Brewery & CIP Automation Systems

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Thank you for the invitation!
What we will cover today:

• Why Automate?
• Automation Justifications
• Anatomy of a System
• Architectures, examples
• Hints for Success
Why Automate?

- Better control and yield
- More consistent product quality
- Reduced energy usage
- Reduced batch time by increasing equipment utilization
  - Schedule batches based on sales and equipment availability
- Reduce labor costs
- Monitor and record variable costs
- Better data collection and reporting
  - Seamlessly report production data to Government agencies
  - Trending
  - Batch-to-batch comparisons
  - Accurate material tracking and batch tracing
  - Manually collected data can be expensive and inaccurate
- Remote control and information available
  - Interface brewery with the web to provide data when out of the office.
Key automation justifications

Brewhouse Automation
- Expands the flexibility of your process to help you create new recipes, modify existing recipes and try new products
- Optimizes the operation of your brewhouse to produce more brews in a day

Fermentation Control
- More Consistent batches with temperature Profiles set automatically.
- No need to adjust temperatures during the off hours
- Trend data analysis
Key automation justifications

- Automate the CIP sequence
  - Production downtime between brews is minimized
  - Water consumption is reduced – *Green Initiatives*
  - Data Logging and reports for QA / QC requirements
  - Reduce waste
  - Personnel safety
  - Regulatory requirements

- Scalability
  - Start with what you **need** and can justify
Anatomy of an automation system

- **Field devices** – *You can only control what you measure*
  - Pressure and Level sensors / transmitters
  - Flow sensors / transmitters
  - Temperature sensors / transmitters
  - On-Line pH and Conductivity sensors / transmitters
  - Automatic control valves
  - Drives and motors

- **Controller and I/O**
  - Distributed Control System (DCS) or Programmable Logic Controller (PLC)
  - Input and output cards (I/O)

- **HMI - Enclosure or Control Room**
  - Human Machine Interface (HMI)….Where? How many?

- **Application Software**
  - Controller configuration program
  - HMI configuration program
  - Reporting and Data Archiving
  - Interface to Business System,
Instrumentation
The most critical aspect of any control system!
Most Critical Measuring & Control Points

- Temperatures, Pressure, Level, Flow
- Raw materials supply
- Quantities
- Water quantities/qualities
- Mash profile
- Lauter tun cycle time
- Brew kettle boil profile
- Yeast temperatures
- Yeast pitching
- Fermentation temperature control
- Batch records for data analysis
Brewhouse – Lauter Tun

- Sparge water flow
- Level
- Vorlauf Flow
- Differential pressure measurement
- Temperature
- Wort mass, Plato and total extract
Fermenting - Primary Fermenter

- **Temperature**
- **Level**
- **Mag Flow**
- **Air mass (sterile)**
- **Pressure**
- **Level / Hydrostatic pressure**
Fermentation tanks
Basic CIP Systems
Craft Brewing Automation Systems

Questions?
Brewhouse CIP Facilities

functions:
- vessel cleaning
- pipe cleaning
CIP Systems overview

- Cleaning-In-Place (CIP) are systems designed for automatic cleaning and disinfecting without having to disassemble major portions of the process.

- **Automatic** CIP systems must include the proper hardware that can be cleaned in place without disassembly and must also provide process separation guarantees to ensure that the brewing process and the CIP solutions do not mix.

- A properly engineered automated CIP system will allow **cleaning** to be carried out in one piece of equipment when the other processes are still in **production** using high end measuring and control components.

- The fully automatic CIP system **optimizes the equipment** utilization while you are able to adhere to the proper sanitation requirements and documentation of the results.
A well designed CIP control system can be expanded to add programs as equipment is added – without additional investment.

Different CIP-programs for different equipment
- Brewhouse vessel CIP
- Wort line CIP
- Filter CIP
- Filler CIP
- CIP of CIP-Vessels

Different cleaning media
- Water (fresh water, recycled water for pre cleaning)
- Acid
- Caustic
- Disinfection agents
Basic CIP Automation System

- Dedicated to CIP System

- Controlled by a stand alone PLC/HMI Panel that requires the brewer to operate the production equipment manually to ensure proper sanitation.

- Oftentimes these systems will require that the brewery be shut down during sanitation as it is too difficult to ensure that the CIP and the Process will not mix.

- Usually without feedback to the rest of the brewery.

