

Instrumentation in the brewing industry

Automation of the brewing process

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The art of brewing

Brewing beer requires dealing with naturally grown products changing from year-to-year, harvest-to-harvest. The brewer needs to react on these changes to prepare a stable quality of beer, and even more, it must taste the same all year, each and every year, to fulfill the expectation of the customer. To follow this moving target, a lot of experience is necessary. It is the art of brewing.

Endress+Hauser is here to help you run your process consistently on a high quality level every day and night. Throughout this document you will find how state of the art sensor technology supports the brewing process. Rising accuracy of process sensors, along with high repeatability enables the user to run a process in the most efficient manner. Optimized raw material use, energy conservancy and best availability of the brewery is the target of automation.

Instrumentation for:

- Malting
- Malt and grain storage
- Brewhouse
- Fermentation
- Filtration
- Packaging
- CIP and water preparation
- Boiler
- CO₂ and natural gas
- Inventory control

Supporting the cleaning process is a basic requirement to save time and energy. All shown sensors are developed to work in hygienic processes. They follow the guidelines of FDA, 3-A and EHEDG.



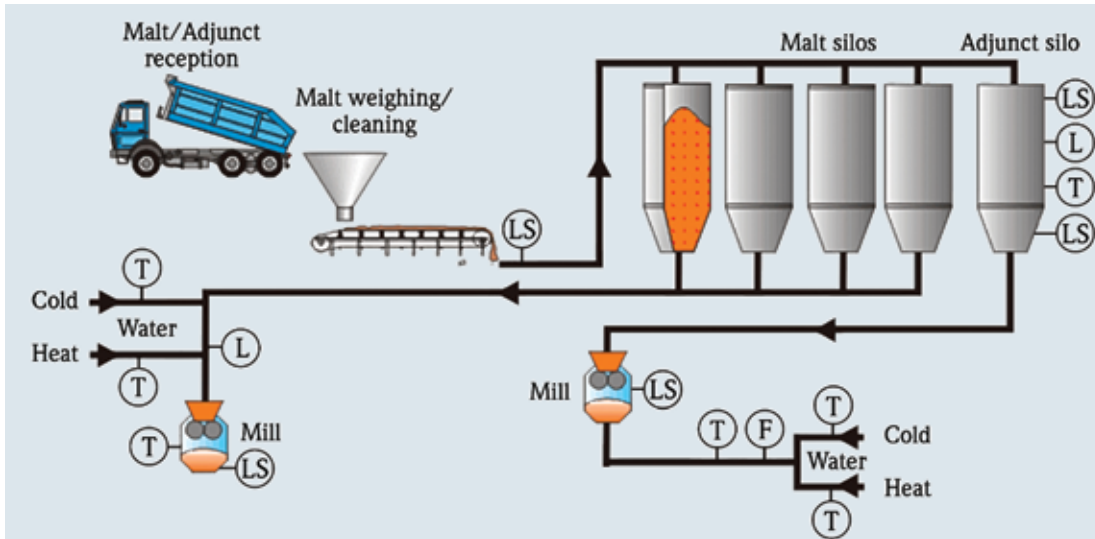
Reliable measurement supplies the necessary data for the ideal process, and supports suitable solutions for tracking and tracing the beer. Flow metering supports constant recognition of extract transfer to help minimize losses.



 Learn more about Endress+Hauser in the brewing industry
www.us.endress.com/beverage-applicator

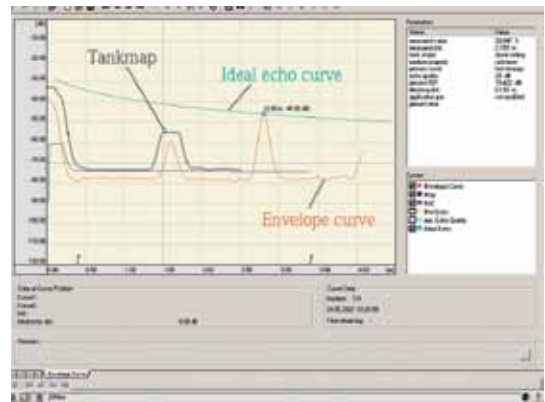
Malt and grain storage

Reliable and visible inventory status



Malt/grain inventory silos Complete inventory management solutions to address rising inventory costs are easily realized with complete packages from Endress+Hauser. Free space (FMR250) or guided wave radar give you the ability to select the best-fit to address measurement challenges due to silo height, diameter and dust.

