Continuous Beer Stabilization –
For Improved Process Economics and Environmental Protection

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Summary
Continuous beer stabilization streamlines production and improves operating efficiencies for breweries. The Pall Continuous Beer Stabilization System (CBS) is designed for this application and provides a seamless link in the brewing process between (continuous) clarification and final filtration. A new fixed bed technologies combined with approved materials for beer stabilization (PVPP) enables the CBS to provide continuous stabilization of all styles of beer. This process also enhances product consistency, maximizes throughput at customizable volumes ranging from 100 to 1000 hl/h and reduces production time, cost, labor and waste. The CBS system was validated at the Carlsberg brewery Frederica, Denmark and was recently shown during the last Brau Beviale in Nuremberg.

Objectives of the development
New product and process developments are often driven by process economics and environmental protection. At this time most of the conventional beer stabilization systems are designed for batch mode operation only in opposition to more modern continuously operating membrane filtration systems. Thus, a major target of this development was the ability of the CBS system to operate continuously with a very high automation level and the lowest possible maintenance. Additional development targets included a compact design, low investment cost and improved operational cost over standard batch mode operation systems currently in use.

Technical approach
By combining three stabilization columns, it is possible to generate continuous operation. Due to increased system utilization and 24/7 operation smaller sized of complete production lines is also possible. In addition, this continuous production line offers an enormous flexibility in terms of brand changes, which is also becoming more important with regard to concentration of brewery plants and increasing numbers of brands.

Process Description
Filtered but non-stabilized beer is routed to the stabilization columns across a valve knot and through a pressure regulated pump. During operation 2/4 out of 3/6 columns are in stabilization mode while at the same time columns 3/5,6 are in cleaning or standby mode. After reaching the cycle time, the used columns will be replaced by the columns which were in standby. This method allows a continuous flow. We recommend a bypass flow at the beginning of operation or when switching to fresh regenerated columns to avoid over-stabilization. In general, performance is controlled by: cycle time; flow rate distribution over the columns; and, if necessary with bypass operation mode.

When the maximum cycle time is reached, the PVPP inside the cassettes must be regenerated with a combination of caustic, acid and water flushing steps. The duration of the whole cleaning procedure takes just 90 minutes. Polyphe- nols and Anthocyanogens content of the beer is currently utilized to calculate the correct dosage of single use PVPP required to maintain the expected shelf life. Using this system these same measures are used to determine cycle time duration.

Test Results
In the period of July 2009 and February 2010 the CBS 3-26 System has been tested in the Frederica Brewery, Denmark. The installed system had a capacity of 250 hl/h and within the test period around 151,000 hl were stabilized.

Table 4: Media consumption volumes per column

<table>
<thead>
<tr>
<th>Process Description</th>
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<tr>
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Consumption data:
Because of the very low hold-up volume of just 215 liters per column the amount of cleaning chemicals, water and energy are reduced compared to other PVPP regenerating technologies. The volumes are so low that there is no need for a CIP.

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<table>
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<tbody>
<tr>
<td>Cold Water</td>
</tr>
<tr>
<td>Deo water</td>
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<tr>
<td>Hot Water</td>
</tr>
<tr>
<td>Caustic</td>
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<tr>
<td>Acid</td>
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<td>Sum</td>
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Features and Customer Benefits

- Reduced stabilization costs
- Enables continuous operation
- Small footprint of the system
- Excellent fit to continuous filtration
- PVPP as stabilizing agent
- Well known material no user restriction
- Highly specific to polyphenols
- Food contact compliance
- Excellent availability of raw material

Low system hold-up volume
- Small footprint
- Very low beer and beer extract losses
- Less media consumption
- Less water consumption
- No need for CIP tanks

Fixed bed technology
- No powder handling
- Lower consumption of media
- Stop and Go – operation independent processing
- No mechanical stress to adsorber material
- Less moving parts thus lower maintenance costs

Fully automated
- Easy to operate
- Reliable stabilization and regeneration process
- Low need for operator engagement
- Dynamic adjustment to stabilization beer needs
- Up to 20 standard programs for the stabilization
- Very quick switch (brand change)

Modem on board
- Enabling remote consultancy
- Enabling online service
- Quick trouble shooting