

Sterilizing Food

Sterilization by means of heat is one of many technologies applied to improve the shelf-life of packaged food. Alternatives can be UHT-processing and aseptic filling (for liquid products) and chilling and freezing (for liquid and/or solid products).

Sterilized food processing lines come in two fundamental solutions: aseptic lines and in-container lines.

In an aseptic line, a sterile container is filled with sterile product in a sterile environment. It is a continuous process typically limited to liquid products with small particles.

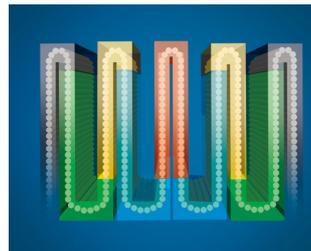
In-container sterilization, on the other hand, is a proven technology that provides safe and effective low acid food products and renders them shelf-stable ($\text{pH} > 4.5$). An unsterile container is filled and sealed with unsterile product in an unsterile environment. The product is then sterilized inside the container as it passes through the sterilization processing line. There are two types of sterilization processing lines: continuous rotary and hydrostatic sterilizers and batch retorts.

Continuous rotary and hydrostatic sterilizers process a constant steady flow of containers into a continuous way. This system ensures the continuous infeed, processing and discharge of the product containers. By means of container guides, containers move through a series of shells or towers to pre-heat, cook, pressure cool and cool each single container exiting the system.

Continuous sterilizers are typically used for high-volume products of a similar container type or size. These retorts permit short-time, high temperature cooking and rapid, efficient cooling in an automatic, continuous operation. Every container is cooked and cooled in the same manner and receives exactly the same thermal process for consistent product quality. Reduced processing time helps preserve the product's natural flavor, nutrients and appearance.



▲ JBT Continuous Rotary Pressure Sterilizer
▼ JBT Hydromatic™





Batch retorts process product containers into baskets or crates. A steady flow of containers moves onto an accumulation table to a basket loader. The filled baskets form a train of product and are moved into a retort vessel for thermal processing. Once the cycle is complete, the baskets leave the retort vessel and are unloaded on a conveyor for further handling.

Retorts can easily be configured to handle a large range of container types and process a wide array of product recipes. Batch retorts offer high product and container flexibility, since the retorts are recipe-driven for each cycle. Batch No. 1 can be peas in a can, Batch No. 2 can be sauce in a pouch and batch No. 3 can be a beverage in a glass bottle. Today's batch retorts can be configured to run multiple processes to afford food processors maximum flexibility.

Automating the basket staging, delivery, loading/unloading results in an **Automated Batch Retort System (ABRS)**. From the crate loader the filled crates are transported to a batch-loading area where a full retort load is composed. A shuttle car then brings this load to one of the retorts and the load is automatically transferred into it. Once the sterilization cycle is completed, the loads are pushed back onto the shuttle car and subsequently transported to the batch unloading area. In such a set-up, the control systems of the individual func-

tions in the retort line are synchronized by an advanced communication system. Automated retort rooms lower labor costs and increase throughput. Including basket readers for basket tracking, allows the system to monitor the sterilization status of each batch of product and to ensure digital record-keeping for quality control and regulatory review.

Generally speaking, continuous sterilizers offer enhanced reproducibility and consistency. A batch retort, on the other hand, frequently offers more product, container and production flexibility.



Putting the heat on

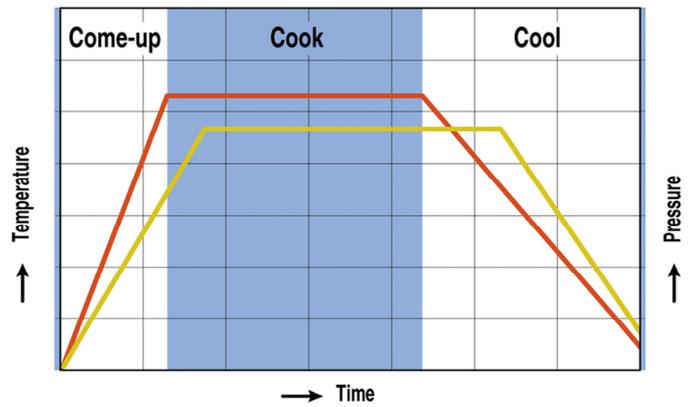
Although product formulation plays an important role in retorted products, it is the thermal process that ultimately affects the finished product's quality. The accurate design of the thermal process for your particular product is the starting point in your search for the most appropriate retort.

Thermal process design Product safety first

The goal of retort processing is to obtain commercial sterilization by the application of heat. While the thermal process is designed to destroy or render inactive spoilage organisms, certain bacteria may survive the process, so the product is safe under normal conditions of storage, but not necessarily sterile. The F_0 value is commonly used to compare heat treatments and describes the amount of time needed to reduce the microbial population by a factor of 10^{12} . For *C. botulinum*, for example, a heating time of 3 minutes at 121°C (250°F) reduces the population by this factor.