Energy conservation Blocked dust filters can be a safety hazard and can also cause unnecessary energy consumption. Pressure transmitters with ceramic membranes provide a reliable and cleanable option to conventional metal membranes. Cerabar M pressure transmitters offer cost effective solutions for dust hazardous areas.



Silos can be easily mapped for fast commissioning and reliable measurement



Inventory and supply chain management

Rising raw material costs drive the need for real-time information

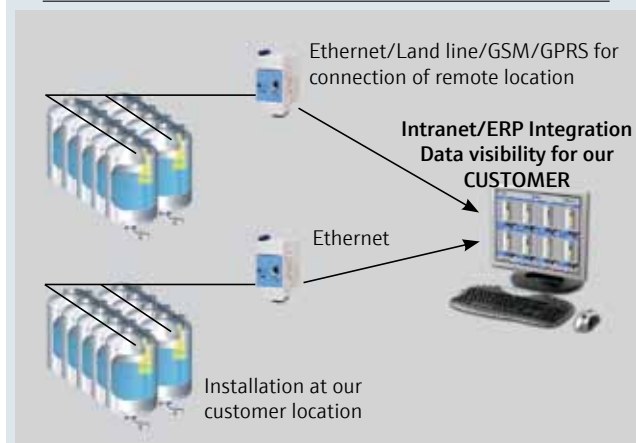
Accounting of bulk inventory kept in tanks and silos traditionally has not had high priority. This is particularly true for bulk material such as malt, adjunct and sugar. However, with the rapidly rising value of these raw materials it is becoming more and more important to have a current status of inventory levels to allow for planning and advanced purchasing techniques.

Endress+Hauser can provide scalable, turnkey solutions for your plant with simple, local monitoring or full integration into your ERP system. Installation costs can be kept to a minimum using wireless solutions or Ethernet connection. Solutions are available for single or multiple site applications. With this solution you minimize the risk of running out of raw materials.

Safety precautions with level alarms Reliable High/Low level alarms for silos and hoppers are critical for any application. Choose between capacitance (Solicap M) or tuning fork (Soliphant M) depending on installation point.

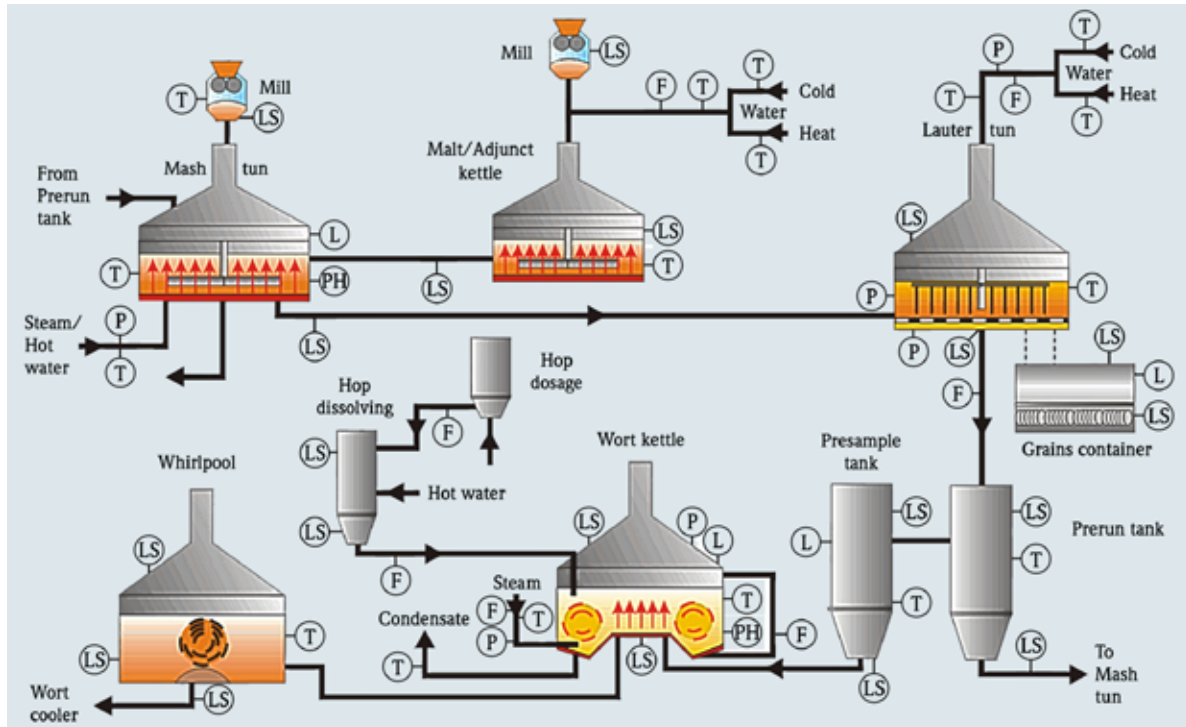


Infrastructure - In Plant Monitoring or Remote Sites



Brewhouse

Optimizing the yield and quality of wort production



Mash tun level The Mash tun level is measured with highest reliability with the temperature compensated Deltapilot hydrostatic level sensor: Remote electronics make access easy.



