District heating runs a low-temperature brewery

Solutions for a highly energy-efficient brewhouse
Our challenges

- The demand for fossil fuels is still growing due to an increasing global population and associated growth in consumption.

- The discovery of new oil resources is decreasing.

- Since 1985 the volume of oil production has outstripped new discoveries.

- Production is becoming increasingly difficult, meaning the price of oil will increase in the long term.

Source: ASPO – Association for the study of the Peak Oil & Gas

New discoveries of oil and oil production (1920 – 2004)
The Murauer energy supplier saw the same challenges

- During the last ice age, average temperatures have **only been 5 °C colder** than today
- **Man did not come in to the game until the end of the last ice age**
- For years, the United Nations (IPCC) World Climate Council has been warning of **dramatic changes**
- **750 billion tonnes of CO₂ left until 2050** ... (IPCC)
- The „point of no return“ is reached with a concentration of **550 ppm CO₂**
Breweries produce in batches

- Therefore, they have to cope with a high energy load at times

- And the energy peaks become even higher because of production overlaps.

Example: boiling load of three 600-hl production lines
The functionality of a brewhouse

- Beer production only works with defined process temperatures
- The average heating temperature is currently mostly between 140 ... 160 °C

<table>
<thead>
<tr>
<th>Process</th>
<th>Temperature Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mashing-in</td>
<td>(≈ 50 °C)</td>
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<tr>
<td>Mashing</td>
<td>(≈ 76 °C)</td>
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<tr>
<td>Lautering</td>
<td>(≈ 76 °C)</td>
</tr>
<tr>
<td>Heating-up</td>
<td>(≈ 92 °C)</td>
</tr>
<tr>
<td>Heating-up (end)</td>
<td>(≈ 99 °C)</td>
</tr>
<tr>
<td>Boiling</td>
<td>(≈ 99...103 °C)</td>
</tr>
<tr>
<td>Cooling</td>
<td>(≈ 8...18 °C)</td>
</tr>
<tr>
<td>CIP</td>
<td>(≈ 80 °C)</td>
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</tbody>
</table>

*High-pressure heating water

- Warm brewing water
- Energy storage
- Warm water

*Steam or HPHW*
Options for eliminating these peak loads

- Installation of an EquiTherm system that uses recuperative energy for the mash tun and

- Installation of a bigger energy storage tank to smooth out the energy peaks
EquiTherm equipment and technology

ShakesBeer EcoPlus

- Minimum fouling
- Maximum heat transfer coefficient
- Maximum energy utilization
- Pillow plate technology with **counterflow heat exchange principle**

⇒ Maximum heat flow

"As simple as possible. But no simpler!"

Albert Einstein

Physical basis:

\[ \dot{Q} = k \cdot A \cdot \Delta \theta = [W] \]

Heat flow

Heat transfer coefficient

(Heating) surface

Temperature difference
Breweries can now produce beer more smoothly

- The energy peaks decrease because of **no production overlaps**.
- With an energy storage tank can also **eliminate these peaks**.

Example: boiling load of a 600-hl production line
EquiTherm produces maximum efficiency not only in the brewhouse

- Mash and wort is **heated up with recovered energy** from vapours and from the 1st wort cooler stage.

- EquiTherm **can be integrated in all breweries**.

- With EquiTherm, boiling in the brewhouse is the only primary energy consumer.

**Advantages**
- Little or **no fouling**
- Reduced primary energy requirement
- Reduction of peak loads at the boiler
- Reduction of electrical load
- Smaller boilers can be used
- Elimination of warm water surpluses
Next step was to build a wood chips heating plant which supplies the whole area

- Maximum process temperature **up to 115 °C**
- **Hot water as heat transfer** medium in a closed system
- Energy provision via a **central storage tank**
- **Multiple use** of thermal energy
- Simple integration of **recuperative energies**
What is important for the design

- A process **temperature as low as possible**
- Hot water as heat **transfer medium** in a closed system
- Energy provision via a **central storage tank**
- **Multiple use of thermal energy**
- With a **high spread**, you can supply a lot of energy
Advantage to connect a brewery on district heating

- A brewery produces more in summer
- Steady utilization of the heating plant over the year
- Increased the efficiency of heating plant
- Just the brewery now saves 700,000 liters of oil
- Approximately 2,000 tons of CO2 savings per year
Conversion and positioning in Murau
District heating runs a low-temperature brewery with STEINECKER EquiTherm

Results achieved by the first real Low-Temperature Brewery worldwide

Energy savings by lowering temperature level and with EquiTherm system

Savings: 700,000 l of fuel (oil) per year

25.5 kWh/hl 160°C

< 19 kWh/hl 115°C

approx. 30%
District heating runs a low-temperature brewery with STEINECKER EquiTherm

Example of potential savings youst with EquiTherm

The ROI calculation for a possible EquiTherm conversion is based with € mil of investment on the following reference data:

- Quantity of cold wort produced yearly: 356,000 hl (without blending)
- It is based on an energy price of 3.4 c/kWh (gas)
- That is why the kWh of steam costs 7.8 c/kWh
- The steam vessel has a 30% utilization degree of 65%
- The system includes losses of subsequent steam, decondensate etc. and is 95%
- Temperature at cold wort 19.8°C
- Hot water 78°C - 80°C (it is only further heated when the temp. falls below 78°C)
- Evaporation 4.5 t of rice + 127 t of MV (71°C - 90°C) & principal mash = 0.91 t of mash + 127 t of MV + 0.94 t of MV (91°C - 76°C) 15.6 t of mash in the lauter tun and the main filter
- A heat consumption of 3.52 kWh/hl (kWh/MV) before the conversion
- Exchange: heat consumption 5.5 kWh/1.41 MV
- Production of 1.41 MV of cold wort per hour (with 18.9°C, 4% total evaporation)
- Wort cooller: 4°C, temperature of wort passage = 4°C, pitching temperature = 11°C
- Heating cold wort energy 8,141 kWh/1.41 MV (CCP of the cold plant = 5.8)

ROI = 3.6 years

MV = mash wort; WV = wort; MV = cold wort; WVk = wort cooler; ct = Euro Cent; ct = electrical, CCP = Coefficient Of Performance
Thank you for your attention!

If you have any questions – don’t hesitate to contact me:

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