

*Liquids to Value*



## Recovery of Vegetable Proteins

From Renewable Resources



# Fundamental Building Blocks of Life



In order to guarantee quality and yield and thus a high degree of added value in recovering protein, the overall process must be tailored in detail to meet the specific requirements of the product to be processed. This requires many years of experience, know-how as well as the ability to innovate.

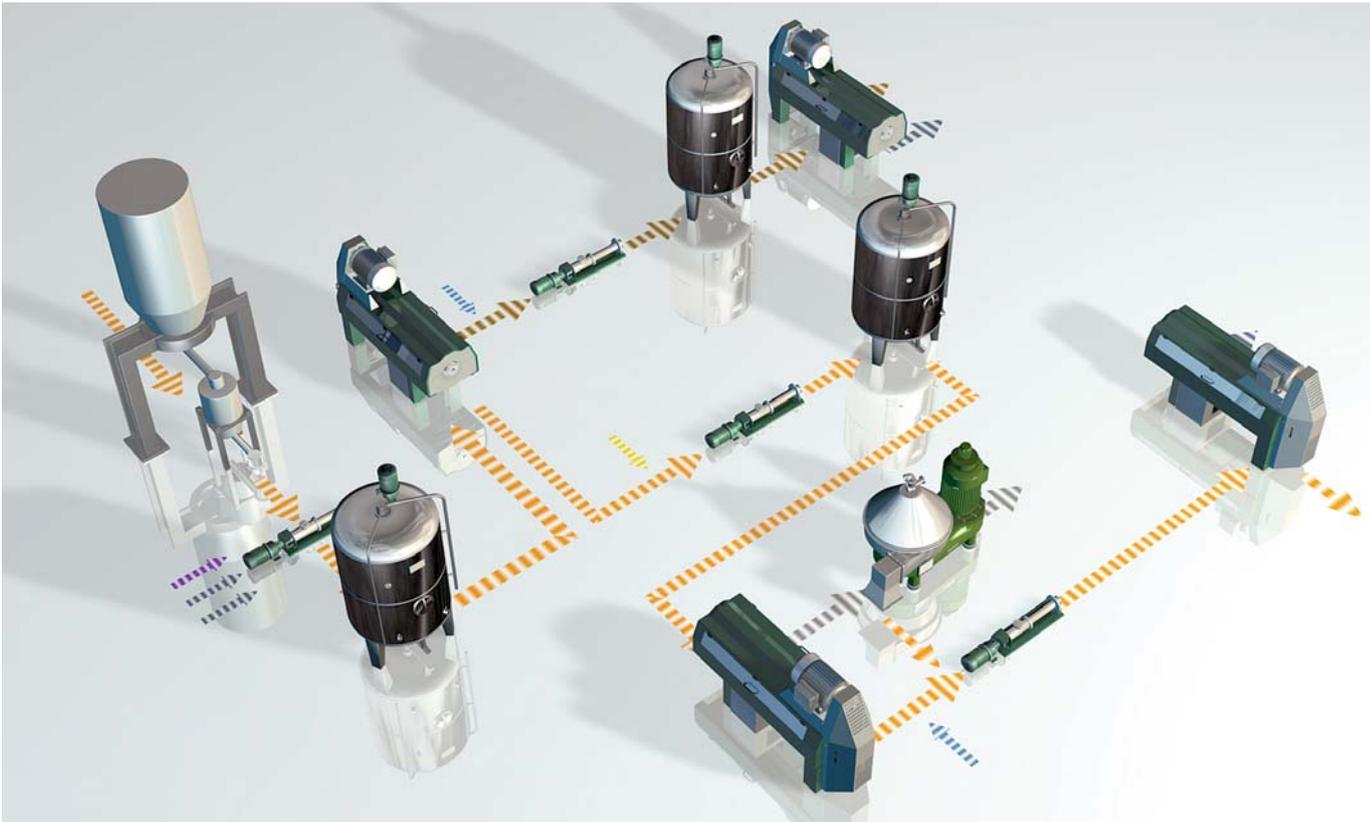
As the market leader in the field of centrifugal separation technology, GEA Westfalia Separator can look back on more than 115 years of experience in engineering and process technology. During this time, the number of areas of application has expanded significantly, and there are now more than 200 areas of application which have been tested in separation technology or which already have a good track record in the field.



