Separators, Decanters and Process Lines for the Fermentation Industry

engineering for a better world

GEA Mechanical Equipment

Yeast has Culture

Yeast – the unknown being. This used to be the case. Today, saccharomyces with around 40 species and more than 500 types is probably the best-known and most investigated micro-organism. There are virtually no limits to its use in the food, pharmaceuticals, biotechnology and cosmetics industries. A yeast cell has a size of only 5 –10 micrometers, but contains an unbelievable variety of valuable constituents. GEA Westfalia Separator's modern separation technology means that it is now possible for yeast cells to be broken down and processed.

Primitive man unknowingly used yeast for preparing beverages containing alcohol. It is still the case that Indian populations in the Amazon region make juices from roots and leaves, which form alcohol as a result of natural yeasts when allowed to stand for some time. Some Belgian breweries still use natural yeast for brewing their Geuze or Lambic beer.

The Romans were aware of the secret of fermentation. Although they had no knowledge of yeast, they took advantage of the effect of fermentation for converting sugar into alcohol. At the start of the last millennium, monks began to brew beer and cultivate yeast. Brewer's yeast was then used as the first yeast for baking bread. After the development of baker's yeast, yeast factories sprang up like mushrooms, and there was a corresponding increase in demand for economical separation from the fermentation broth.

Big and intelligent: the yeast separator

In 1904, GEA Westfalia Separator Group developed the first yeast separator. Just one year later, in 1905, 20 yeast centrifuges, with a capacity of 125 l/h per machine, were delivered to the Bramsch yeast factory in Teplitz. When sliding bearings were replaced by ball bearings in 1921, the capacity of the machines increased rapidly. The first centripetal pump machine, namely the HD 50, enabled the clarified liquid to be discharged under pressure. This solution very much simplified the overall separation process. In 1983, GEA Westfalia Separator Group built the largest yeast separator in the world, namely the HDA 300, with a capacity of up to 260 m^3/h yeast wort.

In subsequent years greater emphasis has been placed on closed systems which were able to respond in a flexible manner to product fluctuations and which ensured a constantly high concentration of end product. Accordingly, 1990 saw the arrival of the

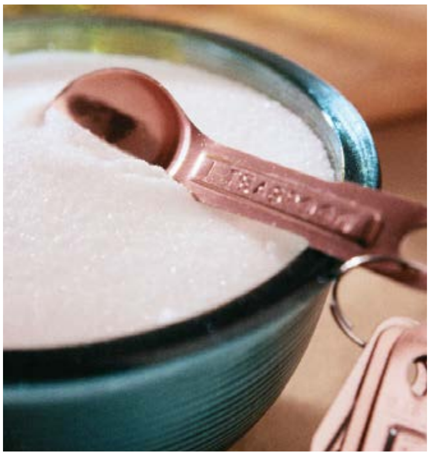
GEA Westfalia Separator **viscon**® system – separators featuring an automatic viscosity control facility (viscosity-controlled nozzles) for the yeast cream, which is discharged under pressure from the separator in a closed system.

Major supplier of amino acids

Yeast has undergone a virtual revolution in the relatively short period during which it has been the subject of scientific research. As a ferment, it is used specifically and in a controlled manner for the production of alcohol, beer, wine and bread. The intracellular component of yeast, the so-called yeast extract, is now an essential part of the food sector. There is hardly any soup in which it is not used as a taste enhancer and valuable supplier of amino acids for human nutrition. Yeast extract is also a popular spread. It is also encountered as a natural medicine in health shops that recommend it for use in a relaxing bath. In the pharmaceuticals industry, yeast is an important provider of raw materials and it is used for developing a very wide range of pharmaceutical products.

Working in sterile environments

GEA Westfalia Separator Group has accompanied the development of yeast for more than 100 years and has made a major contribution towards ensuring that yeast can be used in industrial applications. Nowadays, the research engineers in the field of separator development are working on the requirements of organisms such as yeast in the future. **viscon**® separators are designed in the form of a modular system. This means that machines can also be built in the form of sterilizable separators and can be used in the sterile environments of biotechnology for yeast applications.



Molasses

Molasses acts as a nutrient for the yeast in the fermenter and remains the most used substrate in the fermentation industry. It is left over as a by-product during sugar refining, once no more sugar can be crystallized from the raw mixture. As well as residual sugar, molasses also contains vitamins and minerals that boost the growth of the fermenting micro-organisms.

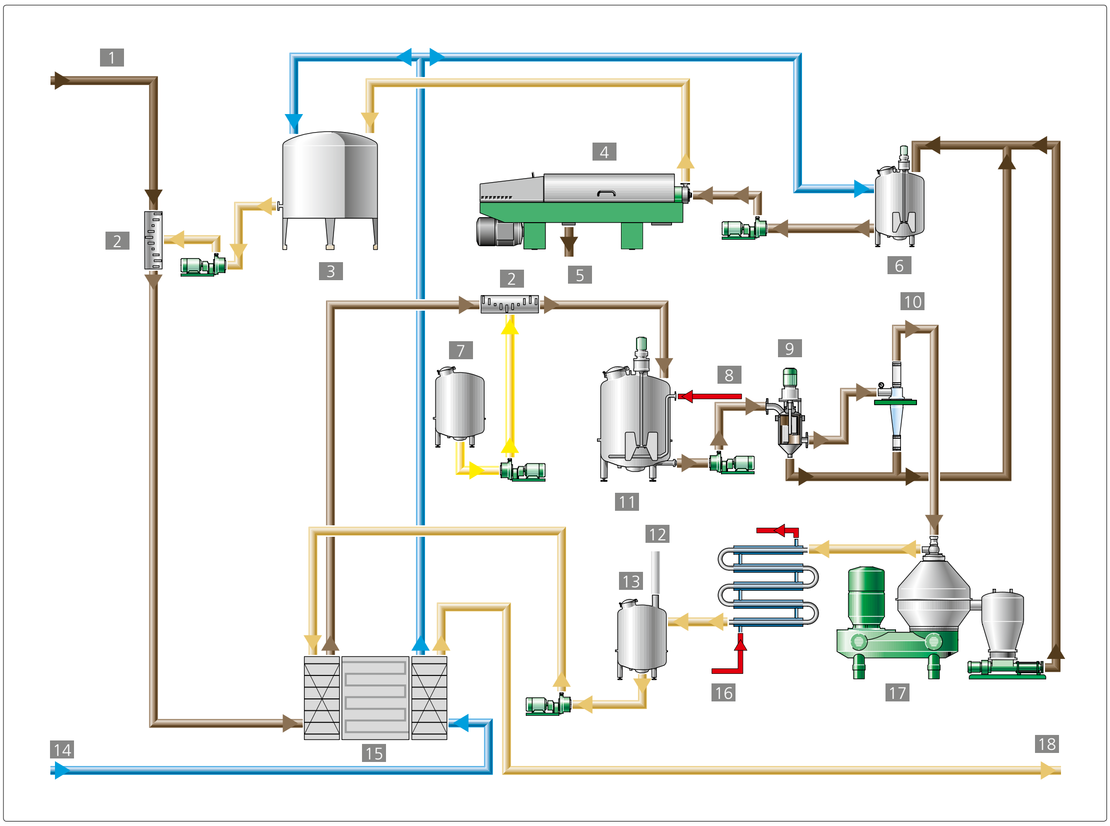
However, alongside these, the raw molasses also contains substances that inhibit the micro-organisms' growth and can lead to difficulties in the downstream process. Among these are sand, calcium and proteins derived from the sugar crop itself or from the sugar production process.

With GEA Westfalia Separator Group centrifuges as a central component in molasses processing, it is possible to eliminate the bulk of these unwanted substances from the molasses. In this way a high yield from the fermentation process is assured and the reliable protection of downstream plant and equipment is maintained.

To reduce its high viscosity, the raw molasses is first diluted with water in a mixer and then preheated via a heat exchanger. The molasses must then be acidified with sulphuric acid. As a result of the acidification, the calcium is precipitated as calcium sulphate and can therefore be easily separated during the subsequent separation process. Coarse erosive particles, such as sand, are separated by means of a rotary brush strainer and/or a hydrocyclone, in order to protect the downstream centrifuges against wear. The actual clarification of the molasses takes place in the separator.

High solids concentration minimizes product losses

GEA Westfalia Separator Group therefore offers separators with self-cleaning bowls specially designed to satisfy the requirements of molasses clarification. The patented hydrohermetic feed guarantees extremely gentle product treatment. The separators have their own control system that controls the discharge process. A sensing liquid continually monitors the solids holding space. If the solids holding space is full, the flow of liquid is interrupted, which is simultaneously a signal to initiate the ejection program. The control system therefore guarantees that the optimum discharge time is always selected for the separator, thus making possible maximum solids concentrations with minimum product losses.



