



Monitoring

English

# Motivation

**“Dairy processors want programmable logic controllers (PLC) that can capture pertinent machine operating data and download it to their back-office systems to help identify operating missteps that lead to unscheduled downtime which slows production and increases operating costs.”**

*2013 Dairy Industry –A Market Assessment, PMMI.*

The target of the Powdered Milk industry is to get maximum powder yield from liquid milk in the most energy efficient, cost effective and environmentally friendly manner, while maintaining the taste, nutritional value and solubility of the product.

For this to happen, the amount of water removed and the rate at which it is removed plays a vital role. The quality of the finished product is compromised by both, too much moisture as well as too little moisture content. This can be better understood with the sticky curve for milk powder, which is translated to the Mollier diagram of humid air in order to identify the optimal exit temperature and relative humidity which will lead to the maximal throughput while avoiding being in the sticky region.

Excessive moisture content causes the milk powder to become sticky, caked or lumpy, this results in reduced flowability and solubility of the product. This not only affects ease of use of the product but also the flavor & odor and reduces the product shelf life, because at a humidity of more than 15% it is susceptible to microbiological growth. Moreover since the product is more sticky, it will stick more to the production equipment and result in lesser output and increased cleaning times and expenses.

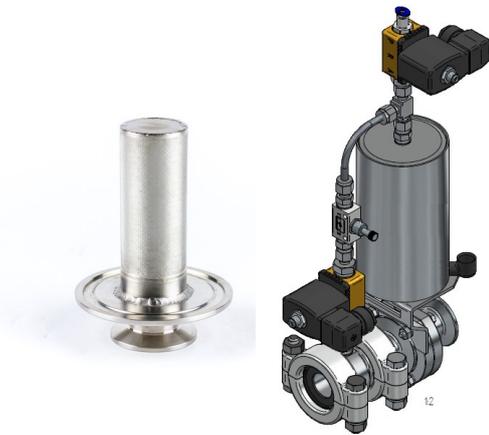
Too little moisture content in the milk powder is also not desirable, as this may also affect the taste, odor, solubility but also the nutritional value of the finished product. Moreover, if the dryer is removing excess water from the liquid milk, this means more energy is being used in the process. An excessive removal of water can also result in an undesired particle size and when the powder is too fine and too dry, risks of a dust explosion in the dryer are higher, as the powder ignition temperature is lowered in these conditions.

Furthermore, a continuous monitoring of the process humidity will result in the prevention of the sticky point and not only improve the product quality, but also reduce the cleaning efforts required to keep the equipment functional. This means that, the product quality and quantity is improved by operating the dryer at optimal parameters, cleaning downtime is reduced, cleaning costs are reduced and the process is more energy efficient by avoiding the excessive removal of moisture.

# Working Principle



The Process exhaust air is sucked at a pressure of 700mbarg at the process temperature using an insulated heated sampling probe. The gas sample passes through this tube which has a high enough temperature maintained to keep the sample air above its dew-point temperature and avoid any condensation to ensure accurate measurement. The sampling tube is ATEX certified for zones 1/2 & 21/22.



A butterfly valve assembly is used for the connection between the process and our system. It can be activated to insulate our system with the process in case of an emergency signal from the customer PLC. A 10µm stainless steel mesh filter is fitted on the process side of the butterfly valve assembly to filter out the product particles and ensure a dust free sample.

The other side of the sampling tube is connected to the hot part (measurement chamber) of the system. The temperature of this chamber is maintained similar to the sampling point temperature using 2 silicone heating elements of 200W power each coupled with aluminum heat distributors.



The temperature is regulated by taking the feedback from a PT100 installed in this chamber. The PT100 returns the chamber temperature in degree Celsius and these values are monitored with a PLC and results in the switching On and Off of the heaters when the pre-defined chamber temperatures are reached and generates warnings for irregular temperatures.



