



## YEAST-STAR™:

The yeast propagation concept for breweries.

# Always the right solution.

Our process systems focus on optimum process sequences, hygienic design and gentle product handling. Whether you choose a system featuring mainly standardized elements or prefer to have it fully customized, you can be sure that GEA Brewery Systems has the experience and the understanding of customer requirements to offer you a solution that is just right for you. When designing a new system we utilize tried and tested principles, modifying them as required to suit each individual case. This strategy ensures optimized plant capacity and maximum functionality. For our customers, this means system efficiency and reliability.

GEA Brewery Systems has gained a lot of experience particularly in the field of yeast propagation. Together with the state of the art and the requirements of our customers this experience forms the basis of our yeast propagation system YEAST-STAR™.

## Features of YEAST-STAR™

- Vigorous, actively fermenting yeast
- Less equipment required
- Optimal aeration rates
- Circulation loop
- Sterile air station with candle filter and product trap
- Optional: In-line alcohol measurement, automatic determination of yeast cell count, etc.

## Vital in the fermenting cellar – yeast management

Yeast management is the core of a brewery. For ideal yeast propagation – and thus for a good beer – hygienic plant design is essential. Yeast quality is defined particularly by the preservation of yeast viability and by optimized yeast vitality. GEA Brewery Systems offers everything for comprehensive yeast management.

Yeast is the most important component in beer production – its properties have a decisive influence on the quality, flavour and filterability of the beer. As the variety of types increases, the degree of automation often increases as well. Thus, professional yeast management gains in importance. Besides the selection of the right yeast strain, the cultivation and propagation of healthy yeast cells, the recycling of excessive yeast also plays an important role.

The aim is to create ideal conditions for the yeast from yeast propagation through fermentation to the storage phase. This is essential for a stable and reproducible fermentation process and consistently high beer quality.



## Yeast management systems from GEA Brewery Systems meet the highest hygienic standards

Tanks and pipes are suited for hot cleaning – the entire system can be steamed. Both aeration and homogeneous mixing take place with minimum shear stress.

### Standard solutions individually adjusted

Based on extensive experience in the field of yeast propagation we have developed our standardized yeast propagation system YEAST-STAR™. The application and combination of well-proven components and procedures ensure very good yeast propagation characterized by high reproducibility and remarkably high yeast quality.

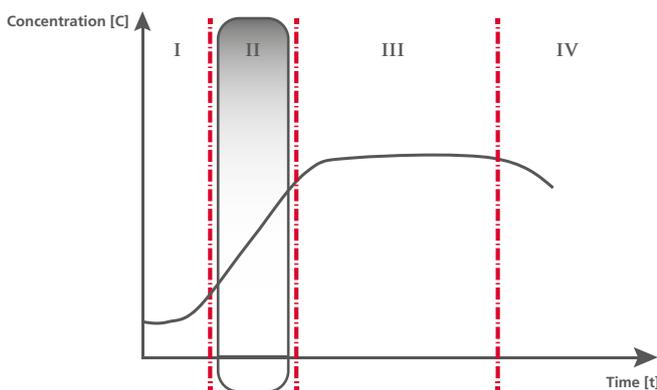
The YEAST-STAR™ has four fundamental characteristics:

- Gentle homogenization of the yeast suspension
- Optimized aeration
- Temperature control adapted to the overall process
- Special yeast nutrition

The applied method is particularly gentle and adapts to the specific requirements of yeast. With the special process technology we optimize the propagation process and thus speak of assimilation. The aim is to prepare the yeast for the later fermentation conditions already during yeast propagation.

The proven repeated-fed-batch process creates constantly stable conditions in the propagation tank. Thus, the yeast does not go through all physiological states: It stays permanently in the logarithmic growth phase. This leads to actively fermenting yeast with an especially high percentage of viable cells. Furthermore, the requested yeast quantity is produced within a short period of time. Depending on the nutrient composition and the yeast strain, yeast cell counts of 100 to 120 million cells/ml are obtained with doubling times of about 8 hours. Even cell counts of 160 million cells/ml have been reached with the YEAST-STAR™.

GEA Brewery Systems has developed three basic types of yeast propagation systems which differ in the degree of automation, from completely manual to fully automatic. GEA Brewery Systems always has an appropriate solution. The technical principles and the process control remain the same.



