pictures: Harter

Infusion bags of various sizes are dried at low temperatures and subsequently cooled in an Airgenex batch dryer with three drying chambers.

Drying and Cooling with a Heat Pump System

No More Drops Left on the Infusion Bag

B. Braun Avitum of Glandorf, Germany, uses an Airgenex system for expanding their production line. The system provides both drying and cooling. Following hot water autoclaving, the efficient heat pump based condensation drying system bridges the gap between sterilization and packaging.

The globally operating B. Braun pharmaceutical group discovered the Harter heat pump based condensation drying method some years ago. Harter and B. Braun realized a pilot project in a joint development effort. Ever since this time, various sites of B. Braun – domestic and abroad – have a large number of such drying systems in operation. Several applications cover the drying and cooling of infusion bags or bottles, or of plastic ampoules of various sizes after hot water sterilization. The application at hand deals with infusion bags of 20 ml to 4,000 ml capacity. The infusion solutions are used in dialysis and for the treatment of lipid metabolism disorders.

Low Energy Technology

Airgenex® or its medical variant Airgenex®med condensation drying is used to dry primary or secondary packaging, any products made from plastic, glass or metal including metal strip, plastic foil and thin plastic films on surfaces. This is done in a gentle way at low temperatures ranging from 10 °C to 90 °C. Higher temperatures may be used for temperature equalization processes. Extremely dry air and custom air routeing ensure reliable and high quality drying results. The heat pump technology integrated in the system provides

high efficiency. Drying takes place in a closed system. This makes it independent of environmental conditions. Clean room and production environments are not affected. Airgenex®med drying systems fulfil GMP requirements. With minor modification, the Airgenex condensation drying system may also be used for cooling.
Sebastion Kürten, the manager responsible for this project, knew from other B. Braun applications how efficient this drying technology was. Nevertheless, he wanted drying tests to be run at the Harter premises to see if Airgenex condensation drying qualified to meet the special requirements of the B. Braun products.

Testing to Develop a Viable Solution

The bags placed on sterilization trays were to be completely dry and cooled to below 30 °C on average at the end of the process. The temperature of the cooling process air was not to be lower than 5 °C. Ideally, the combined drying and cooling time was to be equal to the autoclaving time – 75 min for the smaller, 120 min for the larger bags. Initial tests in the Harter pilot plant station showed that it was extremely difficult to fully dry the bags in horizontal position. Some of the bags had folded-in lugs and foil corners where much water was entrapped. Tests were made with varying temperatures, drying and cooling times. Also, tray designs for better ventilation were used. This improved the results a great deal. Finally, inclining the trays by 5 degrees and providing adequate air routeing did the trick.

Flexible System Layout

Infusion bags which vary largely in size are placed on trays stacked in a sterilization rack. There are two sizes of racks. The numbers of bags and trays vary largely with the various types of bags. For this project, three drying-cooling chambers with one dehumidification module each were installed. The autoclave accommodates three racks. Following sterilization, the racks are moved to the drying-cooling chambers using a hand lift. The chambers have in-built roller conveyors and guide rails. They also include a sensor to identify the size of the rack. The rack is locked in place accordingly. Then, a pneumatic cylinder inclines the rack by the required 5 degrees. When all this is done, the chamber closes automatically and the drying-cooling process starts.
The temperature of the bags is equal or higher than 75 °C. The smaller 20 ml, 40 ml or 50 ml bags are dried at 60 °C and then cooled to 30 °C on average. Recipes for the drying and cooling phases required for the various bag contents are stored in the control system.
The situation for the much larger 3,000 ml or 4,000 ml bags is quite different. These bags are 75 °C hot when they leave the autoclave. The heat in their bigger mass lasts longer and can be used for drying. So, they need only be cooled.
After drying-cooling, the racks are removed from the system using a hand lift, and the bags are passed on to packaging. The chambers may be operated independently. The air flowrate in each chamber is 10,000 m³/h. The power consumption of each chamber is 66.5 kW. The drying and cooling processes are programmable logic controlled and displayed on a touch panel. The drying-cooling chambers may be operated with full or partial loads.

Closed Circuit

High efficiency is achieved using extremely dry, unsaturated process air. This air is passed over the items to be dried. In B. Braun's application, the air is passed over the infusion bags placed on trays. The air absorbs any humidity present as it passes over the bags. The now moist air is stripped of its humidity in the dehumidification module. The humidity condenses and is drained off the system. Then, the cooled air is reheated and returned to the drying chamber. This circuit is closed. The drying cycle is almost emission free.
In the cooling cycle, the air cooler is the only operating device. It cools the air from the drying-cooling chamber. The resulting waste heat is dissipated through an additional condenser and leaves the system. The Airgenex®med, which dehumidifies the air, is attached to or integrated in the drying chamber as desired by the customer or as required to reflect space conditions. For B. Braun's application, a design with minimum space requirements was used for the scarce space available. Basically, it does not matter if Airgenex drying is a continuous or a batch operation. The drying chamber design includes a custom recirculating air system.

Series of tests showed that for successful drying the trays had to be inclined.

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