General process flow sheet for molasses clarification

1	Raw molasses	6	Dilution tank	11	Reaction tank	16	Sterilization
2	Mixer	7	Acid tank	12	Gas	17	Clarifier
3	Balance tank	8	Steam	13	Expansion tank	18	Clarified molasses to the storage tank
4	Decanter	9	Rotary brush strainer	14	Hot water		
5	Sludge	10	Hydrocyclone	15	Heat exchanger		

The ejection process itself is carried out by means of the GEA Westfalia Separator hydro**stop** system. This system discharges precisely the required volume of solids and ensures that no residual solids remain in the bowl and that no previously clarified liquid is discharged as well. In addition, the hydro**stop** system reduces the discharge time to less than one tenth of one second and makes it possible to produce reproducible partial ejections, which has a positive effect on the yield. Of course, all of the bowl's bearing parts and parts in contact with the product in GEA Westfalia Separator Group's centrifugal clarifiers are manufactured from high-quality stainless steels, in order to withstand the high temperatures and the product's acid content. The tried-and-tested stainless duplex steel is used, with its characteristic high strength and excellent corrosion resistance.

The clarified molasses is then sterilized and the volatile acids removed in an expansion tank. En route to the storage tank, the sterilized molasses passes through a heat exchanger, where the high temperature heats the raw molasses.

Two stages for maximum yield

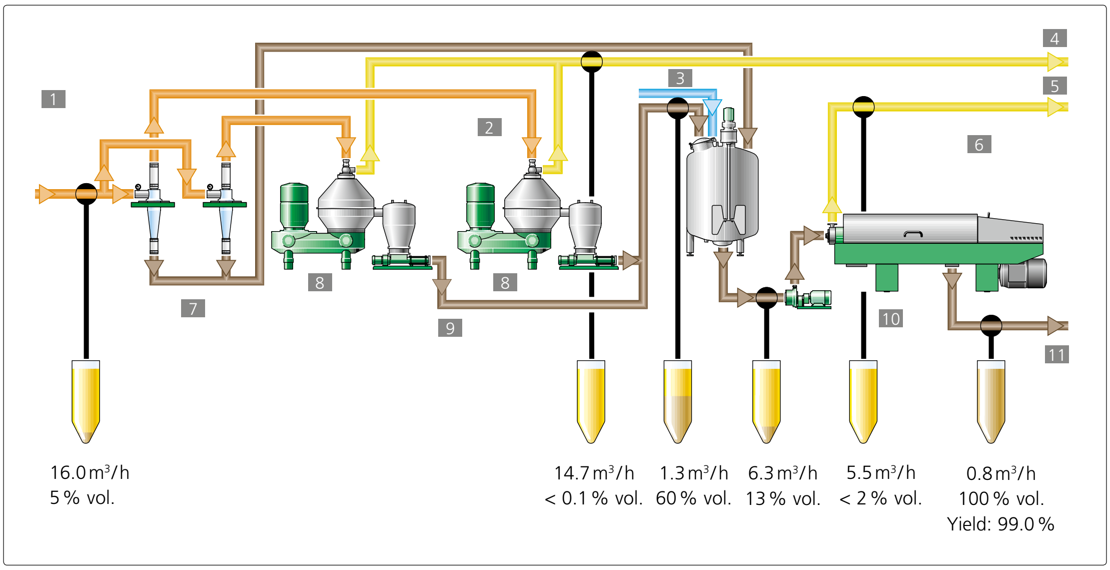
It is not just the quality of the clarified molasses that is critical for the economic efficiency of molasses processing. Sugar yield is also a crucial parameter. Since the valuable product, sugar, is in solution in the liquid phase, the yield increases with the degree of washing out, and the dryness of the spun-off solids. To satisfy the highest requirements of process economy, GEA Westfalia Separator Group offers 2-stage molasses clarification, where the combination of separators and decanters yields the benefits of both types of apparatus simultaneously. In the first stage the separator, thanks to its large equivalent clarifying area and high separation efficiency, removes the pretreated molasses to leave a residual solids contents of < 0.1 % by volume. After dilution of the discharged separator sludge with fresh water, the decanter concentrates the solids in the second stage down to a dry residue of > 60 %, so the total molasses yield can be increased to almost 100 %. The clarified phase, obtained from the decanter supernatant with the residual sugar content, is fed back to the process. In this way the quality of the molasses is maximized, both simply and intelligently, and sugar losses are minimized.

Decanters process suspensions with a solids content of 60 – 70 %, with the discharged solids having a high dry substance. In one-stage molasses clarification, high product losses occur as the solids content in the feed increases.

GEA Westfalia Separator Group's efficient 2-stage molasses clarification process ensures that the molasses yield remains at a constantly high level, irrespective of the feed conditions. However, this is not the only benefit: substances such as waxes, rubber and ashes, which can have a negative effect on the subsequent fermentation processes, are also removed from the process.

The decanters from GEA Westfalia Separator Group convince in its outstanding performance and separation efficiency, topmost availability and low energy consumption. Not only does the separation process itself satisfy the highest commercial demands, but the entire concept is designed for maximum possible availability and low service costs. The variety of parts has been reduced. In addition, the hood concept guarantees that all components requiring service can now be accessed extremely easily and quickly.

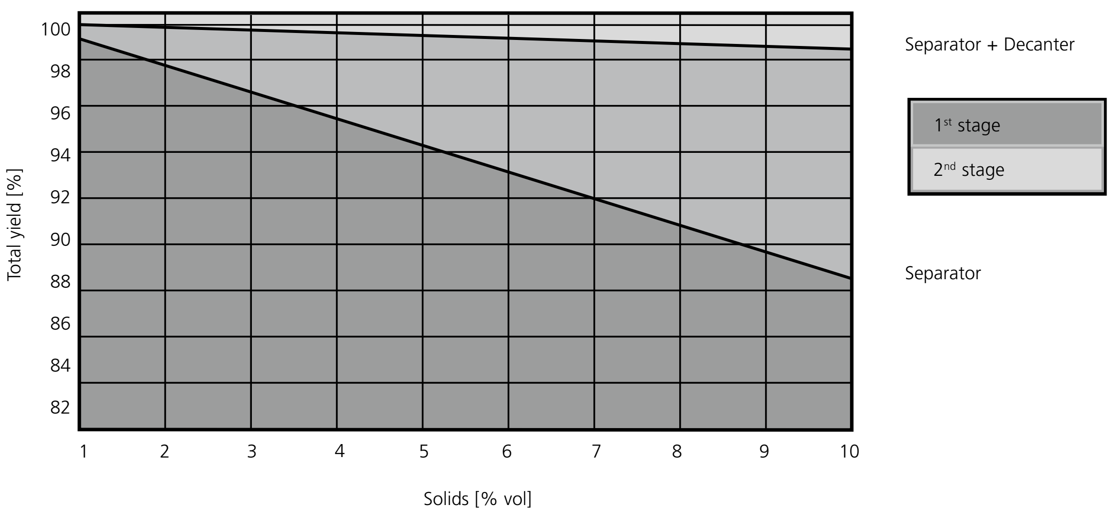
2-stage package unit for clarifying molasses



