

Milk Powder Production

Facts & figures:

- Approx. 600 million tonnes of milk were reported produced in the world in 2001
- Approx. 6 million tones of milk powder (skim & whole) were reported produced in the world 2001
- 140 million tones of whey is produced annually. Only 20% is dried. Corresponding to 1.8 tones of powder.
- An evaporator supplying concentrate for a 15 tones per hour spray dryer contains up to 100,000 meters of tubes. Approx. 150,000 cows are needed to keep the plant running continuously.

Powdered milk in general

Powdered milk or dried milk is a manufactured dairy product made by evaporating milk to dryness. One purpose of drying milk is to preserve it; milk powder has a far longer shelf life than liquid milk and does not need to be refrigerated, due to its low



History and Production

Marco Polo in the 13th century reported that soldiers of Kublai Khan carried sun-dried milk on their expeditions. In more recent times, milk has been dried in thin films on heated rollers. The earliest patents for this process date from the turn of the last century. Such roller drying was the main method of producing milk powders until the 1960s when spray drying took over. Milk powder manufacture is now a very big business.

Milk powder manufacture is a simple process now carried out on a large scale. It involves the gentle removal of water at the lowest possible cost under stringent hygiene conditions while retaining all the desirable natural properties of the milk - colour, flavour, solubility and nutritional value.

Whole (full cream) milk contains, typically, about 87% water and skim milk contains about 91% water. During milk powder manufacture this water is removed by boiling the milk under reduced pressure at low temperature in a process known as evaporation. The resulting concentrated milk is then sprayed in a fine mist into hot air to remove further moisture and to form a powder. Approximately 13 kg of whole milk powder (WMP) or 9 kg of skim milk powder (SMP) can be made from 100l/case of whole milk.



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Why the need to measure humidity?

Optimum dryer performance can be attained by monitoring the inlet and outlet flow to and from the dryer, and measuring the air temperature and the relative humidity.

In most cases two probes are installed on

each dryer. One on the inlet and one on the outlet exhaust. The relative humidity and temperature outputs will then be used to balance the dryer for optimum drying, thus reducing energy costs.

Milk powder production process

SEPARATION / STANDARDIZATION

The conventional process for the production of milk powders starts with taking the raw milk received at the dairy factory and pasteurizing and separating it into skim milk and cream using a centrifugal cream separator. If WMP is to be manufactured, a portion of the cream is added back to the skim milk to produce a milk with a standardized fat content (typically 26-30% fat in the powder). Surplus cream is used to make butter or anhydrous milk fat.

PREHEATING

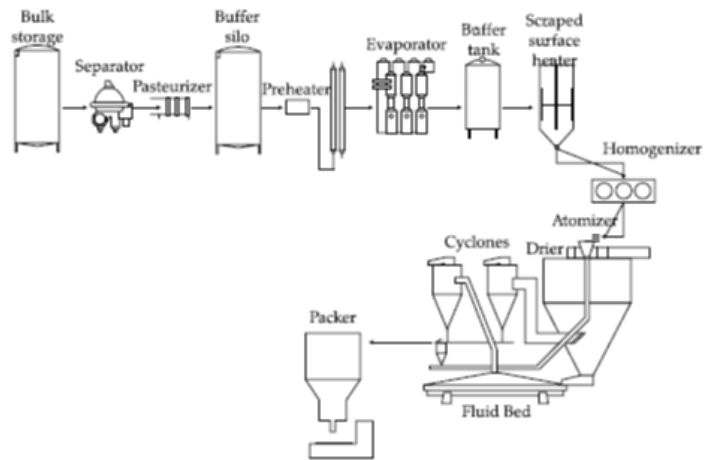
The next step in the process is "preheating" during which the standardized milk is heated to temperatures between 75 and 120 °C and held for a specified time ranging from a few seconds up to several minutes (pasteurization: 72 °C for 15 s). Preheating causes a controlled denaturation of the whey proteins in the milk and it destroys bacteria, inactivates enzymes, generates natural antioxidants and imparts heat stability. The exact heating/holding regime depends on the type of product and its intended end-use. High preheats in WMP are associated with improved shelf life but reduced solubility. Preheating may be either indirect (via heat exchangers), or direct (via steam injection or infusion into the product), or a mixture of the two. Indirect heaters generally use waste heat from other parts of the process to reduce energy costs.

