The “Ins and Outs” of Brewery Water Management

Ontario Craft Brewers Conference 2015

Michael Fagan
Senior VP, BLOOM
Project Description

- **Purpose** - Support the improvement of water and wastewater management practices in the Ontario craft brewing industry

- **Outputs** - Information and guidance necessary for breweries to plan and implement water and wastewater solutions within their operations

- **Success** - Will be measured through meaningful business, operational and environmental improvements - both in the short and long-term
Approach

Simple and Pragmatic

▶ First understand the **issues and needs** of the sector and its participants

▶ Uncover **opportunities** and explore pragmatic **solutions**

▶ Support adoption of solutions to drive **tangible and measurable** results
The Status Quo is Comfortable

Water consumption and wastewater management are *lurking* business issues for breweries – not *yet* impacting the bottom-line.

Perceived *abundance* of quality, affordable water in Ontario – as well as easy, *low-cost* wastewater disposal.

“*Off the radar***” versus other business issues.
Status Quo is Not Sustainable

8 – 14 L water used / L beer

5-10% wort/beer loss to drains

Yeast, trub and DE sent to drains

20-30 times over-strength in drain

Up to $100,000 annual over-strength surcharge
Why Change Now?

- **Get ahead of the curve** – *when ... not if*

- **Integrate** it into your business strategy – not the other way around

- **Control** your own strategy and implementation timeline

- **Trigger** - Emerging *meaningful costs* and other risks associated with wastewater
Costs and Risks?

- **Direct costs** tied to wastewater volume and strength
  - Supply and Sewer charges
  - Over-strength surcharges

- **Unplanned** for and expensive **compliance costs**
  - “end of pipe” and not optimized

- **Growth** restrictions

- **Embedded** “Lost” **value** – products and by-products

- **Relationship** with Community stakeholders
Community Impact

Community Impact - Person Equivalents
Small Brewery - 5K hL/yr

<table>
<thead>
<tr>
<th>BOD, mg/L</th>
<th>Community Impact - Person Equivalents</th>
<th>Small (5K hL) vs Large Brewery (100K hL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>0</td>
<td>L/L</td>
</tr>
<tr>
<td>1000</td>
<td>200</td>
<td>4</td>
</tr>
<tr>
<td>2000</td>
<td>400</td>
<td>6</td>
</tr>
<tr>
<td>4000</td>
<td>600</td>
<td>10</td>
</tr>
<tr>
<td>6000</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>8000</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>10000</td>
<td>1400</td>
<td></td>
</tr>
</tbody>
</table>

Person Equivalents

BOD, mg/L
Surcharge Cost Risk

- **Municipal Discretion** to recoup costs of over strength
  - Model Sewer Use Bylaw (MOE 1988)
  - Implement, revise or ignore

- **Typical** surcharge parameters include $\text{BOD}_5 (300)$, TSS $(350)$, TP $(10)$ and TKN $(100)$

- **Additional** surcharge parameters could include phenols, FOG, and sulphate
Surcharge Cost Risk

Example Cost Equation:

\[(\text{Over Concentration} \times \text{Volume} \times \text{Parameter Cost Factor}) = \$\]

- Surcharge can be additive for each parameter or only for the most out of compliance

- Over Strength Surcharge Review for Toronto Water, City of Toronto - June 2012 - Stantec
## Example Surcharge Parameters

### Wastewater Surcharge Rates in Ontario ($/kg)

<table>
<thead>
<tr>
<th>City</th>
<th>BOD/Phenols</th>
<th>TSS</th>
<th>TP</th>
<th>TKN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ottawa (2012)</td>
<td>$1.44</td>
<td>$0.77</td>
<td>$2.31</td>
<td>$5.75</td>
</tr>
<tr>
<td>Durham (2012)</td>
<td>$0.48</td>
<td>$0.48</td>
<td>$0.48</td>
<td>$0.48</td>
</tr>
<tr>
<td>York (2013)</td>
<td>$0.53</td>
<td>$0.53</td>
<td>$2.65</td>
<td>$0.53</td>
</tr>
<tr>
<td>Toronto (2014)</td>
<td>$0.62</td>
<td>$0.60</td>
<td>$1.69</td>
<td>$1.18</td>
</tr>
<tr>
<td>Hamilton (2012)</td>
<td>$0.67</td>
<td>$0.53</td>
<td>$1.43</td>
<td>$2.03</td>
</tr>
</tbody>
</table>

