Brewery Layout & Equipment Selection



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Our Global Offices

Briggs of Burton, Inc.

• Pittsford, NY

Briggs of Burton, PLC

• Burton on Trent

McMillan Coppersmiths and Fabricators

• Prestonpans, near Edinburgh

Briggs Asia

• Shanghai



Our UK Offices

Briggs of Burton PLC

• Burton on Trent

McMillan Coppersmiths and Fabricators

• Prestonpans, near Edinburgh

Brewing Experience

- Raw Material Handling
- Mashing and Lautering
- Wort Boiling & Trub Separation
- Hop & Additions Handling
- Yeast Propagation, Collection & Pitching
- Fermentation, Maturation, Filtration & Bright Beer
- Energy Minimisation & Recovery
- Keg Racking
- CIP
- Automation

- Based in
 - Burton on Trent, UK
 - Rochester, NY USA
 - Shanghai, China
- Long history in Brewing
- Projects around the world





Brewery Layout & Equipment Selection

- Objectives
- Process
- Equipment Selection
- Factory Layout
- Practical Examples



Objectives

- Explore factors that affect equipment selection
- Focus on areas of key equipment selection within a brewery
- Explore factors that affect brewery layout
- Focus on some real life examples of brewery layouts

Brewery Process Flow

- Dry Process
 - Milling
- Hot Process
 - Brewhouse
- Cold Process
 - Fermenting & Conditioning
 - Filtration & Process





Equipment Selection



Factors Affecting Equipment Selection



Equipment Selection Example 1 : Brewhouse - Mash Separation

- Process of Filtration and Leaching (Sparging)
- Different technologies available:
 - Infusion Mash Tun
 - Lauter Tun (with Mash Vessel)
 - Mash Filter (with Mash Vessel)
 - Nessie







Infusion Mash Tun

- Traditional Ale Brewing
- Combines Mash Conversion & Separation in one Unit
- Normally used with Steeles Masher
- Well Modified Malt
- Low Extract Recovery
- Simple & Effective
- Fixed Height Grain Discharge arms
- No Lautering capability





Lauter Tun

- Large diameter
- Slotted False Bottom
- Mash Distribution
- Sparge Distribution
- Lauter knives
- Grains Discharge
 - Plough Bar
- Grains Valves
- Lauter Drive







Mash Filter

- Mash Filter Capability -
 - Up to 14 BPD
 - High extract yield (100% +)
 - Up to 100% unmalted adjunct
 - Minimal effluent
 - Drier spent grains
 - Limited flexibility (turndown)





Visual appearance/Finish







Bed Loading and Cycle Time (10 Te Malt)



Equipment Selection Example 2 : Fermenting & Conditioning

- 2 Stage Process in Separate Tanks
 - Fermenting
 - Transfer via Chiller and Centrifuge
 - Maturation / Conditioning/ Aging
 - Dedicated tanks
 or
 - Dual Purpose Tanks (DPVs)
- Single Tank process in Unitank
 - No tank to tank transfer
 - All tanks fully jacketed



Fermentation and Conditioning options

2 Stage Process in Separate Tanks



Standard Single Unitank Process Unit Operation Vessel 1 Fermentation Vessel 1 Racking Cooling Via Vessel 1 Jackets Maturation Vessel 1 ►►< -5 °C To beer Cooling filter



Dual Tanks vs Unitanks

Dual Tanks

- Dedicated FVs & CTs
 - reduced jacket area on CTs
 - Less flexibility
- DPVs
 - Flexible
 - All tanks fully jacketed
- In-line chilling rapid chill back possible
- CIP two vessels
- Losses during tank to tank transfer
- CO₂ required for transfer & to purge CTs

Unitanks

- Flexible
- Reduced CIP single vessel
- All chilling in tank
- No tank to tank transfer
 - Reduced losses
 - Better utilisation
 - Reduced CO₂ consumption
- Chill back time limited by jacket area as no inline chiller

Vessel access and size



Lower room with most of vessel external – improved operator working environment, especially in colder climates



Smaller vessels can be located indoors



Completely open top and bottom – OK for warmer climates

Equipment Selection Example 3 : Beer Filtration

- Is Filtration required?
- Number of streams
 - 1, 2 or more
 - Equal or different sized streams
- DE Filtration
 - Batch
 - Disposal costs / sustainability
- Membrane (Crossflow) Filtration
 - Lower losses
 - Lower O2 pickup
 - Higher capital costs
 - Lower running costs



Membrane Filtration

- 470 hl/h Membrane Filter Stream
- One of 2 streams installed in 2007
- Pall Membrane technology
- Continuous system



- 400 hl/h Membrane Filter Stream
- One of 2 streams installed in 2015
- Pentair Membrane technology
- Batch system



