To achieve optimal results in the hot phase in the brewhouse, both the practice of wort boiling and energy management need to be considered as one entity. This is precisely what GEA does. We see the process as an integrated package comprising the heating stage, the actual wort boiling, wort treatment during cast-out and cooling. Each individual step plays a decisive role on the next one and contributes to the overall optimization of the process in terms of outstanding beer quality and high efficiency. Our open concept provides plenty of possibilities for process improvement, is retrofit-compatible and makes a positive contribution to your product quality.
Wort boiling – A comprehensive process

1: External wort preheating
When using an energy storage system, the wort is gently heated to boiling temperature using an external plate heat exchanger. Compared with a conventional internal boiler, this process protects the high-molecular foam-positive nitrogen and considerably reduces the thermal stress, which benefits the flavor stability of the beers produced with this technique.
2: Process optimization
GEA offers a wide range of wort boiling options to perfectly meet the specific requirements of every brewery. We have decades of experience in the construction of boiling systems – for atmospheric pressure boiling as well as for low-pressure boiling. From energy storage systems to vapor compression units and combined whirlpool/wort kettles, GEA can supply state-of-the-art solutions for any type of brewhouse and any type of beer.

3: Gentle precooling, less DMS
The DMS concentration in the finished product can be significantly reduced by wort precooling during cast-out. This is achieved using a separate small plate heat exchanger or by cooling a partial wort flow with the existing wort cooler. This process does not affect the warm water balance of the brewhouse.

4: Vapor condenser
Energy recovery systems in the brewhouse are applied where most thermal energy is consumed: during wort boiling. Apart from the start-up and shutdown quantities, which are technically unavoidable, the vapor condenser also helps to significantly reduce vapor emissions.
Innovative design and reliable functionality: the GEA JETSTAR®

GEA recommends the use of an internal boiler for wort boiling as it offers considerable advantages compared with an external one.

An internal boiler works on a purely physical basis: steam bubbles create a density difference between the wort in the internal boiler tubes and the kettle, thus ensuring continuous circulation. This principle, also known as thermosiphoning, works without a circulation pump and minimizes mechanical stress on the wort.

With internal boilers, wort circulation rates are much higher than with external ones. During boiling, wort is circulated at a rate of 15–30 times per hour, depending on the boiling conditions, which ensures a homogenous temperature throughout the entire wort kettle. The tube bundle is located in the middle of the medium to be heated; it emits heat straight into the wort and not the surroundings. With the patented JETSTAR®, our innovative internal boiler design achieves better wort homogeneity in the kettle.

Always hygienically safe

The JETSTAR® allows optimal cleaning. Compared with circulation pump-based systems, it enables the complete drainage of water and detergents without residues. A short intermediate cleaning stage during the normal brewing process ensures constant boiling conditions and, thus, on-specification wort qualities.

The short program includes prerinsing with water, caustic cleaning, neutralizing and post-rinsing with water and takes only 20 minutes. As such, the brew cycle time is not affected.

The Subjet: key for process intervention

With the Subjet – an adjustable and switchable opening below the wort surface – wort boiling is made even more flexible; the process can be controlled more precisely and recipes can be designed more flexibly.
During wort heating, the Subjet is open and the wort flows back into the wort kettle below the wort surface. Without counterpressure, the circulation rate of the internal boiler increases and wort homogeneity in the kettle is improved, which reduces thermal stress during heating. The inherent tasks of controlling the temperature-dependent substance conversions and evaporation can now be designed largely independently.

**Efficient evaporation with the two-level wort spreader**

The two-level wort spreader distributes the wort over the wort surface on two different levels. The more homogenous flow conditions and the larger surface area ensure the efficient evaporation of undesired aromas. At the same time, foam formation on the wort surface is also significantly reduced.

1. Two-level wort spreader
2. Subjet orifice
3. Cone
4. Shell and tube heat exchanger
5. Steam/hot water
6. Condensate/hot water
Two-phase boiling for efficient processing

Phase 1: Thermal conversion
At the beginning of the boiling process, the Subjet remains open and the wort continues to flow out below the wort surface. Then, a boiling phase with an extremely low evaporation rate follows. It is, however, possible to influence certain temperature-dependent reactions, such as hop isomerization and protein coagulation, to eliminate undesirable odorous substances and enhance the formation of important flavor components via the time parameter. High circulation rates at low steam pressures preserve the foam-positive substances in the wort. Furthermore, optimized mixing of the kettle content ensures a uniform wort temperature.