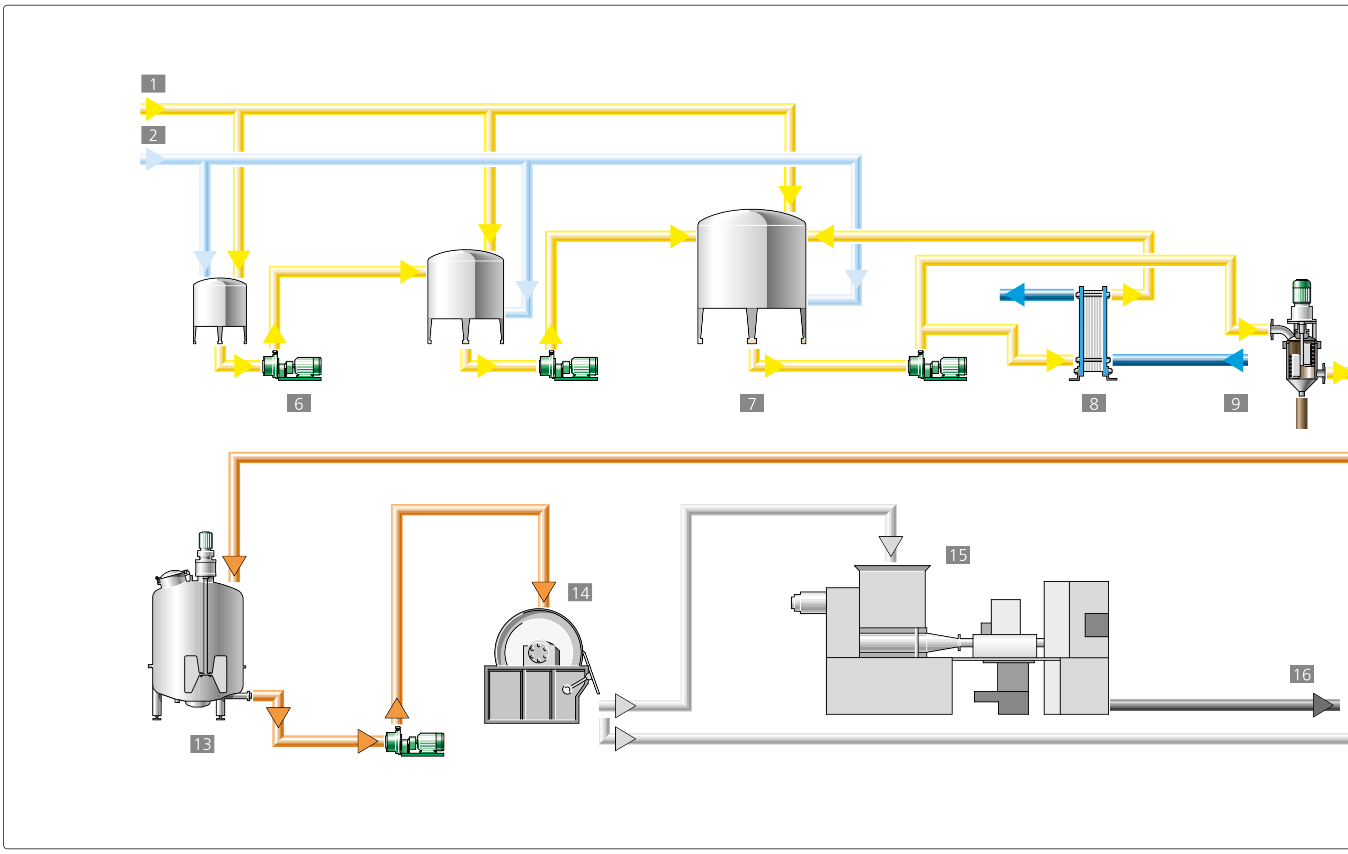
Volume balance for clarifying molasses

1	Diluted raw molasses	5	Dilution of raw molasses	9	Sludge for recovering sugar
2	1st stage	6	2nd stage	10	Decanter
3	Hot water	7	Hydrocyclone	11	Sludge
4	Clarified molasses to storage tank	8	Separator		

Compared with the single-stage molasses clarification process, the decanter in the second stage increases the level of sugar yield to almost 100 %. Another major benefit of 2-stage molasses clarification is the considerably lower loss of materials as the solids content increases. Experience has shown that the pay-back period for a decanter used as a second stage is very short thanks to the high yield and low losses.



Total yield with respect to the solids content in the molasses.
Comparison of 1st and 2nd process stages.



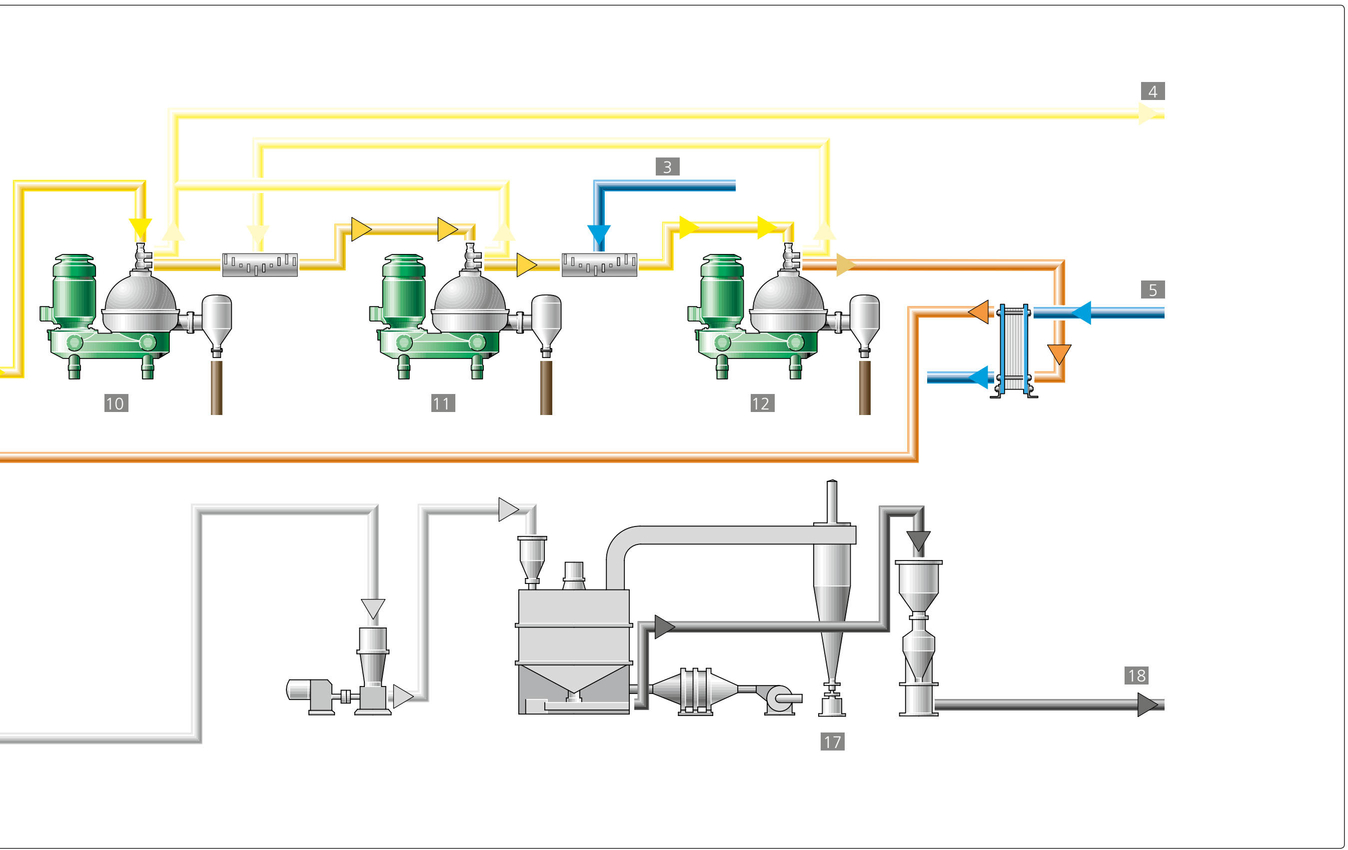
General process flow sheet for obtaining baker's yeast

Baker's Yeast

Whether 3-stage processes with two or three separators or four stages with three or even four separators, GEA Westfalia Separator Group, with its exhaustive expertise and extensive range of products, is able to meet even the most demanding customer's needs when it comes to the efficient production of baker's yeast. The important thing for GEA Westfalia Separator Group is to ensure that each customer is able to obtain the best combination of machine size and process stages for their individual production needs.

Most fermentation processes for obtaining baker's yeast include far more than just one separation stage for biomass separation. In terms of life and colour, the high standards required make a multi-stage separation and washing process essential. For this purpose, the biomass must first be separated off from the fermentation broth and concentrated. Multi-stage washing of the yeast concentrate must also reliably remove the dark molasses colour, together with the residue of the fermentable substrate between the cells.

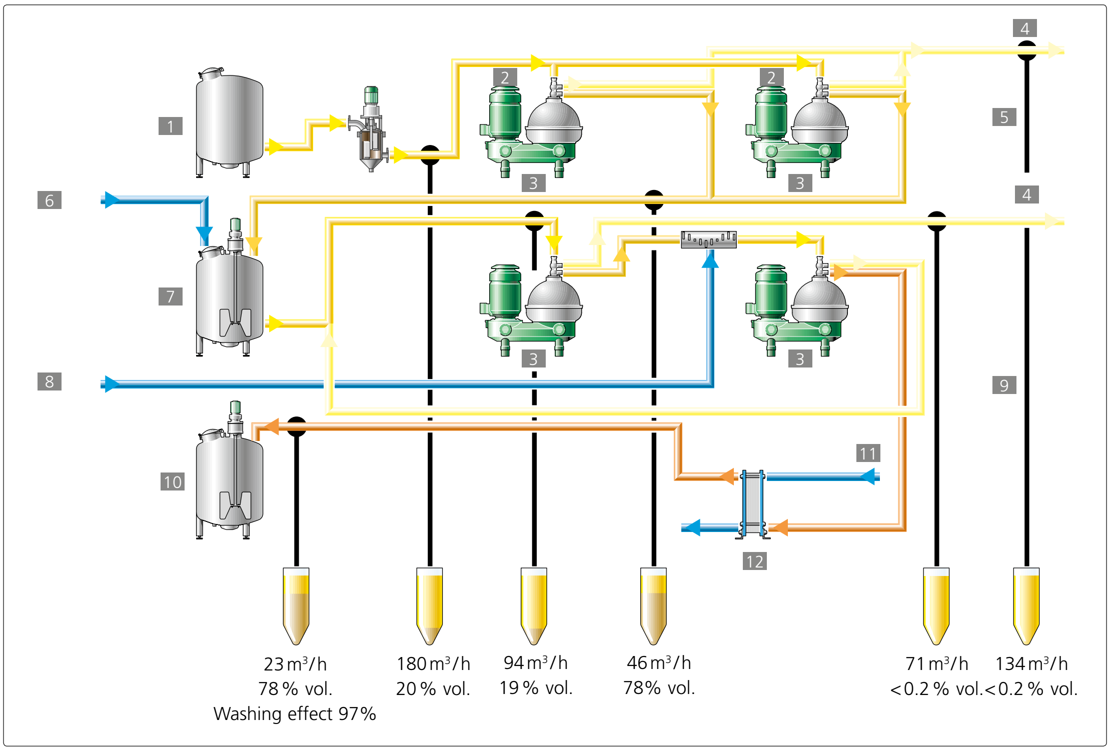
Various separator configurations are possible for this purpose. They differ in required separator capacity and the desired number of washing stages to be installed, with each configuration having its own benefits and advantages. As a partner to the yeast industry for more than 100 years and having a selection of yeast separators which covers virtually any performance range, GEA Westfalia Separator Group ensures that each customer obtains an optimum process which is tailored to his individual needs. The separator's size is based on the volumetric flows to be processed, which in turn depend on the fermenter size and desired separation period. The number of separators is determined according to the required flexibility and the washing effect aimed for.



