The MEURABREW: the brewhouse of the future!

ABSTRACT

In the last two decades, important brewhouse performances have been achieved. For example, the productivity of brewhouses increased from 8-10 brews/day to 14 brews/day and even more if equipped with a Meura 2001 mash filter. Despite these important improvements to the batch brewhouses, breweries keep asking for further productivity increases together with a reduction of the utilities consumption and waste disposal. The current method of batch brewing has limited room for further improvements and only a conceptual change can reply to the current and future inquiries of the brewing industry. Traditionally Pioneer, Meura started in 1998 a research program to develop a continuous brewhouse (called the “MEURABREW”). The first industrial plant has been successfully started-up in May 2007.

INTRODUCTION

Reasons to develop a continuous brewhouse

The idea of a continuous brewhouse is not a recent topic; in the sixties, some continuous brewing systems were installed at pilot and even industrial scale, but these were progressively aborted for different reasons.

The current changes in the brewing industry are leading to several reasons to develop continuous brewhouses:

Downstream product differentiation. The last decade, high gravity brewing became an industry standard within the large lager breweries. One of the consequences is that product differentiation is done downstream the production process tat the beer filtration step and finally, the variation of wort types in the brewhouse are decreasing. The major criticism to the continuous process, a lack in flexibility, is therefore no longer an issue.

Increased plant capacities. With the consolidation and concentration of the brewing industry, the breweries’ average production capacities are increasing. Brewhouses with above 1200 hl batch size are becoming more and more regular and close to the maximum workable size. For higher capacities the brewhouse has to be doubled, which is from investment and operational points of view costly.

Pressure on the commodity costs. The increase in oil and other commodity prices is putting pressure on the industry to reduce the utility consumption. In the brewhouse, it mainly concerns the thermal (steam) and electrical energy consumption. Further, the costs of raw materials, like malt and hops, increased tremendously last year.

Sustainability
The extended utility consumption during the wort production leads to an important CO₂ footprint. A sustainable industry needs the ambition to implement the most efficient technologies. The beer processing consumes an important amount of drinking water, which is getting in more and more area’s scarce. The pressure from the society to reduce waste water is increasing.

These tendencies in the industry and society made Meura to rethink the brewhouse technology and ended in a continuous brewhouse concept, called the “Meurabrew”.

History of the Meurabrew development

In 1998, Meura started the development of the continuous brewing concept. A complete pilot plant was installed in 1999 (investment: 1,5 millions €). The first results focussing on a continuous boiling step were published at the EBC congress in 2001. Pilot trials of the full continuous brewhouse process were presented at the following EBC congress in 2003. Based on these successful pilot trials, Meura’s engineering department started in 2004 with the development of an industrial plant. With this information, it was possible to start looking for a “first mover”. In 2005, the discussions started with the Martens brewery in Belgium, leading to an order in June 2006. The first operation of the Meurabrew on an industrial scale of 200 hl/h wort (up to 20°P) took place on the 12/05/2007. In January 2007 a similar order for a plant in Fuzhou (China) was obtained.

The industrial results described in this article are based on the figures from the plant installed in Belgium.
Continuous versus batch

Continuous processes are used in several food industries. For example in the continuous extraction and processing of vegetable oils or the continuous processing of Ricotta cheese. In general, continuous processes are more energetically efficient, easier to control and consequently lead to a lower production cost. Specific for the brewhouse process, the main reasons to develop a continuous brewhouse are as followed:

Reduced peak consumption of utilities
The most important utilities consumed in the brewhouse are steam and cooling liquid. In a batch brewhouse, different batches are processed at the same time and consequently lead to an important steam peak. The wort cooling takes place normally within 50-60 minutes which is giving peak consumption in that period.

Reduced energy and extract losses
Besides the important peaks of utilities with batch brewhouses, the heat losses are also more important compared to the continuous process. The batches are pumped from vessel to vessel and by each transfer air is entering the vessel and at the same time cooling the vessel down. The transfer of batches is also responsible for extract losses since vessels are never completely empty.

Reduced waste disposal

Rinsing water between batches is drained, leading to increase water consumption, extract losses and charging the waste water plant. Especially in case of high gravity brewing an important BOD and COD is sent to the waste water plant.

Limited space requirements
The most state-of-the-art batch brewhouses are only making about 14 batches a day. About every 100 minutes 1 batch is produced, which consequently requires vessels taking the required volumes. Brewhouse vessels of a big size also mean important piping diameters, big sized valves and pumps at the high flows. A continuous flow will reduce significantly the plant dimensions.

Easy process control
In practice, it is difficult to have the same process conditions between similar batches. The fouling of the mash tun(s) and wort kettle during the production are changing the heating performance of these vessels and thus changing the process conditions. Consequently an important variation in for example colour, bitterness ... is noticed between batches of the same brands. These fluctuations could be limited with a continuous process.

A comparison between a batch brewhouse at 12 brews/day and a continuous brewhouse for a brewery with 3 million hl final capacity is showed in Table I.

