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Steam and Heat Generation in Breweries

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All sorts of technical facilities are used for the production of beer, depending on the size of the brewery. Every brewery is equipped with a heat generation plant. Because the physical property of steam is to release a large quantity of energy upon condensation whilst maintaining a constant temperature, water vapour has proved successful and been adapted as a heat medium for the thermal processes.

The starting situation is crucial

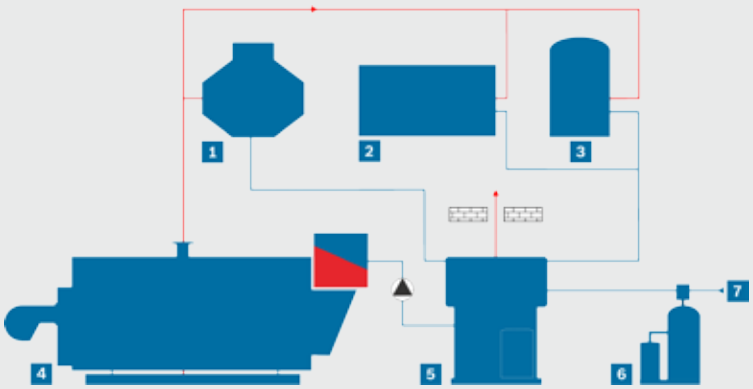
Size, the sequence of processes, range of products and working rhythm determine the size of the boiler and the system of equipment. The primary objective of all planning and renewal is to achieve maximum efficiency, or the best value for money. Setting up a new brewery offers the best preconditions for planning as a whole, with the wide-ranging coordination of all heat consuming units. If breweries are only partly renovated, the planning is more difficult, but here too appropriate measures can be taken to increase the efficiency of equipment.

Steam can be generated in a way that is functionally adequate or optimized in terms of heat economy. Very cheap solutions generally result in higher operating costs. The greater the load on thermal consumer units, the more it is worth paying extra for low-loss systems.

Steam generation for small brewery companies and breweries in restaurants

The main components are a steam generator, an unpressurized feed water container, a water treatment system, the chemical dosing device and blow-down expansion tank.

This investment can be made most cheaply with a reverse flame boiler. This supplies the heat consumers designed for high-pressure steam between 2 and 6 bar via a pressure-reducing unit. A Water service module WSM for partial deaeration and a Water



1 Brewing kettle
2 Bottle cleaning for high-pressure steam
3 Hot water heater
4 High-pressure steam boiler
5 Water service module WSM
6 Water treatment module WTM
7 Untreated water

Figure 1: Steam generation for a restaurant brewery with open condensate recirculation

treatment module WTM for softening the make-up water complete the system.

The Water service module combines a feed water container, deaeration, chemicals dosing, drainage and expansion container, boiler feed water device and water sample cooler into a multifunctional unit. In the feed water contain, the condensate and make-up water are thermally deaerated and the feed water treated with the chemicals. The desalting water and blow-down water is passed into the expansion container, expanded and cooled for passing into the mains drainage system. All regulating, control and protective functions are computer-aided and automatically executed with pressure and temperature sensors using an SPC with text display.

The Water treatment module WTM works on the ion exchange principle. In the lowest price version, the ready-to-connect module is supplied as a volume-control individual unit.

For the typical restaurant brewery with recurrent long operating breaks, this variant is economical and recommended.

For higher level of utilization, with parallel operation of the brewing kettle and bottle cleaning, a larger boiler is needed plus Water treatment module WTM, made as a double system for continuous use, is recommended.

