NETWORKING PROJECT FOR DANISH MICROBREWERIES

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A series of network meetings have been held among Danish microbrewers with the aim of generating ideas to improve Key Performance Indicators (KPI) in small-scale beer brewing. Ideas from these seminars are presented as checklists.

NETWORK FORMATION

Since 2009, the Scandinavian School of Brewing (SSB) has collected figures for Key Performance Indicators (KPIs) among some of the small brewery and microbrewery members of the Danish Brewers Association (DBA). Several of the microbreweries have contributed to defining these KPIs, of which the definitions of the main KPIs are listed in the table below.

In order to get the full benefit from the collected KPI figures, a network project was initiated by the Danish Brewers Association (DBA) with funds from the Danish AgriFish Agency (the Ministry of Food, Agriculture & Fisheries of Denmark) and the European Agricultural Fund for Rural Development (EAFRD). The network meetings were arranged by the Scandinavian School of Brewing (SSB). It was a precondition that all Danish microbrewers could participate in the meetings – also non-members of the Danish Brewers Association.

Based on the collected KPIs, seminars were set up for discussing how to improve production economy under the following headings:

- How to maximize brewhouse yield and minimize volume losses
- How to save energy for heating
- How to save electricity consumption
- How to increase productivity by better organisation of the work
- How to reduce consumption of water and CO_2

The main point before even starting to discuss any of these subjects must be to emphasize the following:

IF YOU CANNOT MEASURE, YOU CANNOT CONTROL.
IF YOU CANNOT CONTROL, YOU CANNOT IMPROVE.

KPI	UNIT	DEFINITION	RANGE
Water consumption	hl/hl	Consumption of water per hl produced beer	2.5 – 13.5
Energy consumption – heat	kWh/hl	Consumption of heat per hl produced beer	7.6 – 90
Energy consumption – electricity	kWh/hl	Consumption of electricity per hl produced beer	22 – 106
CO_2 – consumption	kg/hl	Consumption of CO_2 per hl produced beer	0.5 – 6.3
Brewhouse yield Y1	%	kg extract in cold wort / kg extract in raw materials	65 – 97
Productivity	hl / FTE	Total amount of beer produced per Full Time Equivalent (FTE) employed directly in production	63 – 2360
Total volume loss	%	Difference between wort and beer volume / wort volume	1.5 – 23

Definition of main Key Performance Indicators (KPI) for Danish microbreweries with range for 2009, 2010 and 2011

MINIMIZING LOSSES

The Overall Brewhouse Yield (OBY, Y1) among the breweries in the survey ranged from 65% to 97%. Ideas to improve extract in wort in the brewhouse can be seen in the table below:

CAUSE OF LOW BREWHOUSE YIELD	CHECK LIST
Bad malt quality	High content of dust, 'glassy' kernels and stones Low/non-uniform modification – low extract content
Error in weighing	Calibration of the scale
Grist too coarse or contains whole kernels	Set roller distance in mill Wear on rollers or uneven distance
Too low enzymatic activity in malt	Malt quality – low diastatic power Too high temperature of conditioning steam or water
Thin mash	Water balance – too little water left for sparging
Wrong mashing programme	Mashing temperatures and times
Extract in spent grains	Grist too fine or too coarse – mill roller settings Lautering irregular – timing, compaction, blockage
Extract in last runnings	Collection of last runnings and water/wort mix
Extract in trub	Weak trub formation Transfer of trub to lauter tun

Check list for increasing overall brewhouse yield.

The losses after the brewhouse were ranging from 1.5% to 23% (average 11% in 2011). The following could be checked as causes for the losses:

CAUSE OF PRODUCTION LOSSES	CHECK LIST
Fermentation	Yeast growth too high Real Degree of Fermentation (RDF) Beer in surplus yeast Over-foaming Too small batch size
Filtration	Beer/water mixing zones and brand change - filtration temperature, kieselguhr consumption, length of filter run
Packaging	Beer unsteady – temperature and counter pressure Beer/water mixtures and brand changes Over- and under-filled bottles Over-foaming Bad bottle quality

Check list for losses in fermentation, filtration and packaging.

