Full of Spirit: Designing Multi-Spirit Distilleries

James Ludford-Brooks,
Briggs of Burton
Quickly – Who are Briggs of Burton?

- US Engineering Company
  - Equipment Design and Manufacturing
  - Project Management
  - Process Design
  - Health and Safety
- Long history working in the brewing and distilling industries
- Head office in the home of brewing
  - Burton on Trent, UK
Briggs – Distilling
Distilled Spirits Market

- Markets shift:
  - Focus on modular and flexible systems
  - Capable of producing a range of spirits under one roof
  - Premiumisation:
    - Malts
    - “Grain-to-Glass”
    - “Single Estate”

- Cross-over from Craft Brewing
  - Diversification
  - Excess wort production for spirits
Talk Outline

Processes to make these:

- Whiskies
  - American
  - Bourbon
  - Single Malt
- Scotch
  - Single Malt
  - Grain
- Irish
  - Pot Still
- Neutral Spirit
  - Gin
  - Vodka

Grain Processing:

- Grain Cooking
- Mashing / Lautering
- Fermentation
- Distillation
- Column
- Pot

“Brewstilleries?”
Grain Processing
# Grain – Alcohol Yields

<table>
<thead>
<tr>
<th>Starch</th>
<th>Alcohol Yields</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L / Te</td>
</tr>
<tr>
<td>Maize (Corn)</td>
<td>387</td>
</tr>
<tr>
<td>Barley</td>
<td></td>
</tr>
<tr>
<td>Malted Barley</td>
<td>379</td>
</tr>
<tr>
<td>Wheat</td>
<td>334</td>
</tr>
<tr>
<td>Rye</td>
<td>321</td>
</tr>
<tr>
<td>Oats</td>
<td>278</td>
</tr>
<tr>
<td>Rice</td>
<td></td>
</tr>
<tr>
<td>Potato</td>
<td></td>
</tr>
</tbody>
</table>
# Mashing – Starch Gelatinization Temp.

<table>
<thead>
<tr>
<th>Starch</th>
<th>Gelatinization Temp. Range</th>
<th>°C</th>
<th>°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize (Corn)</td>
<td></td>
<td>62 – 77</td>
<td>143 – 171</td>
</tr>
<tr>
<td>Barley</td>
<td></td>
<td>60 – 62</td>
<td>140 – 144</td>
</tr>
<tr>
<td>Malted Barley</td>
<td></td>
<td>64 – 67</td>
<td>147 – 153</td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
<td>52 – 66</td>
<td>126 – 151</td>
</tr>
<tr>
<td>Rye</td>
<td></td>
<td>49 – 61</td>
<td>120 – 142</td>
</tr>
<tr>
<td>Oats</td>
<td></td>
<td>52 – 64</td>
<td>126 – 147</td>
</tr>
<tr>
<td>Rice</td>
<td></td>
<td>61 – 82</td>
<td>142 – 180</td>
</tr>
<tr>
<td>Potato</td>
<td></td>
<td>56 – 71</td>
<td>133 – 160</td>
</tr>
</tbody>
</table>

Source: Briggs et al., Brewing Science and Practice, page 38.
# Example – Mash Bills

<table>
<thead>
<tr>
<th></th>
<th>Bourbon</th>
<th>Tennessee</th>
<th>Rye</th>
<th>Scotch Malt</th>
<th>Scotch Grain</th>
<th>Irish Pot</th>
<th>Neutral Spirit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize (Corn)</td>
<td>70</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Barley</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>60</td>
<td>✓</td>
</tr>
<tr>
<td>Malted Barley</td>
<td>15</td>
<td>10</td>
<td>15</td>
<td>100</td>
<td>20</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
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<td></td>
<td></td>
<td></td>
<td>80</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Rye</td>
<td>15</td>
<td>10</td>
<td>85</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
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<tr>
<td>Oats</td>
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</tr>
<tr>
<td>Rice</td>
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</tr>
<tr>
<td>Potato</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

*Oats low yield but recognised as a filter aid*
Mashing – American Whiskies

Grain Milling

- Not typically milled
  - Corn (Maize)
  - Buckwheat
  - Rice
  - Oats
- Milled
  - Barley
  - Wheat
  - Rye
- Using Hammer Mill or closed gap 4 Roller mill

Mashing Process

Mash Conversion Vessel (MCV) or pot still
- “All Grains” = No husk separation
- Atmospheric vessel (MCV)
- Backset ‘Sour mash’
  - 10% Mash Water vol.
- MCV Cooling
  - Mash Water – (Single Vessel Decoction)
  - Malt addition
- Dual purpose jackets
  - heating (steam medium)
  - cooling (cooling water inlet).
- Mash Cooler
  - Heat recovery
  - Tubular or Wide gap Plate HEX