Effect of Volume & Concentration

Surcharge Cost vs BOD (6 L/L water use)

- Annual Surcharge, $
- 5,000 hL
- 10,000 hL
- 15,000 hL
- 30,000 hL
- 70,000 hL
- 100,000 hL

Total BOD, mg/L

- $-
- $50,000
- $100,000
- $150,000
- $200,000
- $250,000
- $300,000
- $350,000
- $400,000
Effect of Volume & Concentration

Surcharge Cost vs BOD (10 L/L water use)

- Brewery Size:
  - 5,000 hL
  - 15,000 hL
  - 30,000 hL
  - 70,000 hL
  - 100,000 hL

- Total BOD, mg/L
- Annual Surcharge, $
Why – Effect of Volume & Concentration

Surcharge vs BOD (6 L/L water use)

- Annual Surcharge, $
- Total BOD, mg/L

Brewery Size
- 5,000 hL
- 15,000 hL
**Full Water Cost**

**Stacked Impact of Volume and Loading - 30,000 hL Brewery**

<table>
<thead>
<tr>
<th></th>
<th>10 L/L &amp; 6000 BOD</th>
<th>5 L/L &amp; 600 BOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overstrength Surcharge</td>
<td>$93,850</td>
<td>$2,995</td>
</tr>
<tr>
<td>Sewer Volume</td>
<td>$73,016</td>
<td>$36,508</td>
</tr>
<tr>
<td>Water Supply</td>
<td>$50,794</td>
<td>$25,397</td>
</tr>
</tbody>
</table>
“What if we don’t change at all ... and something magical just happens?”
Wastewater is fresh water **plus everything that you put in it**

**So...**
- Prevent contaminants entering the wastewater
- Find opportunities to divert byproducts
- Business case better than you think - consider direct costs, lost potential revenue, employee time, regulatory risks, and potential impact to brand
- Technology solutions should always be the last step to consider
Managing the “Ins and Outs”
Volume, Load and Concentration

- **Understand** the “ins” and “outs” – that is what you can control

- Wastewater **concentration** is a product of both **volume** and **loading**

\[
\text{Concentration (mg/L)} = \frac{\text{Load (mg/day)}}{\text{Volume (L/day)}}
\]

- **Concentration** is result of not having control of what you put into the water “**loading**” and how much water you use - “**volume**”
Managing the “Ins and Outs” – An Example

Assumptions

► 10,000 hL brewery @ 8 L/L
   – 7,000,000 L/yr or 19,178 L/day wastewater
► Assume brewery loses 4% produced beer (40,000 L) to drain @100,000 mg/L

Calculate Maximum brewery load to drain

► Max allowable loading = (19,178 L x 300 mg/L)/(1000000 mg/kg) = 5.75 kg/day

Calculate contribution of beer loss to drain

► Load = (10,000hL x 100L/hL x 0.04)L x 100,000 mg/L / 365 = 10.959 kg/d
► Concentration Impact = 10,959,000 mg/d/ 19,178 L/d = 571 mg/L BOD
Understand Your Operations

Follow the Water

- Make a process drawing of all equipment
- Show on the drawing all water inputs and water uses
  - Equipment
  - Hoses and Sinks
- Show on the drawing all wastewater outputs
  - Both direct (plumbed) and indirect (procedures)
- For both the brewing process and the cleaning
Mash Tun

