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## On-Line Measurement of Plato Degree during Beer Fermentation Using SMAR DT302 Density Transmitter

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#### The Beer Fermentation Process

Fermentation is the process through which fermenting carbohydrates are converted by yeast into alcohol, carbon dioxide and other by-products. The fermentation process is dependent on the composition of the must, yeast and process conditions. Factors affecting fermentation conditions include time, must temperature, volume, fermentation vessel design, pressure, agitation and must currents.

Plato Degree is used to effectively monitor and control the beer fermentation process.

Plato Degree is a concentration unit, and is defined as the percentage of saccharose mass present in a solution.

#### Continuous and On-line Plato Degree Measurement

The [DT302 Density and Concentration Transmitter](#) is a device developed by SMAR for continuous, on-line measurement of liquid density and concentration in industrial process applications.

The DT302 uses the principle of differential hydrostatic pressure ( $d=\Delta p/g.h$ ) to calculate the process fluid density. It is a patented instrument containing a probe, immersed in the process fluid with two pressure sensors and one temperature sensor, the latter being used to automatically compensate for any variation in the process temperature.



Figure 1: Density Transmitter - Sanitary Model DT302S

The unique design and assembly of the pressure and temperature sensors make it possible for small variations in the process to be instantly detected and translated into a high accuracy density measurement.

Once the process fluid temperature and density are known, the Plato Degree can be calculated. The transmitter then supplies an output signal proportional to the calibrated range to be used to monitor and control the beer fermentation process.

The installation of the DT302 is made directly on the fermentation tank. SMAR has developed an adaptor that can be installed in new or existing tanks to eliminate any unnecessary welding or maintenance to the tank.

The following illustrates the tank adaptor for installation of the Density Transmitter:

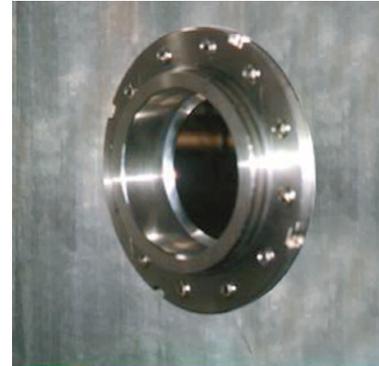


Figure 2: Adaptor seen from outside the tank



Figure 3: Adaptor seen from inside the tank

The sanitary model density transmitter is recommended for brewery installation and uses a tri-clamp connector for equipment mounting.

The probe shape was specifically designed to allow for CIP cleaning without the need to remove the instrument from the process. The external finishing complies with the FDA norm 3A requirements. The DT302 is an integrated unit, without remote electronics. Information for identification, configuration, range adjustment and diagnostics may be accessed remotely through configuration and diagnostic tools.

The DT302 is a two-wire loop powered device with Foundation Fieldbus communications protocol. It is also available with HART and Profibus communications. As a digital device, the instrument is capable of providing extensive amounts of process information, including Plato Degree and process temperature. As this information is available digitally, there are no errors in the transmission of the information.



Figure 4: DT3025 Installed on a Fermentation Tank

#### **On-Line DT302 and Beer Analyzer Results Comparison**

The on-line [DT302](#), with a direct Plato Degree output, allows simple, accurate, and reliable control of the fermentation process. Especially when compared to grab sample and lab analysis.

On-line measurement provides real time process information and allows for immediate operator interaction to maintain product quality and consistency. This minimizes the losses and snap shot samples normally incurred during sampling.

The [DT302](#) indicates the exact moment when the fermentation process ends and the batch is ready. The [DT302](#) also helps in the maturation process by managing the refrigeration process and consequently optimizing the power requirements. The following is an actual comparative analysis between on-line Plato Degree measurements done by the [DT302](#) and a beer analyzer. The comparisons were made at a lab, as the analyzer sample needs to be filtered, and decarbonated before measurement can be made.

#### **Conclusion**

Date	Hour	Sampling	Plato Degree Smar	Plato Degree Beer Analyser
05/07/2002	0:00	1		
	6:00	2		
	12:00	3		
	18:00	4	10.21	10.17
06/07/2002	0:00	5	9.99	9.79
	6:00	6	9.32	9.16
	12:00	7	8.90	8.74
	18:00	8	8.27	8.22
07/07/2002	0:00	9	7.70	7.60
	6:00	10	7.33	7.17
	12:00	11	6.75	6.62
	18:00	12	6.50	6.25
08/07/2002	0:00	13	5.95	5.78
	6:00	14	5.62	5.41
	12:00	15	5.19	5.01
	18:00	16	4.82	4.54
09/07/2002	0:00	17	4.41	4.19
	6:00	18	4.07	3.84
	12:00	19	3.79	3.51
	18:00	20	3.49	3.28
10/07/2002	0:00	21	3.24	3.03
	6:00	22	3.04	2.86
	12:00	23	2.77	2.63
	18:00	24	2.68	2.52
11/07/2002	0:00	25	2.61	2.45
	6:00	26	2.55	2.39
	12:00	27	2.52	2.43
	18:00	28		

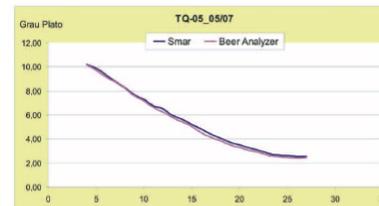


Figure 5: Actual Fermentation Curve Data

There are many significant advantages for using the **SMAR DT302 Density Transmitter** during the beer fermentation process. These include:

- Real-time continuous measurement of Plato Degree, density, and temperature compensated volume;
- Real-time measurements allow for automation of the process;
- Reduced power consumption in the refrigeration system;
- Elimination of product losses and sampling errors;
- Increase in process reliability, ensuring greater end-product uniformity and quality.

**Testimonial: Eng. Homero Guercia - Industrial Manager, Schincariol - Cachoeiras de Macacu - RJ**

"After several months of operating SMAR Density Transmitters on the fermentation tanks, we experienced an improvement in the quality of our production process as well as improving product quality through the continuous measurement of Plato Degree.

The continuous measurement of Plato Degree enabled to precisely trigger when we start our maturation process and consequently, significantly reduce our power costs.

We were also able to increase production, as we no longer needed to sample off-line, which we had found contributed to added time, labor and waste to our production process".



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