Heat Pump Based Condensation Drying

Dry and independant

Specific parameters are required to dry liquid jelly. When employed, they enable uniform dehumidification. Antiquated technology often implies critical aspects - such as supply and exhaust air, high energy consumption - let alone quality issues. Here is an example of a pharmaceutical manufacturer who introduced a drying method to place themselves well for the future.

We are talking about heat pump based condensation drying. The method has meanwhile been employed by manufacturers of throat lozenges and sweets, too. In fact, these applications are similar.
It does not matter if the final product is a fruit gum or a throat lozenge. The starting material is always a liquid jelly which is filled into moulds. Subsequently, the mass requires clearly defined drying.
A manufacturer of medicinal pastilles used a drying system that entailed very long drying periods and was highly susceptible to climatic impact. The jelly must not be dehumidified other than at low temperatures. So, it took a whole week for the jelly to dry in the moulds. This long period was utterly unsatisfactory to the manufacturer. Also, during this period, an employee had to watch changes in the weather and respond to such changes by altering dryer settings. The dryer intook ambient air. This process air showed humidities varying daily as a result of the weather, and this was a problem. Moreover, the company is located in an urban surrounding so that the ambient air is not completely clean. This required a filter system . The whole situation had long been intolerable. The pastille manufacturer wanted an up-to-date technology to advance toward the future.

Dehumidification of throat lozenges necessitates low temperatures and a reproducible process. This also includes drying without exhaust air and filtering.

Photo: Harter

Testing and Solution

Drying system manufacturer Harter offers tests in their Test Center to begin with. This is done to determine parameters, such as time, humidity, temperature, airflow rate, air speed, plus the important air routeing. In certain cases, however, it is reasonable to do the testing at the prospective customer's premises. This was the case with the manufacturer of the pastilles because the jelly in the moulds could not be transported to Harter. "To arrive at conclusive results, the tests had to be performed in the actual process" explains Reinhold Specht, Managing Owner of Harter.
So, the Harter engineer responsible for tests used a laboratory dryer to run series of tests on site. The results were excellent. This opened the way for introducing this technology throughout the company. The biggest project included six chamber dryers of identical design placed next to each other, separately and still as one.
Each chamber dryer has 11 spaces to put racks in. The total number of such spaces is thus 66. The drying chambers are 10 m long and 1.7 m wide each. The new drying process is now as follows. As before, plastic trays are filled with starch in which holes are punched with a die. These holes form the moulds in which the jelly-like liquid is poured. The trays are stacked on special pallets, and the pallets moved into the chamber. Each drying chamber accommodates 2 * 11 pallet racks, two side-by-side each, totalling 22. Altogether that makes 132 racks in all chambers. The trolleys are manually moved into the dryers.
Each batch includes 2,000 kg maximum of liquid jelly. The jelly is dried +40 °C to

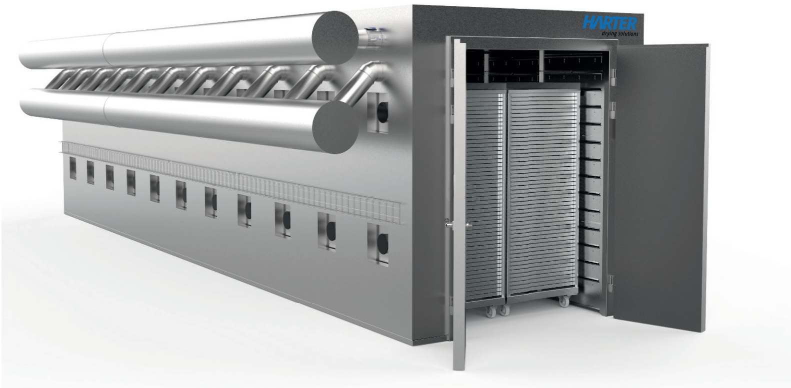

Photo: Harter

The dryer consists of 11 chambers and accommodates 132 pallet racks. The rated power of the heat pump dryer in production operation is about 33 kW.

Photo: Harter

Pastilles have reached the desired consistency after drying at +40 °C for 72 hours. The drying period is much shorter and the process maximally reliable today.

obtain the dry matter content specified by the manufacturer. Upon completion of the process, the pastilles have the exactly defined consistency, and the remaining weight of the batch is about 1,300 kg. The drying period is about 72 hours today. The drying period is more than 57 percent shorter than before.

Cleaning and Control

All chamber dryers have double-winged doors opened and closed by automatic actuation. This door design was desired by the manufacturer who considers using an automatic guided vehicle (AGV) system. Harter designed the drying system to be ready for the planned use of AGV. Cleaning and rinsing provisions were also installed. After each drying cycle, nozzles apply a spray of demineralised water to the evaporator – exactly to the places where the condensate precipitates. This safeguards the continued performance of the evaporator.
The manufacturer processes different lozenges which, by nature, have different flavours and aromas. To prevent cross-contamination when products are changed, the air inside the drying chamber is completely replaced.
The process is controlled through an HMI panel located in a prominent place on the chamber dryer. There is also a superior control system to monitor and vary all drying parameters as required. Drying data is recorded and stored in a digital archive automatically.

Special Fan Technology

Each chamber dryer has process air provided by a heat pump module. The heat pump module conditions the process air required and is also responsible for the condensation process. It is either integrated in a compact drying system or placed apart from the drying chamber, normally if space is a factor. The module is connected to the drying chamber through insulated ducting in which the process air flows. In this application, the heat pump modules are placed behind the drying chambers.
22 special EC fans provide for air recirculation in each drying chamber. Harter has them produced for this particular purpose. They provide an airflow rate of 3,000 m³/h and the rated power is only 1,5 kW. Each chamber features special air guiding plates to ensure uniform internal air routeing. Three temperature and three humidity sensors monitor the relevant parameters in the air circuit. The dryer is made from 1.4301 stainless steel and meets GMP requirements. The entire system is 24/7 in operation and has a rated power of 33 kW. Excess heat is dissipated from the system by a separate fan.

In a Closed System

This method of drying is based on two essentials, namely efficient air dehumidification through a heat pump and perfect air routeing. Harter uses an alternative physical approach for drying. The process air is largely dehumidified in the heat pump module. This extremely dry and thus unsaturated air is passed into the drying chamber and over or through the items to be dried. In this process, the air absorbs any humidity present. Back in the heat pump module, the air is cooled in two stages and the humidity condenses to form water. Using the energy recuperated the process air is then reheated, in two stages again, and returned to the dryer. Drying always takes place at a temperature that may be varied between +20 °C and +90 °C as required for the specific application. “Now it is important to combine air dehumidification with targeted air routeing”, explains Specht, “because the dried air is only instrumental if directed to exact place where it can absorb humidity.”
The integrated heat pump is intrinsically highly efficient. Its efficiency is further raised by the fact that it is used in a closed air system. This means that no exhaust air is emitted in the regular drying process. This is a benefit for the environment. Also, production areas and the people working therein are not affected by exhaust air. Finally, a closed system also ensures that the operator is independent from the climate and other external conditions.
The manufacturer of throat lozenges needs much less manpower for drying and no more filter system today. The reliable and reproducible process uses the required low temperature. The air routeing system ensures uniform drying of the pastilles from the inside out.

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