Krombacher relies on METTLER TOLEDO for its inline control of DO in filter lines

The Krombacher Brewery Bernhard Schadeberg GmbH & Co. KG has incorporated highly successful modern measurement technology from METTLER TOLEDO into its traditional brewing process, with reliance on the dissolved oxygen measurement technology downstream of the separators and at the filling station.

Best flavor thanks to DO measurement technology from Mettler-Toledo Ingold

The Krombacher Brewery has indeed enjoyed continuous success since its foundation in 1803, and last year the main product of the company, Krombacher Pilsner, established itself as the brand of beer most sold in Germany. This achievement is largely due to the excellent quality of the raw materials used, and to the strict quality standard set by the brewery. The Krombacher Brewery continuously monitors oxygen concentrations throughout the entire brewing process. The DO measurements are carried out using measuring equipment supplied by METTLER TOLEDO. The aim of the brewery is to ensure that the unique flavor of Krombacher beer is not impaired by the occurrence of any elevated concentrations of dissolved oxygen during the course of the process. The oxygen measurement systems from METTLER TOLEDO are, above all, important downstream of the separators and at the filling station.

Of the over 30 oxygen measurement systems monitoring the quality of the beer during the entire brewing process, 12 alone are installed at the filling station. Amongst other types, the trace oxygen sensors InPro® 6900 and the modular dual channel M700 transmitter are widely employed. The InPro® 6900 sensors have been specially developed for brewing applications, and their use in conjunction with the M700 transmitter, provides an ideal combination for Krombach to ensure that the strict quality standards of the brewery are
The versatility of the M700 transmitter is supplemented by the following performance features:

- simultaneous measurement of: \( \text{O}_2/\text{O}_2 \), \( \text{O}_2/\text{Cond} \), \( \text{pH}/\text{Cond} \)
- high operational safety and measurement quality
- backlit LC graphic display
- basic unit M700S: made of stainless steel, and hygienically designed
- data saving/storage on SmartMedia™ card
- wide range of use due to a plurality of software options, e.g.
  - AI recorder
  - ServiceScope
  - enhanced logbook
  - sensor network diagram
  - configurable calibration timer

The versatility of the M700 transmitter is supplemented by the following performance features:

- simultaneous measurement of: \( \text{O}_2/\text{O}_2 \), \( \text{O}_2/\text{Cond} \), \( \text{pH}/\text{Cond} \)
- high operational safety and measurement quality
- backlit LC graphic display
- basic unit M700S: made of stainless steel, and hygienically designed
- data saving/storage on SmartMedia™ card
- wide range of use due to a plurality of software options, e.g.
  - AI recorder
  - ServiceScope
  - enhanced logbook
  - sensor network diagram
  - configurable calibration timer

The versatility of the M700 transmitter is supplemented by the following performance features:

- simultaneous measurement of: \( \text{O}_2/\text{O}_2 \), \( \text{O}_2/\text{Cond} \), \( \text{pH}/\text{Cond} \)
- high operational safety and measurement quality
- backlit LC graphic display
- basic unit M700S: made of stainless steel, and hygienically designed
- data saving/storage on SmartMedia™ card
- wide range of use due to a plurality of software options, e.g.
  - AI recorder
  - ServiceScope
  - enhanced logbook
  - sensor network diagram
  - configurable calibration timer

The versatility of the M700 transmitter is supplemented by the following performance features:

- simultaneous measurement of: \( \text{O}_2/\text{O}_2 \), \( \text{O}_2/\text{Cond} \), \( \text{pH}/\text{Cond} \)
- high operational safety and measurement quality
- backlit LC graphic display
- basic unit M700S: made of stainless steel, and hygienically designed
- data saving/storage on SmartMedia™ card
- wide range of use due to a plurality of software options, e.g.
  - AI recorder
  - ServiceScope
  - enhanced logbook
  - sensor network diagram
  - configurable calibration timer

The versatility of the M700 transmitter is supplemented by the following performance features:

- simultaneous measurement of: \( \text{O}_2/\text{O}_2 \), \( \text{O}_2/\text{Cond} \), \( \text{pH}/\text{Cond} \)
- high operational safety and measurement quality
- backlit LC graphic display
- basic unit M700S: made of stainless steel, and hygienically designed
- data saving/storage on SmartMedia™ card
- wide range of use due to a plurality of software options, e.g.
  - AI recorder
  - ServiceScope
  - enhanced logbook
  - sensor network diagram
  - configurable calibration timer