In order to ensure commercial sterility, the entire food mass in the container must undergo the required temperature for the required time. However, extended exposure to heat affects the quality of the finished product. The higher the temperature, the faster the kill rate, and therefore the shorter the exposure necessary. Most retorted products will benefit from a high-temperature, short-time process.

Another perspective to consider is heat transfer within the product container: the time it takes to reach the thermal processing temperature (the come-up time) at the coldest point in the container. It stands to reason that different container shapes and types require special thermal designs. In the retort process, the heat must be transferred through the wall of the container to the product. Different types of packaging have different thermal conductivity values: metal has the highest and plastic the lowest. Other critical factors to consider are e.g. the headspace in the container, the viscosity of the product and the initial temperature of the



product before entering the retort. Lastly, does your product need agitation? Indeed, some products benefit from agitation during the thermal process for better induced convection heating and to protect the product nearest to the outside from 'burning' at higher temperatures.

Batch retorts also may contain rotating racks that agitate the product in an end-over-end manner. This speeds up the heat transfer in products that flow by agitating the content by moving the air bubble through them that is created by the headspace. Without this bubble, there is little if any advantage in using an agitating system for solid pack foods.

To conclude, there are two aspects in determining the optimal thermal process. There is the microbiological side where we need to know what the resistance is of a particular organism of concern in order to determine the amount of heat needed. On the processing side, we determine how much heat is transferred to the product in the container. Bridging the two perspectives gives us the required thermal process.

Thermal process design A scheduled temperature/pressure process

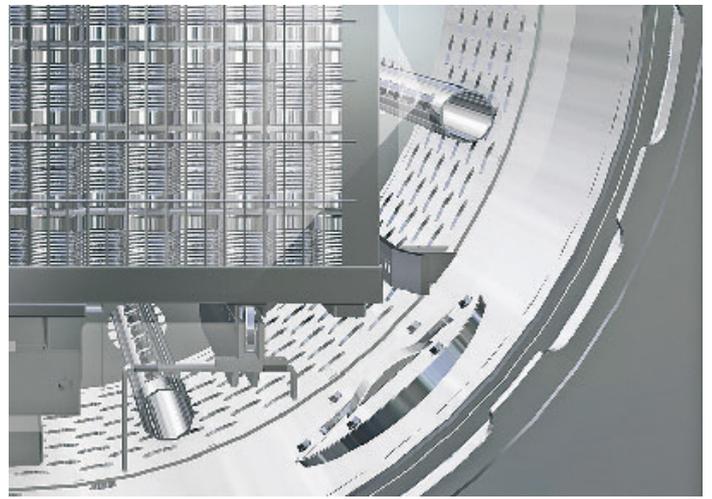
During the retort process, pressure inside the product container increases due to the expansion of the product, increased vapor pressure and the heating of air in the headspace. To maintain container integrity this phenomena must be compensated for by overpressure in the come-up, cook and cool stages.

Catching up with JBT Batch Retort Technology

For JBT, a performant retort system is based on an advanced processing principle with a unique sterilization control system that provides a consistent, optimal and efficient thermal processing system under full management control. Our guiding principles in this matter are consistent product quality and safety, and the lowest cost per unit produced. JBT customers achieve these set values through different technical developments installed on JBT batch retorts.

The Steam Water Spray™ Process

The steam water spray technology is standard installed on static and agitating JBT batch retorts. Steam is directly injected in the bottom of the retort for fast and uniform come-up. Water sprays running over the entire shell length intensively mix steam and water and create homogeneous temperature distribution. The key to the steam water spray functionality is the ability to pump the process water and spray it turbulently throughout the retort. The water re-enters the shell through specially designed nozzles that 'atomize' it into very small droplets or vapor. The spray pattern from the nozzles is conical, which creates overlapping spray patterns throughout the retort and virtually leaves no dead spots. This technology ensures uniform