Beer loss reduction / boundary metering

The Promag H magnetic flowmeter is applied to accurately measure the transfer of wort/beer between stages in the brewery. Goal is to identify any beer losses. For higher accuracy and also to see the yield, a Promass Coriolis mass flowmeter provides flow, totalized value and Plato° information.



Wort kettle pressure

Stable and faster boiling is achieved by applying pressure to wort kettle. The Cerabar M pressure transmitter is ideal for this application - simple and reliable pressure control.



Boiling In-line extract measurement with Liquiphant Density ensures stable wort quality, along with optimized occupation time of the wort boil.





Steam supply Accurate measurement of the steam supply for the mash tun and wort kettle is used to identify fouling and can have a direct impact on process time and energy cost. Prowirl 73 with steam computer gives you direct BTU readings.



Mash and foundation water pH must be monitored closely to achieve best quality in mash tun. Non-glass IsFet pH sensor and retractable holders combined with Memosens® technology bring highest reliability and accuracy.



Adjuncts, dextrose and enzymes Liquefied adjuncts and dextrose must be added with high accuracy to optimize raw material usage. The Proline Promass provides the best temperature stability and accurate measurement available today. Combine this with the possibility to ensure performance between calibrations using the FieldCheck verification tool.



Lauter tun Differential pressure across the lauter tun with ceramic membrane avoids damaged membrane due to abrasive grains. The Cerabar ceramic membrane pressure transmitters provide a reliable and highly accurate alternative. Lauter tun sparging water temperature control is critical to ensure the yield of the lauter process. Quicksens is the fastest temperature sensor on the market ensuring stable conditions.



Energy and extract loss reduction To avoid wasting extract, lauter systems are monitored with Proline Promass F. Stopping the flush water at the exact right moment optimizes flavor and saves energy during the boil.

