Automated Liquid Bromine Feed Systems: The Next Generation

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ABSTRACT

The initial concept and application for pasteurizer halogen feed was presented at the 1997 MBAA convention in Baltimore. Since that time the novel prototype has evolved into a system suitable for the transition into the new millennium.

Programmable logic controllers, modems, faxes, alarm capabilities, and telecommunications have resulted in a package, which has substantially more capabilities than the initial design. These features have provided valuable information to the brewery not even expected with the original concept. The data available has become a useful tool for water conservation, optimizing on-site waste treatment systems, and detecting variations of contamination in the pasteurizers. This new liquid feed system has been adopted in breweries throughout the U.S., and installations in Canada are ongoing.

This poster will focus on the design, installation, and experiences with start-up at the Anheuser-Bush plant in St. Louis. An on-line demonstration of the data acquisition capabilities will be displayed. This product was an example of an intensive, coordinated effort by ChemTreat, Inc., and Anheuser-Busch personnel.

Keywords: Pasteurizer Treatment, Pasteurizer Halogen Feed

SINTÉSIS

El concepto inicial y la aplicación para la comida halogenada pas­teurizada se presentó en la convención del MBAA de 1997 en Baltimore. Desde ese tiempo el prototipo original ha evolucionado en un sistema apropiado para la transición al nuevo milenio.

Los controladores lógicos programables, modems, faxes, capaci­dades de alarmas y la telecomunicación han resultado en un paquete, el cual tiene mucho mas capacidades que el diseño original. Estas características han previsto información invaluable a la cervecería no esperada por el concepto original. La información disponible se ha convertido en una herramienta útil para la conservación del agua, para el uso óptimo de los sistemas de desecho y para la detección de contaminación en los pasteurizadores. El nuevo sistema de comida líquida ha sido adoptado en cervecería por todo Estados Unidos y las instalaciones en Canadá están empezando.

Este cartel se enfoca en el diseño, instalación y las experiencia con el comienzo en la plantas de Anheuser-Bush en St. Louis. Se exhibirá una demostración de las capacidades de adquisición en línea. Este producto es un ejemplo de un esfuerzo intenso y coordi­nado por el personal de ChemTreat, Inc., y Anheuser-Busch

INTRODUCTION

The importance of chemical control of pasteurizer chemical water treatment systems has been well documented. Improper functioning chemical control systems can result in the following problems:

1) Off-spec musty beer taste
2) Blocked sprays, resulting in pasteurizer problems
3) Can staining
4) Increased corrosion
5) Worker safety issues
In 1997, Tom Soukup presented a paper at the Baltimore convention describing experiences with a novel automated liquid halogen feed system. Since that initial installation, the technology has developed rapidly, allowing for communication of essential data by computer phone lines, faxes, and pagers. This has resulted in 24-hour a day coverage of key parameters of the chemical treatment system.

**TREATMENT GOALS**

The goals of a properly applied chemical treatment program have been well documented in various technical publications and papers presented at Master Brewers conventions. Achieving these goals insures maximum equipment performance, resulting in higher production and reduced maintenance costs. These are essential factors in the operation of a modern brewery.

**BIOLOGICAL**

**CAN PATH - 4 MINUTES**
(Taken June, 1998)

- No visible slime
- Water heterotrophic biocounts < $10^4$ col/ml
- Target airborne microflora:
  - Total bacteria < 200 cfu’s/m$^3$
  - Fungus and mold < 100 cfu’s/m$^3$

\[
\begin{array}{c}
\text{Fungus and Mold} \\
1488 \text{ cfu’s/m}^3
\end{array}
\]

\[
\begin{array}{c}
\text{Actual} \\
\text{Total Bacteria} \\
3188 \text{ cfu’s/m}^3
\end{array}
\]

**CORROSION GOALS**

**INDIVIDUAL PASTEURIZER COMPARTMENTS**

<table>
<thead>
<tr>
<th>Location</th>
<th>Pasteurizer Metallurgy</th>
<th>Target Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Phase</td>
<td>Mild Steel</td>
<td>&lt; 15 mpy</td>
</tr>
<tr>
<td></td>
<td>Copper</td>
<td>&lt; 0.2 mpy</td>
</tr>
<tr>
<td></td>
<td>Galvanized Steel</td>
<td>&lt; 15 mpy</td>
</tr>
<tr>
<td></td>
<td>Stainless Steel</td>
<td>&lt; 0.2 mpy</td>
</tr>
<tr>
<td>Vapor Phase</td>
<td>Mild Steel</td>
<td>&lt; 15 mpy</td>
</tr>
<tr>
<td></td>
<td>Copper</td>
<td>&lt; 0.2 mpy</td>
</tr>
<tr>
<td></td>
<td>Galvanized Steel</td>
<td>&lt; 15 mpy</td>
</tr>
<tr>
<td></td>
<td>Stainless Steel</td>
<td>&lt; 0.2 mpy</td>
</tr>
<tr>
<td></td>
<td>Admiralty Brass</td>
<td>&lt; 0.2 mpy</td>
</tr>
</tbody>
</table>
CARBON STEEL COMPARTMENTS