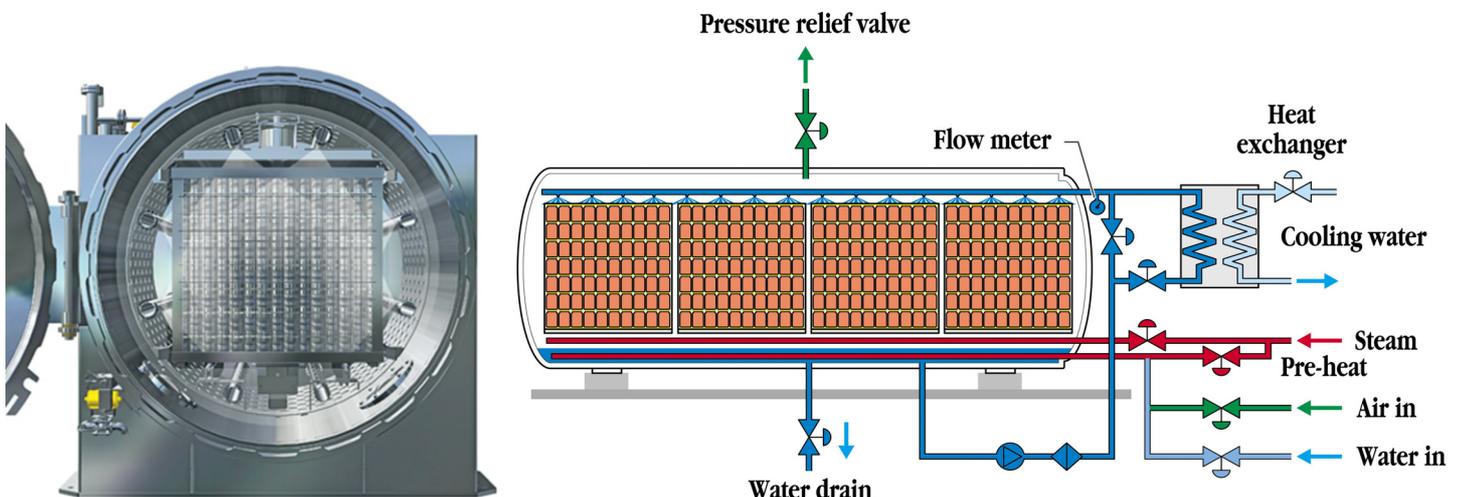


thermal treatment of all containers while providing an efficient counterbalance to the pressure created inside the packaging.

Highly sensitive temperature and pressure probes, high quality proportional control valves and PID control loops ensure accurate process control during the entire sterilization cycle. For maximum product safety, retorts are standard fitted with an absolute flow meter and analogue water level control probe.

The Steam Water Spray process enables micro-cooling. This controlled and gentle transition from sterilization to cooling avoids thermal shock or uncontrolled pressure drop. For other, particular product types, the turbo-cool option increases cooling capacity resulting in reduced cooling time and higher throughput.

JBT batch retorts equipped with steam water spray technology are considered to offer the highest degree of versatility for all types of packaging designs.



Efficient Agitation

JBT retorts can be equipped with an optional JBT Efficient Agitation unit. The containers are horizontally positioned into the baskets. The baskets are then gently shaken horizontally during the process. This back-and-forth agitation creates optimum headspace movement and considerably improves convection heating in the container. Lab tests demonstrate that efficient agitation delivers more movement of liquid and particles inside the container, resulting in faster heat transfer, less clumping and better mixing of particles and liquid. In addition, efficient agitation reduces investment cost, maintenance cost and energy consumption for the agitation process in comparison with end-over-end or rocking agitation.

Energy Recovery Systems

The JBT Steam Water Spray retorts can be equipped with energy savings systems to save water, water treatment chemicals and energy.



Reduced process water volume

To reduce process water volume, the retort can be equipped with an optional suction pipe that allows lower water levels during processing. This significantly reduces the amount of process water and therefore reduces the steam consumption and the load on the cooling tower.

Process water pre-heating

Another optional process water pre-heat system saves energy and ensures consistent process delivery for warm- or hot-filled products. How does it

work? Heat from the hot cooling water is recovered to pre-heat the cold process water before the start of the sterilization process.

Specifications and assumptions

Product: non-carbonated beverage
Can: Ø52 x 104 mm - 180ml (= 180g)
Process 75 min
Preheat: 3 min
Come-up: 12 min
Cook: 30 min
Cool: 30 min
Hot-fill: 70°C
Sterilization t°: 121°C
Process water t°: 35°C
Material handling time: 10 min - Total cycle time: 85 min
28,980 containers/retort
Production: 7,200 h/yr - Net production: 6,500 h/yr (90%)
Number of cycles/yr/retort: 4,575 - Number of retorts: 4
Cost of steam: 68€/ton
Cost of (hot) boiler feed water: 30€/ton

Calculation of savings

REDUCED PROCESS WATER VOLUME

The reduction in process water volume is estimated at 650 liters. This results in a reduction in steam consumption of approx. 100 kg/cycle.

PROCESS WATER PREHEATING

Process water is heated from 35 to 95°C using energy from the hot cooling water. Total heat recovered from the cooling water is approx. 308,000kJ.

INDIRECT HEATING

Indirect heating recovers the condensate as boiler feed water. Assuming that both reduced process water volume and process water preheating are implemented, the net steam consumption drops with 25%.

SAVINGS

Steam consumption per cycle: 237 kg
Value per year per retort: $237 \times 4575/1000 \times €68 = €73,730$
Total value for 4 retorts: €294,920

Boiler feed water per cycle: 690 kg
Value per year per retort: $690 \times 4575/1000 \times €30 = €94,700$
Total value for 4 retorts: €378,800

Total annual saving: > €680.000

Indirect heating through a steam-water heat exchanger

Instead of direct steam injection, the recirculating process water passes through a steam/water heat exchanger. This allows the condensate to be recovered and returned to the boiler, avoiding the costly make-up and preheating of the boiler feed water.