#### Typical course of yeast propagation

- I: Lag phase (start-up phase)
- II: Log phase (logarithmic phase) – assimilation process
- III: Stationary phase
- IV: Death phase

Feature		YEAST-STAR™ type		
		Basic	Standard	High-End
Overall system	Manual	x		
	Semi-automatic		x	
	Automatic			x
Process connection	Automatic			x
Aeration	Automatic		x	x
Homogenization	Automatic		x	x
Temperature control	Automatic		x	x
CIP connection	Automatic			x

#### The degree of automation of the YEAST-STAR™ is adapted to customer requirements

The capacity of the YEAST-STAR™ is designed according to the requirements of the brewery. Only in this way can the optimal yeast quantity be produced exactly when it is needed. With standardized calculation programs we can determine the design parameters of your YEAST-STAR™ quickly and easily, tailored to your individual needs.

# Focussing on the best possible yeast quality.

The main elements of the YEAST-STAR™ are two tanks – a propagator and an assimilator. Both tanks have the same technical components, but they are used for different processes.

The yeast quantity required for the assimilation process is produced with the single-use method in the propagator. The yeast suspension from a Carlsberg flask is filled into the propagator and gradually mixed with fresh wort – while it is aerated and homogenized – until the desired yeast quantity with the requested cell concentration is obtained. Then the propagator content is transferred into the assimilator, where it is again gradually mixed with fresh wort, aerated and homogenized. In this process, the required yeast quantity for pitching in the fermentation tank as well as a residual quantity that remains in the assimilator is produced. This residue is used for the next propagation step in the repeated-fed-batch process.

## Homogenization

Advantages at a glance:

- Particularly homogeneous mixing
- Gentle to the product due to reduced shear forces and little foam formation

The YEAST-STAR™ is based on the circulation of the suspension through a circulation pipe by means of a speed-controlled centrifugal pump.

Reduced flow rates of 1 m/s minimize the shear forces and increase the vitality and viability of the yeast significantly.

The return socket of the circulation line is located below the minimum filling level in the tank shell. The special arrangement of the return socket ensures a very homogeneous mixing of the tank content.

As there are no agitators, there is no risk of infection caused by built-in components. Easy cleaning and the corresponding microbiological safety are essential and are special features of the YEAST-STAR™.

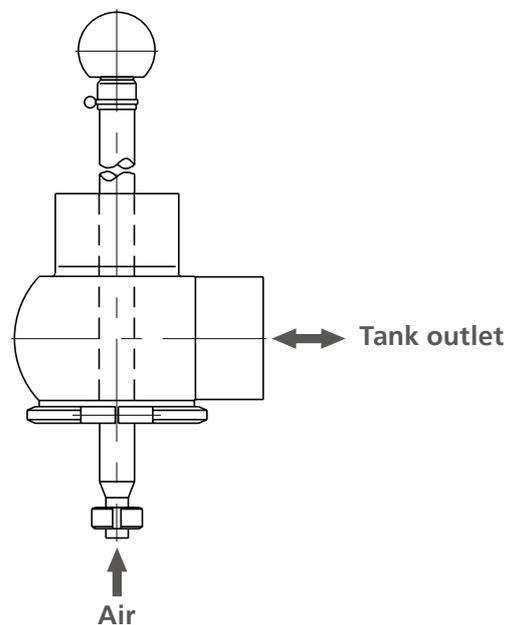
## Aeration

Advantages at a glance:

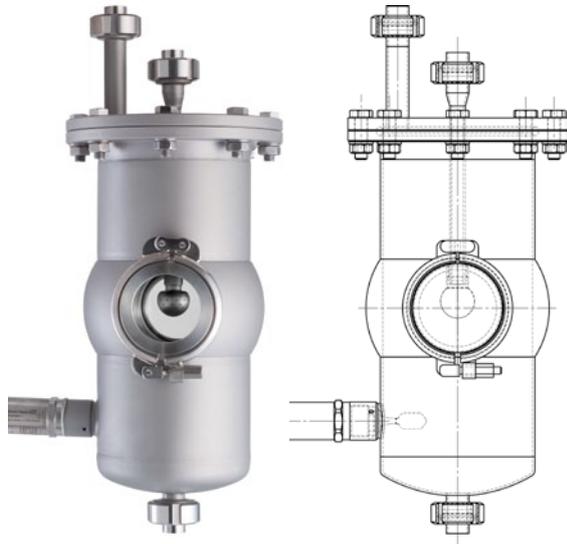
- Additional mixing
- Reduction of oxidative effects
- Less foam formation
- Excellent microbiological process safety

Aeration of the tanks is realized with a vertical aeration pipe in the cone. The simple design without any rotating internal components ensures optimal cleaning.

Moreover, a special product trap prevents the product from flowing back into the sterile aeration system. Also here, product safety is of paramount importance.



Aeration fitting in the tank outlet



**Product trap for safe separation of sterile air from the process**

Whether aeration is done with oxygen or with air – the use of individually tailored measuring equipment ensures optimal aeration control.