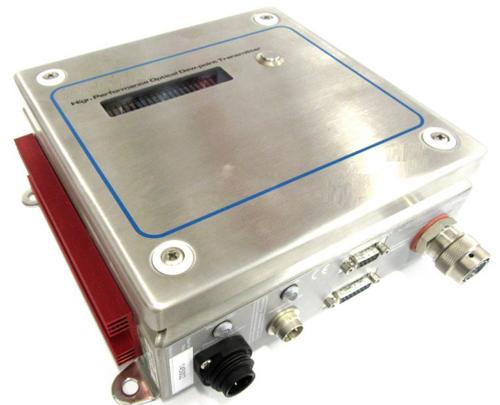
# Working Principle



The sample air from the sampling tube enters the measurement chamber and is conveyed to the humidity sensor fitted into a sensor housing. The sensor works with the 'Chilled mirror principle', it first adjusts its temperature to identify the sample air's dewpoint to cause condensation on a mirror where the sample air collides. A light is then reflected upon this mirror and the emitted light is then compared to the amount of light received back. This difference of light along with the sample air dewpoint is transferred to the analyzer in the cold part (analysis chamber).

The data received from the sensor is analyzed and converted to relative humidity (%), absolute humidity(g/Kg), mixing ratio(g/m<sup>3</sup>), dewpoint(°C) and displayed on the analyzer screen respectively. This information is also transferred to the PLC of the system to be transferred to the customer PLC, the system touch panel and logged into the data logs of the system.

The analyzer is also continuously monitoring the state of the mirror inside the sensor and it generates appropriate warnings in case the mirror requires any manual cleaning. Furthermore after every 4 hours of operation the mirror goes into the DCC (Dynamic Contamination Control Mode) where it readjusts the mirror condition to ensure accurate measurements from the system.



# Working Principle



The sampling rate is being regulated by using a pump coupled with a mass-stream controller. The sample air is being sucked in at a flowrate of 30l/hr and this value is regularly being monitored by the PLC. In case of any irregular rise or drop in the flowrate, the PLC generates appropriate faults and warnings and notifies the operator to perform an inspection and ensure that none of the system elements is being blocked due to any powder accumulation.

The temperature of the measurement chamber (cold part) is being regulated by using a vortex cooler operating with pressurized oil-free and dry air at pressures 5.5-7bar.

The cooling is important to ensure a safe ambient temperature for the electronic equipment installed in the chamber. A PT100 placed in this chamber gives temperature values to the PLC, which then turns the cooler On until a safe ambient temperature is reached and then the cooler is turned Off. The PLC also generates respective warnings in case of abnormally high temperatures.

Furthermore, a non-return valve and a condensation control element are also installed in this chamber to prevent a pressure build up from the cooling air coming in and to counter the effects in case the cooling air condenses.



# Working Principle



The system has a Siemens S7-1200 series CPU with extra analog and digital modules attached to it. The CPU performs all the control and monitoring tasks for the system. Furthermore it also processes all the customer inputs and switches to the respective mode for that specific input, and turns all the required components On/Off for that situation.

The CPU is also continuously monitoring and analyzing all the analog inputs. The values are being sampled and averaged for more accurate and stable results. In case any of these values exceed the normal ranges defined, the CPU generates the respective warning and assumes the required operational mode.

The output values may be transferred to the customer via both the PLC outputs as well as via the Network.

The system is installed with a Siemens HMI panel. This panel displays the complete system status, the current mode of operation and the measurement values for the on floor operators.

In case of a fault, the customer PLC only receives the signal of Priority 1 and Priority 2 faults, and then the complete fault details can be seen from this touch panel in order to help resolve the issue.

All the important faults, measurement values and operational mode changes are continuously being logged into a USB stick connected to this panel, which can be useful for maintenance and servicing.





## Idle Mode

When the system is powered on but there is no signal from the customer PLC, in this case the system assumes the Idle mode. In this mode no sample is being taken and all measurement and analysis components are powered off.

However, the system heating i.e. the hot part heaters and the heated sampling tube are powered on and maintain their temperatures in order to avoid the condensation of any residual air inside the system. In this mode, if the temperature of the cold part rises above the preset temperature, the cooler will also be activated.

Furthermore, the inlet valves in the butterfly valve assembly are also open.

## Preheat Mode

Normally when the system is turned on, it waits for the 'Pre-heat' signal from the customer, which means that the customer has started to pre-heat their dryer and will soon start production. With this signal, the system also starts making necessary initializations and when these conditions are met, we send the 'System Ready' signal to the customer meaning that we are ready for measurements.

