Beer Fermentation Monitoring

Relevant for: Breweries

To guarantee constant product quality and to meet predetermined standards online monitoring of the beer fermentation process is becoming increasingly important. Great savings can be achieved by exact end-point determination and reduction in laboratory and process time.

Anton Paar's inline Fermentation Monitor 5100 has proven to be well suited for the continuous monitoring of beer fermentation processes and can be directly installed into the fermentation tank to measure extract and alcohol content as well as degree of fermentation in real-time.

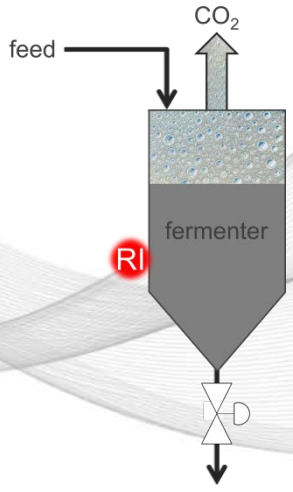
1 Beer Fermentation

Fermentation is a key process in the beer production and takes place in fermentation tanks. During the fermentation process yeast converts the glucose (sugar) in the wort to alcohol and carbon dioxide.

The key variable by which the brewers characterize the state of their fermentation is the extract concentration and hence the degree of fermentation. As the fermentation proceeds, the extract concentration drops and is typically measured off-line at least once a day. These measurements require a careful pretreatment of the samples drawn from the fermenter, are time-consuming and provide measurement values with a considerable time delay. Only online process measurements ensure continuous process control and exact end-point determination and thus enable comprehensive regulation of product quality and process efficiency.

2 Fermentation Monitoring

By installing Anton Paars' Fermentation Monitor 5100 (based on the measurement of the refractive index RI) into the side wall of a fermentation tank a continuous fermentation monitoring is accomplished to ensure a consistent and high beer quality.



During fermentation two opposing processes are responsible for determining the change in the refractive index of beer: the reduction in the concentration of sugars due to yeast metabolism and at the same time the increasing concentration of alcohol (Figure 1).

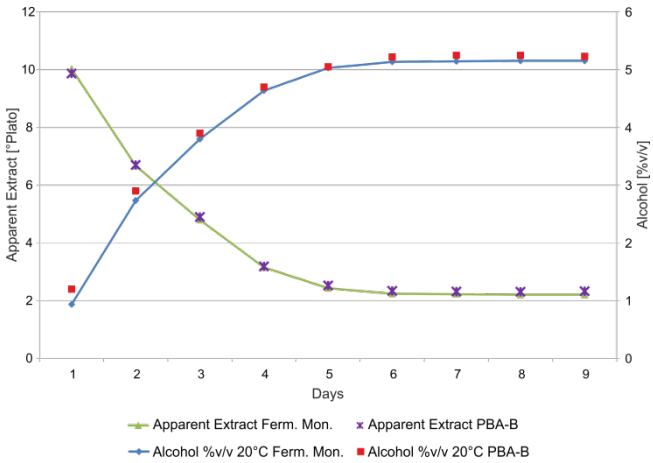


Figure 1: Decrease of Apparent Extract and parallel increase of Alcohol during fermentation

These opposing influences on the refractive index (RI) are very predictable and correlate very well with the conventional laboratory measurements of density.

Fermentation control with the Fermentation Monitor 5100 delivers:

- Original Extract [°Plato]
- Apparent Extract Density [°Plato]
- Alcohol [%w/w]
- Alcohol 20°C [%v/v]
- Real Extract [°Plato]
- Real Degree of fermentation [%]
- Fermentation Speed [Alcohol 20°C increase in %v/v / h]

The measurement values can be displayed and recorded with the mPDS 5 evaluation unit or the Pico 3000 HMI transmitter.

3 Measurement Setup

The Anton Paar solution for controlling the fermentation process consists of the Fermentation Monitor 5100 which is installed directly in the fermentation tank and measures the refractive index and temperature continuously.

Figure 2: Fermentation Monitor 5100

Specifications of Fermentation Monitor 5100:

Refractive Index	1.3100 to 1.5400 Accuracy: nD ±0.0002 (equivalent to ± 0.1 % mass) Repeatability: nD ±0.0001 (equivalent to ± 0.05 % mass)
Process temperature	-20 °C to 105 °C CIP/SIP up to 145 °C for 30 minutes
Ambient temperature	-20 °C to 60 °C
Pressure range absolute	100 mbar to 16 bar (10 bar @ >120 °C)
Communication (using Pico 3000)	Analog HART Modbus RTU PROFIBUS DP PROFINET IO EtherNet/IP

The Fermentation Monitor is mounted into a Varivent® flange on the side wall of the fermentation tank.

The best position for the installation of the instrument is 1/3 of the cone height above the upper part of the cone. This avoids interference from yeast and reduces the impact of gas bubbles.

The application specific calculations are carried out in the mPDS 5 or with the Pico 3000 HMI. Up to 4 Fermentation Monitors can be connected to one mPDS 5 and the results can be displayed and transferred to a PLC or to the Davis 5 data acquisition and visualization software.

Alternatively the Fermentation Monitor can be connected to a Pico 3000 RC housing for remote control (for a single fermentation tank).

Figure 3: Fermentation Monitor 5100 installed in beer fermentation tanks

4 Benefits

The reliable and accurate Fermentation Monitor 5100 enables to

- eliminate manual grab sampling of the wort and avoid sampling errors
- continuously track the progress and determine the endpoint
- detect any irregularities and control the process in real-time
- ensure fermentation consistency
- realize greater end-product uniformity
- reduce operating costs

5 Other Anton Paar Sensors in Brewery

Extract / Original Extract / Plato Monitor

Wort Monitoring in Lauter Tun, Mash Filter, Kettle, Whirlpool and Wort Cooler

L-Col 6100 Color Measurement

Filtration, Pre-Filler and Packaging

Beer Monitor 5500/5600

After Filtration, Pre-Filler and Packaging

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