1 Nutrient salts, clarified molasses, water
2 Air
3 Washing water
4 Centrate to waste water
5 Cooling medium
6 Pre-fermentation
7 Fermentation
8 Cooler
9 Cooling medium
10 1st stage nozzle separator
11 2nd stage nozzle separator
12 3rd stage nozzle separator
13 Yeast cream tank
14 Rotary vacuum filter
15 Packing
16 Pressed yeast
17 Drying
18 Dry yeast

The more washing stages there are, the higher the purity of the baker's yeast obtained. Furthermore, less fresh water is needed to achieve the same washing effect. This is an advantage which favourably affects running costs and also waste water disposal costs.

All of the plant concepts have one thing in common: a rotary brush strainer is installed in the feed to protect the downstream separators from damage and nozzle blockages due to coarser particles.



Volume balance for obtaining baker's yeast with two separators

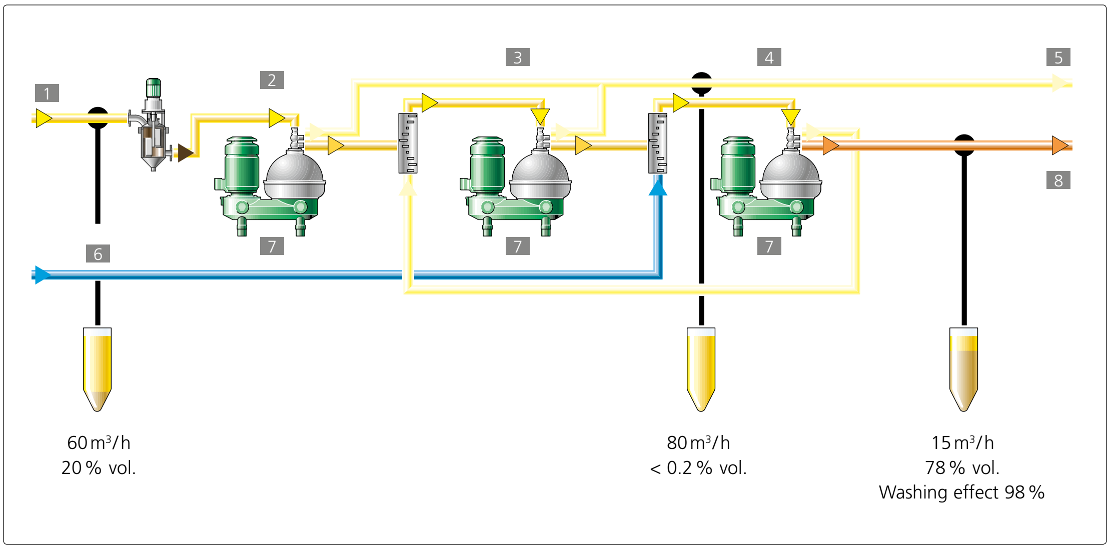
1 Fermenter
2 90 m^3/h
3 Nozzle separator
4 Centrate to waste water
5 1st stage
6 Washing water 11 m^3/h
7 Washing tank
8 Washing water 65 m^3/h
9 2nd stage
10 Yeast cream tank
11 Cooling medium
12 Cooler

3-Stage with Two Separators and Washing Tank

The minimum investment for separating and washing baker's yeast is a separator system consisting of two nozzle separators and one washing tank. To 'harvest' the fermenter's 'crop' both machines are connected in parallel, to achieve a large volumetric flow and short harvesting times. The yeast concentrate is then collected in a washing tank and diluted by adding fresh water. Both separators are then connected in series during the subsequent washing process. Wash water is added to the concentrate from the first separator and then separated again in the second separator. The overflow is fed back to the process, in order to dilute the yeast cream from the washing tank.

Such a system therefore makes it possible to carry out one separation stage and two washing stages with minimum plant expenditure.

The advantage of this system is the low investment requirement. It uses the HF series of nozzle separators, which has been developed by GEA Westfalia Separator Group specially for obtaining yeast. The distinguishing feature of the separators is the special **viscon**® nozzles which have been designed and patented by GEA Westfalia Separator Group, which make it possible to keep the discharge concentration constant, even with different feed conditions. Discharge concentrations of up to 22 % DS yeast are possible.

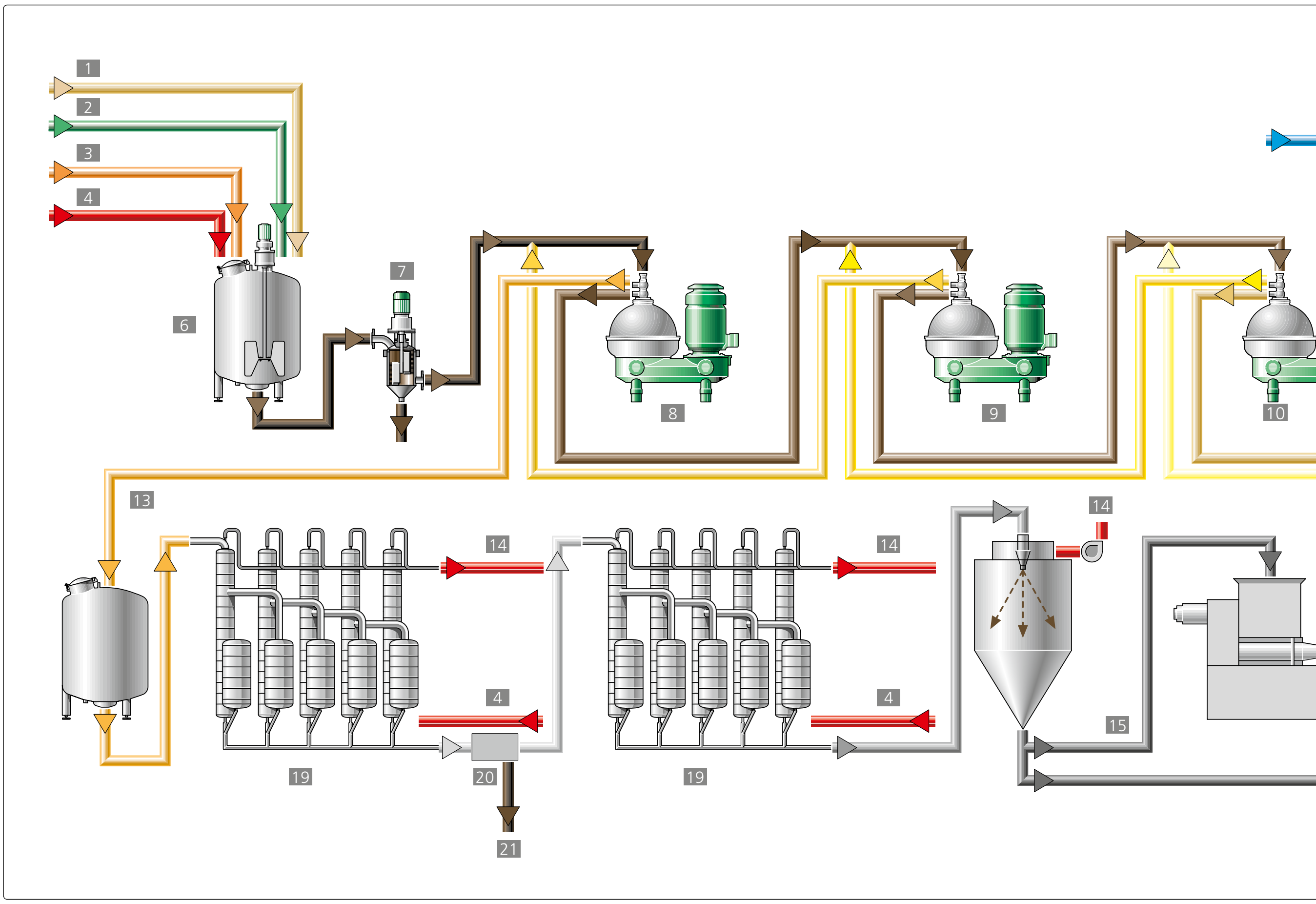


Volume balance for obtaining baker's yeast with three separators

1	Feed	4	3rd stage	7	Nozzle separator
2	1st stage	5	Centrate of waste water	8	Yeast to cream water
3	2nd stage	6	Wash water 35 m^3/h		