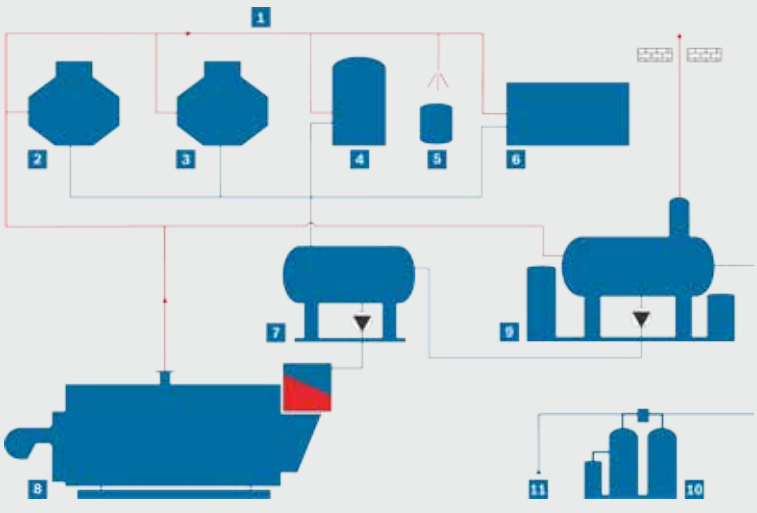
Steam generation for medium-sized and large breweries

The new construction option (Figure 2)

Building a new brewery offers the best preconditions for steam generation that is optimized in terms of heat economy. If all the steam consumers are designed with heating surfaces for approximately the same steam pressure in the HP range, the condensate from all heat consumers can be forwarded to a common HP condensate service module. No expansion steam losses occur. Softened water and chemical dosing volumes remain very low and are only required to cover leaks and direct steam consumption without condensate backflow. This system gives the maximum savings compared with open condensate systems with the same consumption structure.

Partial renewal

The steam consumer units or steam generators of many breweries are replaced, which allows the separate recirculation of low-pressure and high-pressure condensate.



1 HP
2 Mash kettle
3 Wort kettle
4 Hot water heater
5 Barrel cleaning
6 Bottle cleaning for high-pressure steam
7 Condensat high pressure plant CHP
8 High-pressure steam boiler
9 Water service module WSM
10 Water treatment module WTM
11 Untreated water

Figure 2: New construction of a steam generating concept for medium-sized and large breweries with closed condensate recirculation

There are various solutions which are suitable for partial renewals. In any case, the condensate from the low-pressure consumer units and the additional feed water can be passed via the trickle deaeration device into the water service module.

For the high-pressure steam consumers, a modified high-pressure condensate service module is installed. The condensate is fed directly into the high-pressure steam boiler without expansion steam losses. This solution is not tied to the volume and pressure conditions of the consumers. It is suitable for any operating set-up and working rhythm without any reduction in efficiency (Figure 3).

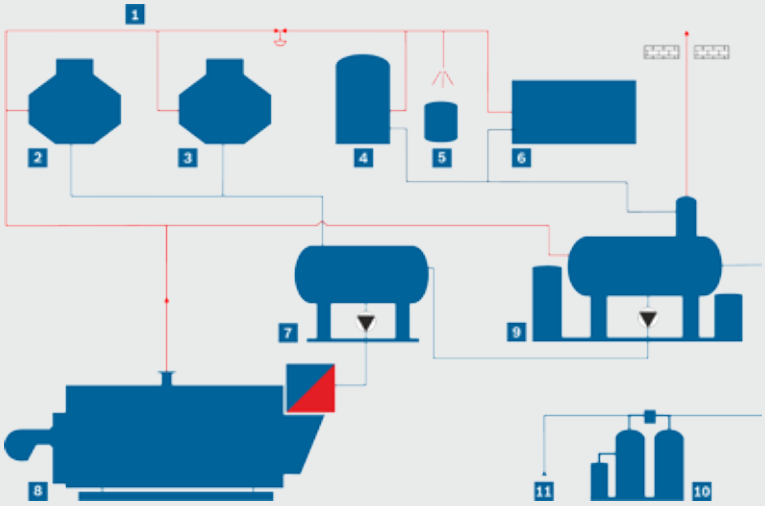
A cheaper solution is the use of a pressure-reducer for the feed and expansion of the condensate from the high-pressure steam consumers (Figure 4). The condition here is the parallel operation of low-pressure consumer units to feed in the expansion steam that occurs. The expanded condensate is forwarded to the feed water container of the water service module. As soon as the expansion steam can no longer be used constantly, the economic efficiency of this system declines.