JBT PROCESS TECHNOLOGY CENTRE AT YOUR SERVICE

With PTC's in Europe, Asia and the Americas, JBT provides a broad range of added-value services to improve processing and packaging techniques. JBT has the staff, equipment and experience to perform the required heat penetration, temperature distribution, container performance testing and process validation studies in our pilot facility or right in your own plant.

The JBT Pilot Sterilizer simulates rotary, hydrostatic or still processing for all container sizes and speeds, and is used for heat penetration tests, container performance testing and product quality evaluation. JBT is a USDA/FDA-recognized process authority.

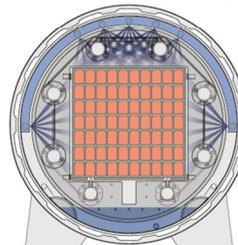


SuperAgi™ The Ultimate in Thermal Processing Flexibility



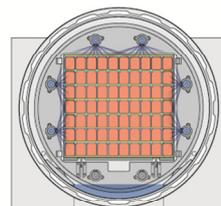
The compact and innovative design of the SuperAgi™ vessel generates particularly attractive benefits for food processors. The new design ensures less utility consumption per unit produced. How does it work? In a conventional retort vessel with a conventional basket of 954 x 954 x 909 mm and a heavy tubular structured drum, the shell measures 1,800 mm. In a SuperAgi™ the light perforated plate structured drum closely links to the basket - with spray pipes integrated in the drum. The vessel measures 1,500 mm. The narrow fitted drum enables top clamping of the basket, ensuring high holding capacity for a large range of container types. The smaller diameter of the vessel and the narrower void between drum and shell generate savings in steam, compressed air and cooling/process water with minimal Fo differences.

Conventional design



Basket : 954 x 954 x 906
Drum: 1610 mm outside
Shell: 1800 mm inside

SuperAgi



Basket : 954 x 954 x 909
Drum: 1450 mm outside
Shell: 1500 mm inside

Excellent temperature distribution Utility consumption gains

The new design also ensures better heat distribution in static or agitating mode through a patented process water delivery method. The system pumps water to the spray pipes integrated in the drum through a rotary coupling located inside the shell. This way, process water follows the product, eliminating shear effect and ensuring deeper water penetration into the load. The offset nozzle configuration provides even water distribution for the whole container surface area. This innovative water spray technology results in superior temperature distribution and significant energy and cooling water savings.

Furthermore the unique spray concept allows operation at high rpm (up to 20) while still achieving excellent temperature distribution.

Since the useful life cycle of a retort is a minimum of 25 years, energy and water savings are of particular relevance to lower production cost per retorted container.

Multi-process capability

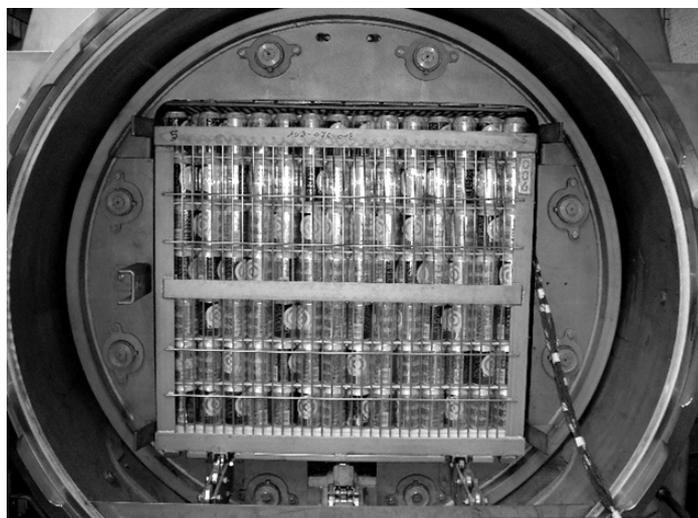
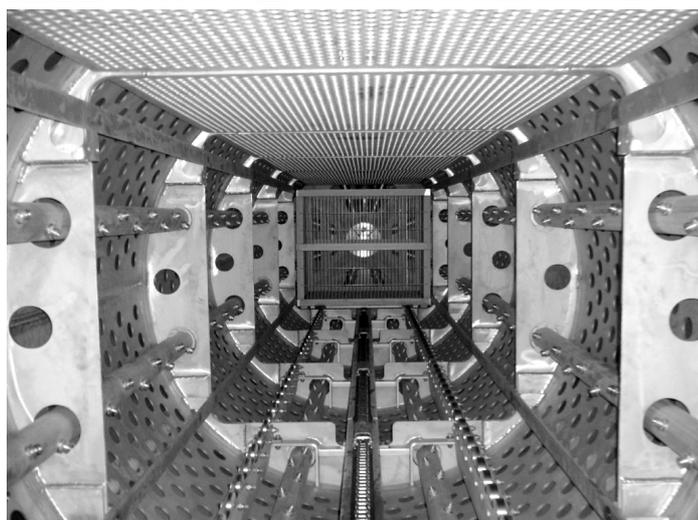
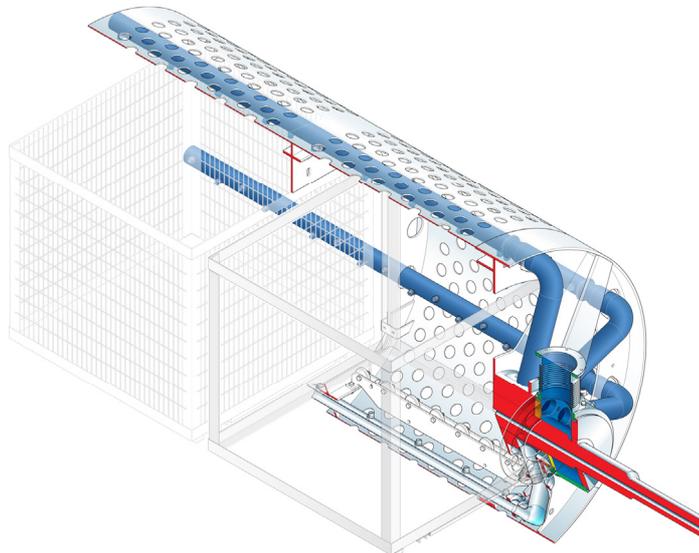
SuperAgi™ is available in steam water spray and full or partial water immersion mode, offering full container and process flexibility. Water immersion for high RPM processing and containers that require buoyancy. Partial Immersion for tight-pack rigid containers with minimal water channeling capability. By combining different process modes in one single machine, every package/product combination gets the most economical and gentle process.