Membrane Filtration vs DE

Filter Media	Lower cost than DE	10 – 30%
Electrical Energy Cost	 Comparable to DE 0.3 –0.6 kWh 	
Thermal Energy Cost	Lower than DE	60 – 75%
Water Consumption	 Lower than DE Water consumption < 0.15 hl/hl beer 	25-40%
Manpower	Lower than DE	80%
Disposal Cost	Lower than DE	>95%
Service Cost	Lower than DE	30 –50%

Brewery Layout







Factors affecting brewery layout

Process requirements

Straight-line Flow

Pro's:

- Simple process flow
- Simple building design (shed)
- Small building span
- Utilities engine room close to FV's

'Dog-leg' Layout

Pro's:

- Control Room, Lab, Workshops close to all plant
- Utilities does not extend beer flow distances, and close to FV's

Con's:

Packaging

distances

CR & Lab cannot be close to BH &

Utilities location extends beer flow

Workshop not close to C/R

Con's:

- Building design more complex
 - multiple inter-linking buildings



RM = Raw Materials BH = Brewhouse YR = Yeast Room Utils = Utilities Engine room C/R = Control Room W/S = Workshops (+Stores) BBTs = Bright beer tanks



Process requirements

U-Shape Flow

Pro's:

- Control Room, Lab, Workshops close to all plant
- Utilities does not extend beer flow distances, and close to FV's

Con's:

• Utilities – distance to Packaging







Production Scale



Everards - Leicestershire, England Scale: 20,000 hl/yr = 3.5 million pints/yr



Shiner, Texas, USA Scale: 1,000,000 hl/yr

= 175 million pints/yr



Shenandoah, Virginia, USA Scale: 9,500,000 hl/year = 1.7 billion pints/yr

Note – Capacity approximate as an illustration only.

ABI Sutton Bonington

Craft Scale – Example 1

- Straight line flow concept
- Compact foot print
- All process and utilities in one room across two floors.
 - First floor included
 - Raw material handling
 - Steam generator
 - Control room
 - Hop store
- Large process area relative to packaging
- Limited room for expansion (although designed for research so key process units are all skid mounted)



Large Scale – Example 1 USA Brewery

- Dual Lauter Tun brew streams installed at full 1. capacity
- Scale of vessels Large FVs/BBTs/Silos external (cones within building), more cost effective 2.
- 3. Use of existing equipment & buildings
- Expansion 4.
 - 1. Future constructability taken into account
 - 2. Raw Material Storage, FVs, MVs, BBTs

New / Modified

In Existing

Building

New

5. Logistics

Existing

Equipment &

building

- Malt in via rail 1.
- 2. Access to site
- 3. Security



Large Scale – Example 2 African Brewery

- 1. Dual Mash Filter brew streams
- 2. Scale of vessels Scale of vessels Large FVs/BBTs/Silos fully external, more cost effective
- 3. Greenfield site
- 4. Processing area relatively small section of the site compared to packaging and storage
- 5. Use of Ammonia required dedicated utility room but this isn't always the case depending on where in the world the plant is.
- 6. Logistics
 - 1. Access to site
 - 2. Security
 - 3. Lorry Park/holding area
 - 4. Goods in/out via Road
- 7. Expansion
 - 1. Future constructability taken into account
 - 2. Raw materials storage/Uni-tanks/ BBTs



Environment and Location





- 1. Topography
- 2. Ambient Conditions
- 3. Envelope of land
- 4. Single story/multi storey



Key watchouts:

- Layout will evolve over the project. Your first layout won't be your final layout!
- You might be expected to develop a layout before knowing final site. If so, start with your ideal layout based on best assumptions at the time and then fit onto site afterwards
- Consider how equipment is going to be maintained
 - What if the lauter drive gearbox needs maintenance? Large LT drives can be 4.5te!
 - Is there sufficient room around equipment for an engineer to work safely
 - Packaged equipment often comes with an defined area required for maintenance
 - Is there a requirement for lifting beams?



Key watchouts:

- Don't forget to allow enough room for ancillary equipment. With only the major equipment on the layout it can look like there is a lot of space until you put in the following:
 - Pipe bridges
 - Cable trays
 - Drainage
 - Walkways
 - Fork truck access route
 - Ingredient storage (hops, yeast etc)
 - Hose reels
 - Safety showers
 - Structural steel work
- Consider venting of vessels within the layout, often there are restrictions on where penetrations can be made through the building/roof (from both structural and architectural considerations)



Other considerations

People

- Production team
- Maintenance Team
- Sales/Admin location
- Operation/Automation
 - Fully automated/manual
 - Central control location/dispersed
 - CIP manual/Automatic
- Greenfield/Brownfield site
 - Integration into existing process flow
 - Completely new site

- Visitors
 - Does there need to be a visitor route?
 - Segregation of certain areas from visitors?
- Good site location (relative to market) e.g. Courage Berkshire Brewery
 - Replaced old town centre brewery
 - Originally on greenfield land close to Motorway junction
 - Over time area developed, land became high value site sold and production relocated.
- Details
 - Drainage
 - Electrical supplies/cable trays
 - Floor slopes

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- Practical Examples
- Thank you Any Questions?