The versatility of the M700 transmitter is supplemented by the following performance features:

- simultaneous measurement of: \( \text{O}_2/\text{O}_2 \), \( \text{O}_2/\text{Cond} \), \( \text{pH}/\text{Cond} \)
- high operational safety and measurement quality
- backlit LC graphic display
- basic unit M700S: made of stainless steel, and hygienically designed
- data saving/storage on SmartMedia™ card
- wide range of use due to a plurality of software options, e.g.
  - AI recorder
  - ServiceScope
  - enhanced logbook
  - sensor network diagram
  - configurable calibration timer

The versatility of the M700 transmitter is supplemented by the following performance features:

- simultaneous measurement of: \( \text{O}_2/\text{O}_2 \), \( \text{O}_2/\text{Cond} \), \( \text{pH}/\text{Cond} \)
- high operational safety and measurement quality
- backlit LC graphic display
- basic unit M700S: made of stainless steel, and hygienically designed
- data saving/storage on SmartMedia™ card
- wide range of use due to a plurality of software options, e.g.
  - AI recorder
  - ServiceScope
  - enhanced logbook
  - sensor network diagram
  - configurable calibration timer

The versatility of the M700 transmitter is supplemented by the following performance features:

- simultaneous measurement of: \( \text{O}_2/\text{O}_2 \), \( \text{O}_2/\text{Cond} \), \( \text{pH}/\text{Cond} \)
- high operational safety and measurement quality
- backlit LC graphic display
- basic unit M700S: made of stainless steel, and hygienically designed
- data saving/storage on SmartMedia™ card
- wide range of use due to a plurality of software options, e.g.
  - AI recorder
  - ServiceScope
  - enhanced logbook
  - sensor network diagram
  - configurable calibration timer

The versatility of the M700 transmitter is supplemented by the following performance features:

- simultaneous measurement of: \( \text{O}_2/\text{O}_2 \), \( \text{O}_2/\text{Cond} \), \( \text{pH}/\text{Cond} \)
- high operational safety and measurement quality
- backlit LC graphic display
- basic unit M700S: made of stainless steel, and hygienically designed
- data saving/storage on SmartMedia™ card
- wide range of use due to a plurality of software options, e.g.
  - AI recorder
  - ServiceScope
  - enhanced logbook
  - sensor network diagram
  - configurable calibration timer

The versatility of the M700 transmitter is supplemented by the following performance features:

- simultaneous measurement of: \( \text{O}_2/\text{O}_2 \), \( \text{O}_2/\text{Cond} \), \( \text{pH}/\text{Cond} \)
- high operational safety and measurement quality
- backlit LC graphic display
- basic unit M700S: made of stainless steel, and hygienically designed
- data saving/storage on SmartMedia™ card
- wide range of use due to a plurality of software options, e.g.
  - AI recorder
  - ServiceScope
  - enhanced logbook
  - sensor network diagram
  - configurable calibration timer

The versatility of the M700 transmitter is supplemented by the following performance features:

- simultaneous measurement of: \( \text{O}_2/\text{O}_2 \), \( \text{O}_2/\text{Cond} \), \( \text{pH}/\text{Cond} \)
- high operational safety and measurement quality
- backlit LC graphic display
- basic unit M700S: made of stainless steel, and hygienically designed
- data saving/storage on SmartMedia™ card
- wide range of use due to a plurality of software options, e.g.
  - AI recorder
  - ServiceScope
  - enhanced logbook
  - sensor network diagram
  - configurable calibration timer

The versatility of the M700 transmitter is supplemented by the following performance features:

- simultaneous measurement of: \( \text{O}_2/\text{O}_2 \), \( \text{O}_2/\text{Cond} \), \( \text{pH}/\text{Cond} \)
- high operational safety and measurement quality
- backlit LC graphic display
- basic unit M700S: made of stainless steel, and hygienically designed
- data saving/storage on SmartMedia™ card
- wide range of use due to a plurality of software options, e.g.
  - AI recorder
  - ServiceScope
  - enhanced logbook
  - sensor network diagram
  - configurable calibration timer
InPro 6900 monitors CO₂ production of highest purity in recovery process