EVAPORATION



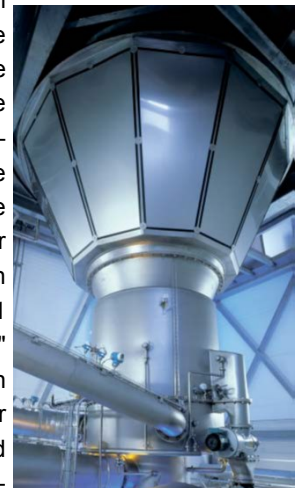
In the evaporator the preheated milk is concentrated in stages or "effects" from around 9.0% total solids content for skim milk and 13% for whole milk, up to 45-52% total solids. This is achieved by boiling the milk under a vacuum at temperatures below 72 °C in a falling film on the inside of vertical tubes, and removing the water as vapor. This vapor, which may be mechanically or thermally compressed,

is then used to heat the milk in the next effect of the evaporator which may be operated at a lower pressure and temperature than the preceding effect. Modern plants may have up to seven effects for maximum energy efficiency. More than 85% of the water in the milk may be removed in the evaporator. Evaporators are extremely noisy because of the large quantity of water vapour travelling at very high speeds inside the tubes.



SPRAY DRYING

Spray drying involves atomizing the milk concentrate from the evaporator into fine droplets. This is done inside a large drying chamber in a flow of hot air (up to 200 °C) using either a spinning disk atomizer or a series of high pressure nozzles. The milk droplets are cooled by evaporation and they never reach the temperature of the air. The concentrate may be heated prior to atomization to reduce its viscosity and to increase the energy available for drying. Much of the remaining water is evaporated in the drying chamber, leaving a fine powder with around 6% moisture content with a mean particle size typically of <0.1 mm diameter. Final or "secondary" drying takes place in a fluid bed, or in a series of such beds, in which hot air is blown through a layer of fluidized powder removing water to give product with a moisture content of 2-4%.



PACKAGING AND STORAGE

Milk powders are immensely more stable than fresh milk but protection from moisture, oxygen, light and heat is needed in order to maintain their quality and shelf life. Milk powders readily take up moisture from the air, leading to a rapid loss of quality and caking or lumping. The fat in WMPs can react with oxygen in the air to give off-flavours, especially at higher storage temperatures (> 30 °C) typical of the tropics. Milk powder is packed into either plastic-lined multi-wall bags (25 kg) or bulk bins (600 kg).



What solution can Rotronic offer?

Humidity and temperature probes:

- HC2-S**
 -50...100 °C,
 0...100%rh,
 Ø15 mm,
 ±0.8%rh and ±0.1 K...
- HC2-ICxx (PPS)**
 -100...200 °C,
 0...100%rh,
 Ø15 mm, Ø15/25 mm,
 ±0.8%rh and ±0.1 K...
- HC2-IMxx (chrome nickel steel)**
 -100...200 °C,
 0...100%rh,
 Ø15 mm
 ±0.8%rh and ±0.1 K...



HC2-S



HC2-ICxx probe



HC2-IMxx probe

Transmitter:

- HF5 series**
 For interchangeable probes,
 Various analogue and digital
 outputs, Display,
 All psychrometric calculations
 available...
- HF8 series**
 Two interchangeable probes
 -100...200 °C,
 3/4 wire configuration,
 Various analogue outputs,
 Relay and data logging
 All psychrometric calculations
 Display...



HF5-series



HF8-series

Customer Benefits

Accuracy:

Choosing Rotronic gives you the best accuracy and long-term stability on the market.

Precise humidity measurements enables the dryers to work at their maximum performance and to dry milk as fast as possible.

Long-term stability:

With a long-term stability of under 1%rh per year (depending on the environment), Rotronic offers the possibility to "plug & play": install the device and leave it.

Calibration:

In order to calibrate humidity measurement devices, we can offer a factory calibration certificate or even an SCS certifi-

cate if this is required. We can also supply a humidity and temperature generator, the HG2-S as well as unsaturated salts for on-site calibration.