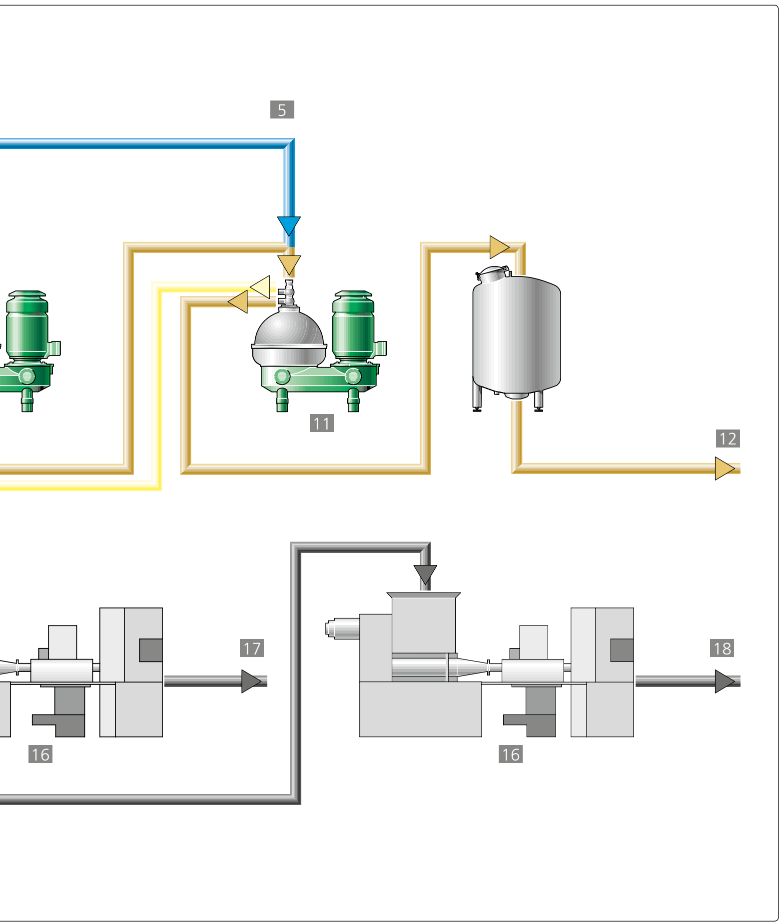
3-Stage with Three Separators

The current standard for yeast separation in the fermentation industry is three or more separators arranged in series. In these models the principle of counter-current washing is employed, where concentrate from the first separator is mixed with the clarified effluent from the third separator and then fed to the second separator for separating off and fresh water is added to the second separator's concentrate. From first to last separation, a concentration of the biomass and depletion of the soluble substances in the intercellular fluid take place. Additional washing stages reduce the quantity of washing water needed, which pays off due to, among other things, the lower waste water load and associated lower costs. In general, limited separator operation is possible, even if individual machines are stopped. By diverting the product flow to the remaining separators, it is possible to achieve a high degree of flexibility, even when machines are stopped for maintenance purposes. However, the benefits of this are not just limited to the process's high level of flexibility and reliability: the baker's yeast thus obtained is, additionally, of very high quality in terms of cell activity and colour. Furthermore, the saving in the amount of fresh water required reduces the running costs.



General process flow sheet for obtaining yeast extract

1	Pretreated yeast	7	Strainer	13	Extract
2	Enzymes	8	1st stage nozzle separator	14	Condensate
3	Sodium cloride	9	2nd stage nozzle separator	15	Drier
4	Steam	10	3rd stage nozzle separator	16	Packing
5	Hot washing water	11	4th stage nozzle separator	17	Powder extract
6	Autolysis	12	Cell walls as folder	18	Paste extract



19 Evaporator
20 Filter
21 Solids

Yeast Extract

There are many ways to obtain the autolysate. The one that is finally selected depends upon the desired end product. Thus, the range of possible end products extends from flavour enhancers and sandwich spreads, to beneficial bath additives and suppliers of raw materials in the pharmaceuticals industry. The source materials for obtaining the yeast extract are fresh cultures or fermentative process by-products geared towards the particular intended purpose such as debittered brewer's yeast. The yeast cells can be lysed thermally, mechanically, chemically or enzymatically. Nozzle separators then separate the extract from the cell walls. There are no standard solutions. Optimum design of the separation stage must make allowance for the particular process and product parameters, for example the density of the liquid and solid particle size and the viscosity of the liquid. This is precisely where GEA Westfalia Separator Group's expertise and great experience as a partner to the yeast industry come in.

As in the production of baker's yeast, multi-stage counter-current washing can be regarded as the process most often employed. HFA generation nozzle separators from GEA Westfalia Separator Group are the answer if the greatest possible clarifying efficiency is sought.

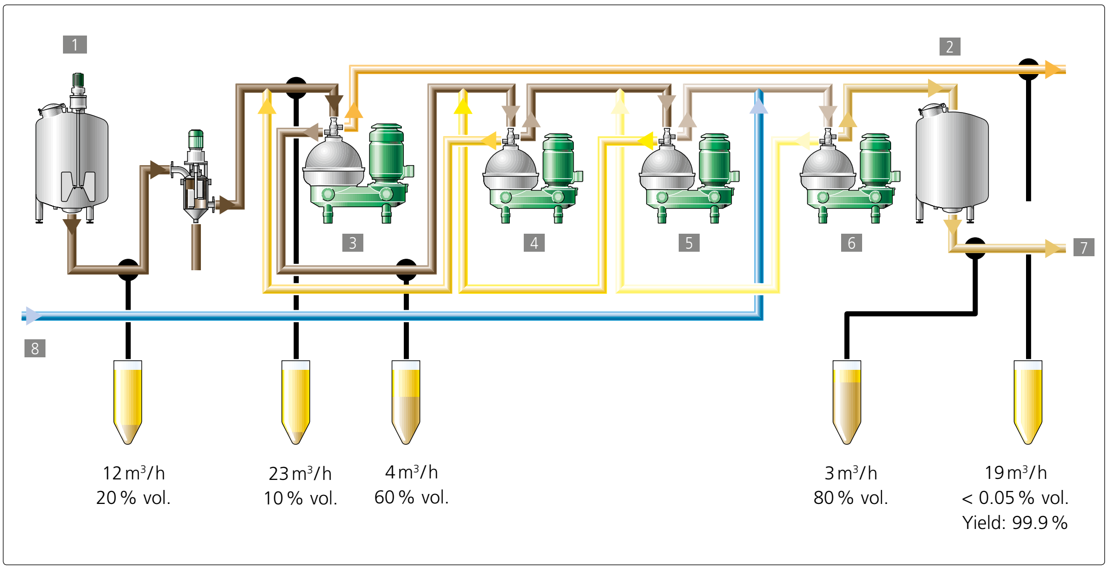
Whatever solution is put into effect, planning and implementation are consistently focused on the economic efficiency of the process and the quality of the end product.

4-Stage with Four Separators

The cell-wall suspension to be separated is taken to the first separator via a rotary brush strainer; this protects the separators from being damaged or their nozzles being blocked by coarse solid particles. The clarified effluent from the second separator is added to the feed of the first separator. The concentrate from each separation stage is then diluted by the counter-current method with the clarified effluent of the down-stream stage. Fresh water is added to wash the concentrate from the third separator. The valuable soluble elements, now separated from the cell-wall suspension, are thermally concentrated in the subsequent process steps before eventually reaching the packing stage. Fresh water consumption can be further reduced by means of additional washing stages, without reducing the washing effect. A welcome side-effect is the associated slight dilution of the extract, which favourably affects the energy balance of subsequent thermal concentration processes.

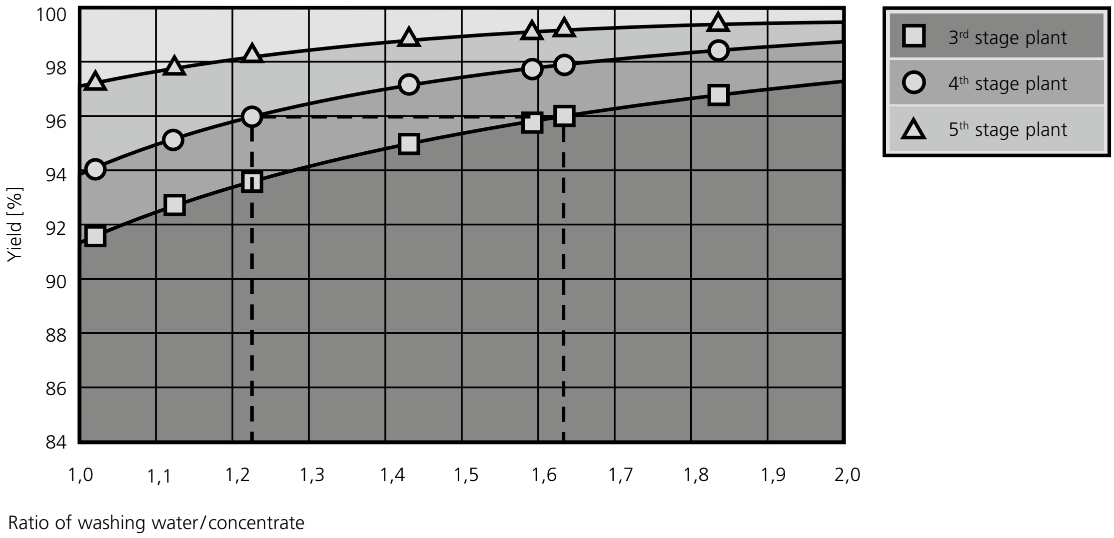
The patented GEA Westfalia Separator **viscon**® nozzles ensure a high concentration of the cell walls, which not only maximizes the material yield, but also reduces the energy requirement during the subsequent drying of the ancillary product. The cell walls can be used in the dried form as feed additives. Another advantage of **viscon**® is that a relatively large nozzle diameter can be used, even with small quantities of concentrate, thereby reliably avoiding the possibility of blocked nozzles.