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HEATING ENERGY

Consumption of heating varied between the microbreweries from 7.6 to 90 kWh/hl. It should be noted that breweries with a low consumption use electrical heating for mashing and wort boiling, which is dealt with separately below. The two major heat consumers in the brewery are the brewhouse (mash kettle and wort kettle) and the packaging (pasteurisation). Again, it is important to register the heat consumed in order to get an idea of how to reduce the consumption. The table below summarises ideas for heat savings:

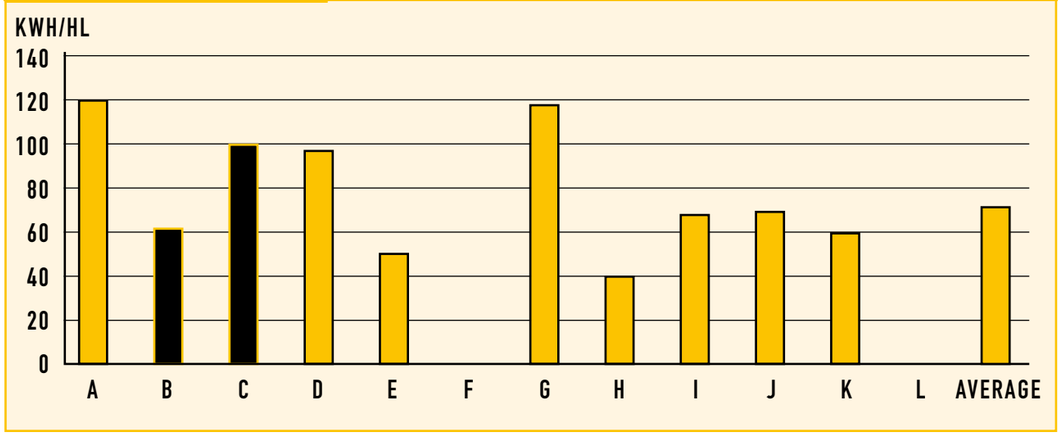
HEAT CONSUMER	CHECK LIST
Heating surfaces	Avoid fouling by thorough cleaning
Wort kettle	Control rate of evaporation – evaporate less and maintain quality? Possible heat recovery system
Hot water	Avoid draining hot water Recover hot water from wort cooling – plan consecutive brews Planning of CIP – after each other whenever possible
Steam	Avoid leakages, collect condensate and insulate pipes
Pasteurisation	Do not over-pasteurise

Heat savings in the microbrewery

ELECTRICITY CONSUMPTION

The figures for electricity consumption among the microbreweries varied between 22 and 106 kWh/hl. Here, the high consumption figures are from breweries having electrical heating. In the breweries not using electrical heating, the major consumers of 80-90% of the electricity are motors. Motors are used for pumps, valves, compressors, conveyors, agitators, etc. Factors to consider when motors are selected include efficiency, operating conditions, frequency control, etc. New energy-efficient motors combined with frequency controls can save a lot of money on a yearly basis. Pumps should be installed with a characteristic suited for the purpose and, in addition, systems that provide cooling, ventilation and compressed air should be correctly sized for their purpose and should be run under optimal conditions. It should also be considered whether part of the operations could run at times during the night, when electricity prices are lower.

TOTAL ENERGY CONSUMPTION



Total energy consumption for heat and electricity in kWh/hl from 10 of the 12 microbreweries in the survey for 2011. Black columns represent breweries without small pack filling lines.