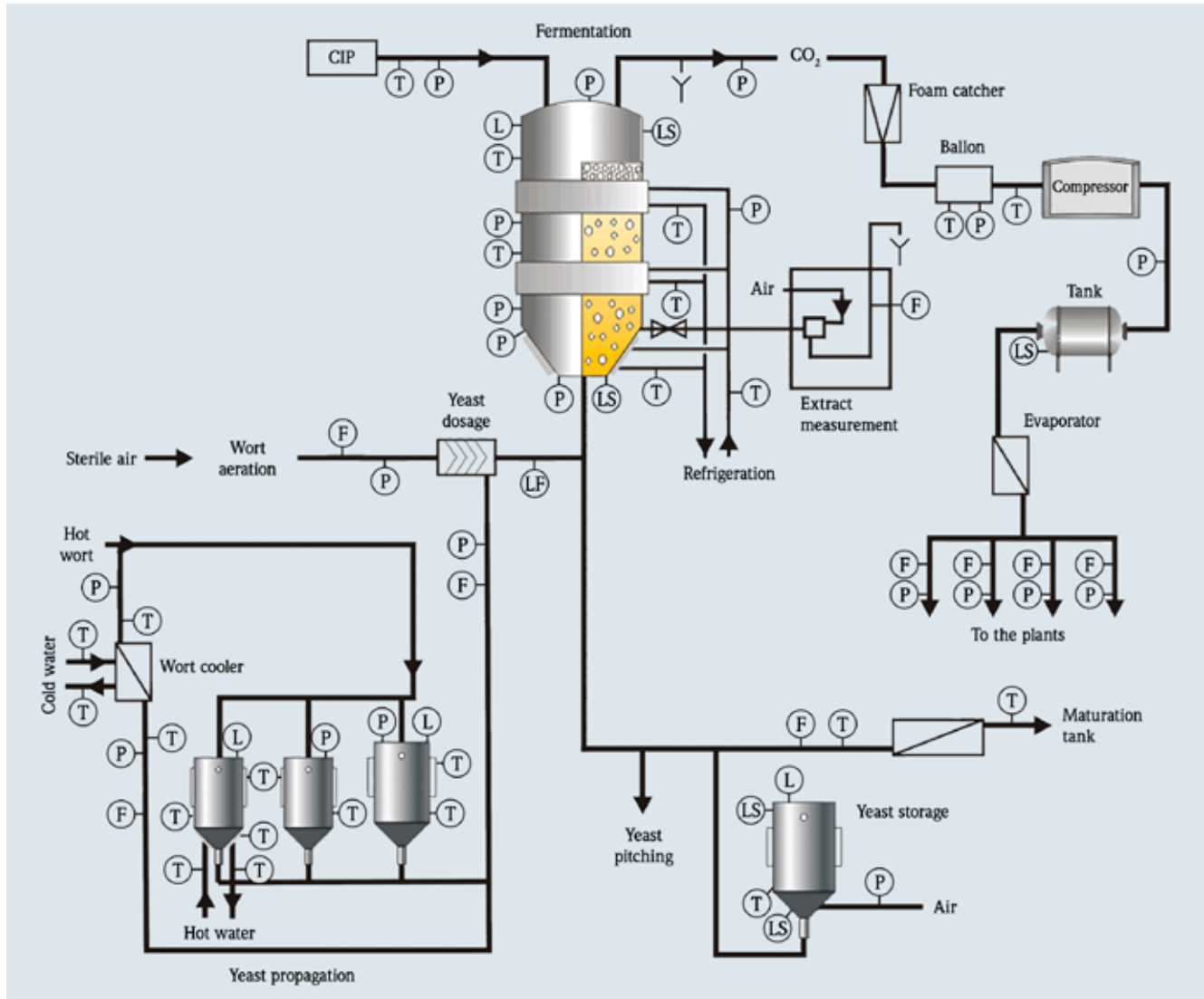


Reliable level in silo Overfilling the spent grain silo is a big mess. Avoid this situation with reliable level measurement using free space radar Micropilot, protected from splatter.



Fermentation

Consistent quality batch-after-batch





Promag in fermenter outlet

Wort aeration The goal in fermentation is to produce alcohol. Based on the condition of the yeast, oxygen supply level is controlled, using Dissolved Oxygen measurement, allowing the yeast to populate at an optimal rate.



Sterile air supply Sterile air supply to wort aeration is best done with a thermal mass flowmeter. The t-mass series is capable of highly accurate measurements with a large turndown range.



Level measurements Level measurement of fermentation, aging and bright beer tanks are ideally done using the highly accurate and temperature compensated Deltapilot hydrostatic level transmitter. Electronic differential pressure compensates for CO₂ head pressure.



Yeast dosing The amount of yeast is measured with a magnetic flowmeter Promag H combined with an optical turbidity sensor to monitor the cell concentration.



Temperature measurement Reliable temperature measurement is key throughout the brewing process and utilities. Highest quality RTDs combined with fast response tips in hygienic design ensure optimal temperature control.



Extract monitoring Extract measurement with an accuracy of ~0.15 Plato° in the fermentation vessel with Liquiphant Density ensure a stable fermentation process by allowing continuous adjustment, as needed by the actual brew for up to 5 tanks/system.



Level measurement CO₂ storage tank level must be monitored closely to ensure uninterrupted supply. Levelflex M guided wave radar provides a set-and-forget alternative that eliminates the need for periodic calibrations. The coaxial probe is ideal. Rod or cable can be used in combination with patented "end-of-probe" function.