What are the benefits of closed condensate recirculation?

The table shows the losses from open condensate systems compared with closed systems. For breweries with an average requirement of 1 000 kg/h over 8 hours a day on 250 working days, this gives an annual requirement of 2 000 tonnes of high-pressure steam. The costs of losses are between € 4 920 and € 8 220 a year. A brewery of this size operating in three shifts consequently has avoidable costs of € 14 770 to € 24 6500. The investment costs for the supply and installation of a high-pressure condensate service module will be, depending on level of equipment, between € 40 000 and € 65 000. The time taken for the return on investment is thus between 0.9 and 5 years, depending on the system size and utilization.

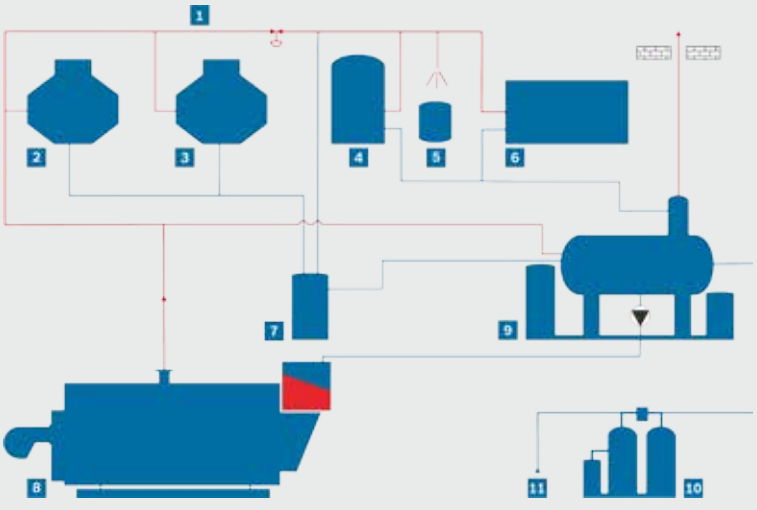
There are other advantages from:

- reduced consumption of chemicals for water treatment
- reduced desalting and blow-down volumes
- reduced corrosion in the condensate system
- avoidance of additional losses from steam slippage at condensate drain-off fittings



1 HP 50 – 70 % –>| <– LP 30 – 50 %
2 Mash kettle
3 Wort kettle
4 Hot water heater
5 Barrel cleaning
6 Bottle cleaning for high-pressure steam
7 Condensat high pressure plant CHP
8 High-pressure steam boiler
9 Water service module WSM
10 Water treatment module WTM
11 Untreated water

Figure 3: Concept for a partial renewal and use of a HP condensate service module



1 HP –>| <– LP
2 Mash kettle
3 Wort kettle
4 Hot water heater
5 Barrel cleaning
6 Bottle cleaning for high-pressure steam
7 Expansion unit
8 High-pressure steam boiler
9 Water service module WSM
10 Water treatment module WTM
11 Water untreated

Figure 4: Concepts with partial deaeration using a low-priced expansion unit

Table			
Condensate system	**Unit**	**Open**	**Closed**
Condensate gauge pressure	bar	0	2–5
Condensate/feed water temperature	°C	95	133–158
Expansion steam	%	6.5–10.5	0
Heat loss	kWh/t steam	44–74	0
Water loss	kg/t steam	65–105	0
Additional fuel costs at 0.50 € / l oil and 95 % boiler efficiency	€/t steam	2.35–3.95	0
Additional water costs at 2 € / m^3	€/t steam	0.13–0.21	0
Total additional costs	**€/t steam**	**2.48–4.16**	**0**

Based on 2017 costs

Summary

Depending on the initial situation and the size and degree of utilization of the breweries, an economical supply of energy can be ensured with a wide range of different concepts. Rising energy costs mean that higher initial investments can be profitable even with smaller systems. The modular technology that has become established over recent years reduces the planning, coordination and assembly work considerably. New constructions or modernization are absolute child‘s play.

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