Craft Brewers: Froth with Opportunities

Pacific Northwest Pollution Prevention Resource Center (PPRC)
September 2016
Some of our Brewery Acquaintances

1. Midnight Sun Brewing Co., Anchorage, Alaska
2. Redhook, Est. 1981 Seattle
3. Fort George Brewery + Public House, Astoria, Oregon
4. Hub, HOPWORKS URBAN BREWERY
5. Worthy Brewing, Bend, Oregon
6. Widmer Brothers Brewing
7. Payette Brewing Co.
8. Sierra Nevada
9. Denali Brewing Co., Talkeetna, Alaska
10. Seward Brewing Co.
Some of our Technical Assistance Friends
P2 Checklist for Craft Brewers (by CBA) (Excerpt)

**ENERGY**

<table>
<thead>
<tr>
<th>Feature</th>
<th>PDX</th>
<th>WD</th>
<th>PS</th>
<th>KO</th>
<th>Status/Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submeter pub &amp; office usage</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Shutoff idling equipment during breaks &amp; end of production</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>Conveyors. Look at interlocking racking conveyors so go off auto.</td>
</tr>
<tr>
<td>For upgrades &amp; replacements, purchase energy efficient versions</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clean heat exchangers periodically</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don’t use hot water for cleaning when not necessary - lower temp where possible</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don’t use compressed air for cleaning when not necessary</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shade windows that may be causing heat gain to an area. Close shades in the evenings</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation is in place and in good condition (steam, hot water, chilled water, &amp; glycol)</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Lighting**

<table>
<thead>
<tr>
<th>Feature</th>
<th>PDX</th>
<th>WD</th>
<th>PS</th>
<th>KO</th>
<th>Status/Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prioritize T5s &amp; LEDs. Replace HIDs, metals halides, T12s, T8s, incandescent, etc.</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Install photocells, occupancy sensors &amp; timers, including on exterior fixtures</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximize daylighting - skylights, photocells by window banks, solar tubes</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delamp when light levels are adequate to perform tasks safely - check required</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1=no progress; 2=underway; 3=complete*
Resounding Environmental Priorities and Efforts

◆ Energy
◆ Water Consumption
  (Reduce ratio of BBL water to BBL beer)
◆ Wastewater Reduction/ Management
◆ CO$_2$

◆ Organic & Solid Wastes
◆ Certifications: B Corp / Salmon Safe
Energy

- High-efficiency HVAC / e.g. Smart chiller (with VFD “brain center”) & 95% efficiency boiler @Worthy
- Lighting retrofits
- Automated controls - conveyor shut-off, refrigeration, etc
- Compressed air leaks/optimization
  - $19,000/year savings for Redhook (ultrasonic leak detect)
- Insulation of steam & glycol systems & lines  
  @Fort George/Payette
- Solar panels to preheat water @Worthy
- Separation & auto controls /seasonal “air sharing” between climate control areas @ Summit
- Bike Friendly Work Place/incentives @Fort George
Steam Systems (Traps, Piping, Etc)

Motors/Pumps/Belts

Glycol Lines

Cold Storage & Climate Controlled Zones

Weatherization

IR Audit Findings

~199°F without insulation

Male End

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>303°F</td>
<td>312°F</td>
</tr>
<tr>
<td>173°F</td>
<td>147°F</td>
</tr>
<tr>
<td>32°F</td>
<td>53.2°F</td>
</tr>
<tr>
<td>36°F</td>
<td>54°F</td>
</tr>
<tr>
<td>39°F</td>
<td>60°F</td>
</tr>
<tr>
<td>41.2°F</td>
<td>78.4°F</td>
</tr>
<tr>
<td>40.1°F</td>
<td>54°F</td>
</tr>
<tr>
<td>36°F</td>
<td>51°F</td>
</tr>
</tbody>
</table>
Energy

AR No. 1, Lighting
Install an automated integrated lighting control system to control lighting schedules and replace incandescent lighting with more efficient lighting sources. This will increase lighting efficiency while reducing associated annual energy consumption by 61%.

AR No. 2, Insulation
Wrap exposed pipe, steam generator surface, and condensate tank shell with fiberglass and calcium silicate insulation. This will reduce heat loss from hot surfaces, lowering energy consumption by 87% per year.

AR No. 3, Expansion Analysis
During a planned upcoming pub house expansion, install compact fluorescent lighting instead of traditional incandescent. This will use 67% less energy and require 75% less maintenance.