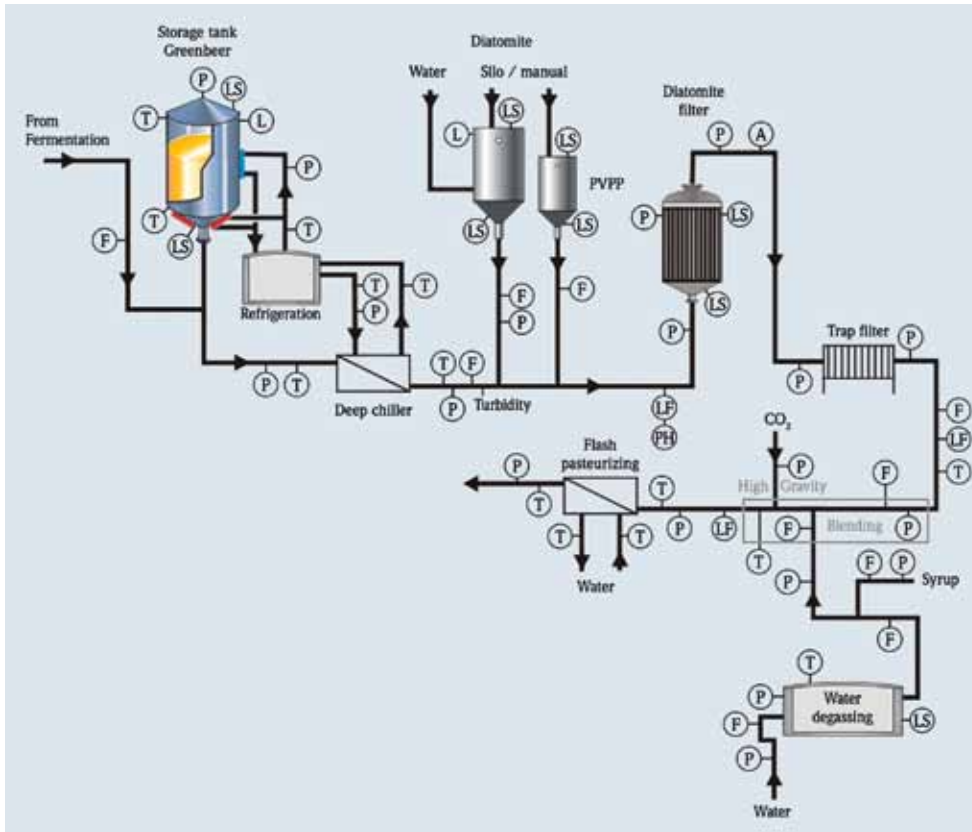


Empty pipe – high/low tank level or detection of foam in CO₂ line The Liquiphant M is a universal switch with no need for calibration or adjustment throughout the life cycle of the instrument. Version is available tuned to detect foam in CO₂ line.



Filtration

Production of a consistent product with minimal beer loss



Degassed water pH of the degassed water must be monitored closely. Non-glass IsFet pH sensors and retractable holders, combined with Memosens® technology, brings highest reliability and ensures purity of water.



Filter performance Differential pressure is a common indicator for filter performance. Conventional DP transmitters or electronic DP systems provide needed reliability.



Dissolved Oxygen measurement Example applications are for trim cooler output, degasser, packaging release and in carbonation stage. The Endress+Hauser DO sensor provides reliable measurement with minimal maintenance.



High gravity blending Minimize beer loss with combination of high performance metering - Promag on water and Promass 83F for combined flow including extract (Plato°) value.

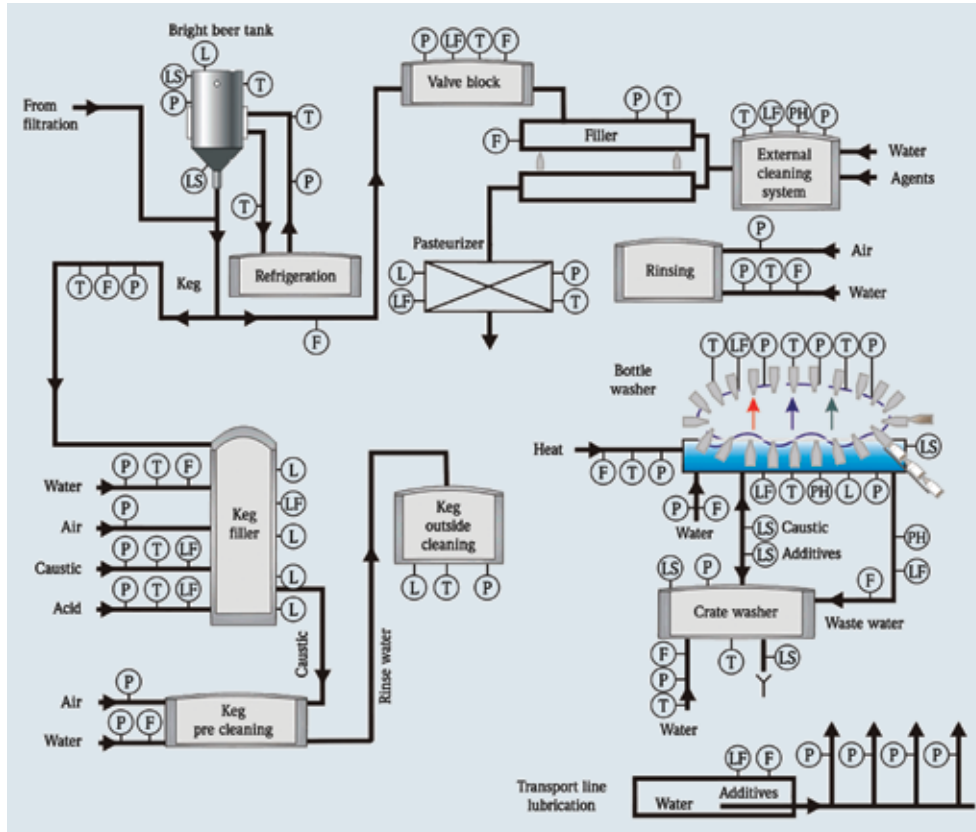


Liquid storage or transfer tank Point level detection in any liquid storage or transfer tank is done reliably without the need for calibration with the tuning fork point level switch Liquiphant.