<table>
<thead>
<tr>
<th>Pasteurizer Component</th>
<th>Initial Metal Thickness</th>
<th>Performance Specifications</th>
<th>Estimated Time to 60% Metal Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side Walls</td>
<td>375-400 mils</td>
<td>&lt; 15 mpy (water phase)</td>
<td>@ 5 mpy - 45 years @ 15 mpy - 15 years</td>
</tr>
<tr>
<td>Walking Beam Webs</td>
<td>311-375 mils</td>
<td>&lt; 20 mpy (vapor phase)</td>
<td>@ 5 mpy - 45 years @ 20 mpy - 11 years</td>
</tr>
<tr>
<td>Grate Angles</td>
<td>150-250 mils</td>
<td>&lt; 15 mpy</td>
<td>@ 5 mpy - 24 years @ 15 mpy - 8 years</td>
</tr>
<tr>
<td>Suction Box</td>
<td>250 mils</td>
<td>&lt; 15 mpy</td>
<td>@ 5 mpy - 30 years @ 15 mpy - 10 years</td>
</tr>
<tr>
<td>Deck Cover Grids</td>
<td>125 mils</td>
<td>&lt; 20 mpy</td>
<td>@ 10 mpy - 8 years @ 20 mpy - 4 years</td>
</tr>
<tr>
<td>Piping</td>
<td>240 mils</td>
<td>&lt; 15 mpy</td>
<td>@ 5 mpy - 29 years @ 15 mpy - 10 years</td>
</tr>
</tbody>
</table>

CHEMICAL CONTROL

The only way to achieve these pasteurizer biological and corrosion objectives is through automated control of the pasteurizer water chemistry. Utilization of sodium bromide and bleach for biocontrol is not only the most effective sanitizing method, but also the most economical.

Bleach and sodium bromide, fed at an 8:1 ratio, will yield multiple benefits:

1) Bromine chemistry (hypobromous acid) is very effective for the water phase at pH levels above 7.
2) Chlorine chemistry (hypochlorous acid) is 2.5 times as volatile as bromine and will provide vapor phase cleanliness, but is not very effective in alkaline pH ranges.

**Bleach/Bromide Control**

- 8:1 Ratio
- Pasteurizer water below 90°F, 650–750 ORP free halogen
- Pasteurizer water 90°F, 550–650 ORP free halogen
- Heat and hold zones intermittent halogenation

**FIGURE 3**

HOCI - HOBr
Biocontrol effectiveness relative to pH.
METHOD

ORP (oxidation reduction potential) is used to control halogen feed to the pasteurizers. ORP actually measures the killing power of the oxidant. For example, a 1.0 residual at a pH of 8.0 would have an ORP of 400, which is not sufficient to control biogrowth. The same 1.0 residual at a pH of 7.0 would yield an ORP of 700, which would result in nearly sterile conditions. ORP is the only method which can provide control in the dynamic environment of a pasteurizer.

ORP vs. PPM

- ORP – Measured in millivolts (mV), is a superior index of microbiological water quality because it monitors the activity of the sanitizer.
- Conventional ppm (parts per million) test kits measure relative concentration.

![Graph showing ORP vs. PPM](image)

**FIGURE 4**
Effect of pH on ORP and PPM

![Diagram of ORP Probe Design](image)

**FIGURE 5**
ORP Probe Design

THE SYSTEM

Automated data acquisition allows for around-the-clock coverage of the chemical feed, corrosion, and chemical levels in the pasteurizer water.

Generally, the signals are separately input to a programmable logic controller, which is the brains of the system. From there the data can be logged for historical reports. With the addition of a phone line to the system, data can be accessed remotely via computer, phone, or fax. For 24-hour coverage, alarms will automatically page service personnel to correct any non-compliance conditions.

Much valuable information is recorded at the PLC. For example, the percent time halogenation is occurring measured against pasteurizer operating time will help to identify pasteurizer contamination and fugitive water losses.

![Table showing tank levels and usage](image)

**FIGURE 6**
Pasteurizer feed station PLC screen

![Table showing pasteurizer status and makeup flow](image)

**FIGURE 7**
Pasteurizer PLC screen
FIGURE 8

Chemical feed system.
Control and monitoring system engineered to meet your needs.
THE RESULTS

Due to the dynamic nature of the pasteurizer environment, it is impossible to provide adequate halogen control manually. A full-time operator dedicated solely to maintaining the halogen system alone could not accomplish the task. An automated system, however, could enable him to adjust the chemical feed rate to adequately meet the demand.

![Figure 10] Manual control

![Figure 11] Automatic control

Monthly reports can be generated to illustrate the success of automation. The charts below show data collected during manual control of halogen feed to the pasteurizers compared with control data obtained following the installation of the automated system. Efficiency was significantly increased by the new system, with the added benefit of remote access via computer to controller data, should an emergency situation occur. With this system in place, in the event of an upset, the service representative would automatically be contacted to correct the problem.

THE BENEFITS

Every key parameter is remotely available and provided in historical database:

- Monthly reports
- Corrosion rates
- Inhibitor levels
- ORP control
- Bromide/bleach ratio
- Product usage
- Water usage

![Figure 12] ORP Trend