ATEX

explosionprotection

Monitoring

English

Motivation and Background

Spray drying is by far the most energy-intensive unit operation in the dairy industry. With the increasing strain on the fast-depleting global energy resources, stringent environmental regulations and high energy costs, innovative steps are needed to reduce spray drying energy consumption.

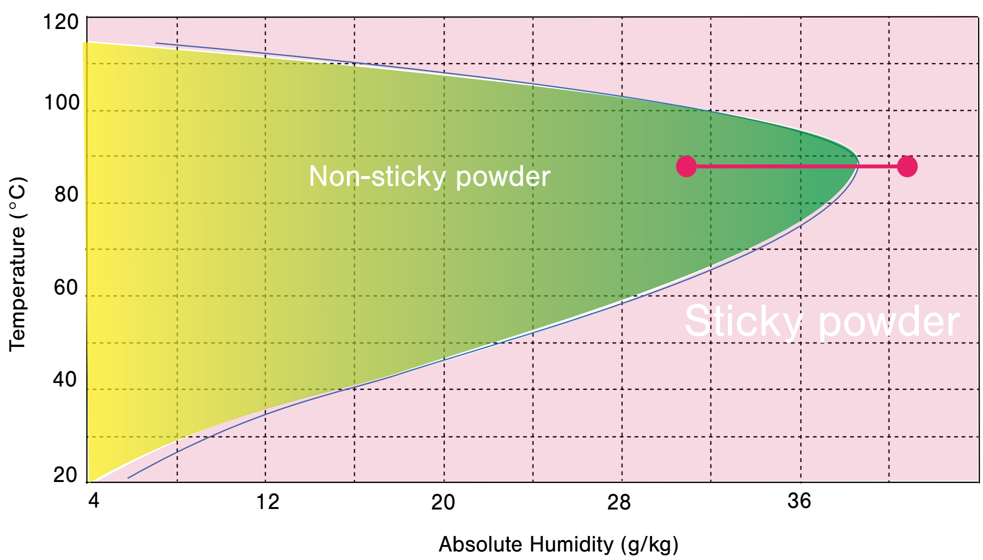
Problem Statement

The quality of dairy powder is, among other factors, characterized by its residual moisture content and the main challenge in controlling a spray dryer is to use a minimum of energy (hot air) to bring the residual moisture in the powder below the specification and to avoid that the powder sticks to the walls of the chamber. This is a challenge, as the operation of the spray dryer must continuously be adjusted to variations in the feed concentration and variations in the ambient air humidity.

Improper moisture content not only affects the physical properties and shelf life of the product, but also affects the process due to loss of product (sticking), time (cleaning downtime) and energy.

In order to optimize the drying process by controlling the residual moisture content, the operators require fast, accurate and continuous measurements. Currently, the residual moisture in the powder is measured by offline measurements of product samples once or twice an hour, where the time between action and reaction is too long and little can be done to improve the quality of a batch once it has left the process.

Whereas, In-Situ relative humidity sensors for exhaust air serve as online feedback for changes in process control parameters. These sensors are highly prone to product accumulation, require periodic calibration and show inaccuracies based on drift and hysteresis. To avoid product accumulation, they are often placed after the filters where in most cases the exhaust air of the dryer is mixed with the relatively dry exhaust air from the fluid bed. Furthermore, relative humidity is not a very good representation of the process, as it varies with temperature and from experience it gives slightly different readings when measured at different points in the same duct.



Accurate humidity measurement and attention to variations in parameters like feed concentration and incoming air humidity is important. The process can move from non-sticky production to a sticky powder production if the production parameters are not controlled and adjusted.