Consistent process delivery

High temperature processes have shorter process times. This entails the need for accurate process control. A deviation in time, pressure or temperature when processing at high temperature for only a short time becomes a more critical issue. In the same way, the cooling process also affects the quality and safety of the finished product.

Each JBT retort in a retort room is equipped with a local controller with touch screen that monitors the sterilization program and allows interventions during the retort process.

JBT's Log-Tec® thermal process controls generally monitor the retort system, consisting of one or

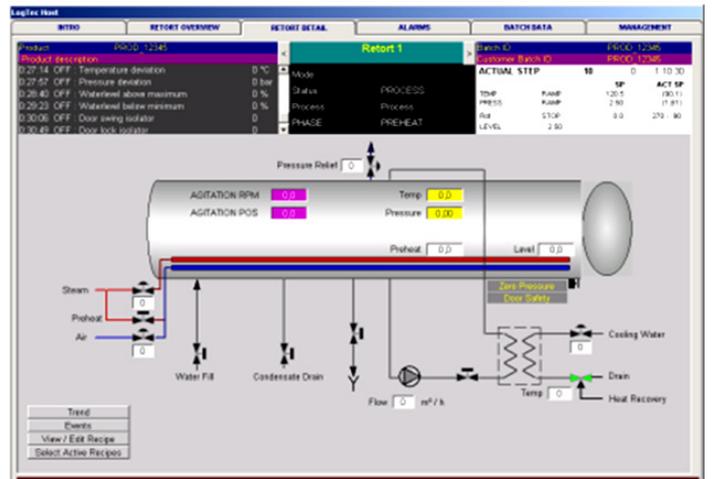
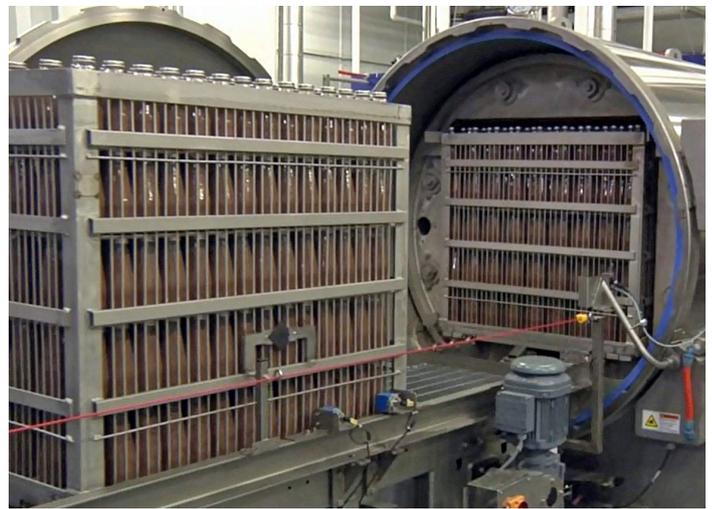


more batch retorts, on a central host PC. They execute self-tests and check all field devices and sensors prior to start-up. Log-Tec® also controls centrally and automatically records temperature deviations without operator intervention. Optional online lethality tracking software allows process deviation correction on the basis of online Fo calculation.

