart is mounted. This way, the carts are used in turn to ensure continuity in operation.

Drying does not produce any exhaust air because Harter systems are closed air types. This was another major benefit for Getinge whose previous system had exhausted air. The rated power of each dryer in production operation is about 8.2 kW.

	BEFORE	TODAY
Time	3 hrs	2 hrs
Air	compressed/dry	recirculating
Temperature	48 °C	48 °C max.
Pressure	1,5 bar	0.1 bar max.
Temperature control accuracy	+/- 5 K	+/- 0,2 K

Previous drying process vs. current dryer

Image: Harter

Reliable and gentle with a heat pump

This drying method is based on two pillars – efficient air dehumidification using a heat pump and proper air routeing. Harter uses a physically alternative approach for drying: The process air is highly dehumidified in the heat pump module. This extremely dry and, thus, unsaturated air is supplied to the dryer and passed over or through the products therein. In this process, the air absorbs any humidity present. When returned to the heat pump module, the air is cooled, in two stages. The humidity condenses to form water. The process air is then reheated, again in two stages, using the energy recuperated and returned to the dryer. Drying always takes place within variable, defined temperature limits.

The integrated heat pump is intrinsically efficient. Its efficiency is multiplied by the fact that it is used in a closed energy circuit, which means that there is no air exhausted during drying. This is easy both on the environment at large and on the production areas and the people working therein. And, finally, a closed circuit means that the operator is independent of climatic and seasonal variations.

Today, Getinge enjoys maximum reliability by a reproducible process. The process uses low temperatures as desired. The drying period was reduced by one third. The air is routed to ensure complete drying of the complex oxygenators. Engineering tricks round out the project. "We are very satisfied with this drying solution. It meets all our requirements in terms of quality and energy. The co-operation with Harter was based on good partnership and was absolutely reliable at any time," summarises Neto. *(kb)*