As in the production of baker's yeast, it is possible for example to continue production by diverting the product flow to the remaining separators, while individual separators are being maintained. The end product, in turn, is distinguished by high purity and therefore high product quality and material losses are minimized.



Volume balance for obtaining yeast extract

- 1 Autolysis
- 2 Centrate to evaporation
- 3 1st stage nozzle separator
- 4 2nd stage nozzle separator
- 5 3rd stage nozzle separator
- 6 4th stage nozzle separator
- 7 Cell walls
- 8 Washing water 10 m³/h



Extract yield with reference to volume of washing water and the number of stages

In principle, there are two ways to increase the yield of yeast extract. For example, the yield can be increased from some 93 to 96 % in a 3-stage process by adding more washing water. However, the same result can be achieved, if the process is designed for four stages from the outset, thus avoiding the increased consumption of washing water – in contrast to three stages.

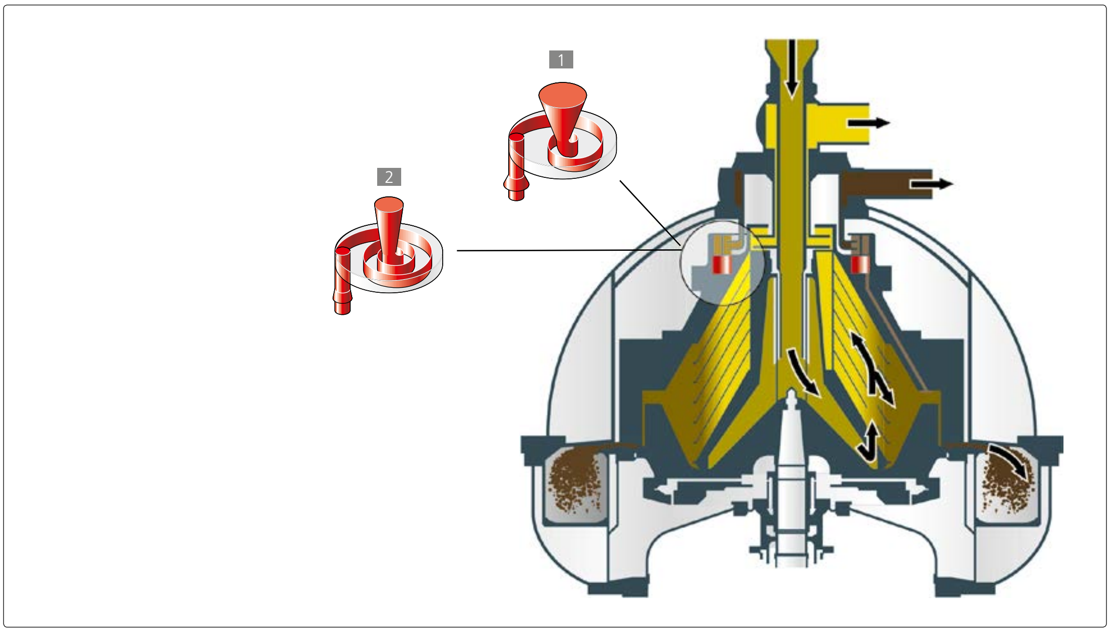
GEA Westfalia Separator **viscon**®

The last few years have seen a great deal of progress being made in the field of concentration centrifuging with nozzle separators. The development of the viscosity-controlled nozzles (**viscon**®) signalled the end of annoying adjustments to the separators' parameters in response to changes in the feed con-ditions, with the result that the solids concentration in the discharge is now constant. The HF series of nozzle separators represents state-of-the-art technology in the production of baker's yeast and yeast extract.

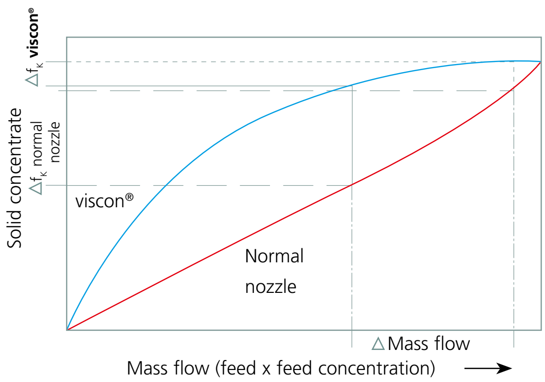
Consisting of a swirl chamber and the downstream outlet nozzle, these special nozzles automatically modify the flow. If, for example, the concentration in the outlet is too low, the volumetric flow reduces and the concentration increases. If, on the other hand, the concentration is too high, the nozzle increases the volumetric flow, which correspondingly reduces the concentration. The suspension is rotated by means of a special flow management system in front of the nozzle. With yeast – as with many other suspensions, the viscosity increases as the concentration increases. The speed of rotation and therefore the flow resistance are thus governed by the concentration and it is precisely this characteristic which **viscon**® uses to control the viscosity.

If the concentration of the suspension is low, this produces a high speed of rotation, as a result of which a high centrifugal force acts on the entrance to the swirl chamber. This counter-pressure at the inlet causes less suspension to flow in, increasing the concentration. However, at high concentrations, the liquid revolves slowly, which creates a lower centrifugal force, so that there is a lower counter-pressure at the inlet. More suspension flows to the nozzle and this reduces the concentration.

Unlike conventional nozzle separators, the nozzles in the **viscon**® system are not located on the circumference of the bowl, but on a smaller diameter in the bowl top. Pressures of up to 250 bar act on the circumference of the bowl, whereas the pressures are considerably lower at the centre; this means that the separated cells are ex-posed to significantly lower shearing forces. In addition, the separators can be provided with a hydrohermetic feed system, to ensure that sensitive products are very gently fed into the bowl.



If the mass flow in the feed is high, rotation in front of the nozzle is reduced, resulting in more suspension flowing to the nozzle and a reduction in the concentration in the discharge. If, on the other hand, the mass flow in the inlet is low, the rotation is increased. As a result of the greater counter-pressure at the nozzle inlet, less suspension arrives at the nozzle and the concentration in the outlet increases.



If the feed conditions in the separator change by mass flow, as for example more product is fed into the separator, or the inlet concentration increases, the solids concentration in the discharge would vary by f_k in a normal nozzle, whereas with the special **viscon®** nozzle the solids concentration remains extensively constant (f_k **viscon®**). In addition, the suspension can be concen-trated more strongly than with normal noz-zles. As the bores of the **viscon®** nozzles are larger, the risk of a possible nozzle blockage is considerably less.

1 High mass flow in the feed
2 Low mass flow in the feed

The main features at a glance

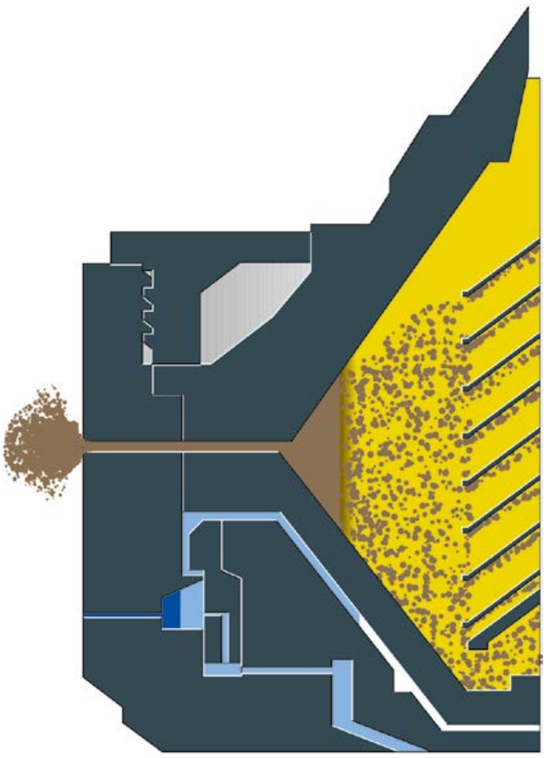
- Extensive selection of clarification and nozzle separators in varying sizes to cover any capacity required
- Use of special **viscon®** nozzles ensures constant discharge concentration, even when feed condi-tions change
- Avoidance of shearing forces thanks to hydroher-metic feed and the location of the discharge nozzles on the bowl top
- Enclosed product handling as a result of the con-centrate and the clarified phase being discharged by centripetal pump
- All separators are completely CIP capable
- Intelligent discharge systems ensure minimum product losses, high flexibility and precision in solids discharge
- All separators are equipped as standard with low-maintenance flat belt drives
- The larger separators can also be equipped with GEA Westfalia Separator Group's innovative direct drive