Lauter Tun

Kettle

Whirlpool

Chiller

Malt
Water
Heat

Wort

Lauter Tun

Water
Heat

Wort

Kettle

Heat
Hops

Wort

Whirlpool

Trub (hops & solids)
Wort

Chiller

Packaging

Filter

Conditioning
/Bright Tank

Fermentation
/Maturation Tank

Beer

Solids

Beer

Beer

Yeast

Beer

Wort

Wort

Water
Heat
Packaging
Material

Wort
Simple Cleaning Drawing

Mash Tun
- Water
- Heat
- Caustic
- Acid
- Sanitizer

Lauter Tun
- Water
- Heat
- Caustic
- Acid
- Sanitizer

Kettle
- Water
- Heat
- Caustic
- Acid
- Sanitizer

Whirlpool
- Water
- Heat
- Caustic
- Acid
- Sanitizer

Chiller

Packaging
- Beer
- Rinse Water
- Sanitizers

Filter
- Beer
- Trub
- Rinse Water
- Cleaners/Sanitizers

Conditioning / Bright Tank
- Beer
- Rinse Water
- Cleaners/Sanitizers

Fermentation / Maturation Tank
- Yeast
- Beer
- Rinse Water
- Cleaners/Sanitizers
Improvement Process

- **Quantify** the “ins and outs” of your various operations

- **Identify Priority Areas** (contributors – not end of pipe)
  - Greatest cumulative **load** (per event x # events)
  - Greatest cumulative water **volume** used
  - Consider both production and cleaning

- **Determine root causes** to identify how to reduce loading and/or volume

- **Make Changes** (processes, procedures, technology)

- **Monitor and Assess** (can’t manage where there is no information)
  - Manual (analyses and metering)
  - Automated (analyses and metering)
Need Data to Manage Water

The first step in understanding your operations is to establish a baseline of:

− **How much** water is used at various points in the facility (*volume*)
  - Use per event and how many events

− **How much of what** material (*load*) enters the wastewater stream for each step
  - Production and Cleaning

The starting baseline is what you use to measure improvement against.
Where and How to Measure Water Use

- **Volume per Event**
  - Calculate Volume (i.e. tank filling)
  - Metering
  - Bucket and Timer

- **Number of Events**
  - Production Log
  - Detailing in SOPs
How to Measure Wastewater Composition

- **Representative Sampling**
  - Collect smaller volumes in small vessel (i.e. tote or barrel) – stir to ensure representative sample
  - Large volumes (i.e. after tank cleaning) – grab various samples at different times in the draining step – combine into one composite sample
  - OR grab a dip sample from the top of a vessel if the contents tend to be well blended
  - OR grab samples from drains or sumps

- Contract with a **certified lab** – approx. $120 per sample

- Provide a **list of samples** to be collected and **parameters** to be tested for

- **Sampling**

- **Results**
# Production Examples

## Analytical Results

<table>
<thead>
<tr>
<th>Sample Name</th>
<th>pH</th>
<th>TSS (mg/L)</th>
<th>TDS (mg/L)</th>
<th>TKN (mg/L)</th>
<th>P(tot) (mg/L)</th>
<th>BOD (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unfiltered Lager</td>
<td>4.26</td>
<td>288</td>
<td>28,200</td>
<td>684</td>
<td>121</td>
<td>66,100</td>
</tr>
<tr>
<td>Filtered Ale</td>
<td>4.43</td>
<td>13.3</td>
<td>23,200</td>
<td>695</td>
<td>127</td>
<td>65,200</td>
</tr>
<tr>
<td>Stout</td>
<td>4.45</td>
<td>20</td>
<td>51,100</td>
<td>1,320</td>
<td>326</td>
<td>121,000</td>
</tr>
<tr>
<td>Wort</td>
<td>5.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>150,000 – 240,000</td>
</tr>
</tbody>
</table>