The interest in environmental protection at the Krombacher Brewery is not only something to do with the concept of preservation of rainforests, for which this year Krombacher will donate 500’000 Euros to the WWF, but is something which is a matter of course during the everyday brewing process. Krombacher runs its own CO₂ recovery plant to process the CO₂ produced during fermentation. Only CO₂ in its purest form is dosed into the beer without any risk of impairment of shelf life or flavor. This necessitates continuous monitoring of CO₂ purity, for which the INGOLD oxygen sensor InPro 6900 is used. At a glance, the DO sensor captivates through its outstanding performance features:

- extremely low detection limit of 1 ppb at enhanced signal stability
- Quick Disconnect-System
- high process operation reliability thanks to durable material and robust design
- ease of cleaning due to N5/Ra16 surface finish
- excellent hygienic design certified to: EHEDG and 3-A.

INGOLD, your leading partner for liquid analytical measurement solutions, offers you a wide variety of sensors and transmitters for various applications. Distributed automation and control solutions based on open fieldbuses like FOUNDATION Fieldbus and Profibus® PA are currently the standard in many sectors of the process industry. Only fieldbuses permit full use of the functional advantages of digital communication such as improved resolution of measured values, remote diagnostics and configuration.

Three certified transmitters are available:

- pH 2100eFF
- O₂ 4100eFF and
- Cond 7100eFF

METTLER TOLEDO integrates your analytical measurement into your control system

Open field integration to your control system with "FOUNDATION Fieldbus" technology for liquid analytical measurements.
Turbidity measurement ensures wort quality and taste of beer

Measuring systems from METTLER TOLEDO support breweries in their endeavors to achieve high quality and productivity. With the inline turbidity measurement at the lauter tun a wort of the best possible clarity is attained, since wort with too high a degree of cloudiness (turbidity) can negatively influence both the taste and the storage life of the beer.

Background
Quality and productivity are both important cornerstones of a modern and competitive brewery business. This essential basis for success calls for the use of high-quality raw materials, the implementation of an optimized process management system and the employment of efficient methods of enhancing product yield. At the end of the production line, a beer should then emerge which is convincing both in flavor and through its long shelf-life.

Process
The mashing process stage, in which the starch and protein content of the malt is subjected to various conversion and dissolution sequences, results in the formation of a mixture of wort (liquid phase) and spent grains (undissolved substances = draff). In the next process step, so-called lautering, the draff is separated from the wort by filtration and sparging. This is carried out in a lauter tun in stages which include:
- recirculation of cloudy wort
- drawing off of first wort
- sparging/last runnings

These three operations can be monitored and controlled by using an inline turbidity sensor installed in the main collector line of the lauter pipes. (Fig. 1).

Trub wort pumps
The draft takes on the function of a filter by precipitating to the false bottom of the lauter tun, thereby forming a filter bed. The initial outflow of wort from the tun is always cloudy, since the filter bed is then still in the process of formation. As soon as the build-up has been completed, the wort becomes clearer and no longer has to be pumped back (recycled) to the lauter tun, but can be fed directly to the wort copper. The improvement in clarity is registered by the turbidity measurement system which can then automatically switch over the trub wort pumps from the recycling function to the lautering sequence.

Run-off of first wort
The wort which is now pumped from the lauter tun to the wort copper is known as first wort. The signal from the turbidity measuring instrument is used to control the knives of the draff cutting device in the lauter tun, i.e. on an increase in turbidity of the wort, the cutting device is raised away from the draff, and at a decrease in turbiditiy is then lowered again. This ensures being able to maintain a first wort run-off of uniform rate and clarity.

Sparging
In order to produce as much malt extract as possible, sparging water is introduced into the lauter tun shortly before the end of pumping of the first wort. This is done in order to extract as much residual wort as possible from the draff. In this procedure too, operation of the cutting device is automatically controlled via the turbidity signals, in combination with a differential pressure measurement.

Control of the cutting device on the basis of the level of turbidity, results in being able to achieve a wort with a low degree of turbidity throughout all phases of
lautering. With the use of modern lautering tuns, it is quite easily possible to achieve worts with a turbidity value clearly lower than 20 EBC/80 NTU.