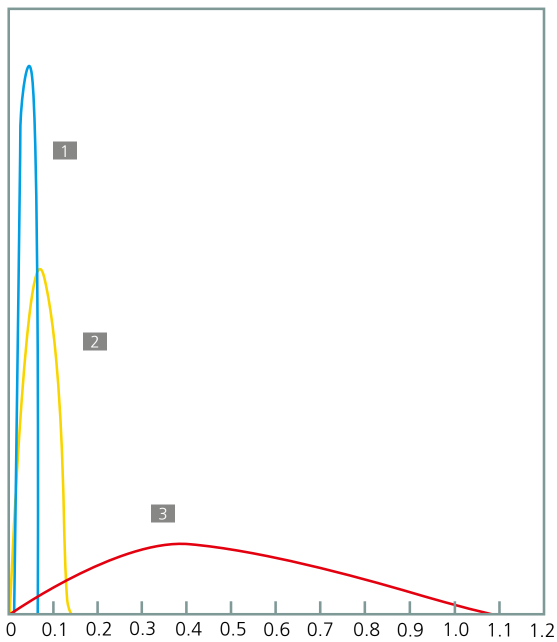
Discharge with GEA Westfalia Separator hydro**stop**

The hydro**stop** system is a special discharge system for molasses clarification that can be adjusted precisely and reproducibly to the specific solids concentration requirements of the process. This patented discharge system enables the discharge process to be optimized extremely quickly. It reduces the actual discharge time to less than 1/10 of a second and also permits reproducible partial discharges.

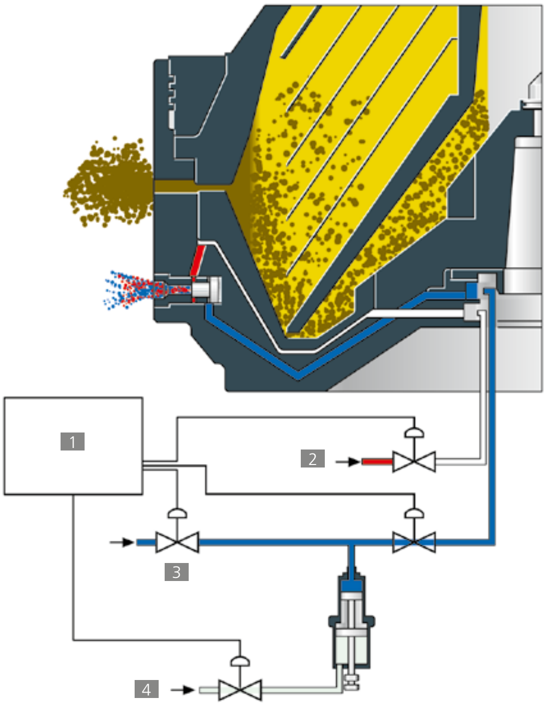
Extremely precise even with extremely small volumes

The major disadvantage of older discharge systems was that they were much slower and less precise; there were significant fluctuations in the volume and thus the concentration of the solids. It was not possible to exert any influence over the process. GEA Westfalia Separator Group has completely solved these problems with the hydro**stop** system: even small volumes of 1.5 to 2 litres can be discharged reproducibly with an error of less than 10 %. This innovative technology is the key to precise and rapid discharges and, therefore, to much higher and better quality yields. For the clarified molasses, this also means that extremely compacting solids can be discharged more easily. This is made possible thanks to the bowl's relatively large opening. At the same time this also guarantees lower flow velocities during partial ejections and, therefore, considerably less erosion.





1 GEA Westfalia Separator hydro**stop**
2 Discharges through metering piston
3 Previous standard



1 Valve cabinet control unit
2 Closing water
3 Opening water
4 Compressed air

Discharge with Metering Piston

In the HF generation of nozzle separators, the solids are discharged by means of metering pistons. The basic idea of this control system is for metering devices to supply an accurately metered quantity of opening water to the bowl during partial ejections. Thus, precise discharge volumes can be achieved which can, in addition, be adjusted flexibly from the outside. Therefore, if partial ejections are desired with particular products, these can be carried out efficiently and with minimum product losses with the metering piston system.

This system is proving itself in the fermentation industry, particularly during CIP cleaning of the nozzle separators, during total ejections. The bowl can be opened over its entire circumference and a relatively large annular gap can be selected, both of which create very high flow turbulences in the bowl, resulting in a positive cleaning effect.

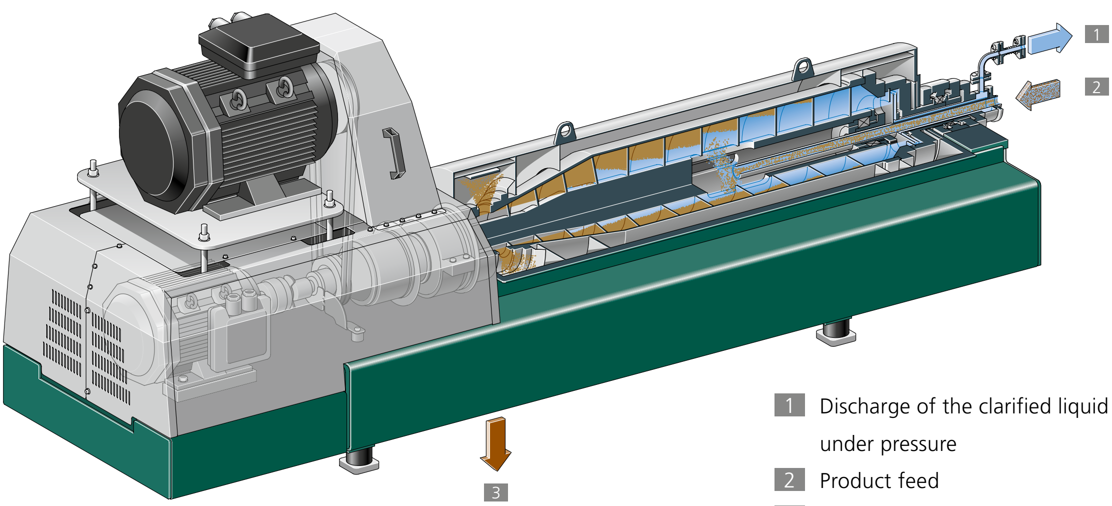
The metering device is filled with water through the inlet valve. Compressed air is then forced into the lower chamber of the metering device through the valve. When the opening water valve has been operated, the compressed air acts on the piston of the metering device, and the set quantity of water is injected into the opening chamber. The air pressure for the metering device should be 4 to 4.5 bar. The pressure booster installed in the metering device ensures perfect discharge processes, thus overcoming line, valve and injection chamber resistances.

Decanters for 2-Stage Molasses Clarification

The high process temperatures and the erosive characteristics of the molasses demand a great deal from the decanters. To provide the decanter with the highest possible wear protection, GEA Westfalia Separator Group therefore armours all of the parts of a decanter, which are likely to be subjected to increased wear. For example, a continuous layer of hard metal is welded onto the decanter's scroll flight. Depending on the application and the customer's wishes, GEA Westfalia Separator Group also welds tiles either on the entire screw flight or just on certain areas of it, instead of hard metal. Also armoured are areas in the distributor, which are protected from abrasion by very effective wear protection. A further area of potential wear, which GEA Westfalia Separator Group especially protects, are the solids discharge bowl ports, where specially sintered hard metal bushes are used. These wear on one side as a result of the centrifugal forces, but they can then be simply turned over, so that they only have to be replaced when both sides are worn.

The main features at a glance

- New decanter generation GEA Westfalia Separator **eco**force with external gears. This segregates the product space from the drive space, so that the gears are much less exposed to for example high product temperatures, with a positive impact on service life.
- Intelligent drive systems ensure maximum separation efficiency by automatically adapting the high-torque drive to the feed conditions prevailing in the decanter. The result is a differential speed which is always set to the optimum.
- New drive concept GEA Westfalia Separator **summation**drive for the new decanter generation **eco**force provides full torque across the whole differential speed range, so there is no drop in performance.
- **summation**drive with optimized power flow: the differential speed is provided in full, in an energy-efficient manner across a broad range.
- High bowl speeds for maximum clarification and dewatering efficiency as well as high throughput capacities.
- 'Deep pond' design decanters ensure optimum clarification and low energy consumption
- Centripetal pump, hydrohermetic operation for saving energy thanks to small diameter
- Special wear protection for maximum decanter availability



1 Discharge of the clarified liquid under pressure
2 Product feed
3 Solids discharge

Types of machine	Product capacities * (depending on product and process in l/h)	Motor size [kW] Decanter: Primary motor + secondary motor	Areas of application
Self-cleaning separators			
FSC 20	2000 – 4000	11	Molasses
FSC 35	4000 – 6000	18,5	Molasses
FSC 70	6000 – 8000	37/45	Molasses
FSC 100	8000 – 15,000	60	Molasses
FSC 150	15,000 – 25,000	60	Molasses
Separators with GEA Westfalia Separator **viscon®** nozzles			
HFB 15	6000 – 8000	11	Baker's yeast
HFE 45	35,000 – 45,000	45	Baker's yeast
HFB 65	45,000 – 65,000	60	Baker's yeast
HFC 100	65,000 – 90,000	90	Baker's yeast
HFC 130	90,000 – 120,000	132	Baker's yeast
HFB 15	500 – 2000	11	Yeast extract
HFE 45	5000 – 7000	45	Yeast extract
HFA 65	7000 – 10,000	60	Yeast extract
HFC 100	10,000 – 15,000	90	Yeast extract
HFC 130	15,000 – 20,000	132	Yeast extract
Decanters			
FCE 205	500 – 1500	7.5+0,75	Molasses sludge
FCE 305	1500 – 3000	15+2.2	Molasses sludge
FCE 345	3000 – 5500	15+2.2	Molasses sludge
biomassMaster CF 4000	5500 – 10,000	22 to 90 + 11 to 22	Molasses sludge

*The product parameters described as standard below are based on GEA Westfalia Separator Group's experiences with various customers and refer to the strain of yeast, saccharomyces cerevisiae.