## Measurement Mode

After sending the 'System Ready' signal, the system then waits for the 'Customer Ready' signal from the customer PLC, which means that they have reached the desired temperature and are now ready to go into production.

Once the 'Customer Ready' signal is received, all system components become active and the system starts taking samples and returning values to the customer.

## DCC & Data Hold

When the Optidew analyzer is turned on and after every 4 hours of operation, it goes into the DCC (Digital Contamination Control) mode, where it heats the sensor mirror to remove it of all the moisture and if any moisture or particles still remain after it is taken as reference and treated as zero. The DCC mode is normally followed by a Data hold mode, during this time no samples are taken and all values of humidity and flow-rate are set to zero.

# Operational Modes

## CIP Mode

When the customer is performing CIP, a 'CIP Signal' is sent to our system and in this case, the system stops all measurements. The inlet valves are closed, insulating the system from any liquids and chemicals from the process and pressurized air is blown through the filter in order to remove and particle deposition across its surface. In case the filter element is installed close to a CIP nozzle, the filter element will automatically be cleaned hence resulting in reduced maintenance.

During this mode, the system still continues the suction through the pump and mass-stream controller after closing the valves. The PLC monitors the flow-rate and if this value falls below a pre-set value, then the system gives out a signal that the sampling tube does not have a leak in it. However if there is still some flow after a specified time, the system gives out a fault that the sampling tube has a leak in it.

The operator must then inspect the tube and perform a manual leak check after making necessary maintenance steps.

## Emergency Shutdown & Maintenance Shutdown

In case of an 'Emergency Shutdown' or a 'Maintenance Shutdown' signal from the customer, the system instantly stops all measurements and sampling. The valves are also closed instantly to avoid any unwanted materials from coming into the system.

No leak test is performed in these cases.