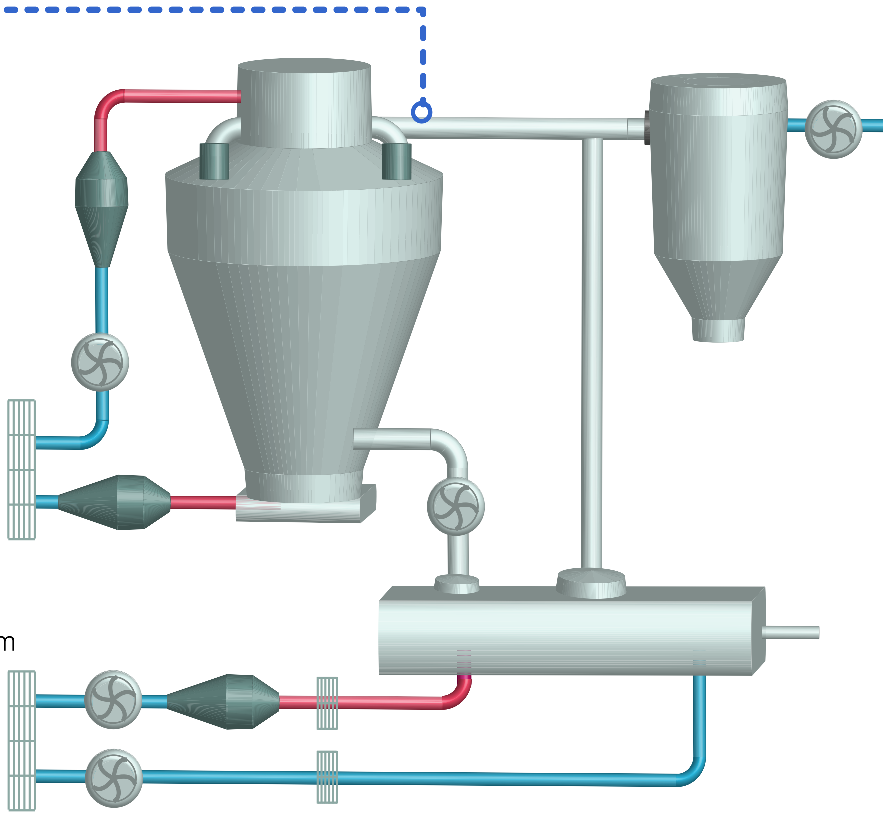
Precise measurement

Sampling technique/Measurement point

The maximum energy usage as well as the highest effect on the product takes place in the drying chamber itself. This means that there is a larger room for improvement here as compared to the later production steps taking place in the fluid bed. So, in order to optimize the process it is much more fruitful to measure directly at the exhaust of the drying chamber, as this will provide a direct feedback of any changes to the controlling parameters.

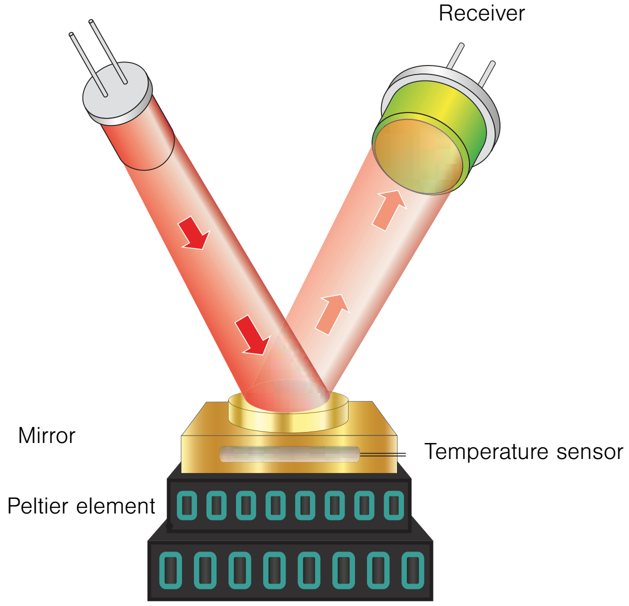
The system has been designed to be wall mounted close to the measurement point where specially designed 5µm filter elements and periodic purging allow us to extract dust free air samples even from high powder loaded parts of the process. The samples are transported through heated lines to avoid any pre-mature condensation before the sample reaches the sensor.