BRIGGS
Grain Cooking

Roller Mill → Malt Grist Case → Briggs Masher → Briggs Mash Conversion Vessel

Mash Coolers → Cold Water
Mashing – Grain Cooking
Grain Cooking / Mash Conversion Systems

Heating and Cooling

- Jacketed vessel
- Direct steam injection
  - Preference for clean steam generator
  - Avoid taint from boiler feed water
- Internal heating coil
  - Cleaning
Grain Cooking - Decoction Mashing Process (Rice)
Mashing – Scotch, Irish and Japanese Whiskies

Grain Milling

- Course grits requirement for malt
  - MCV / Lauter Tun
  - 4 roll mill
- Un-malted Barley
  - 4 roll mill with close gap setting
  - Or separate Hammer mill

Mashing Process

Options:

- 100% Malt Whiskey
  - Mashed directly to Lauter Tun
- Irish ‘Pot’ Still Whiskey
  - Malt and Barley
  - Mashed into Mash Vessel then transferred to Lauter Tun
- Clear Worts Obtained
- Wort Cooler
  - Heat recovery
  - Tubular or Wide gap Plate HEX
Distillery Lauter Tun

- Malted Barley
  - Malt Whiskies
    - American
    - Scotch
    - Irish
    - Japanese
- Husk forms filter bed
- Influence Wort Clarity
  - Clear (Beer)
  - Cloudy
Lautering
Grain Cooking + Lautering (Irish Style)

- Roller Mill
- Malt Grist Case
- Briggs Masher
- Briggs Mash Conversion Vessel
- Briggs Distillery Lauter Tun
- Mash/Sparge Weak worts Tanks
- Cold Water Coolers
- Cold Water
- Spent Grain
Distillery Lauter Tun - Operation

- Sparge weak worts to improve yield
- Question on payback at Craft Scale
- Without weak worts collection the mash in the Lauter Tun is thicker
Distillery - Mash Filter

- Design for high volume, Mash separation in the brewing industry
- Consistently clear wort
- Two in Scotland
  - Diageo Teaninich Distillery
  - InchDairnie Distillery
Fermentation

• Materials of construction
  • Wooden
  • Stainless Steel
• Variables (Control)
  • Time
  • Temperature
  • Yeast strain
  • % ABV
    • largely affected by extract yield
  • Foaming
  • Nitrogen Content (FAN)
    • Grains are FAN deficient
    • Compensated with Backset?
• Agitation
  • Grains In
• CO₂ = Asphyxiating
Distillation
Distillation

Wort / Wash

Steps:
• Fermentation
• Distillation

Source:
• Distillery
• From existing Brewery wort

Neutral Spirit

Steps:
• Vodka
  • Rectification
  • Filtering
• Gin
  • Infusion with botanicals
  • Rectification
Grain Whiskey Spirit (GWS)
Industrial Neutral Spirit Production

Primary columns – GWS

Secondary columns – GNS (Vodka)
Infused Spirits (Gin)
Brewstillery Concept
Distilling and Brewing – Quick Comparison

**Distilling**
- Malt
- Grain Cooking
  - Grains In
- Clear or Cloudy wort
- Not Boiled
  - Secondary Fermentation
- Weak Worts collection (optional)
- Distillers Yeast
  - Higher Temperature and %ABV
  - Single-Use

**Brewing**
- Malt
- Grain / Adjunct Cooking
  - Mash Separation
  - Lauter Tun / Mash Filter
- Clear Wort
- Wort boiled in Kettle
  - Increased Gravity
  - Hops added
- Yeast
  - Ale / Lager
  - Temperature and flocculation
  - Crop and re-pitch
Brewstillery Concept – Grain Whiskies

Briggs Masher

Briggs Lauter Tun

Mash Vessel

To FVs
Brewstillery Concept – Whiskies (Irish Style)
Brewstillery Concept – Distillation

- Briggs Kettle / Still
- Briggs Lauter Tun
- Spirit Condenser
- Seal pot
- From FVs

Spirit
Brewstillery Concept – Beer

- Briggs Masher
- Thermosyphon
- External Wort / Wash heater
- Briggs Kettle
- Briggs Lauter Tun
- Wort Coolers
- From FVs
- To FVs
- Spent Grain
Summary

Overview

Choice of spirits to make:
- Neutral Spirit Production
  - Vodka
  - Gin
- Whiskies
  - Cereal Cooker and Lauter Tun allows a wide range of whiskies to be produced
  - Similarities between malt whiskey distilleries and breweries
  - Process modifications allow production of both

Questions

- Make your own Neutral Spirit?
- Excess brewery wort, how to integrate into a distillery process?
Thanks

Any Questions?

Booth #107