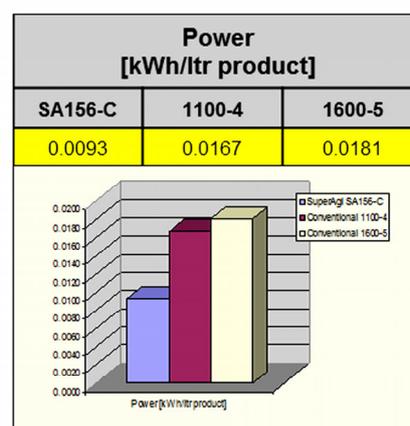
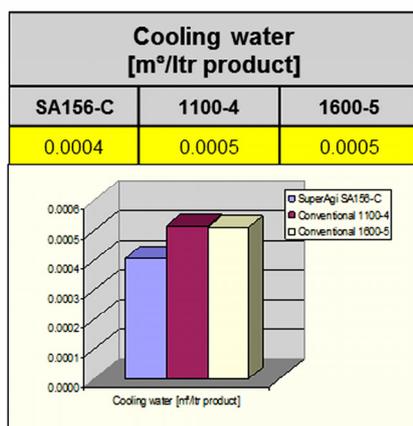
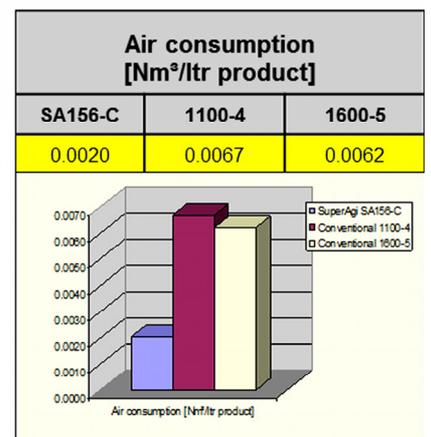
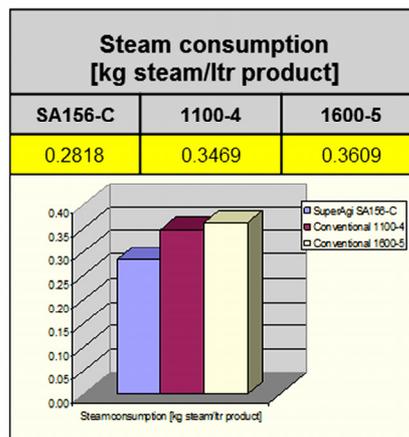
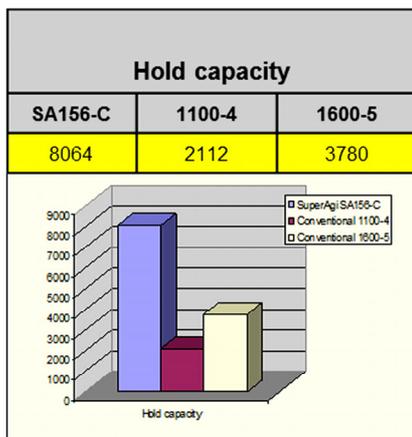
Log-Tec® thermal process controls incorporate a central host PC for easy supervision of the retort installation. Process recipes are edited and managed on this host PC. Process data is safely stored in encrypted format and access to the various functions of the host system is password-protected.

The comprehensive Log-Tec® software ensures exact repetition of programmed sterilization profiles, such as programmed temperature ramps in the come-up and cooling phases, temperature overshoot at start of cook etc., reducing Fo spread.

Log-Tec®-generated process records meet HACCP requirements and are unconditionally accepted by the FDA and USDA.



▼ Utility consumption example. SuperAgi™ SA156-C model versus conventional 1100-4 and 1600-5 retorts



Automated Batch Retort Systems

The trend in food processing is to move away from small retort vessels to larger shells to improve efficiency and product safety. Larger vessels imply larger baskets that can't be handled manually. Large baskets are simply too bulky and too heavy for one person to move around.

The need to handle these enormous baskets opens the way for ABRS. 'Automated Batch Retort Systems' (ABRS) refers to the fully automated integration of all hardware designed for transportation of baskets from loader station to sterilization retorts and from there on to an unload station and packaging area. The global handling system can be monitored by a basket/pallet tracking system.