ATEX Dewpoint Measurement System



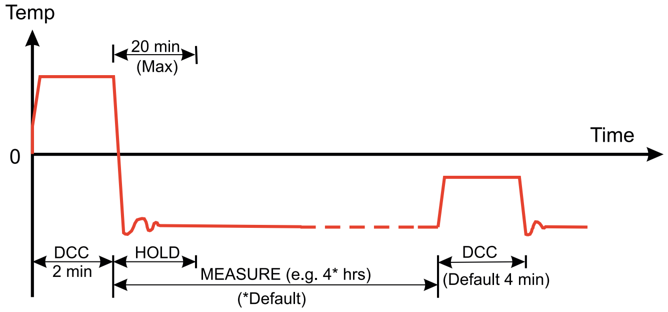
Measurement Principle

The system uses a chilled mirror hygrometer to measure the humidity content of the air sample and the values are then passed on to the operator after being processed by the analyzer.
Such instruments have no drift or hysteresis, since they measure a primary characteristic of moisture (the temperature at which condensation forms on a surface), making them inherently repeatable and giving long term reliable measurements.



The measurement principle is quite simple, the sample gas is passed over a temperature controlled polished mirror surface, where at a temperature dependent upon the moisture content in the gas, and the operating pressure, the moisture in the gas condenses out on the surface of the mirror.
The condensation is detected by the optics system and the corresponding temperature is registered as the dew point temperature of the sample.

In order to ensure that any contamination (dust/powder particles) present on the mirror surface does not influence the measurement, the sensor checks the status of the mirror surface periodically. On start-up, the sensor goes into Digital Contamination Control Mode (DCC) where it heats the mirror surface until all condensation present on it evaporates and the mirror surface including any remaining contaminant particles is then taken as the reference.
This is then repeated at a user defined interval during measurement in order to continuously update the reference and inform the user if the mirror surface requires manual cleaning.