## Location pH TSS (mg/L) TDS (mg/L) TKN (mg/L) TP (mg/L) BOD (mg/L)

<table>
<thead>
<tr>
<th>Location</th>
<th>pH</th>
<th>TSS (mg/L)</th>
<th>TDS (mg/L)</th>
<th>TKN (mg/L)</th>
<th>TP (mg/L)</th>
<th>BOD (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mash Tun</td>
<td>5.35</td>
<td>5,148</td>
<td>21,640</td>
<td>419</td>
<td>90.1</td>
<td>19,100</td>
</tr>
<tr>
<td>Kettle</td>
<td>5.42</td>
<td>19,820</td>
<td>79,700</td>
<td>2,350</td>
<td>563</td>
<td>63,200</td>
</tr>
<tr>
<td>Whirlpool</td>
<td>5.13</td>
<td>3,488</td>
<td>42,140</td>
<td>618</td>
<td>197</td>
<td>22,400</td>
</tr>
<tr>
<td>Chiller to Fermenter - Flush</td>
<td>6.68</td>
<td>66</td>
<td>8,016</td>
<td>83.7</td>
<td>22.6</td>
<td>5,620</td>
</tr>
<tr>
<td>Filtering</td>
<td>4.3</td>
<td>4</td>
<td>11,380</td>
<td>232</td>
<td>35</td>
<td>26,400</td>
</tr>
<tr>
<td>Packaging</td>
<td>4.68</td>
<td>24</td>
<td>6,476</td>
<td>144</td>
<td>2.99</td>
<td>13,500</td>
</tr>
<tr>
<td>Boiler</td>
<td>9.09</td>
<td>13</td>
<td>256</td>
<td>11.5</td>
<td>16.8</td>
<td>34</td>
</tr>
<tr>
<td>Final Drain</td>
<td>10.51</td>
<td>2,314</td>
<td>2,658</td>
<td>209</td>
<td>64.4</td>
<td>1,120 – 5,250</td>
</tr>
</tbody>
</table>
## Production Examples