Everything is possible – aeration over fixed time intervals with specific volume flows, aeration that is adjusted to the oxygen concentration or aeration dependent on the cell count.

The measuring equipment and the degree of automation of the YEAST-STAR™ are adapted to individual customer needs. Excessive aeration is always avoided to reduce oxidative effects and the discharge of yeast cells from the suspension by foaming.



### **Temperature control**

For a faster start of fermentation, conditions that are similar to fermentation are created in the assimilator.

A temperature range of about 6°C above the fermentation temperature has proven to be particularly suitable. With this temperature range, the start of fermentation is improved, which also has a positive effect on the occupancy times of the fermentation tanks.

### **Nutrition**

Advantages at a glance:

- No sterilization of wort – complete range of nutrients is available
- No overfeeding of yeast – minimization of undesired secondary processes

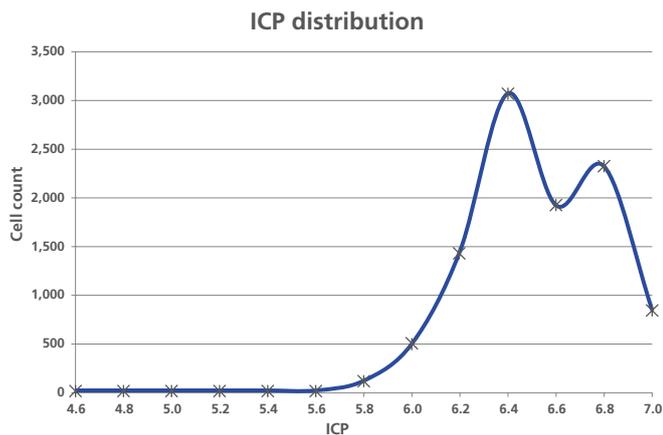
Not only in terms of temperature control, but also in terms of nutrient supply the conditions should be similar to those during fermentation.

Yeast that is actively fermenting right from the start must be adapted to the nutrient composition. Therefore, additional wort treatment steps like wort sterilization are not performed in the basic system. Wort heating results in a reduction of the wort's nutrient content. Particularly the complete spectrum of ingredients is necessary for yeast propagation. If the yeast is not adapted to this range, there may be negative effects even during fermentation.

Since the wort is not sterilized again, it is particularly important that the propagation unit is manufactured according to EHEDG guidelines. They are the basis of our process systems. It is essential that the yeast concentration does not fall below a minimum concentration of approximately 20 million cells per ml, so that the resistance of the yeast cells against infections is maximized. Undesirable ancillary processes are minimized by the improved ratio of yeast cell count to nutrient concentration.

# Yeast quality – Our conclusion.

The following diagram shows the distribution of the ICP value of a yeast sample measured in Weihenstephan. The yeast quality was determined by flow cytometric measurement of the intracellular pH value (ICP). The distribution is almost completely above the value of 6.0 and can thus be regarded as "very good".



Distribution of the ICP value in the yeast sample of a German brewery

By means of the CIP return pump the cleaning medium is removed from the yeast propagation system through the CIP return line. It is also possible to sterilize all the piping and tanks with steam.



## Air supply and cleaning (CIP)

Advantages at a glance:

- Microbiological safety due to excellent cleaning results
- Flexible and compact design
- Easy distribution and regulation of CIP/gas (supply and removal)

Depending on the chosen degree of automation of the system, the gas and CIP supply is also equipped with either swivel bends or with automatic seat valves. With these components it is possible to regulate the air supply and the distribution of the cleaning medium.