Phase 2: Evaporation
For the evaporation phase, the lower Subjet opening is closed. By adjusting the steam pressure, the evaporation rate is increased to the required value and the wort circulates via the two-level wort deflector. The large surface area thus created ensures the effective evaporation of undesired aromas. Owing to the extensive reduction of the DMS precursor in phase 1, a comparably low evaporation rate is sufficient to achieve the desired final content of free DMS and other flavor components in the cast-out wort. This two-phase wort boiling process is not only suitable for atmospheric kettles, but can also be combined with Dynamic Low-Pressure Boiling (as shown below).
Higher brewhouse capacity

Improved wort homogeneity in the kettle
Implementing the JETSTAR® results in a substantial improvement of the mixing process in wort kettles with an internal boiler. Owing to an increased impulse exchange, the usual short circuit flows are almost completely eliminated and temperature distribution is improved. The more homogenous temperature distribution accelerates conversion processes. The chart illustrates the comparative degradation of DMS-P in a conventional internal boiler and a JETSTAR®. The higher average temperature in the JETSTAR® kettle reduces the half-life of the DMS-P by 7 minutes.

Trial conditions
- Constant atmospheric boiling
- Same wort kettle
- Same brew length (650 hL CW)
- Raw material composition (same malt silo)
- etc.
Atmospheric boiling or low pressure boiling

Because of their altitude, some brewery locations may require the application of increased pressure during wort boiling. Here, we can accommodate any specific requirement, from boiling at constant pressure up to low-pressure boiling.

GEA has developed the low-pressure boiling system to a level that’s suitable for practical application. We have consistently advanced this technology and developed the Dynamic Low-Pressure Boiling system (Dyn. LPB). Today, we combine atmospheric boiling with Dyn. LPB and the JETSTAR® to create user-oriented solutions.

A more dynamic process
The advantage of the Dyn. LPB is the faster evaporation of undesired aromas owing to intensive interval boiling. As soon as the predetermined pressure is reached, a systematic pressure reduction starts under strictly defined conditions. As pressure is reduced, the boiling temperature in the vessel decreases, accompanied by spontaneous steam bubble formation throughout the entire kettle. This “controlled boiling delay” results in a very large gas/liquid contact surface, thus ensuring the optimum stripping of volatile aromas.

Pressure control during Dyn. LPB
Depending on whether a vapor condenser is used or not, various methods can be employed to control the pressure. In plant without vapor condensation (see left in the next page), we can install a bypass pressure control valve in the vapor pipe. When using a vapor condenser, the pressure is controlled via the water flow rate from the energy storage tank. The water feed is considerably reduced during the pressure build-up phase (see right in the next page).

Facts & Figures
• Innovative wort boiling process with two-phase boiling – the thermal conversion processes and evaporation are independent from each other
• Natural circulation evaporator – no additional circulation pump required
• Reduced pulsation
• Efficient evaporation with a two-level wort spreader
• Stationary operating conditions during wort heating
• Homogenous wort mixing in the wort kettle with low TBI values
• Better hop yield owing to higher average temperatures in the wort kettle
• Technological flexibility enables varied recipe design for special beer types
• Easy to retrofit into existing wort kettles
• Hygienic design facilitates cleaning
• Energy efficient and works well with any type of energy storage system
• Intelligent Wort Management (IWM) software compatible
1. Divert Valves
2. Pressure Probe
3. Wort Kettle
4. Vapor Condenser

Wort kettle with JETSTAR®
- without vapor condensator
- with vapor condensator

Wort

Vapor

Condensate

Warm water from energy storage

Hot water to energy storage

Vapor Condenser

Wort Kettle

Pressure Probe

Divert Valves
GEA is one of the largest technology suppliers for food processing and a wide range of other industries. The global group specializes in machinery, plants, as well as process technology and components. GEA provides sustainable solutions for sophisticated production processes in diverse end-user markets and offers a comprehensive service portfolio.

The company is listed on the German MDAX (GiA, WKN 660 200), the STOXX® Europe 600 Index and selected MSCI Global Sustainability Indexes.

We live our values.
Excellence • Passion • Integrity • Responsibility • GEA-versity