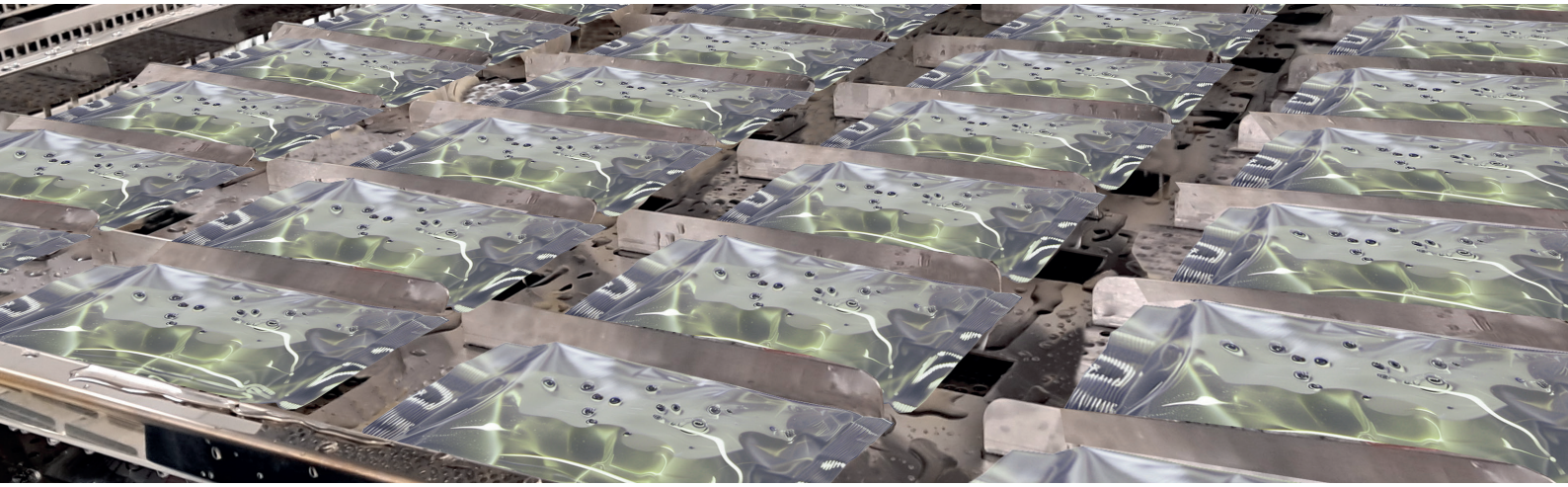

Energy Efficient Drying with a Heat Pump

Drying pharmaceutical products and by-products has become a standard service offered by Harter. The German company participates in the global market when it comes to dehumidifying packaged products, pharmaceutical accessories and agents. Complete and uniform drying is a widespread issue. The fact that it may be achieved with an energy efficient solution is an on-top asset for the pharmaceutical industry.

Condensation drying with a heat pump – developed by Harter more than 30 years ago – is highly important today, more than ever. Energy and carbon savings range among the priorities of operators. At the same time, there are many applications where quality is foremost. „Getting the products completely dry at all is often a problem", reports Reinhold Specht, managing owner of Harter. Some applications demonstrate the challenges to be met again and again.

Uniform drying of wet granulates

Desitin Arzneimittel GmbH, a company specialised in therapeutics for neurological and psychiatric diseases, was looking for a quality drying process for their wet granulates. „Our aqueous and ethanol-based granulates require drying before they are pressed to form tablets", explains Moritz Offenloch, Director Production und Logistics Operations of Desitin.

The basic problem posed by this project were the very diverse products to be dried, each with their individual properties. Aqueous and ethanol-based granulates are particularly challenging for drying.

Harter normally conducts drying tests in their own Test Center to ascertain drying feasibility and to determine the principal parameters initially. In this case, the two parties chose to run series of tests in a laboratory system at the Desitin premises. This was the best way to simulate the drying process including the upstream and downstream processes in the sequence of operations. The granulates were tested for their response to drying, and the drying parameters – such as

temperature, time, air speed, airflow rate, air routeing and bulk height – were determined. As a result, it became clear that a chamber dryer would be the solution to fulfil all Desitin requirements.

The chamber drying system consists of a drying chamber, a heat pump module, and a rack trolley accommodating special pans. The whole system meets hygienic design requirements and conforms with all GMP requirements so that it qualifies for cleanroom operation. The purpose-made pans have a customised geometry. It ensures a smooth airflow through the wet granulate with resultant uniform drying. The granulate is filled in the pans 60 mm high maximum. The drying period varies largely as required for the specific granulate composition. It ranges between 2 and 15 hours. The drying temperatures, too, vary between 20 °C and 80 °C as required for each product. The drying process stops automatically when the humidity sensor signals the limit specified in the relevant recipe. The system features an additional air exhaust provision. This is a separate air system emitting solvent-laden air when required and supplying fresh air to the drying chamber. A solvent sensor triggers the process once a certain limit is exceeded. „We got government subsidy, we save energy and operating cost, we have a very good quality result and a reliable drying process. All our wishes are fulfilled." summarizes Offenloch.

Fig. 1: Very diverse granulates for producing tablets are uniformly dried to obtain a defined residual humidity. The bulk height is 60 mm maximum.