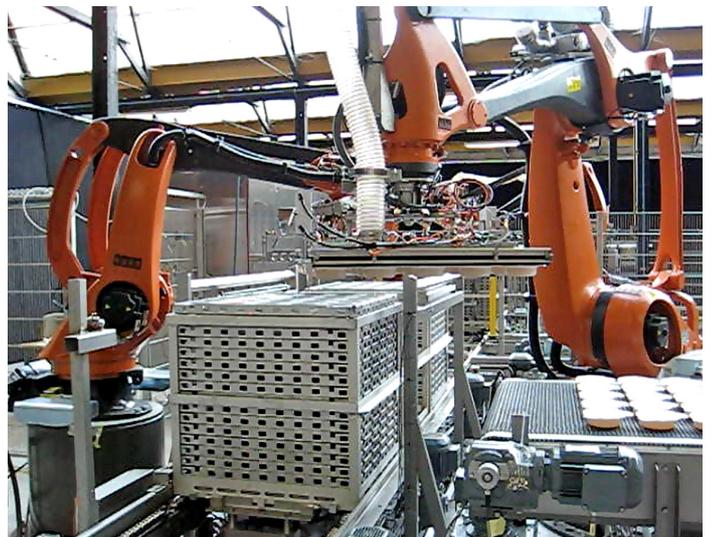
Loading and unloading systems

For the design of baskets, layer pads and loading/unloading hardware, JBT is working with experienced, dedicated partners. With over 20 years' experience in the field, JBT can offer a wide range of solutions for the loading/unloading of glass, metal, flexible and semi-rigid containers in baskets or trays destined for sterilization in autoclaves. The range of JBT loaders and unloaders extends from semiautomatic systems for low outputs (1-1.5 layers/min) to fully automated systems for high-speed requirements (over 5 layers/min).

Equipment is entirely made of stainless steel. Modular solutions allow the plant to be easily adapted to the customer's spatial needs and the type of basket used.

In a semiautomatic loading/unloading system, the plastic layer-pad is placed/removed by the operator. All other operations are automatic once this manual action is completed.

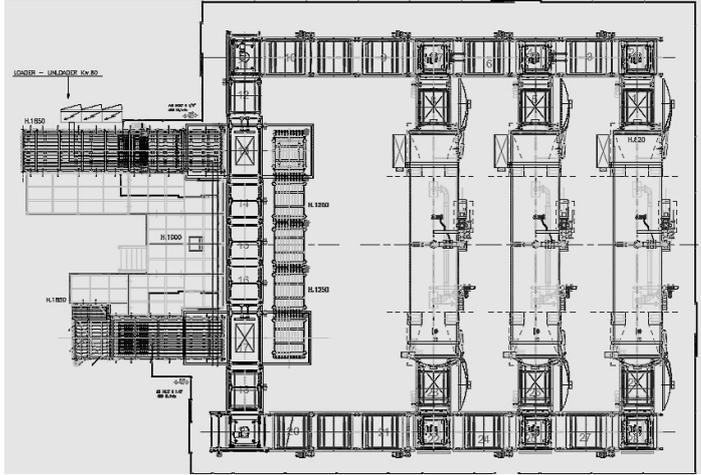
Examples of full automatic load/unload systems



Transport systems

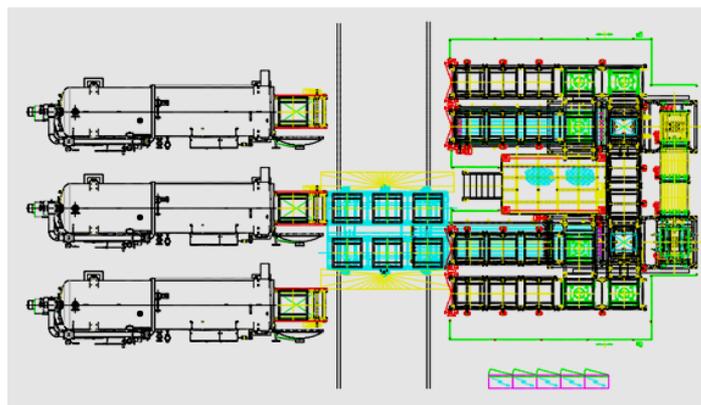
Different alternatives are available to transport full/empty baskets to/from the retorts: by fixed conveyor, shuttle on rails or automated guided vehicles (AGV).

All JBT retorts can be ordered with resident, internal conveyors for automated basket loading/unloading. Conveyors are made of stainless steel and are designed to integrate with external conveyors.



- ▲ Loaded baskets feed the retorts by a fixed conveyor (double-door vessels)

The shuttle is an automated basket delivery system that delivers and collects batches. The shuttle is integrated with the conveyor system of loader/unloader.



- ▲ Loaded baskets feed the retorts by a shuttle on rails (single-door vessels)

The JBT automated guided vehicle (AGV) is a machine that operates without track. A short conveyor section is mounted on the AGV that docks with the

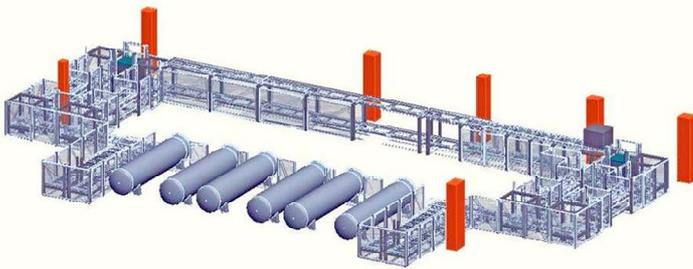


loader to pick up baskets for retorting. A fleet of conveyor-deck AGVs transports baskets from the loader conveyors to the batch retorts for high temperature cooking. Once the sterilization cycle is complete, the retort opens automatically and an AGV is sent for unloading. An AGV is ordered to remove the baskets and deliver them to the unloader or a buffer conveyor. AGVs also transport empty baskets to and from the buffer conveyors.