Standard baker's yeast with 200–220 g/l, H28 feed, concentrate 800–850 g/l

Particle size of the cells	> 4.6 µm
Viscosity of the cell-free fermentation broth*	< 1.23 Pa s
Relative density of the cells*	> 1100 kg/L
Relative density of the cell-free fermentation broth*	< 1024 kg/L
Separation temperature	max. 40 °C
Feed concentration	max. 18 % v/v

*At separation temperature

Yeast extract

Particle size of cells	> 2.3 µm
pH value	5.3
Dynamic viscosity	0.62 mPa s
Relative density of the cells	> 1.09 kg/L
Relative density of the cell-free fermentation broth*	< 1.00 kg/L
Separation temperature	max. 60 °C
Feed concentration	max. 18 % v/v

*At separation temperature

Molasses

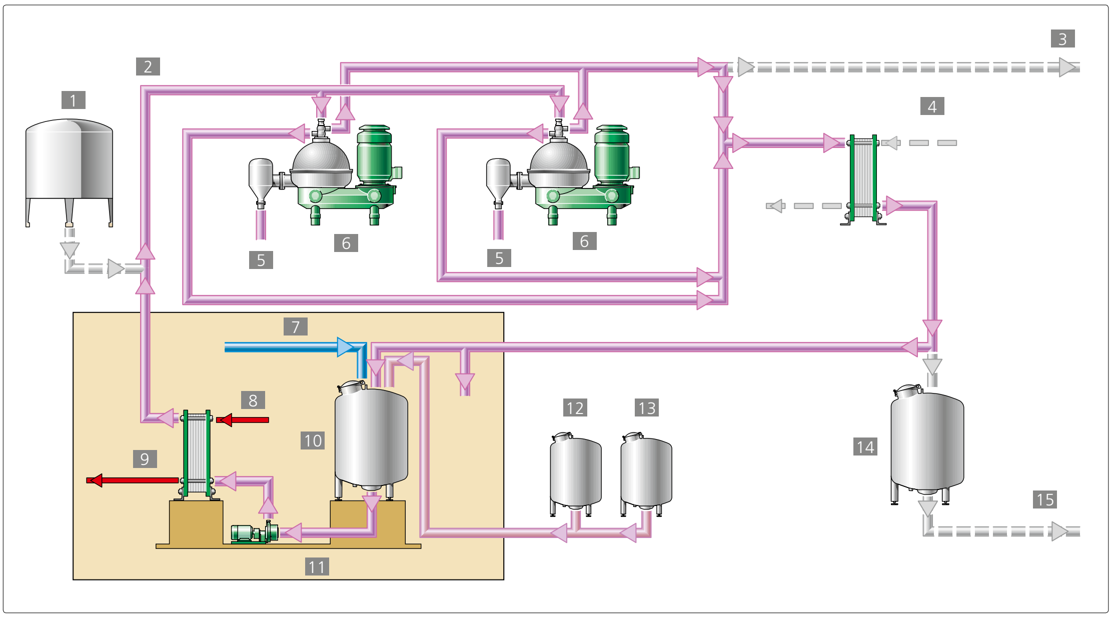
Brix	max. 48 °C
Particle size of the cells	> 4.6 µm
Centrifugable solids	max. 5 % v/v
pH value	2.5 – 5.5
Viscosity of the free liquid*	less than 8 mPa s
Relative density of the solids which can be spun off*	min. 1.45 kg/l
Relative density of the suspension*	max. 1.2 kg/l
Concentration of chloride ions	8000 ppm or less (8 g/kg)
Separation temperature	80 °C

*At separation temperature

CIP Cleaning Systems

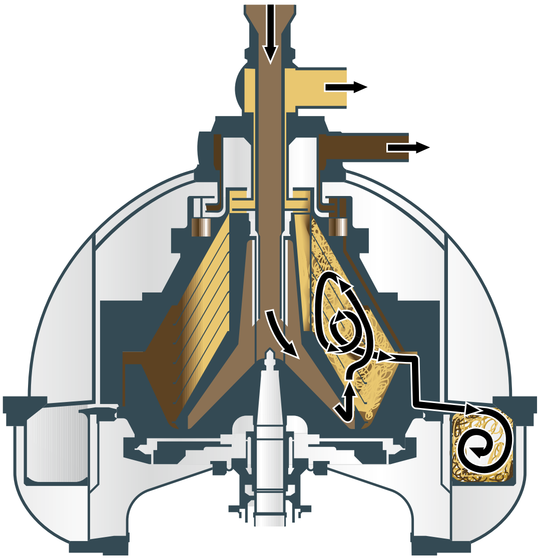
GEA Westfalia Separator Group not only supplies separators and decanters, but also the associated CIP cleaning systems. These include the tanks, heat exchangers, valve blocks and metering pumps as well as the appropriate control system required for chemical cleaning. To ensure that the CIP units can be easily integrated into the process, the individual components are installed on a base frame and delivered completely ready for connection. The great benefit of this ‘one-stop solution’ is that all components are optimally adjusted to the centrifuges in the process. GEA Westfalia Separator Group’s CIP systems also ensure that the principle of maximum efficiency applies not only to operation, but also to the cleaning of the plant parts.

The know-how of GEA Westfalia Separator Group is applied downstream of the fermenter. The product is first forced out of the separator system with cold water, to minimize product losses. It is mixed with the medium required for the respective cleaning step in the CIP tank. This medium can be cold water, hot water or a mixture of lye and water or acid and water. The individual media are successively circulated through the process line for 5 to 10 minutes each, with each cycle being repeated and ending with a total discharge of the system. The sequence, duration and the number of repetitions of the cycles are governed by the previously programmed process sequence or the programmed timing and are also governed by the respective product features. Following mixing in the tank, the medium is heated to the temperature required in each case. The cleaning cycle starts as soon as the temperature and pH value have achieved the required value. On completion, the medium is completely discharged from the circuit via a pipe.



General process flow sheet for CIP cleaning

- 1 Fermenter
- 2 CIP feed
- 3 Centrate
- 4 Cooling medium
- 5 Channel
- 6 Nozzle separator
- 7 Water
- 8 Steam
- 9 Condensate
- 10 CIP tank
- 11 CIP unit
- 12 Lye NaOH 45 %
- 13 Acid HNO_3 65 %
- 14 Cream tank
- 15 Filter, drier



During total ejection of the bowl high flow turbulences are created due to the fall in pressure. These promote the cleaning effect of the CIP medium and ensure that all of the solids are discharged from the bowl.

It is important that the separators and lines can be completely emptied, to reliably avoid any cross-contamination. The cleaning liquid for the next sequence is added to the tank at the start of the next cycle. These process steps are repeated until such time as the complete CIP procedure has been run through. Once cleaning has been completed, the centrifuges can quickly resume operation.

Care must be taken during cleaning of the separators used in the process to ensure that the cleaning fluids reach all areas in contact with the product and that even extremely compacting solids are completely removed from the bowl. To do this, the cleaning fluid must achieve a sufficiently high flow turbulence, which is done by totally emptying the bowl.

The feed is closed and the entire contents of the bowl are instantaneously ejected. The resulting drop in pressure provides the desired turbulences, which in addition to the chemical effect of the CIP medium, cause the discs, nozzles, inlet and all other areas in contact with the product in the separator to be mechanically cleaned. In this way, the solids can be reliably removed from the separator.

We live our values.

Excellence • Passion • Integrity • Responsibility • GEA-versity

GEA Group is a global engineering company with multi-billion euro sales and operations in more than 50 countries. Founded in 1881, the company is one of the largest providers of innovative equipment and process technology. GEA Group is listed in the STOXX® Europe 600 Index.

GEA Mechanical Equipment

GEA Westfalia Separator Group GmbH

Werner-Habig-Straße 1, 59302 Oelde, Germany
Phone: +49 2522 77-0, Fax: +49 2522 77-1794
www.gea.com

B_RR-13-08-0007 EN