<table>
<thead>
<tr>
<th>#</th>
<th>Description</th>
<th>Percent Savings</th>
<th>Energy Savings (MMBtu/yr)</th>
<th>Energy Savings ($USD/yr)</th>
<th>Total Cost ($USD)</th>
<th>Payback (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lighting</td>
<td>13.0%</td>
<td>74.1</td>
<td>$1,439</td>
<td>$9,079</td>
<td>6.3</td>
</tr>
<tr>
<td>2</td>
<td>Insulation</td>
<td>76.4%</td>
<td>434.0</td>
<td>$4,050</td>
<td>$3,100</td>
<td>0.8</td>
</tr>
<tr>
<td>3</td>
<td>Expansion Analysis</td>
<td>10.5%</td>
<td>59.8</td>
<td>$2,676</td>
<td>$437</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>Totals</td>
<td>100.0%</td>
<td>567.8</td>
<td>$8,165</td>
<td>$12,616</td>
<td>1.5</td>
</tr>
</tbody>
</table>

~220’ of exposed pipe + boiler & condensate shell tank

Water

◆ Reclaim (e.g., capture wort-cooling water -1500 gal tank allows reuse of almost all KO water @MSBC)

◆ Ionized air “rinse” for cans @Redhook Portsmouth

◆ Water broom

◆ Lube-free conveyors avoids lube @Redhook

Source: City of Portland Cleaning & Sanitation Factsheet
https://www.portlandoregon.gov/water/article/372313
Pilot Projects (Goal: Reduce heated water and sanitation chemicals)

◆ Pending: Fog-In-Place sanitation (using PAA) (@Widmer Brothers)
  Estimate reduction in water use by over 90%: technology currently used in some beverage production (e.g., OJ)

◆ Electrochemically Activated Water Sanitation (@Merrimack Ales)

<table>
<thead>
<tr>
<th>Material</th>
<th>Units</th>
<th>Old Process</th>
<th>ECA Process</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleaner (PBW)</td>
<td>lb/week</td>
<td>10.77</td>
<td>5.387</td>
<td>50% reduction</td>
</tr>
<tr>
<td>Acid (Nitric/Phosphoric) Cleaner</td>
<td>Gal/week</td>
<td>4.14</td>
<td>0.78</td>
<td>Eliminated except for special quarterly process</td>
</tr>
<tr>
<td>Sanitizer</td>
<td>Gal/week</td>
<td>0.673</td>
<td>0.048</td>
<td>Eliminated except for special quarterly process</td>
</tr>
</tbody>
</table>

## Proposed ECA Process & Operating Costs

<table>
<thead>
<tr>
<th>Tank</th>
<th>Steps</th>
<th>Materials Used</th>
<th>Weekly Cost for chemicals, water and energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mash Tun</td>
<td>Rinse, Water</td>
<td>50% reduced PBW + 30% catholyte</td>
<td>$12.53</td>
</tr>
<tr>
<td>Wash</td>
<td></td>
<td>20% anolyte</td>
<td></td>
</tr>
<tr>
<td>Sanitize</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Rinse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brew Kettle</td>
<td>Rinse, Water</td>
<td></td>
<td>$25.13</td>
</tr>
<tr>
<td>Wash</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sanitize</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Rinse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fermenters</td>
<td>Rinse, Cold Water</td>
<td></td>
<td>$25.86</td>
</tr>
<tr>
<td>Wash</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sanitize</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Rinse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fermenters &amp; Bright Beer®</td>
<td>Rinse, Hot Water</td>
<td></td>
<td>$7.51</td>
</tr>
<tr>
<td>Wash</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sanitize</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bright Beer®</td>
<td>Rinse, Cold Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sanitize</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rinse</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Total Weekly Cost: $62.59
Total Monthly Cost: $266.03

◆ Pending: Electrostatic Spray Sanitation (using hypochlorus) (@Merrimack Ales)

Merrimack Ales/Toxics Use Reduction Institute (TURI)
Wastewater

Water conservation = Less Wastewater

(e.g., suggestions on previous slide)

◆ Determine highest strength streams (beer & yeast loss, trub, tank heel, beer in returned kegs/bottles, DE, etc) – segregate/pull
◆ Automatic pH monitor/adjust system @ Fremont Brewing
◆ Solids interceptor
◆ Cyclone - 5 -10% reduction in beer loss @Payette
◆ Some larger breweries turning wastewater into biogas and /or water
  ◆ Co-gen system offset 10% of natural gas @Redhook NH
  ◆ Bio-electric system provides energy and water recovery/reuse @Bear Republic 50% (estimate) offset of energy use @Lagunitas Brewing 40% reduced water footprint

www.environmentalleader.com/2016/05/12/water-treatment-system-recycles-brewerys-wastewater/
Wastewater BMPs

- King County issuing BMPs for craft brewers in jurisdiction
  <3,000 BBL expected to implement BMPs, no permit
  >3,000 BBL expected to implement BMPs, permit pH & solids
- Brewer’s Association – New wastewater BMP manual pending
- Look to cities/counties for assistance – Collaborative effort

Reno, NV: “Lately we are the land of microbrewer-ys. We issue a permit stating that they have to put filters on floor drains and no disposal of material in sewers”.