An AGV Manager Host Software system coordinates all vehicle movements and communicates with plant production software to facilitate basket movement.

For more info about JBT AGV, please go to www.jbtc-agv.com



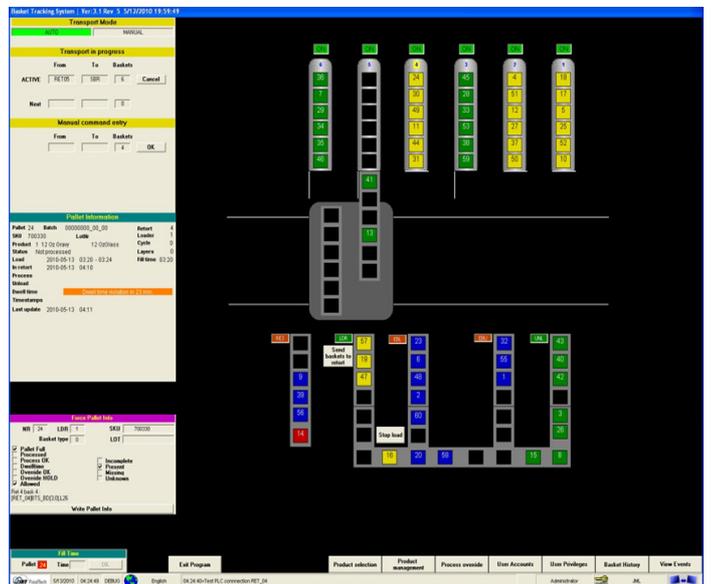


Basket/Pallet Tracking System (BTS)

The whole operation of an ABRs stands or falls with a performant tracking system for the baskets and product process batches.

BTS not only coordinates all movements of baskets, but also records all data and monitors pre-process dwell time deviations. The eyes of the BTS are the barcodes that identify the baskets in key locations of the process while they move along: loading (fill time for dwell time tracking), in the retort, Process start and end, and unload. BTS flags any anomaly (e.g. baskets with a different product, unsterilized or wrong product at unloader etc.). In that case, a QC privilege is needed to release the product that has been flagged.

Screen visualization provides a good system overview, so that only a small number of operators can keep an eye on a multi-retort system.



JBT can offer you a complete turn-key solution for the implementation of an automated batch retort room: batch retorts, loaders/unloaders, transport system, tracking system and central host monitoring.

Our JBT lab assists you in designing your thermal process to deliver consistent product quality and safety, at the lowest cost per unit produced.

hello@jbt.com
www.jbtcorporation.com



Food processing expertise at your service, around the globe

Our mission: providing you with maximum uptime and smooth operation. Therefore, you can count on JBT for technological support, installation supervision, training and after-sales support anywhere in the world.

JBT has a long history of food processing equipment. Having sold over 40,000 machines worldwide our service technicians have faced and solved some of the toughest problems for processors within the food industry. JBT offers OEM parts for repairs and maintenance. Over 6,000 parts can be shipped within 24 hours to all continents. Other examples of JBT customer service include the standard exchange assemblies and preassembled kit to reduce downtime due to maintenance and repair. Our range of service packages make sure your equipment keeps running as profitably as possible, for as long as possible. With minimum downtime.

More than 50% of the world's shelf-stable foods are filled, seamed or sterilized on JBT equipment. With several thousands of canning lines in operation worldwide, JBT is the world's leading supplier of integrated processing solutions for metal, glass and plastic containers. From single machines to complete processing lines, we enhance product value and safety. JBT equipment captures the quality, nutrition and taste of your product at the lowest cost per unit produced.



Europe

John Bean Technologies N.V.
Breedstraat 3
9100 Sint-Niklaas | Belgium

Tel: +32 3-780.1211
Fax: +32 3-777.7955
fpsd.info@jbtc.com

JBT Netherlands B.V.
Gyroscoopweg 84-1
1042 AX Amsterdam | The Netherlands

Tel: +31 20-723.4700
Fax: +31 20-411.8273

John Bean Technologies S.p.a.
Via Mantova 63 A
43122 Parma | Italy

Tel: +39-0521-908.411
Fax: +39 0521-460.897
sales.parma@jbtc.com

North America

John Bean Technologies Corporation
2300 Industrial Avenue
Madera CA 93639 | USA

Tel: +1-559-661.3200
Fax: +1-559-661.3156
madera.fpsd@jbtc.com

Latin America

John Bean Technologies Ltda.
Av. Engenheiro Camilo Dinucci, 4605
14808-900 Ararquara SP | Brazil

Tel: +55-16-3301 2000
Fax: +55-16-3301 2155
latinamerica.info@jbtc.com

Asia Pacific

John Bean Technologies Thailand Ltd.
159/26 Serm-Mit Tower, Room no. 1602-3
Sukhumvit 21 Road
Klongtoey Nua Sub-district, Wattana District
Bangkok 10110 | Thailand

Tel: +66-2257.4000
Fax: +66-2261.4099
infoasia-jbtfoodtech@jbtc.com

