BREW KETTLE CLEANING

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ECOLAB®
AGENDA

- Safety Moment
- Sanitation Process
  - 4x4 Cleaning Model
  - Typical recipe
- Soil Types
- Kettle Soil Examples
- Chemistry
  - Match cleaner to soil
  - Pros & cons
  - Additive program
- Equipment
- Calandria Example
- CIP Verification
SAFETY MOMENT
SAFETY MOMENT

• When performing any tasks with chemicals proper PPE is essential

• **Signage** should be used to communicate that a cleaning process is occurring

• **Safeguards** should be used to keep manways and ports from exposing workers, visitors and tours to hazards such as temperature extremes and cleaning solutions
4X4 Sanitation process applies to all methods of cleaning:

**Four Basic Steps to Sanitation:**

1. Pre-Rinse
2. Clean (Wash)
3. Rinse & Inspect
4. Sanitize

**Four Factors of Effective Cleaning:**

- Concentration
- Temperature
- Mechanical Action
- Time
Impact of each cleaning factor varies with cleaning method:

- **Manual (Hand) Cleaning**
  - Mechanical Action
  - Time
  - Temperature
  - Concentration

- **Foam Cleaning**
  - Mechanical Action
  - Time
  - Temperature
  - Concentration

- **CIP Cleaning**
  - Mechanical Action
  - Time
  - Temperature
  - Concentration

- **Brew Kettle**
  - Mechanical Action
  - Time
  - Temperature
  - Concentration
TYPICAL WASH RECIPE

• Pre-rinse with hot water

• Circulate 3-5% active caustic solution at 60-75°C (140-170°F) for 45-60 minutes

• Rinse with ambient water to makeup water pH

• Periodically, an acid rinse if scale is present

• Inspect
# COMMON BREW KETTLE SOILS

<table>
<thead>
<tr>
<th>ORGANIC</th>
<th>INORGANIC</th>
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<tbody>
<tr>
<td>• Protein</td>
<td>• Water Hardness Scale</td>
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<tr>
<td>• Carbohydrates</td>
<td>• Iron, manganese, other metallic deposits</td>
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<tr>
<td>• Oil &amp; Grease</td>
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- Heated tanks and circuits in the brewhouse create heat-hardened/burned-on soils:
  - Carbohydrates and sugars from brewing ingredients
  - Protein precipitation/trub

- Mineral Scale Formation:
  - Calcium Hydroxide
    - Results from sodium hydroxide reacting with hard water (calcium or magnesium bicarbonate)
  - Beer Stone:
    - Calcium Oxalate from the brewing process
KETTLE ORGANIC SOILS

• Organic soil typically appears a dull brown color
  • Can have a rainbow hue, depending on amount of protein residual
• Wort boiling in the brew kettle creates highest level of heat-hardened soil
  • Calandria challenging to clean
• Amount of soil – and difficulty removing -- depends on specific beer, brewing process and the number of brews between cleaning
Calcium Carbonate

“pure” scale in hot water line

Calcium carbonate
In beer transfer line. Color related to beer ingredients

“Dry” calcium/magnesium carbonate

“Wet” calcium/magnesium carbonate
“Beer Stone”:

- A combination inorganic soils from both beer and water.
- Predominantly calcium oxalate plus organic components and minerals.
KETTLE SOIL EXAMPLES
BREW KETTLE SOIL - EXAMPLES

• Heat hardened soil
• Heavy concentration of starch and protein
• Brown or rainbow appearance
BAFFLES & SHADOWING EFFECT
Pooling in bottom of tank by drain reduces impingement of cleaning solution
KETTLE AND CALANDRIA
BREW KETTLE - CALANDRIA HEAT-HARDENED SOIL
BREW KETTLE - CALANDRIA HEAT-HARDENED SOIL
## MATCH CLEANERS TO SOIL

### ORGANIC SOILS
- Protein
- Carbohydrates
- Oil & Grease

### INORGANIC SOILS
- Water Hardness Scale
- Iron, manganese, other metallic deposits

### MATCHING CLEANERS

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<tr>
<th>ORGANIC SOILS</th>
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<td><strong>ALKALINE CLEANERS</strong></td>
<td><strong>ACID CLEANERS</strong></td>
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### Match Cleaner to Soil

**Alkaline Cleaners:**
- Solution with pH >7
- Dissolves/Disperses Organic Soils
- Common Sources:
  - Caustic soda NaOH
  - Caustic potash KOH
  - Silicates
- Technical Data Sheet lists strength as %Na$_2$O

**Acid Cleaners:**
- Solution with pH <7
- Dissolve mineral soils
- Mineral Acids: Phosphoric (H$_3$PO$_4$), Nitric (HNO$_3$), Sulfuric (H$_2$SO$_4$)
- Organic Acids: Citric, Hydroxyacetic, Methane-Sulfonic
**PROS & CONS**

What are the Pros & Cons of each category of cleaner as it pertains to the brew kettle?