Packaging

Keep consumers happy with clean, crisp product



Bright beer tank Highest accuracy is needed to plan for bottling line free space radar (Micropilot) or hydrostatic level sensor (Deltapilot) provide this key information.



Bottle and keg washing Sanitizer concentration must be monitored to ensure optimal cleaning efficiency. Endress+Hauser offers a full line of analytical sensors to monitor concentration.



Boundary or “taxation meter”

Requires documented traceable periodic verification of performance. FieldCheck verification tool is easily used to ensure performance and generate documentation that meets 27CFR part 25 for the Promag magnetic flowmeter between calibrations.



Fillerbowl level To ensure complete fills and avoid beer loss the fillerbowl level must be controlled accurately. The Liquicap capacitance level sensor provides best accuracy level under fast moving conditions.



Product identification prior to packaging

Conductivity is monitored throughout the process. A key measurement is on the packaging release tank. A conductivity sensor is used to verify that the expected product is in the line. This can be combined with optical color measurement for added safety.

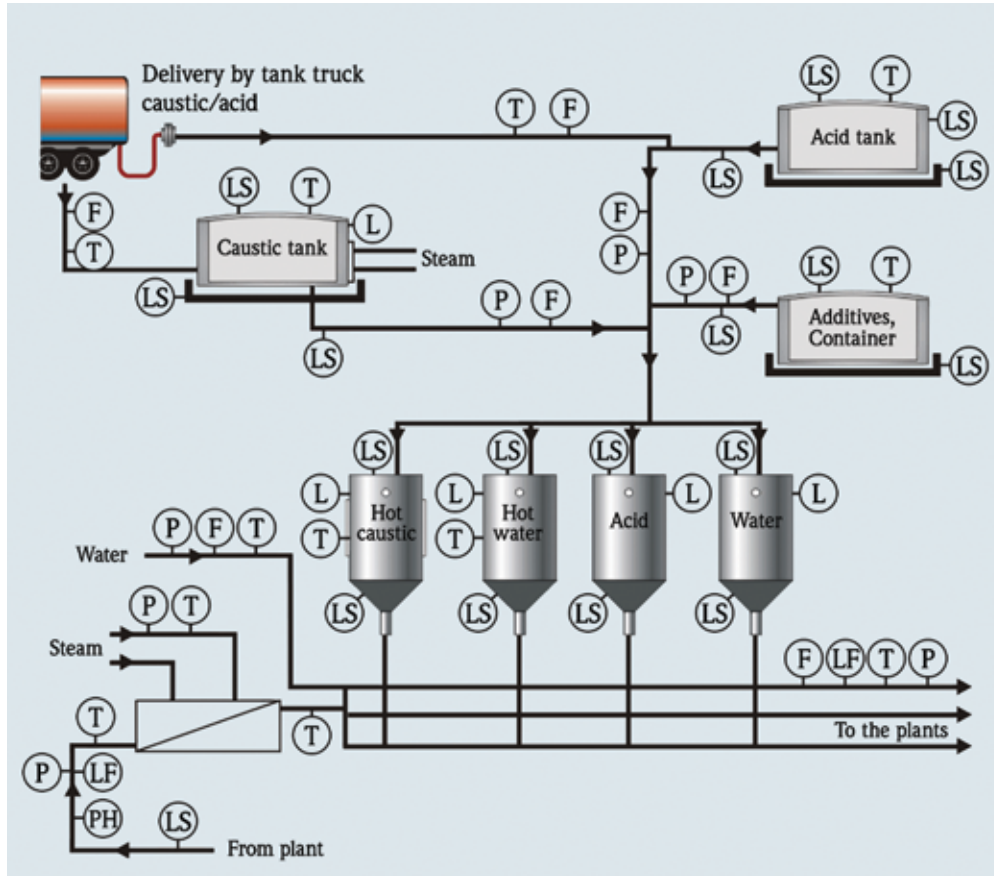


Washdown To ensure sterility and food safety during filling the whole area is often washed down with strong detergents/sanitizer. All instruments are IP67 or better to ensure safety in washdown environment.



CIP optimization

Key process for quality, safety and yield



Secure records CIP records are kept secure in video graphic recorders capable of meeting 21CFR part 11.