This is the basis for constantly developing new applications for separators, decanters and ceramic membranes as well as for constantly improving existing applications. With new ideas in the field of process engineering, the development engineers focus on those areas where product quality and product quantity are factors which determine success. This is because only a perfect combination of theoretical knowledge, practical experience and close cooperation with the client results in user-oriented solutions which generate a high benefit.



There are good reasons why separators, decanters and membrane filtration of GEA Westfalia Separator are nowadays used throughout the world in key industries, such as the chemical and pharmaceutical industry, biotechnology, starch technology, oils and fats recovery, in environmental technology and mineral oil recovery. This foundation is built on to constantly develop specific processes for new areas of application and improving existing processes. Experience and knowledge, which is being applied more and more intensively for protein recovery.



Besides fats and carbohydrates, proteins represent a principal constituent in the food chain and are thus one of the three most important natural substances. They enable organisms to recover energy, and are also responsible for generating and renewing body cells. They are composed of up to 20 different amino acids. Plants may contain large quantities of proteins, but they are not cultivated exclusively for protein recovery; instead, they are also used for recovering oil and starch. For instance, in addition to the seeds of protein rich legumes (soy, lupine, alfalfa, peas), typical starch plants, e.g. wheat and maize, are also rich in protein.

In order to achieve greater added value, it accordingly makes sense to take advantage of the synthesis potential of these plants by way of industrially recycling the protein-rich residue which occur in the process of oil and starch recovery. Soy, as a raw material, is exceptionally important in this respect. No other cultivated plant in the world

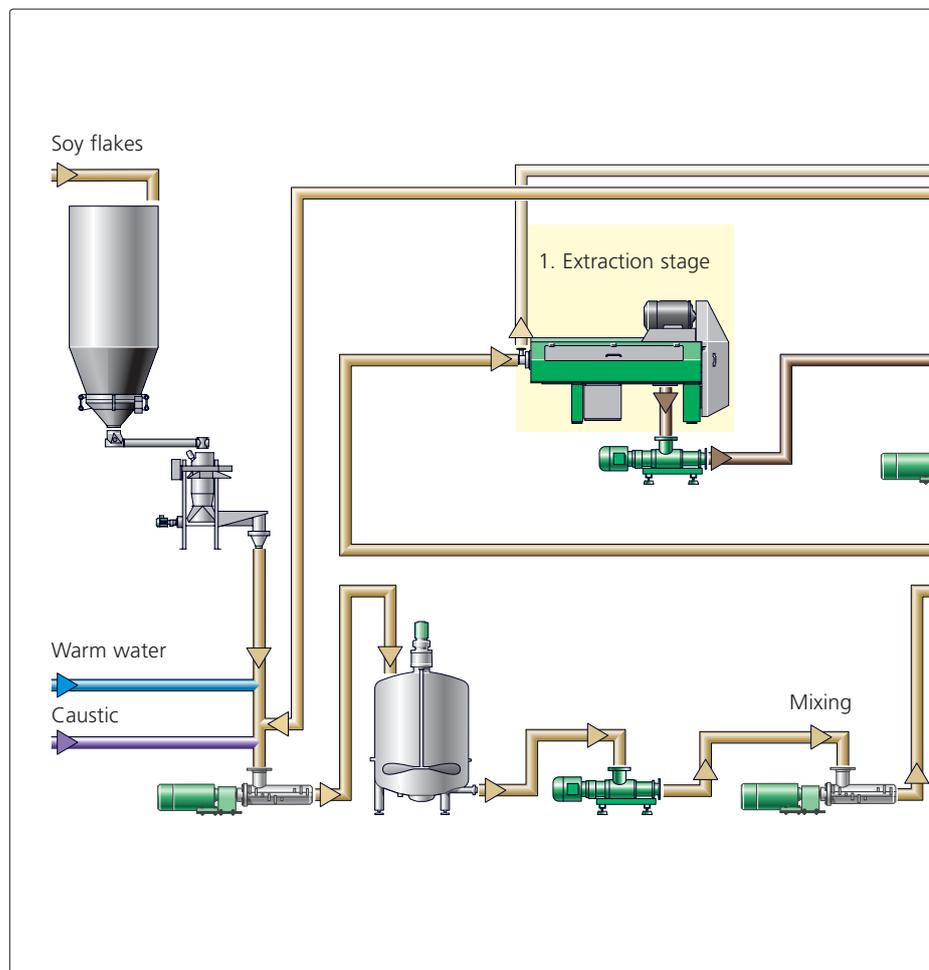
can be processed into so many products as the soy bean. Examples of such products are vegetable oil, baking and frying fat, meat substitute, baking additives or animal feed concentrate. Further examples are carrier media for printing inks or primary substances for biodegradable plastics or biodiesel. What other cultivated plant is able to compete with the extremely versatile soy bean? In the food industry, soy concentrate and soy isolate are gaining in significance. They are used in meat production and sausage production, as well as in baby foods and food for athletes. The technology of GEA Westfalia Separator for protein recovery is designed precisely for creating a native raw material which at all times meets the requirements of this wide range of applications.