PRODUCTIVITY – ORGANISATION OF BREWING

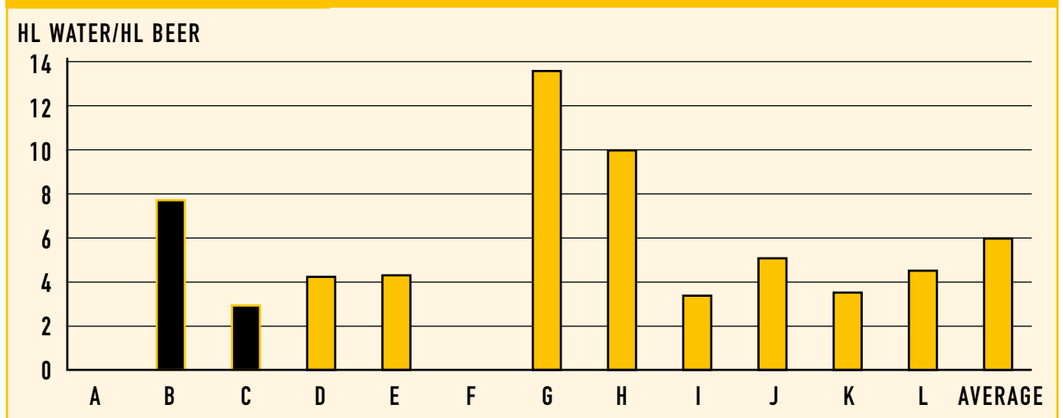
The productivity of the microbreweries was in the range of 500 to 2400 hl/FTE (Full Time Equivalent, employed directly in production) with a few exceptions of very low productivity. It raises the question of how to organise brewing efficiently. These issues should be considered:

- How small could the yearly sales volume be to support one full time employee? – Experiences from Danish microbreweries show that this limit is around 500 hl per year.
- Could production be organised so that an employee also has time for distribution, sales and administration within the working week? – Automatic start-up of mashing-in and planning brewing in the start of the week will make time for filtration and packaging in the middle of the week and hence distribution, sales and administration in the end of the week.
- Can second-hand equipment be used to reduce the capital expenditure?
- Is it more attractive to be a contract brewer using other breweries' equipment than to invest in your own brewing equipment? – Several microbrewers have found this option more feasible, at least to begin with.

WATER CONSUMPTION

The water consumption in hl water consumed per hl beer produced ranged from 2.5 to 13.5 hl/hl for the microbreweries, with an average of 6 hl/hl (2011). There is room for improvement by applying more than one quality of water (larger microbreweries), by applying high-gravity brewing (might be a quality issue for some), by stopping leaks, by reusing excess hot water from brewhouses and bottle rinsers, by optimising CIP, etc.

WATER CONSUMPTION



Water consumption in hl water/hl beer for 10 of the 12 Danish microbreweries in the survey for 2011. Black columns represent breweries without small pack filling lines.

CO_2 CONSUMPTION

The consumption of CO_2 ranged from 0.5 to 6.3 kg/hl beer, the majority being in the low end. Possible reduction in the consumption of CO_2 can be realised by pushing beer with N_2 or deaerated water instead of CO_2, by looking for leakages and by applying a CO_2 balancing system for bright beer tanks. The last option is not relevant for the smallest microbreweries.

CONCLUSION

A network of Danish microbrewers has been established. A set of tools has been made for making beer in a more economical way and with more consideration for the environment and the surrounding society. This will again improve the competitiveness of the Danish microbreweries.

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LIST OF DANISH MICROBREWERIES PARTICIPATING IN THE NETWORK PROJECT.

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ABOUT THE AUTHOR

Kim Johansen is educated Chemical Engineer from Danish Technical University (1986) and has a Diploma in Brewing from Institute of Brewing and Distilling (1991). Kim has been employed with Danish Fermentation Industries (1986-1989), Alfred Jørgen Laboratory (1989-2000), Danbrew (2000-2002), Ørbæk Juice Factory (2002), Alectia (2008-2009) and has his own company Pomona cider since 2003. Kim is Training Manager with the Scandinavian School of Brewing since 2009.