<table>
<thead>
<tr>
<th>Sample Name</th>
<th>pH</th>
<th>TSS</th>
<th>TDS</th>
<th>TKN</th>
<th>P(tot)</th>
<th>BOD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pH units</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>6.00-10.0</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>mg/L</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mash drain out</td>
<td>5.96</td>
<td>91.4</td>
<td>29,500</td>
<td>388</td>
<td>70.6</td>
<td>27,100</td>
</tr>
<tr>
<td>Mash spray out</td>
<td>7.39</td>
<td>2,240</td>
<td>2,170</td>
<td>115</td>
<td>27</td>
<td>3,070</td>
</tr>
<tr>
<td>Kettle rinse</td>
<td>7.08</td>
<td>6,200</td>
<td>8,210</td>
<td>669</td>
<td>106</td>
<td>11,500</td>
</tr>
<tr>
<td>Whirlpool rinse</td>
<td>7.23</td>
<td>4,950</td>
<td>6,200</td>
<td>360</td>
<td>57.9</td>
<td>8,060</td>
</tr>
<tr>
<td>Heat exchanger/whirlpool flush</td>
<td>6.8</td>
<td>274</td>
<td>16,600</td>
<td>229</td>
<td>48.6</td>
<td>16,700</td>
</tr>
<tr>
<td>Tank yeast drain</td>
<td>4.98</td>
<td>Not Av</td>
<td>Not Av</td>
<td>10,300</td>
<td>2,270</td>
<td>90,500</td>
</tr>
<tr>
<td>Tank cold rinse</td>
<td>4.92</td>
<td>74,500</td>
<td>9,630</td>
<td>3,480</td>
<td>1,350</td>
<td>44,700</td>
</tr>
<tr>
<td>Filter cold rinse</td>
<td>7.04</td>
<td>13,700</td>
<td>1,650</td>
<td>169</td>
<td>17.3</td>
<td>3,390</td>
</tr>
<tr>
<td>Cartridge filter dump</td>
<td>4.7</td>
<td>35,700</td>
<td>25,300</td>
<td>1,080</td>
<td>275</td>
<td>76,600</td>
</tr>
<tr>
<td>Canning line production sample</td>
<td>6.89</td>
<td>19.3</td>
<td>3,320</td>
<td>92.5</td>
<td>20.3</td>
<td>5,300</td>
</tr>
<tr>
<td>Canning line rinse</td>
<td>4.78</td>
<td>147,000</td>
<td>4,080</td>
<td>781</td>
<td>178</td>
<td>71,900</td>
</tr>
<tr>
<td>Location</td>
<td>Process</td>
<td>pH</td>
<td>TSS (mg/L)</td>
<td>TDS (mg/L)</td>
<td>TKN (mg/L)</td>
<td>TP (mg/L)</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
<td>-----</td>
<td>------------</td>
<td>------------</td>
<td>------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Mash Tun</td>
<td>Flush</td>
<td>7.5</td>
<td>1306</td>
<td>720</td>
<td>59.2</td>
<td>9.46</td>
</tr>
<tr>
<td>Mash Tun</td>
<td>Caustic</td>
<td>13.39</td>
<td>210</td>
<td>26528</td>
<td>49.4</td>
<td>5.94</td>
</tr>
<tr>
<td>Mash Tun</td>
<td>Hot Rinse</td>
<td>11.85</td>
<td>251</td>
<td>1340</td>
<td>2.46</td>
<td>1.23</td>
</tr>
<tr>
<td>Kettle</td>
<td>Flush</td>
<td>7.35</td>
<td>1022</td>
<td>4028</td>
<td>82.2</td>
<td>45.1</td>
</tr>
<tr>
<td>Kettle</td>
<td>Caustic</td>
<td>13.39</td>
<td>674</td>
<td>41828</td>
<td>121</td>
<td>394</td>
</tr>
<tr>
<td>Kettle</td>
<td>Hot Rinse</td>
<td>9.92</td>
<td>60</td>
<td>580</td>
<td>2.14</td>
<td>4.61</td>
</tr>
<tr>
<td>Kettle</td>
<td>Sani Rinse</td>
<td>0.84</td>
<td>23</td>
<td>36976</td>
<td>4</td>
<td>11000</td>
</tr>
<tr>
<td>Whirlpool</td>
<td>Hot Rinse</td>
<td>8.63</td>
<td>168</td>
<td>420</td>
<td>2.21</td>
<td>4.64</td>
</tr>
<tr>
<td>Whirlpool</td>
<td>Flush</td>
<td>5.47</td>
<td>19206</td>
<td>57472</td>
<td>1250</td>
<td>376</td>
</tr>
<tr>
<td>Whirlpool</td>
<td>Caustic</td>
<td>12.7</td>
<td>140</td>
<td>18400</td>
<td>8.67</td>
<td>0.17</td>
</tr>
<tr>
<td>Fermenter</td>
<td>Purge</td>
<td>4.65</td>
<td>30874</td>
<td>29320</td>
<td>2230</td>
<td>993</td>
</tr>
<tr>
<td>Fermenter</td>
<td>Flush</td>
<td>4.68</td>
<td>149</td>
<td>204</td>
<td>21.9</td>
<td>1.3</td>
</tr>
<tr>
<td>Fermenter</td>
<td>Caustic</td>
<td>8.24</td>
<td>104</td>
<td>13124</td>
<td>17.8</td>
<td>0.179</td>
</tr>
<tr>
<td>Fermenter</td>
<td>Hot Rinse</td>
<td>7.92</td>
<td>77</td>
<td>2800</td>
<td>4.84</td>
<td>0.232</td>
</tr>
<tr>
<td>Fermenter</td>
<td>Sani Rinse</td>
<td>3.17</td>
<td>&lt;4</td>
<td>108</td>
<td>0.83</td>
<td>8.02</td>
</tr>
<tr>
<td>Brite</td>
<td>Flush</td>
<td>6.55</td>
<td>22</td>
<td>140</td>
<td>5.66</td>
<td>0.168</td>
</tr>
<tr>
<td>Brite</td>
<td>Caustic</td>
<td>13.18</td>
<td>5</td>
<td>34660</td>
<td>12</td>
<td>0.039</td>
</tr>
<tr>
<td>Brite</td>
<td>Hot Rinse</td>
<td>11.69</td>
<td>31</td>
<td>2068</td>
<td>1.03</td>
<td>0.014</td>
</tr>
<tr>
<td>Brite</td>
<td>Sani Rinse</td>
<td>2.88</td>
<td>&lt;4</td>
<td>96</td>
<td>0.49</td>
<td>12.2</td>
</tr>
<tr>
<td>Filter (DE)</td>
<td>Flush</td>
<td>4.41</td>
<td>23226</td>
<td>20128</td>
<td>2290</td>
<td>287</td>
</tr>
<tr>
<td>Filter (Beer)</td>
<td>Flush</td>
<td>4.35</td>
<td>247</td>
<td>29816</td>
<td>675</td>
<td>231</td>
</tr>
<tr>
<td>Filter</td>
<td>Caustic</td>
<td>12.77</td>
<td>6</td>
<td>14116</td>
<td>3.21</td>
<td>0.034</td>
</tr>
<tr>
<td>Filter</td>
<td>Hot Rinse</td>
<td>11.26</td>
<td>11</td>
<td>320</td>
<td>0.53</td>
<td>0.007</td>
</tr>
<tr>
<td>Filter</td>
<td>Sani Rinse</td>
<td>3.53</td>
<td>4</td>
<td>100</td>
<td>0.25</td>
<td>7.59</td>
</tr>
<tr>
<td>Packaging</td>
<td>Flush</td>
<td>4.97</td>
<td>&lt;4</td>
<td>336</td>
<td>4.61</td>
<td>1.85</td>
</tr>
<tr>
<td>Packaging</td>
<td>Caustic</td>
<td>12.92</td>
<td>&lt;4</td>
<td>8656</td>
<td>2.09</td>
<td>0.837</td>
</tr>
<tr>
<td>Packaging</td>
<td>Hot Rinse</td>
<td>8.84</td>
<td>&lt;4</td>
<td>88</td>
<td>0.5</td>
<td>0.034</td>
</tr>
<tr>
<td>Packaging</td>
<td>Sani Rinse</td>
<td>3.37</td>
<td>&lt;4</td>
<td>100</td>
<td>0.42</td>
<td>7.15</td>
</tr>
</tbody>
</table>
Reduce Loading