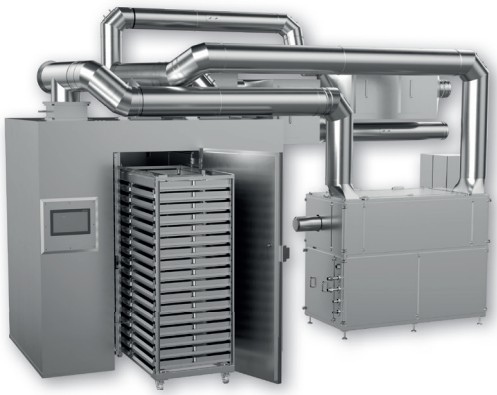

Fig. 2: The heat pump module (right) supplies dehumidified process air to the drying chamber and is also responsible for the condensation process.

Reliable drying after the cleaning operation

Drying plastic boxes of a biotech company known worldwide was an entirely different application. The boxes are used for material handling. The plastic boxes are cleaned after use, dried and reused. „The operator used a combined cleaning-drying system of which the drying provision did not nearly get the job done", reports Specht. „We see such situations very often und are then brought in as a problem solver." Ideally, manufacturers make themselves knowledgeable about the drying operation. Instead, it is assumed to be a simple and feasible job, which is often disconnected from reality.

Tests in the Test Center revealed drying to be much of a challenge. The boxes and associated lids have very diverse geometries and weights. The reinforced

edges of the boxes are liable to high water entrapment. Too much air moved the lids vigorously, little air left the folds and recesses in the bodies moist. More than 30 years of experience in drying system manufacture and high innovation mindedness, however, helps the German company always find a good solution. The engineering tricks developed in the Test Center are part of the company's know-how which Harter does not want to expand upon.

Today, the biotech company uses a drying-cooling tunnel directly downstream the cleaning station. The tunnel features conveyance to provide for seamless connection between cleaning and drying. The cleaning and drying chambers accommodate one box carrier each. This carriage has a special configuration to ensure that the plastic items are appropriately positioned. The drying tunnel includes air blow-off nozzles to enhance the drying process. The nozzles use non-compressed air. They are activated the moment when the carriage moves from the cleaning to the drying zone. This is an automated process. This way, a certain amount of water is removed mechanically before final drying. The plastic items are now processed at 75 °C to become completely dry within 40 min. The cooling operation is included in this period. Heat pump drying makes it quite easy to switch from drying to cooling. The PP boxes leave the system completely dry and at a temperature of 40 °C, ready for immediate further use.

No more humidity problems

A US-American pharmaceutical company was in need for drying of their infusion bags after sterilisation. This is an application where a package is to be dried, strictly speaking. Further processing is not possible unless the package is completely dry. Quite a few operators are not aware how important the drying operation is as they plan and commission a new production line. „They are in for a shock when the real process starts, this is a state of emergency then, and we appear on the scene", describes Specht the day-to-day situation as it presents itself to the drying system manufacturer. Testing was required because this job was very challenging, again. The 50 ml, 100 ml and 250 ml bags lie next to one another on trays with each batch including bags of the same size. 21 trays are stacked on a rack. Four of these racks each are sterilised at a time for 90 min.

Fig. 3: The plastic boxes are processed at 75 °C to become completely dry within 40 min. Engineering creativity was required to cope with geometries that defied drying.

Testing demonstrated that condensation drying with a heat pump could dry the infusion bags within the specified cycle time. Cooling was not wanted for the specific process. Following spray water heating, four racks each are moved, in a fully automated process, in the drying tunnel and dried completely at a temperature of 70 °C. Wet products are a thing of the past. The critical engineering job for this project was appropriate air routeing to ensure all bags were reached by the same quantity of unsaturated air at the same time. „As the project was launched the customer gave us the impression that we were the only ones to offer a solution for their issue", says Specht.

Process reliability and government subsidy

The condensation drying principle is based on a sophisticated system of air dehumidification and air routeing.

Fig. 4: Infusion bags are dried at 70 °C in this drying tunnel following spray water heating. While cooling and, sometimes, also temperature equalisation zones are integrated in other projects, such zones were not required here.

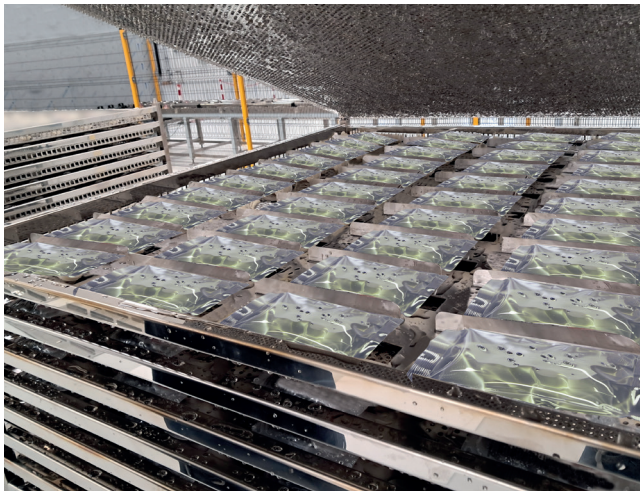

Fig. 5: Infusion bags lying side by side on 21 trays stacked in a rack. All bags can be fully dried at a time using extremely dry air appropriately routed.

A heat pump module conditions the required process air – extremely dry and thus unsaturated air – and is also responsible for the condensation process. This enables complete drying, often faster than before. Low temperatures are gentle on the products, defined temperature limits provide process reliability. Constant parameters are ensured by the closed air system which is consequently exhaust-air-free. They provide independence from climatic conditions. Harter dryers may be used for batch or continuous operation. For quite some time, drying of whole cleanrooms or individual workplaces has also been part of the German company's portfolio. The highly efficient, power operated condensation dryers with a heat pump were classified as future fit technology in 2017 and are eligible for government subsidy in Germany, Austria and Switzerland. Energy savings of up to 85 percent have been demonstrated.

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