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<tr>
<td><strong>Pros</strong></td>
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</tr>
<tr>
<td>Proven</td>
<td>Effective at removing beer stone</td>
</tr>
<tr>
<td>Effective</td>
<td>Rinses easily from kettle</td>
</tr>
<tr>
<td>Compatible with oxidative additives</td>
<td></td>
</tr>
<tr>
<td><strong>Cons</strong></td>
<td><strong>Cons</strong></td>
</tr>
<tr>
<td>Scale formation if not built</td>
<td>Not compatible with sodium hypochlorite</td>
</tr>
<tr>
<td>Higher concentrations not easily rinsed</td>
<td>Many not compatible with copper</td>
</tr>
<tr>
<td>Compatibility (if highly built)</td>
<td>Very poor at removing organic soils</td>
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ADDITIVE PROGRAMS

Additives can be beneficial for the removal of heat hardened soils in a brew kettle.

• Built Cleaners
  • Stabilizers/water conditioners (e.g. Sodium Gluconate)
  • Surfactants
  • Chelants (e.g. EDTA)

• Additive to a CIP wash solution
  • Hydrogen Peroxide (H2O2) – Example on next slide
  • Sodium Hypochlorite (Chlorine)
  • Peracid Override
  • Chelants (e.g. EDTA)
ADDITIVE PROGRAM EXAMPLE

- For heat-hardened protein in Brew Kettle heating stack
  - Alkaline followed by Acid Rinse leaves soil residues, despite 5-step process
  - Alkaline cleaner plus oxidizer delivers superior results in fewer steps (3)

Cleaned with Alkaline followed by Acid Rinse

Cleaned with Alkaline + Hydrogen Peroxide (oxidizer)
BREW KETTLE CONSIDERATIONS

• CIP Cleaning and caustic brew frequency guidelines:
  
  • No “rule of thumb” exists
  
  • Cleaning frequency is recipe, process and equipment-specific
    • Each unique brewery and brew leaves varied soils
  
  • Daily, weekly or after certain number of brews
Drivers for this frequency include but are not limited to:

- Heat exchanger efficiency
- Steam pressure / on jacket temperature
- Soil build up in a calandria
- Interaction from brew to brew
- Next brew frequency
- Consumer/production demand
CAUSTIC BREW

- A “Caustic Brew” uses chemistry which is passed through each vessel to the next and cleaning each as part of a CIP process.

- Vessels included in typical Brewhouse CIP circuit:
  - Cereal Cooker
  - Mash Tank
  - Lauter Tun
  - Brew Kettle
  - Whirlpool
  - Wort Cooler / Heat Exchanger (may be included OR part of separate CIP system)
CIP EQUIPMENT
CIP EQUIPMENT

- Rinsing after caustic can be an issue particularly when using higher concentrations of caustic.
- Rinsing equipment varies by brewery design

- Rotating Spray Jets
- Spray balls
- Pig Tails
- Deluge Nozzles
BREW KETTLE CIP EQUIPMENT
BREW KETTLE CIP EQUIPMENT
CIP EQUIPMENT

- Pros and Cons of each option to consider
  - Cost (Total Cost)
  - Kettle design
  - Effectiveness
  - Water use
  - Impingement
  - Location
  - Time
CALANDRIA EXAMPLE
Proper brewing process makes cleaning easier.

\[
\text{Wort} + \text{Circulation} + \text{Steam} = \checkmark
\]

\[
\text{Wort} + \text{Steam} = \times
\]

\[
\text{Circulation} + \text{Steam} = \times
\]
CALANDRIA EXAMPLE

Completely plugged tubes
ADDITIONAL CALANDRRIA EXAMPLES
CIP VERIFICATION
CIP VERIFICATION

The Internet of Things (IOT) environment (“Big Data”) allows continuous CIP monitoring and reporting possibilities driving quality and efficiency.

Recent innovations in CIP include:
• CIP verification software
• Remote analysis
• Web enabled reporting

Software monitors the CIP program/recipe and reports when pertinent criteria are not met.
• Flow
• Temperature
• Concentration
• Time
CIP VERIFICATION EXAMPLE
BREW KETTLE CLEANING

Thank you!

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Sr. Program Leader

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