- **Source Reduction**
  - Where does it enter wastewater stream
  - What is it and how much
  - How to capture
  - Divert and/or dispose

- **Production**
  - Biggest issues are solids (grains, trub, DE, yeast) and wort/beer

- **Chemicals**
  - Every chemical purchased, ends up in drains
  - Refine SOP to use only what is needed to get job done
  - Consider equipment that will support minimum water and chemical use
Reduce Loading Grains/Trub

- **Keep it out of drain** – wet solids represent TSS and BOD

- **Need clear procedures** to ensure it doesn’t hit floor – if it does, sweep it up and put in solid waste tote or feed bin

- **A hose is not a broom** – stop “chasing” spent grain around the floor and into drain – contributes to loading AND increases water use and therefore wastewater volume

- **Disposal**
  - Mix captured solids in with grain for farmer
    - Note – bitterness of trub can limit appeal to livestock
  - Dispose as solid waste
  - Could also be diverted to compost and/or biodigester
Reduce Loading Grains/Trub

- **Brewers Spent Grain**
  - Production 14-20 kg/hL produced beer
  - 80-85% moisture (as it leaves the vessel)

- **Trub**
  - Consists of insoluble high weight proteins, hop residues and miscellaneous precipitates
  - Production 0.2 – 0.4 kg wet trub/hL produced beer
  - 80-90% moisture (as it leaves the vessel)

- Explore the use of rigid SS screens to capture coarse grains and other solids before they hit the floor
DE Filter

- **Used Diatomaceous Earth**
  - After use, the quantity of DE and filtered organic solids can be three or more times greater than the mass of original DE

- **Loading**
  - BOD due solid organic material and beer that is retained in solids
  - Suspended Solids due to DE and organic solids

- **Keep it out of Drain**
  - Often sent directly to the drain
  - Where DE is used, divert filter cake to solid waste disposal, OR
  - Avoid use of DE - lenticular filters or centrifuge to clarify
    - Lenticular filters – beware of backwash to drain issues
Residual Brewers Yeast aka Spent Yeast

- It leaves the fermenter as a very wet slurry of yeast solids and beer 85 – 90 % moisture
- Represents 4 – 7 % loss of total produced beer