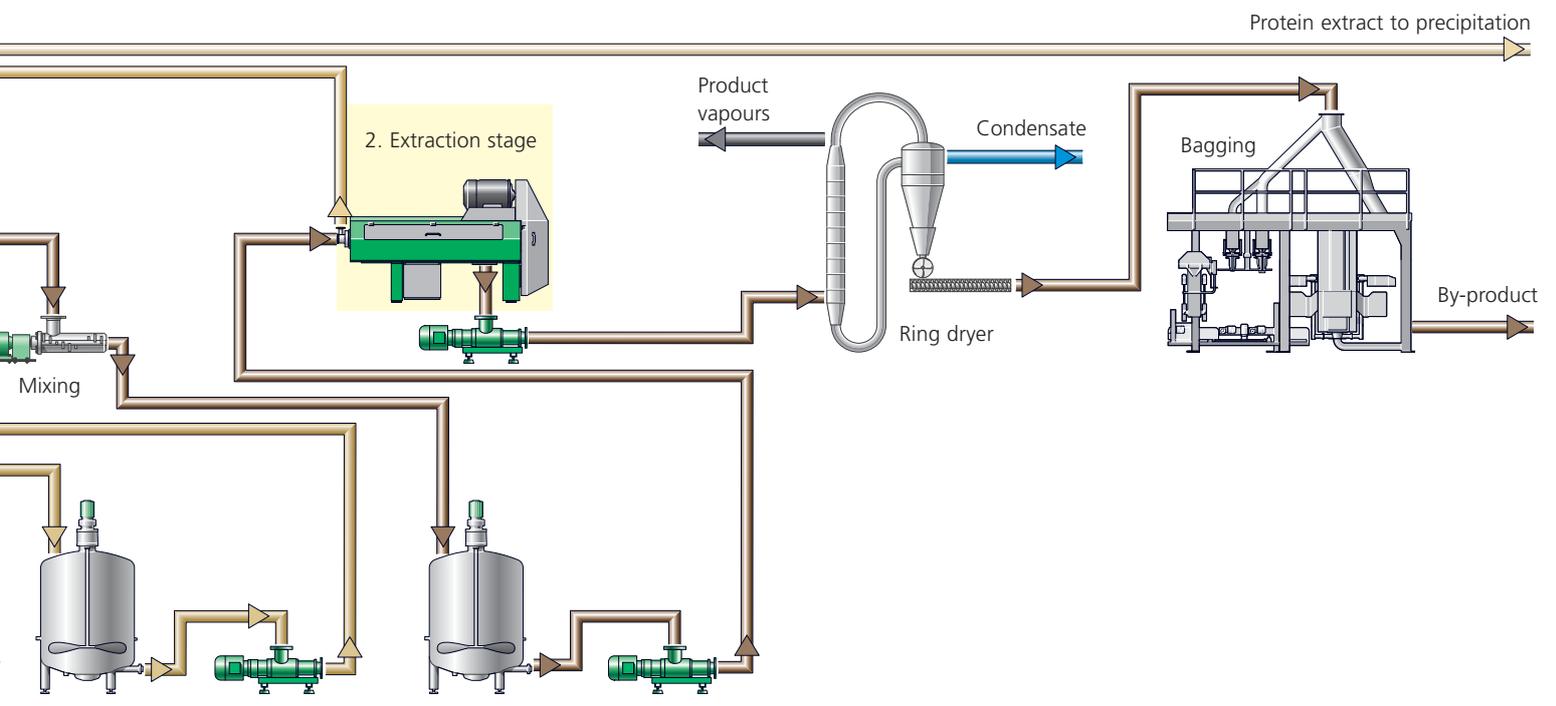
# Protein Extraction

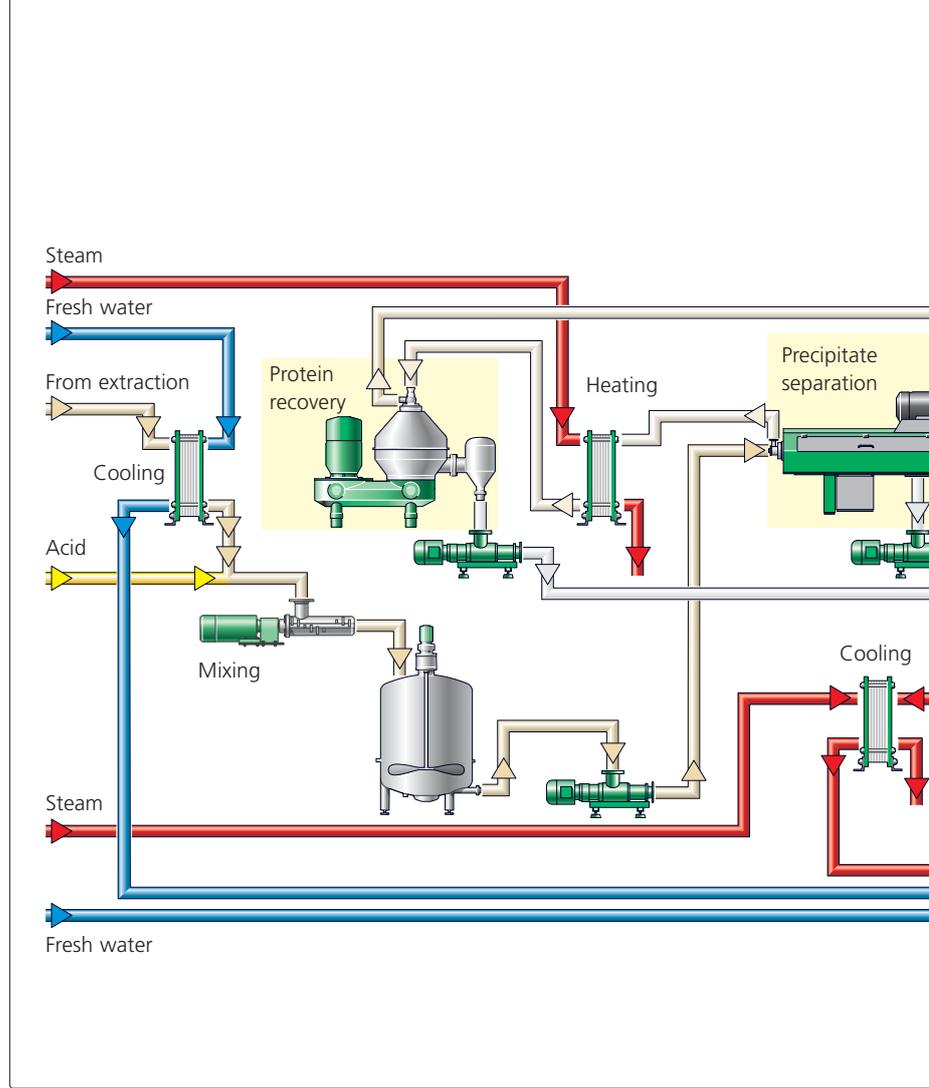
Whether soy protein concentrate or isolate, in the interests of constant product quality and quantity as well as installation hygiene the installations are equipped with continuously operating decanters and separators due to the high solids concentration.

This is because optimized protein recovery is associated with low fresh water consumption. And this also results in a significant reduction in the volume of waste water. The installation features a high degree of automation, and the capacity is generally designed for the operating capacity of the main elements in order to guarantee cost-effectiveness and rational production in conjunction with high quality and yield.

After the defatted soy flakes have been mashed and the proteins have been extracted from the flakes in several stages, the solid phase is separated from the protein phase in two decanter stages. In the first extraction stage, the solid and liquid phases are separated and solids are continuously discharged. Because the solids which are obtained in this phase still contain residual protein, a second decanter operating on the principle of counter-current extraction is installed downstream of the first extraction stage. The solids fed into the system are first again diluted with water, and the necessary pH value is automatically adjusted. The centrate from the second decanter stage is used as water for diluting the flakes in the mashing stage in order to reduce the level of water consumption in the installation. The solids which have been extracted two times still contain bonded and insoluble protein, which can be dried and then used as animal fodder.