CIP flow measurement

Correct flow velocity is critical to achieve best cleaning results. Promag H provides best value for the money.



CIP make-up and chemical tank inventory Level measurement for inventory or process control of aggressive chemicals is solved by multiple options depending on tank size and user preference - capacitance, ultrasonic or free space radar are most common.



CIP concentration CIP concentration is critical to food safety but also has big impact on use of detergent and wastewater costs. Endress+Hauser conductivity transmitters have the fastest temperature compensation on the market and offer dual range capability. Fast temperature compensation ensures best-in-class performance.



Water, Air, Gas, Electricity & Steam

Make a difference in the environment and the bottom line



The starting point for any conservation program is to know where you stand today and then identify potential areas for improvement. For example; need a larger air compressor or can you reduce the air usage? By applying simple permanent or temporary measurements you can make qualified decisions based on facts.

Endress+Hauser can help you monitor resources to ensure success of your conservation initiatives. One of our customers in the brewing industry **reduced overall energy consumption by over 300%** since implementing a monitoring program in 2006.



They now, for example, **measure and recover over 90% of all CO₂** and have reduced overall water consumption and natural gas usage.

Typical energy monitoring in a brewery involves steam measurement to monitor overall efficiency and to detect problems with steam traps. Vortex flowmeters combined with a steam computer give you direct energy readout.

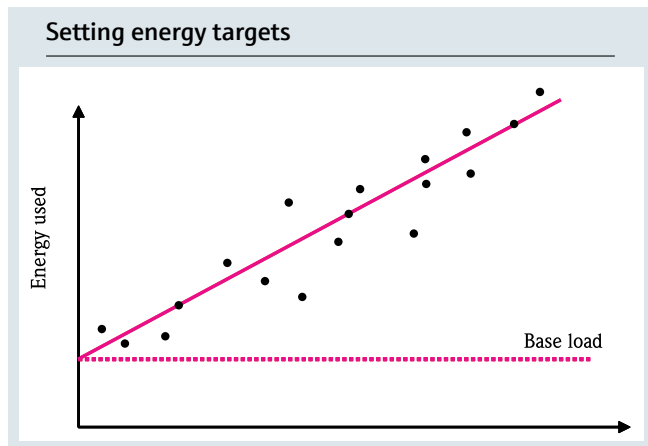
Water consumption is a big issue in the brewing industry. A simple magnetic flowmeter or a temporary clamp-on ultrasonic flowmeter will help measure cleaning and phase shift processes while making improvements.



With compressed air, a ¼" leak can cost thousands of dollars in energy losses. Monitoring of pressure or flow using thermal mass flow or Vortex flow meters can help identify leaks and usage during active and idle periods.

CO₂ and natural gas can be measured with Vortex but more and more opt for entry level Coriolis flowmeters that provide highest accuracy and direct reading in mass flow without the need for additional pressure or temperature compensation.

Measurement information is collected and presented in easy to use program for trending and planning purposes. Immediately see the result of your conservation programs and identify opportunities.