**METTLER TOLEDO solution for turbidity measurement**

The collection of standard methods of the “Central European Brewing Technology Analysis Commission” (MEBAK) recommends that during lautering, a sensor be used which measures particles on the basis of the forward light scattering technique. In this way, a good correlation between solids concentration and the measured value is achieved. The concept of the InPro 8400 sensor is in accordance with this technique, whereby simultaneous measurement of the absorption (two beam compensation method), compensation of disturbing influences such as differences in wort color, deterioration of the light source, and soiled windows is effected. The InPro 8400 with sapphire optics, and fully compatible with CIP procedures, has been designed for direct insertion into the main flow line of the lautering installation. Suitable process adaptions such as the Varivent housing (Fig. 2), milk pipe thread, or TriClamp adaptors are available in a range of various nominal diameters.

The measurement system is configured via the transmitter type Trb 8300 F/S (Fig. 3) which features intuitive fulltext menus. This enables rapid and straightforward start-up and configuration during everyday operation. The reading of the turbidity value is given directly in EBC turbidity units. 4…20 mA outputs are present in order to integrate the turbidity signal in an overall process control system.

**Advantages at a glance**

- Inline measurement of turbidity in a lautering tun using METTLER TOLEDO turbidity systems
- supports improvement of the daily capacity of the lautering tun
- guarantees uniform wort quality relative to low turbidity
- efficiently controls the cutting device during pumping of first wort and during sparging
- conforms to MEBAK in accordance with “Brewing Technology Analysis Methods”, Vol. 2, published by MEBAK

The Trb 8300 F/S/InPro 8400 turbidity system is an ideal complementary system to the METTLER TOLEDO portfolio of measurement technology for breweries. A worldwide network of own local branches guarantees competent advice and rapid service.
Non-glass pH technology opens a wide range of inline measurement.

Breweries are turning more and more to the use of non-glass electrodes for inline pH measurement. The intention is to establish control of production processes as well as monitoring of product quality during the entire process. The InPro 3300 electrode, based on innovative ISFET technology, was tested by our customer, a well-known German brewery.

With an output of nearly 5 million hectoliters, our customer is one of the most important breweries in Germany. Since sustainability, quality, and continuous improvement are important guidelines for our customer, he invests nearly 10% of his total turnover in protection of the environment and further development of brewing technology. His intention is therefore to increasingly establish inline control of parameters such as pH, turbidity and oxygen, in order to monitor the processes in real time and to be able to react within seconds.

**Non-glass pH electrodes sought for**

Although brewing is a traditional process, well known for many hundreds of years, every brewer has his own secrets for slightly refining several of the process steps to achieve a “personal” characteristic flavor of his product. Malt from barley, the grain most commonly used for brewing beer, is milled and then brought together with brewing water in the mash mixer. After mashing, the liquid malt extract, the wort is filtered. The beer is then centrifuged, filtered, and bottled. Any upstream equipment problems prior to bottling are reflected in a change in pH value so that this is indeed an important process parameter in efforts to guarantee constant quality of the beer being filled. In order to assure that no active yeast from the fermentation remains in the beer, or that damaged filters cause contamination in the final product, our customer therefore intended to establish indirect equipment monitoring via inline pH measurement.

There were however certain reservations due to the fact that conventional pH electrodes are mainly made of glass. “Breakage of glass, particularly at a late stage of our production process, would be an economic disaster for us”, explains the master brewer. “Therefore it was clear to us to call up METTLER TOLEDO in Germany. We already knew their product portfolio for process control and were curious to test the new non-glass ISFET sensor, InPro 3300”.

**METTLER TOLEDO InPro 3300: good accuracy and short response time**

The InPro 3200 was tested in a newly established automatic beer analysis unit directly before filling. Data acquired was compared to the pH values in samples taken from the process and transferred to the laboratory for measurement with a glass electrode. “Results were very promising”, summarizes the director of the brewery plant. And the master brewer adds, “During a two-week period, we calibrated daily and had a consistent deviation between ISFET inline and glass offline in the lab of around 0.15 pH units. Since we are monitoring pH as a quality parameter, and problems with the centrifuges or filters would have a significant impact on pH, this accuracy is sufficient by far.”