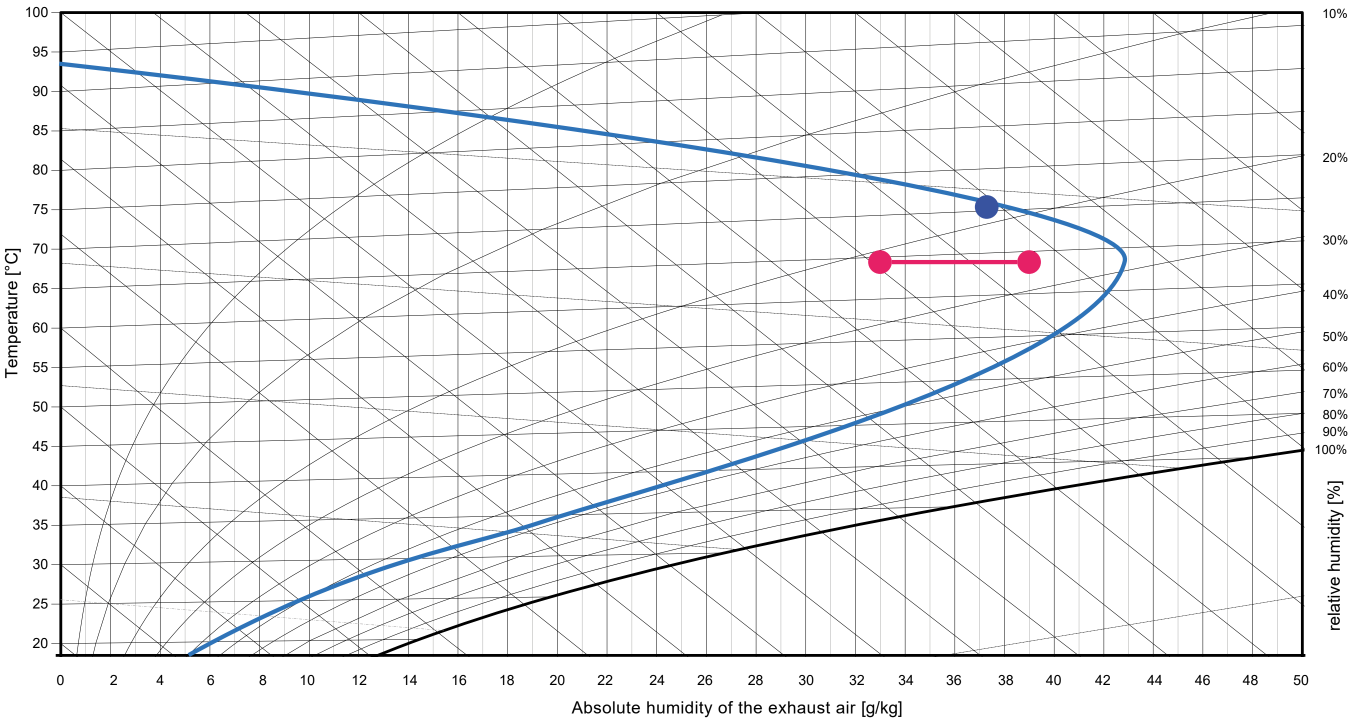


Typical operating cicle

Accurate values for process optimization

For every powder that is dried, there is a curve called the “Sticky Curve” which dictates the stickiness of the powder based on the temperature and absolute humidity of exhaust air.
The sticky curve can be placed on the HX diagram of moist air and directly pinpoint the optimal exhaust air humidity for that product as shown below.
The operator can then adjust the process parameters to get direct feedback regarding the effect of these changes until the target exhaust air humidity is achieved.

The process team can then use this information to first assess where they currently are in the sticky/non-sticky region for their product and how far away they are from the optimal point. (blue dot in graphik)
With this they can then test how different actions affect the exhaust humidity as well as the end product humidity. The ultimate goal is then to minimize the gap between the current position and the ideal position on the below graph, and to be able to continuously adjust their process to any incoming changes so that the end product quality is maintained constant.



The above example has been taken from the Dairy industry, however the system can be installed in most powder production applications, some are:

1. Dairy industry
2. Coffee, Chocolate & Tea drying
3. Starch, Sugar, flavorings and other dried food products
4. Chemical/Pharma drying processes.
5. Yeast and probiotics

Benefits

- **Improving process efficiency by helping to identify the optimal process parameters for each product i.e. humidity and temperature.**

- **Provide an early identification of drying process abnormalities based on the humidity values.**

- **Save humidity values for each batch, to be used by the quality management team.**

- **Improve product quality and yield by helping to operate the process at the optimal parameters and reducing the powder stickiness.**

- **Reduce process downtime and cleaning costs.**

- **Provide fast feedback of seasonal/weather effects on the process for the operators to make counter-settings.**

- **Reducing the drying after CIP time by measuring the actually humidity inside the process equipment during the drying activity and allowing the process to go into production earlier than to wait for a calculated time.**

Specifications

Range & Accuracy

Dew Point Measurement Range	-25 to +90°C
Dew point measurement accuracy	±0.15°C
Reproducibility	±0.05°C
Sensitivity	±0.01°C
Pressure Measurement RangeMeasurement Range	0 – 1.6 bara
Pressure Measurement accuracy	±2.5% FS
System Accuracy	< ±0.5% g/kg

I/O Communication

Digital Inputs	Customer in Pre-heating Customer in Production Cleaning in Progress (CIP) Process Shutdown
Digital Outputs	System in Measurement System Fault
Available Analog Outputs	Two parameters as 4-20mA Outputs
Available Measurement Parameters	Dew point °Cdp or °Fdp Relative humidity - % Absolute humidity - g/m3, ppmV Mixing Ratio - g/kg Wet Bulb Temperature (Twb) - °C, °F Water Vapour Pressure (wvp) - Pa Ambient Temperature - °C, °F pressure converted DP - °C, °F pressure - KPa, Bara, Barg, Psia, Psig
Data Logging	All measurement parameters and system faults

Other Specifications

Sampling Tube Length	Max. 15m
Filtration	5µm
Ingress Protection	IP66
Ambient Temperature	<60°C
Pressure air	6 bar, dry, oil free
Supply Voltage	230V AC, 50 to 60Hz

explosion protection by ATEX

ATEX Protection Systems and Safety Solutions have been developed by Fire and Explosion Protection experts with extensive experience from industry and safety technologies.

The ATEX Fire and Explosion Protection Concept combines the practical requirements of a production oriented industrial installation with the appropriate safety measures. This guarantees the undisturbed operation of your plant and enhances its productivity. The advantage Systems is recognised worldwide.

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