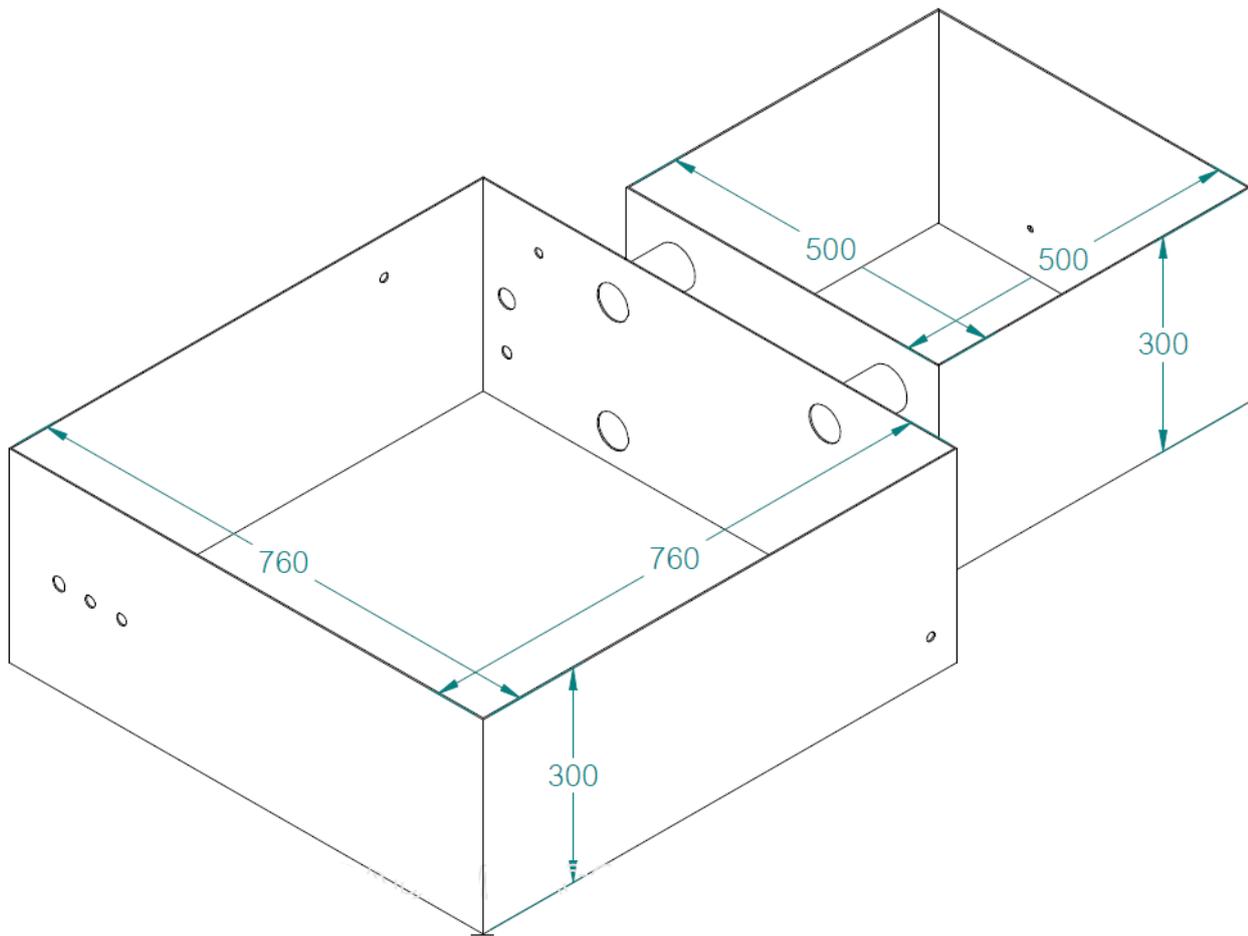


The Atex Dewpoint measurement system provides a continuous monitoring of the process humidity in the desired units. This provides useful information to the operating staff and can be used to achieve better plant performance.

Some of the major advantages of this continuous monitoring are,

- 1** Help identify the optimal process parameters i.e. humidity and temperature.
- 2** Provide an early identification drying process abnormalities based on the humidity values.
- 3** Save humidity values for each batch, to be used by the quality management team.
- 4** Improve product quality and process output by helping to operate the process at the optimal parameters and reducing the powder stickiness.
- 5** Reduce the CIP duration and frequency as a result of less sticky powder.

# Mechanical Drawing



The system consists of two compartments, the hot compartment 500x500x300mm and the cold compartment 760x760x300mm. The two compartments are connected by 4 insulated hollow tubes of length 100mm and diameter 60mm each.

The overall system height is 1360mm.

# Features & Specifications



## Features

- Continuous process humidity monitoring in g/Kg, g/m<sup>3</sup> or %.
- Testing conditions maintained above sample air dew-point for minimal deviations.
- Particle filter to ensure dust free samples.
- Option for data transfer via the Network or via PLC outputs.
- Generation of detailed faults & warnings.
- Large touch panel for system parameters and status monitoring.
- Data logging of process parameters and system status.
- Language change at the press of a button.
- IP66 food industry compatible.

## Additional Options

- Option for process pressure monitoring.
- Filter options for different product sizes available.
- Different touch panel sizes.

## PLC Inputs

1. Pre-heat
2. Customer ready
3. CIP
4. Maintenance shutdown
5. Emergency shutdown

## Specifications

### Accuracy:

±0.2°C Dew point

±0.44 g/Kg Absolute Humidity

### System Temperatures:

Sampling tube: 120°C

(Explosive gas or dust atmospheres zone 1/2 and 21/22)

Hot Part (Measurement chamber):  
80±2°C

Cold Part (Analysis chamber): <40°C

### Sampling:

Sample air flow rate: 30 l/h

Filter mesh size: 10µm

Sampling tube length: 10m

### System Cooling & Filter Cleaning

#### Air:

6 Bar, dry, oil-free

Operating Voltage: 230V AC

**Note:** These are the standard specifications, contact Atex in case of special requirements.

## PLC Outputs

1. Absolute humidity (g/Kg)
2. Pressure (barg) [optional]
3. Hot Part temperature (°C)
4. Sample air flow rate (l/h)
5. System ready
6. Digital contamination control mode
7. System faults 1
8. System faults 2

# ATEX worldwide



## Explosion protection by ATEX

**ATEX Protection Systems and Safety Solutions have been developed by Fire and Explosion-Protection experts with extensive experience from the industry and safety technolo-**

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 of using ATEX Systems is recognized world wide.

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