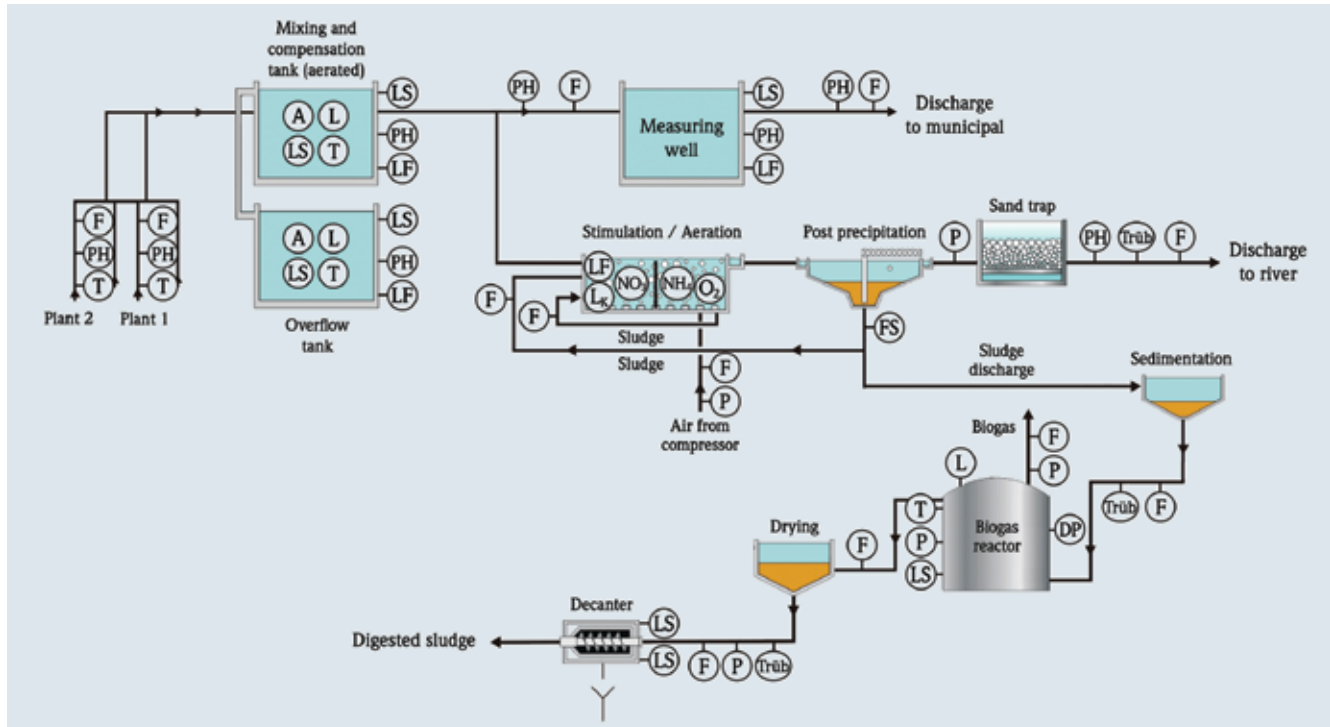


Activity – compressing air, generating steam, ton of product, degree days



Wastewater treatment

Reduced production losses = reduced cost of wastewater treatment



By implementing in-line quality control with checks and balances beer losses can be kept at a minimum. However, even in the best conditions, there will be wastewater generated. By applying simple measurement and controls the cost of water treatment can be minimized.

Step 1 Identify when and what is coming down the drain. A simple optical sensor mounted in the drainpipe can immediately identify a spill and the amount of solids (nutrients). Based on that data, implement a plan to reduce accidental spills and feed forward control for treatment plant.

Step 3 Measuring TOC and DO can optimize local treatment. An example is use of DO in aeration tanks to effectively reduce BOD levels while only running the blowers at most energy efficient levels. Blower air is easily monitored with thermal or vortex shedding flowmeters.



Step 2 Depending on the size of the plant and the local arrangement with your municipal treatment plant you may only need to monitor and balance the pH value. pH sensors in conventional glass or non-glass combined with Memosens technology ensure maximum reliability and low maintenance.



Step 4 You need to monitor and keep records of outgoing volume and residual nutrients. Electromagnetic or ultrasonic flowmeters are commonly used in combination with pH, DO, Chlorine and at times a TOC analyzer, all captured in an electronic record such as the videographic recorder Memograph M. Records can be managed in accordance with 21CFR part 11 and easily shared with authorities.

Calibration and instrumentation maintenance

Focus on your core competence – outsource the rest to the experts

Predictive maintenance and properly executed calibrations are becoming more important as tools to maintain beer quality, reduce downtime and to be in compliance with consumer driven as well as regulatory demands.

Verification of Taxation meters Depending on the country and size of annual production there are requirements to document how much beer is produced. To ensure accuracy of reported production volume, calibration or verification documentation of the flowmeter is required. For example, in the US, the Alcohol Taxation is governed by the US Department of Treasury Alcohol and Tobacco Tax and Trade Bureau (TTB). The TTB requirements are defined in 21CFR part 125.



In addition to 21CFR part 125 Endress+Hauser calibration is adapted and certified for most local regulations, globally. Endress+Hauser provides the option to do a wet calibration or a flowmeter verification that meets the TTB document requirements. Using the FieldCheck verification tool which is traceable to NIST standards a fast on-site verification is done without removing the meter from service, reducing downtime and labor costs.

Instrumentation today offers a wide range of onboard diagnostics that can tell you if a device is in need of a check-up. Unfortunately, many times these functions are not used to their full capability. Let Endress+Hauser help you reach the full potential.



Discussion around the metrology plan



SOPs, calibration certificates, labels and electronic recordings



On-site calibration of flowmeters, pressure, temperature, analysis instruments, using mobile flow rig

Calibration or Verification and Diagnostics, terms often misunderstood

- Calibration = Comparison of performance parameter against a traceable reference
- Verification = Test of electronics or sensor with signal simulator. Simulator should be traceable to recognized standard
- Diagnostics = Onboard or external self check of key performance parameters and signal values that show health of sensor and transmitter

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