Bloomington, IN “We do not design any part of the system for them, but we do make them submit engineer-stamped drawings of pretreatment system, ensuring sizing is adequate for their projected flow. We sample each alcohol manufacturer for BOD & TSS surcharges monthly. We find high and low pH, BOD as high as 20,000 ppm and as low as 700 ppm. We have seen good solids removal with solids interceptors. Because of BOD and pH fluctuations, we permitted our largest brewery”.

Bend, OR - “high strength” wastewater – defined by the City of Bend = over 2,000 mg per liter– can pose a problem for POTWs. ...can be extremely variable in pH, corroding pipes and water collection systems. As more Bend breweries produce higher volumes of beer and waste, they increasingly need to think about managing high strength waste.”
Wastewater BMPs

**Current BMP examples:**
- Capturing water from heat exchange in hot liquor tank
- Increasing number of high strength lines to side-stream tank
- Standardizing brewing and cellaring procedures
  - Reduce chemical usage
  - Side-streaming practices
  - Pinpoint water saving opportunities

**Near future equipment improvements:**
- Centrifuge
- New packing equipment
- Replacing cascading spray balls

**10 Barrel Goals:**
- Reduce overall water consumption
- Reduce organic loading
- Reduce chemical use

Here's an out-of-control fermenter's blow off entering the drains. This material should be side-streamed and land applied as fertilizer.
Address leaks and losses in lines and storage

- CO2 subject to volume loss during transport and storage
- Pinpoint Carbonator @ Hopworks Urban Brewery saves $5k /year
- Hard lines @MSBC
  - Flexible/soft tubing more subject to leaks, friction loss
- CO2 recovery *(according to our current knowledge, this is still only cost-effective for larger operations, but even small breweries emit a large amount of CO2 at around 8-10 pounds per barrel of wort produced (Energy Star)).*
- Nitrogen (N2) generators @Mac & Jack’s, Midnight Sun Brewing Company (MSBC)

Uses for N2
- Cover headspace of stored ingredients, tanks
- Purge kegs, cans, bottles
- Reduce fobbing when discharging beer from storage to filtration
- Purge equipment and pipelines
Nitrogen Generator

- MSBC (8500 BBL) was spending $60k-$70k on CO2
- Installed 15 hp N2 generator (+air compressor)
- $60k full install
- Purity level important, 99.5% pure nitrogen
- ROI 2 years
  - After two years will save:
    - $30-35K in annual CO2 purchases
    - $3-4K when brought online as a compressor

- Mac & Jack’s (Seattle) report good success and much less CO2 usage with their new N2 system
Organic Wastes

- Solids (and yeast) to livestock feed
- Food scrap collection (prep/waste) to compost or feed @Fort George
- Anaerobic digesters
- WiserG (expanding to VanCouver)
Solid Wastes

Work on increased recycling for customers and staff

SIGNAGE IS PROVEN TO INCREASE DIVERSION

Contact Sustainable Connections for help with troublesome recyclables.

Multi-layer hops storage bags, Crosby is testing a PP bag which would be recyclable.
Solid Wastes

- Eliminated disposable cups for in house use (primarily kids' drinks)
- Waste sort/increased recycling
- Establish baseline for benchmark
- Food scraps to farms

@ All Craft Brew Alliance breweries
Stormwater

Galvanized HVAC and roof & siding $\rightarrow$ ZINC in stormwater.
- Coatings (zinc free)
- Filtration at downspouts from roof.

DIY filtration box at downspout
Source: Washington Stormwater Center/Port of Vancouver
https://www.youtube.com/watch?v=COib6WLxTNE

Parking lot filtration pond at HUB.
Join Sustainable Craft Brew ListServ - Share learnings and successes with other brewers so we can all learn from each other. Send email to craftbrewenvirolistserv-subscribe@yahoogroups.com.

New Sustainability Coordinator /Mentor @ Brewer’s Association
John Stier - sustainabilitymentor@brewersassociation.org
Sustainability Dashboard App, Sustainability Benchmarking Report
Release After GABF
Wastewater Manual (Release ~Nov)

PPRC Craft Brew Topic Hub
Contacts: PPRC mgaither@pprc.org
Puget Sound Energy, Hunter Hassig
Washington Department of Ecology – Tony Cooper (360-584-2479)
Sustainable Connections – Mark Peterson
City of Bellingham – Caanan Cowles
Lean/Continuous Improvement
Manufacturing Matters (consultant, along with ODEQ & OSU Energy Efficient Center)

Warehouse Optimizations
Reduced number of can pallets in inventory
Reduce glass breakage (conveyors)
Annual Savings: $35,128

Seasonal Transitions
Reprioritized operation activities; improved “on time” delivery.
Increased Revenue: $35,230

Culture Change and Quality Assurance –
Continuous improvement – weekly meetings – staff involvement/ownership of problem solving
Annual Savings: Priceless

Certifications
- Salmon Safe - facility
- B Corporation