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>Comparison of a 3 million hl final capacity at 12°P</th>
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<tbody>
<tr>
<td></td>
<td>Batch brewhouse</td>
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<tr>
<td>Capacity</td>
<td>12 brews/day of 400 hl cold wort at 20°P</td>
</tr>
<tr>
<td>Pumps</td>
<td>Mash: 1500 hl/h – 15 KW</td>
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<tr>
<td></td>
<td>Wort: 3600 hl/h – 30 KW</td>
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<tr>
<td>Utilities</td>
<td>Steam peak flow: 14 T/h</td>
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<td></td>
<td>Water peak flow: 650 hl/h</td>
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<tr>
<td></td>
<td>Electricity installed: 375 kW</td>
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<tr>
<td></td>
<td>Electricity peak: 300 KW</td>
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<tr>
<td></td>
<td>Peak cooling power: 4.650 kW</td>
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</tbody>
</table>
## THE MEURABREW

### The Meurabrew: part of the “brewery of the future” concept

The first industrial Meurabrew installed at Martens brewery in Belgium is part of the “brewery of the future” concept, which is a combination of the process technologies of Meura (brewhouse) and Norit (cold block including membrane filtration and utilities) and continued with a Sidel PET bottling plant. The brewery of the future at Martens is a 3-million hectolitres brewery, combining the most innovative technologies on the market. Measuring only 200 metres by 350 metres, the plant houses, raw material storage and treatment, milling room, brewhouse, fermentation, beer filtration, yeast management, wastewater treatment and all utilities. The entire operation is managed by 45 people, with just two men per shift to run the brewing operation from raw material intake to filtered beer during the daytime.

The Meurabrew is designed to produce 200 hl/h cold wort at a density up to 20° P. The plant is able to handle different recipes from 100% malt brews up to brews with 40% of adjuncts. On a weekly basis a maximum of 31,200 hl at 20° P cold wort can be produced. After 6.5 days of production the brewhouse is cleaned during less than 12 hours and restarted again.

The continuous brewhouse is connected to a batch fermentation process. During 24 hours one fermenting vessel of 2400 hl net is filled.

### Principle of the Meurabrew

As mentioned in the introduction it took almost 10 years between the first research and the industrialisation of the Meurabrew. Nevertheless, during that period most of the proposed technologies were first industrialised in batch brewhouses. In fact, the Meurabrew is a combination of Meura’s proven technologies that have been adapted to a continuous set-up.

Figure 1 is showing the first part of the Meurabrew from milling till mash filtration using the following technologies:
- **Milling:** Meura’s Classicmill or Carbomill is perfectly able to work in a continuous regime.
- **Mashing-in and mashing:** The Mechamasher assures a continuous lump free mash that will be pumped to the mash group. Different mash vessels are keeping mash at a constant temperature with a specific holding time. A continuous flow is passing these vessels and assures the brew diagram. Thanks to the Aflosjet system, Meura’s patented direct steam heating system, these vessels do not need to be cleaned during the production process. A fouling free mash heating is required for the continuous process. Classical double jackets are thus not an option.
- **Mash Filtration:** Wort filtration is performed with Meura 2001 mash filters with Meuraclean. Three parallel filters are assuring a regular continuous filtration process. Consequently all the renown advantages of the Meura 2001 like for example the yield, wort quality and density are kept with the Meurabrew.

### Figure 2 is showing the continuous wort boiling, hot trub recovery and wort cooling of the Meurabrew using the following technologies:
- **Wort boiling and trub recovery:** In a first step, the wort is in-line heated up to its boiling temperature. Added hop is also homogenized. An adapted agitator is assuring a sufficient mixing for the trub formation. Among other chemical/biochemical reactions, the SMM is turned into DMS. An external agitation must be provided. In a next step the wort is clarified by a continuous Clarisaver. Clarification is necessarily done prior to stripping in order to avoid fouling the column with hot trub. The Clarisaver is a wort settling tank able to recover a non-oxidised trub from the hot wort in a continuous way. Thanks to the avoidance of the oxidation of trub, the trub can be re-used by transferring it to the mash tun. This continuous wort clarification would not be possible using a whirlpool.

From the clarification unit, the wort is then stripped by the Ecostripper, which is a single pass stripping column. The unwanted volatiles will be stripped by counter flow live clean steam. From the bottom of the stripping column, the stripped wort is continuously pumped through the wort coolers.
- **Wort cooling:** Two wort coolers in parallel are assuring a continuous cooling of the wort. Since fouling is unavoidable one wort cooler is cleaned when the other is cooling the wort.
Fig. 1 The Meurabrew: from milling up to mash filtration

Fig. 2 The Meurabrew: continuous wort boiling and hot trub separation
SUMMARY

The brewing industry requires from the brewhouse manufacturers a further productivity increases together with a reduction of the consumption of utilities and waste disposal. The current method of batch brewing has limited room for further improvements and only a conceptual change can reply to the current and future inquiries of the brewing industry. The Meurabrew and the Brewery of the future concept are answering this industry inquiry.

The industrial results show that the Meurabrew combines a lot of exceptional performances:
- Consumption of water at least divided by two!
- Consumption of electricity at least divided by two!
- Consumption of steam at least divided by two!
- Considerable reduction of waste water!
- No peak load in utilities!
- Better productivity (one CIP per week)!
- Drastic reduction in oxydation of mash and wort!
- Improved regularity in the products parameters!
- Very limited extract losses!
- Etc...

The MEURABREW, the Brewhouse of the 21st Century!

REFERENCES