In-line control and monitoring of pH and dissolved oxygen in yeast production

Sugar, in the form of molasses, is the most commonly used and suitable substrate for the production of biomass or yeasts for bread-making. Whatever substrate is used, the production process for yeast can be synthesized in two main stages: prefermentation and fermentation. In-line control and monitoring of the parameters of pH and dissolved oxygen are more than a simple passive monitoring of these stages, but can be used to improve the yield and quality of production.

Production of yeast for bread-making

A major French company which specializes in the production of yeasts for bread-making (pressed or bakers’ yeast and active dried yeast) recently launched a series of tests with the object of optimizing the different stages of fermentation. A strain of pure yeast (Saccharomyces cerevisiae) and molasses – a sucrose-rich by-product obtained in refining beet sugar – were used in the tests. The influence of critical parameters such as pH and dissolved oxygen was evaluated in a 100 l pilot fermenter. Optimal values for these two parameters were determined as precisely as possible for each stage of production.

Measurement of pH and dissolved oxygen

One of the main requirements for the smooth running of these tests is to ensure reliable and continuous in-line measurement of pH and oxygen. The purpose is to enable real-time intervention in the progress of the fermentation process and adjustment of external parameters. The solution provided by METTLER TOLEDO comprises:

- a 2100e transmitter, an InPro 3100 electrode and an InFit 761CIP housing which allows the electrode to be adapted to the fermenter – to measure pH
- a 4100e transmitter linked to an InPro 6800 sensor – to measure dissolved oxygen.

The InPro 3100 electrode is perfectly adapted to this type of procedure thanks to...
its design which precludes any clogging or contamination. Care must be taken during the various fermentation processes to avoid any risk of bacterial contamination. By maintaining a slightly acidic pH and sterilizing the measuring instruments as well as the initial mixture of molasses it is possible to prevent any bacterial proliferation.

The InPro 6800 dissolved oxygen sensor from METTLER TOLEDO is also in total compliance with these requirements, combining advanced hygiene features (sterilizable, autoclavable and surface smoothness rating of N5) with high-precision measurement. The use of these two electrodes ensures precision and reliability of measurement and safety of the procedure.

Results: increased yield and quality

Precise values for pH and dissolved oxygen were determined in order to achieve a significant improvement in yield and in the quality of the final product. The tests demonstrated that better results could be obtained with pH values between 4.5 and 8 between 4.5 and 5 pH units during preparation of the molasses mixture and then between 5 and 8 pH units during the stages of fermentation. Precise values were obtained for the quantity of dissolved oxygen and correlated with the quantity of substrate added during the progress of the reaction. This makes it possible to prevent the formation of ethanol (and other dissolved volatile compounds) due to the transition from aerobic fermentation to anaerobic fermentation. After this pilot phase, the values recorded were extrapolated for direct application in production using fermenters of larger capacity (10 000 and 15 000 l) where METTLER TOLEDO electrodes for pH and dissolved oxygen are used to control the smooth operation of the different fermentation processes.

Finally, thanks to the possibilities offered by METTLER TOLEDO transmitters, the next fixed stage is the automation of the addition of dissolved oxygen in accordance with limiting values determined during the pilot phase. This stage will allow genuine control, in real time, of the fermentation processes as well as more efficient and precise calculation of the quantity of substrate to be added.
Tailored pH measurement solutions in starch slurry for optimal cost of ownership

Acid or base modification of corn starch is used to obtain semi-finished products for the paper and packaging industry. Accurate pH measurement in these industries leads to better production control. METTLER TOLEDO’s automated pH measuring solutions ensure up to 5 times longer sensor life and low maintenance requirement.

Possible applications in the starch industry

Besides the acid or base modification of corn starch applications as food processing, glucose molasses, fermentation and waste water characterize the starch industry.