- You can connect them to the plant system in the future
Fully Integrated CIP Systems

- Plant Integrated systems:
  - One Automation System for your **production** and **CIP** needs. The Brewer can schedule CIP “Batches” as well as production batches on the same system.
  - Custom developed to meet your specific breweries needs.
  - Can trace what has and what has not been cleaned and you can schedule CIP recipes for pieces of equipment (such as a Mash Cooker) or whole production lines (such as the entire brewery).
  - Your brewery automation system can actually hold up batches until the sanitation is guaranteed and documented.
Fully Integrated CIP Systems

CIP System P & I D

- Rinse Tank
- Recovery Tank
- Detergent Tank
- Water
- Drain
- Chemical Supply
- Supply Pump
- Steam
- Condensate Return
- CIP Return
- CIP Supply
- Strainer
Brewhouse CIP

CIP System in the Automation System

[Diagram of CIP System]
CIP Plant (example)
Craft Brewing Automation Systems

Questions?
Be sure your system is Scalable to meet your current and future needs without re-investing in a system.
Typical Entry Level Systems – Microbrewery

Everything in one Enclosure; Controller, I/O and HMI
Typical Mid-Size Systems – Small Craft Brewery

HMI / EWS

Controller / IO
Typical Larger Systems – Regional Brewery

- Dedicated Control Room
- Multiple HMI
- Multiple Control & IO Cabinets
Lauter Tun HMI Representation
Fermenting – Temperature Control

- Glycol and Fermentation Temperature
  - A typical Craft brewer uses less expensive ON/OFF final control elements therefore you must use a control algorithm optimized for this type of control.
  - A Profile is very useful as it does not require the brewer to constantly maintain and control the setpoints.
Recipes/Parameters and Monitoring
Trending and Data Analysis

Automation Control Systems

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SIEMENS PCS 7

Software System for Process Engineering

Automation and Control Systems

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Brew Report Example

**BREW - Report**

<table>
<thead>
<tr>
<th>General Data</th>
<th>Date: 11/09 4:26 PM</th>
<th>Batch: 1000</th>
<th>Brand: Let's Beer</th>
<th>Year: 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplier Code:</td>
<td>Quantity in lb: 7200</td>
<td>7200</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Milling**

- Malting: 15763
- Water: 570
- Gain: 15.5
- Extract: 40
- pH: 4.8

**Mashing**

- Mash: 30
- Saccharification: 100
- pH: 4.8

**Laution**

- Start: 11/09 9:37 AM
- End: 11/09 12:01 PM
- Total: 2:24

**Boiling**

- Start: 11/09 11:44 AM
- End: 11/09 12:41 PM
- Total: 57
- Wort in lb: 74.6
- Average h/l: 375
- Total: 64

**Cooling**

- Start: 11/09 1:32 PM
- End: 11/09 2:41 PM
- Total: 1:09
- Volume in l: 7.8
- A/g in l: 12

**Fermentation**

- Start: 11/09 2:42 PM
- End: 11/09 4:43 PM
- Total: 2:01
- Volume in l: 7.8

**Dosage**

- Wort: 30
- Hop: 5.5
- Wort: 2.8
- Wort: 2.6
- Wort: 2.8
- Wort: 0

**Brew**

- Start: 10/31/09 11:26 AM
- End: 11/09 5:43 PM
- Total: 6:17

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Production scheduling for the Brewhouse

**BRAUMAT weekly program**

**Current order**
- Recipe: Workshop
- Order: 25

**Current brew**
- Brew no.: 0003
- Start time: 25/Mo 06/27/2005 04:20 PM

**Next order**
- Recipe: Test
- Order: 25

**Next brew**
- Brew no.: 0004
- Start time: 25/Mo 06/27/2005 05:20 PM

**Rest:** 1

**Last brew:** 25/Mo 06/27/2005 04:20 PM

**Definition brewing orders**

**Definition of CIP orders**

**Release**
- Brew No.
- Parameter
BATCH Reports

- Very Common to use MS Excel or MS Access
- Analyze Batches and recipe element parameters
- Trend analysis within batch context
Hints to make your automation a success

- Automate what you can afford today but do not lose sight of your vision in the future.
- Buy a system that is scalable and meets your needs today and can grown with you in the future.
- Start simple, understand that, move on to more complex problems.
Craft Brewing Control Systems

THE END