The customer also understands the reason for this small deviation. ISFET technology differs completely from conventional, glass electrode technology. In the ISFET sensor, a highly sophisticated...
semiconductor chip takes over the role of the glass membrane. In his statement, the customer further considers the response time of the electrode to be very good, and confirms full compatibility with the applied conditions relative to pressure (1-2 bar) and to the equipment cleaning agents. Recently, METTLER TOLEDO in Asia reported that the InPro 3300 in brewery applications is not only appreciated for monitoring of quality during production, but also in research and development (R&D) focusing on the optimization of processes. The R&D department of a major Asian beverage company intends to study the optimization of the output of yeast cultures. After a two-month evaluation phase, they purchased a non-glass pH system, consisting of the InPro 3300, a static housing InFit 761, and an Advanced Line transmitter pH 2100e. (Refer to METTLER TOLEDO Brewery News, No. 2, 07/2003).

**Avantages and benefits for customers**

The METTLER TOLEDO ISFET (non-glass) pH electrode

- allows safe inline measurement by eliminating the risk of glass breakage and subsequent product contamination.
- complies with existing (FDA) and possible future regulations.
- displays high accuracy in comparison with glass electrodes, and is superior to competitive ISFET products.
- has an extended lifetime, thereby offering substantial savings in replacement costs.
- assures measurement reliability due to the 45° design of the tip of the electrode, preventing air bubbles covering the sensor surface and inhibiting contact with the sample medium.
- is made of FDA compliant materials which facilitates process validation.
- is equipped with an IP68VP connector making maintenance work on the electrode much easier.

**Technical specifications InPro 3300**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>0 – 14</td>
</tr>
<tr>
<td>Temperature</td>
<td>0 – 80°C (130°F)</td>
</tr>
<tr>
<td>Pressure</td>
<td>0 – 6 bar</td>
</tr>
<tr>
<td>Reference</td>
<td>gel electrolyte, one ceramic diaphragm</td>
</tr>
<tr>
<td>Shaft</td>
<td>PEEK (FDA compliant)</td>
</tr>
<tr>
<td>Connector</td>
<td>VarioPin (VP) IP68</td>
</tr>
<tr>
<td>Insertion length</td>
<td>120 mm</td>
</tr>
<tr>
<td>Temperature sensor</td>
<td>Pt1000</td>
</tr>
</tbody>
</table>
Service XXL – the METTLER TOLEDO service concept

METTLER TOLEDO offers comprehensive and competent service worldwide, from product and application consulting through to installation and maintenance contracts. Competent service technicians ensure fast support in every situation and help improve uptime of equipment and reliability of measurement.

Competence ensures quality and fast support

METTLER TOLEDO field service technicians ensure fast on-site support to maximize process uptime and to provide service and repair assistance. Competent and well trained service technicians repair instruments and sensors at our local service organizations, and ensure fast turnaround time.

Offered service modules are:

Instrument Service
- NIST traceable buffer solutions
- Equipment qualification consulting and support
- Maintenance service for oxygen sensors
- Maintenance contracts

Calibration Service
- NIST traceable calibration service for conductivity sensors
- Calibration service for electrodes, sensors and transmitters

Seminars
- Workshops, seminars and in-house seminars for customers

"Solution Consulting”
- Measurement “solution consulting”
- Measurement automation and system integration

Information Centre
- Internet Webpage
  - Service information
  - Extensive product documentation download area

Service XXL – the METTLER TOLEDO service concept

METTLER TOLEDO offers comprehensive and competent service worldwide, from product and application consulting through to installation and maintenance contracts. Competent service technicians ensure fast support in every situation and help improve uptime of equipment and reliability of measurement.

Instrument Service
- NIST traceable buffer solutions
- Equipment qualification consulting and support
- Maintenance service for oxygen sensors
- Maintenance contracts

Seminars
- Workshops, seminars and in-house seminars for customers

"Solution Consulting”
- Measurement “solution consulting”
- Measurement automation and system integration

Information Centre
- Internet Webpage
  - Service information
  - Extensive product documentation download area

www.mtpro.com

INGOLD
Leading Process Analytics