Process characterization

The duration of the batch process lasts eight hours under the following conditions:

- pH control with HCl and NaOH
- pH range for acid modification pH 2 to 7 and for base modification pH 7 to 11
- Temperature range 45 to 50 °C
- Slightly under pressure
- High viscosity
- Vessel material: polypropylene or special duplex steel (high chlorine content)
- Batch cleaning with high pressure tap water at 50 °C

The major difficulties with this application concern the high maintenance requirements: manual cleaning every hour and short calibration intervals due to drifting signals caused by unstable reference potentials. Experience with conventional liquid-filled and gel pH electrodes from competitors showed that their electrodes did not have a long lifetime due to scaling (without cleaning); the minimal electrolyte outflow of the gel-type electrode also caused drifting problems. Both competitors’ electrodes lasted only between one week and two months.

Extended sensor life and cost-savings with METTLER TOLEDO

Installation of an in-line liquid-filled pH measuring system with automatic cleaning of the electrode by flushing with water (20 °C) at user-determined intervals reduced maintenance of the electrode to a minimum. Furthermore, by using a liquid-filled electrode in combination with overpressure (2 bar), drifting of the reference electrode is avoided. Because of this, the lifetime of the electrode can increase to ten months! We recommend the InPro 2000 pH electrode in conjunction with an InTrac 776e retractable housing.

2100 e pH Transmitter

- Operational safety and reliability
- Loop autonomy and maintenance-free pH measurement
- Flexibility with 4 wire installation or alternatively 2 wire execution with HART® and/or Profibus® and/or FF communication and EEx applications

Combination InPro 2000 pH electrode

- Refillable for increased electrode lifetime and reduced maintenance
- Liquid-fill design ensures fast response, highest accuracy and reliability
- Silver-ion trap to minimize electrode contamination
- Rugged IP 68 VarioPin (VP) connector

InTrac 776 e retractable housing

- Rugged 316LSS or PVD construction for maximum chemical resistance
- Automatic cleaning and calibration reduces overall system downtime
- Guarantees complete separation of process from the outside environment
- Safety interlocks prevent sensor removal from housing while in measuring position
- Manual or pneumatic operation

InPro 2000 with VarioPin connector.

InTrac 776 e (pneumatic type, made of PP).
Welcome to the Mettler-Toledo Process Analytics portal. Whether you are planning an investment or already use a METTLER TOLEDO solution, take advantage of our local and global expertise at www.mtpro.com.

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After opening a product page you may post a question or just learn more about a product or application: simply click on the “Request more information” or the “Get a quote” button. Your inquiry is automatically passed on to the country of your choice.

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Find short information on new product information.

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Low to medium turbidity measurement when clarity matters most in industrial process control

METTLER TOLEDO introduces a system for the measurement of turbidity in process liquids. This optical system for extremely low concentrations perfectly completes the existing product offering for mid to high turbidity ranges. The system consists of the Trb 8300 F/S transmitter and the InPro 8400 sensor series. This system is well suited for optimizing separation processes in the sugar industry.

The forward scattered light technique of the InPro 8400 sensor series enables measurements even in liquids which seem to be clear to the human eye. This requirement for reliable detection of particles in liquid streams for advanced process control and improved quality assurance measurements. Filter performance and particle concentration measurements are typical measuring tasks for the InPro 8400 sensor. This flow-through sensor can be easily installed in main pipes or in a bypass. The rugged sensor design allows installations even in harsh process conditions. The Trb 8300 F/S transmitter enables quick start-up and operation with a full text menu guide in three selectable languages. Sensor diagnostic features provide information on sensor performance and consequently reduces maintenance time. METTLER TOLEDO also provides an outstanding MaxCert™ documentation program with the system. Depending on specifications, sensors are provided with application relevant certificates like, 3.1B, PED, 3A, ATEX and factory calibration certificates to satisfy safety requirements and to guarantee traceability.
**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

Mettler-Toledo GmbH  
Process Analytics  
Im Hackacker 15  
CH-8902 Urdorf  
Switzerland  

INGOLD  
Leading Process Analytics  

www.mtpro.com