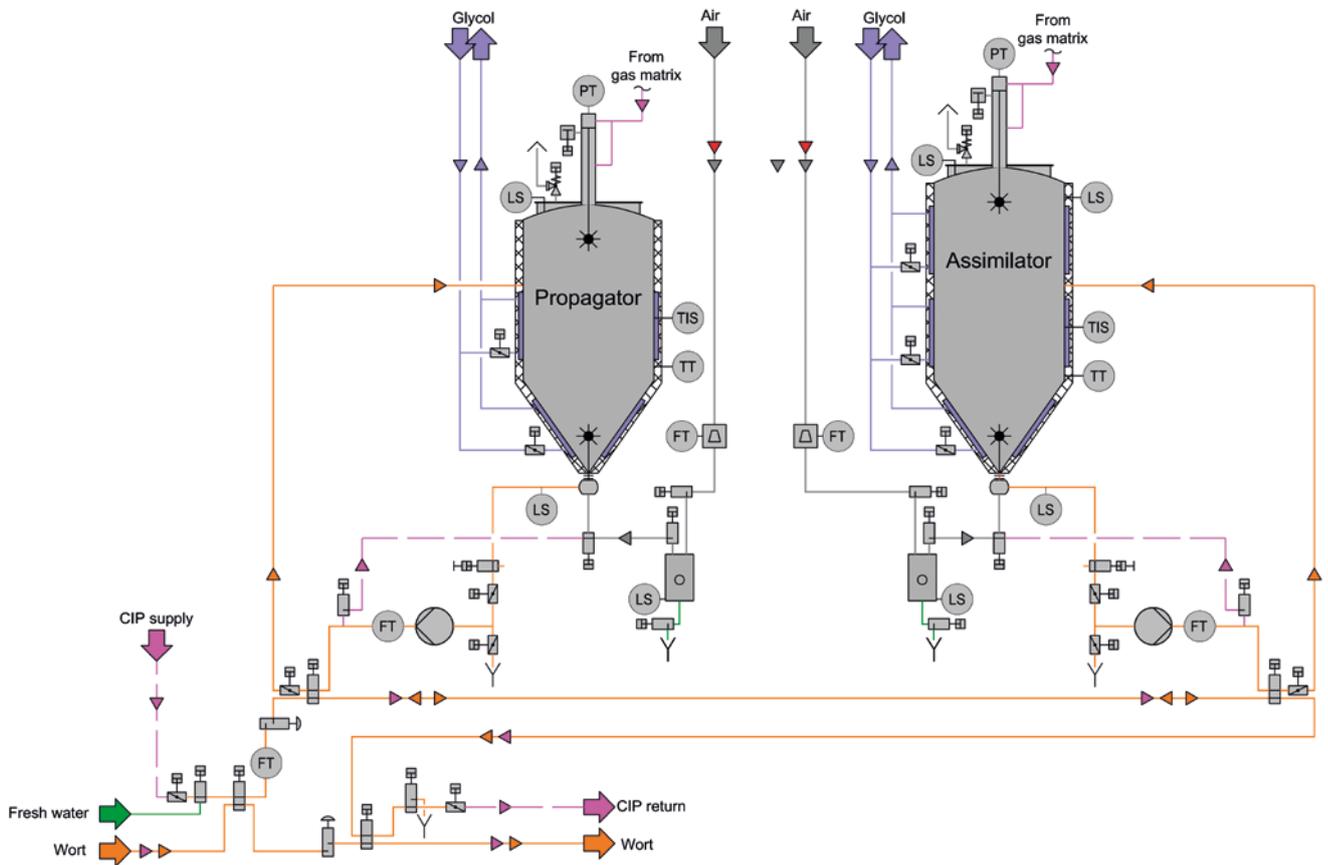
The propagation tanks are supplied with the cleaning medium through spray balls. The CIP medium is accumulated in the tank and circulated through the circulation pipe, so that all fittings are cleaned. The connection for cleaning the aeration device is located in the circulation pipe. So the aeration device can be cleaned as well and there will be no unsprayed areas in the tank, resulting in excellent cleaning.

## Connection and yeast dosing

For correct dosing of the yeast, you have to know the yeast quality and concentration. For this purpose, GEA Brewery Systems provides various analysis tools, from volumetric dosage up to viable cell count measurement.

Optimal yeast management plus suitable instrumentation – this ensures reproducible processes. And this has a positive effect on the fermentation process, the filterability and finally to the quality of the beer.

For such system concepts GEA Brewery Systems could already develop numerous tailored solutions together with customers and successfully integrate them in many facilities all over the world.



### YEAST-STAR™ – optimized propagation with the two-tank method

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|---|--|
| <p><b>Step 1:</b> Fill the content of the Carlsberg flask into the propagator and gradually top up with wort.</p> <p><b>Step 2:</b> Transfer the propagator content into the assimilator.</p> <p><b>Step 3:</b> Gradually fill the assimilator with wort until the final volume is reached.</p> | <p><b>Step 4:</b> 80% of the volume are used for yeast dosing.</p> <p><b>Step 5:</b> Gradually top up the residue in the assimilator with wort again until the target volume with the requested cell count is reached.</p> |
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#### FACTS & FIGURES:

##### Advantages at a glance:

- Maximum microbiological process safety because the EHEDG guidelines are followed
- High constant beer quality due to especially vigorous and viable yeast cells
- Essential nutrients are preserved as additional wort treatment is avoided
- Little foam formation and homogeneous mixing thanks to gentle aeration and homogenization
- Highest possible flexibility due to direct adaptation to customer needs
- Optimized concept in terms of space requirements and costs



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