Interchangeability:

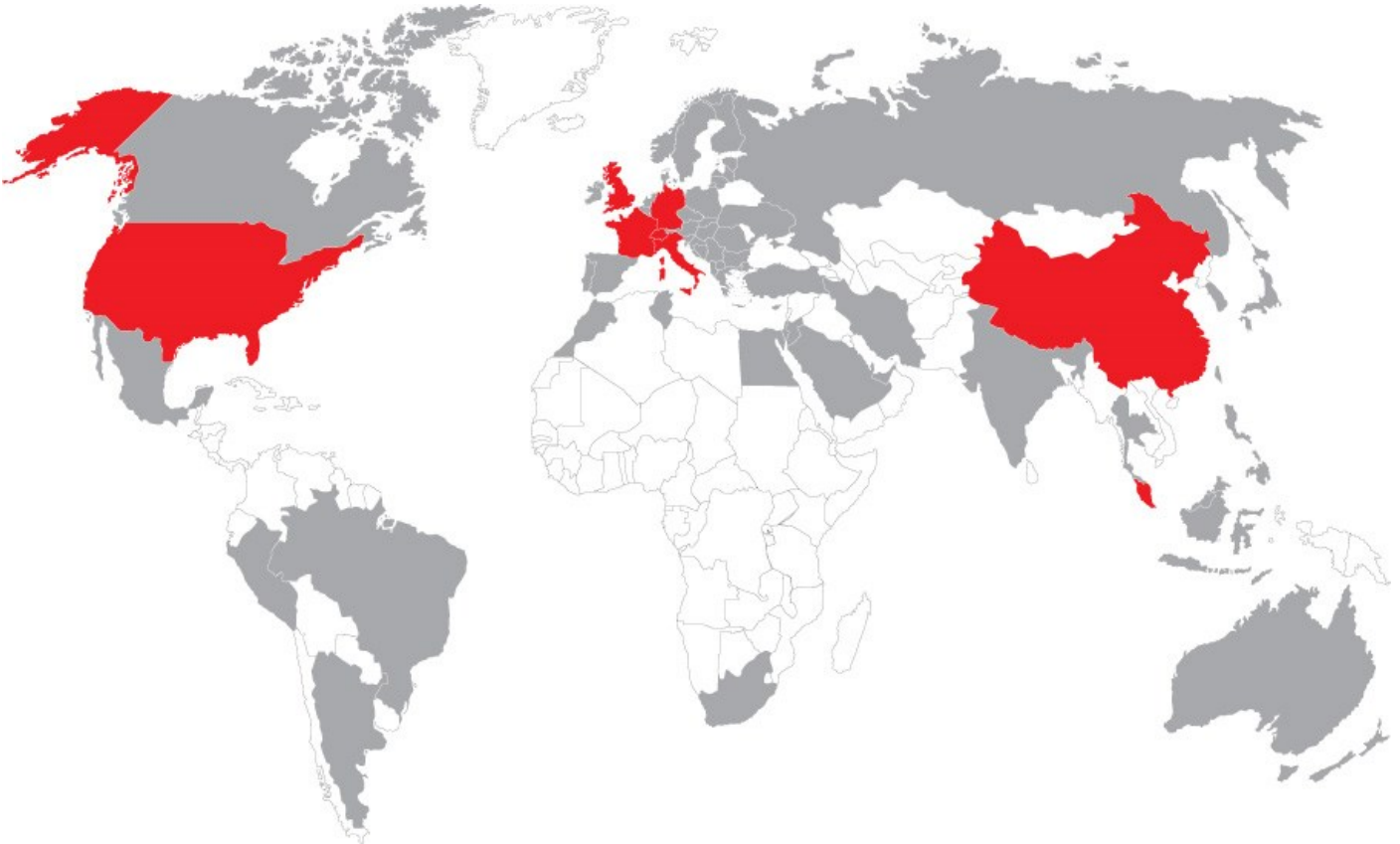
The Rotronic product range is based around the interchangeability feature of the HC2 probes. Whether a handheld, data logger or transmitter interchangeable probes can always be used.

When calibration is required, it is easy to remove a probe from a transmitter rather than removing the entire transmitter from the wall.

On the same level, it is possible to test a system loop using a Rotronic simulator probe that gives fixed outputs. Plug this into the transmitter and quickly check that the loop works correctly.

Contact us:

Rotronic is represented in more than 40 countries around the world. An up to date list of all our partners is available at www.rotronic.com



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