Loading

- BOD due to beer and yeast
- Suspended yeast solids
- Spent yeast slurry is often sent directly to drain during the removal process from the fermenter vessel
- Keeping it out of drain is more complicated than spent grains and trub
Fermenter / Maturation

Two basic options – based on whether beer recovery for sale is an option (A) or not (B)

(A) Beer recovery – use a centrifuge to recover the beer and generate a yeast paste
  – Beer introduced back into the product stream – related revenue pays for centrifuge
  – Yeast should be collected for diversion to one of several options:
    - Sometimes mixed with spent grains and sent to farmer (to ensure the health of the animals, the yeast % is usually limited to 3-4% of the total volume of spent grain)
    - Could also be diverted to solid waste, compost, and/or biodigester
    - Opportunity for additional R&D to extract value
Fermenter / Maturation

▶ (B) Beer not recovered
  – Collect and divert full slurry volume to a biodigester and/or waste disposal
  – Collect slurry in separate tank and allow extended settling or “racking” – however clarified beer will go to drain (adds organic loading to wastewater)
    ▪ Settled yeast can be collected and sent to solid waste disposal, composter or biodigester

▶ Smaller breweries are at greatest risk due to few cost effective options
  – Opportunity to explore other recovery options for breweries of different sizes
Packaging

- **What**
  - Beer loss varies depending on efficiency of bottling equipment, and manual filling practices and procedures

- **Loading**
  - BOD due to beer

- **Keep it out of Drain**
  - Commonly mis-filled bottles are tipped and emptied into drains
  - Over-fill and foam is rinsed to drain
  - Best solution are SOPs to reduce beer losses during packaging
Drains – Not an Afterthought

- Drains are not a hole where things go to disappear
- They should be the first **system** to consider when planning and installing your brewery ...
  ... and decisions are permanent
  - Segregated drains – high strength and low strength
    - Don’t treat what you don’t have to
  - Materials – options and issues
  - Solids screens/buckets – another opportunity to intervene
Drains – Not an Afterthought

- Design Access points and/or sump pits to allow integration of in-facility wastewater treatment solutions

- Ability to properly meter final wastewater flow to sewer (critical to able to manage volume and loading)

- Balancing or equalization Tank
Balancing Tank

- Smooths volume “shocks” by allowing the level in the tank to rise and drop.
- **Load** spikes are blended into the whole volume to provide more predictable average.
- **Chemical and pH** shocks are balanced and/or neutralized to regulated or near regulated levels.
- Additional **Solids** settling.
- Control the **outflow** rate to prevent downstream shocks to treatment:
  - Evening
  - Over days depending on production.
Balancing Tank - Design

- Relatively large tank volume
- Liquid volume AND buffer capacity
  - Minimum 6-12 hours of discharge volume (buffering capacity) above a basic volume of several hours operating volume
  - Facility specific
- Tank options
  - in ground or above
  - Materials - pH, chemicals and temperatures
  - Make sure you can measure and control output flowrate
Wastewater – Discharge Treatment

- Use improved and consistent **SOPs** to reduce load and flow
- Understand what and how much “**needs**” to be treated vs how things are now
- **Don’t assume** - have real data on hand to use in discussion with solution provider

**Solution Expectations:**
- Small Footprint
- Modular
- Mobile
- Blackbox approach
- Remote monitoring
- Procurement models
Demonstration Projects

- **Mantech** – “near realtime” composition analysis
- **Bishop Water GeoTube** – simple removal of TSS and related BOD from wastewater
- **Econse** – Integrated ceramic membrane/advanced oxidation system
- **EcoEthic BioGill** – biological treatment system
- **Volume Monitoring** – manual and automated
Water & Beer Website

- A practical online platform designed to support Craft Brewers in their efforts to better manage their water and wastewater
  - Why, What and How

- Based on BLOOM work with OCB breweries over 2014/2015

- Target launch in early 2016

- Stay Tuned
Contact Information

Michael Fagan
Senior Vice President
mfagan@bloomcentre.com
905.842.1115 x227