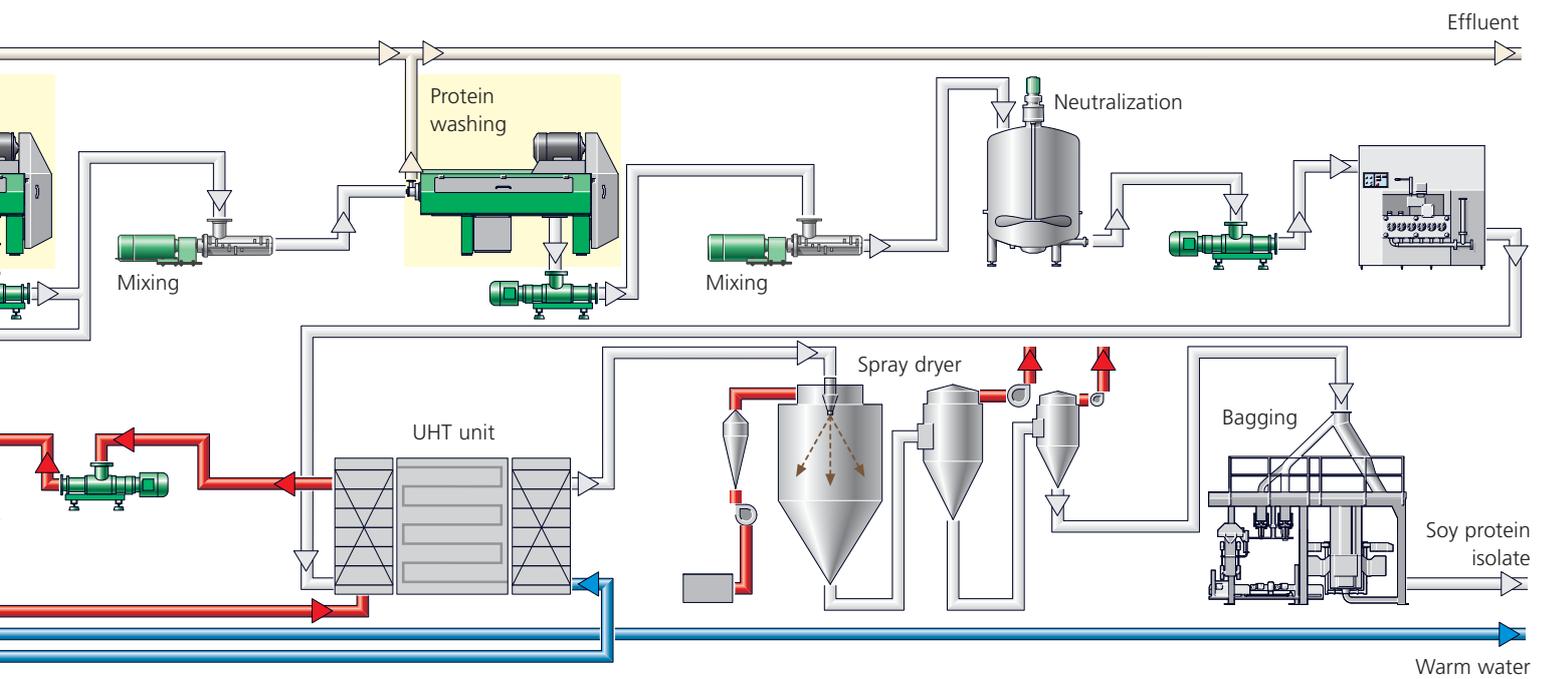
The protein dissolved in the centrate of the first decanter stage is first extracted and then pumped to the precipitation stage. For this purpose, the protein solution is first adjusted inline to the isoelectric point which is between pH 4.0 and pH 5.0. Protein flocs form during precipitation. These are removed by decanters which have been specifically configured by GEA Westfalia Separator for this purpose.

The remaining proteins in the centrate can be stabilized by way of heat treatment and recovered by a high-performance clarifier in order to increase the yield of valuable protein and in order to simultaneously reduce the effluent load.

The protein from the decanter and separator recovered in this way is then sent to the washing stage. For washing the protein, a solids/water ratio of 1:4 is adjusted in the decanter.

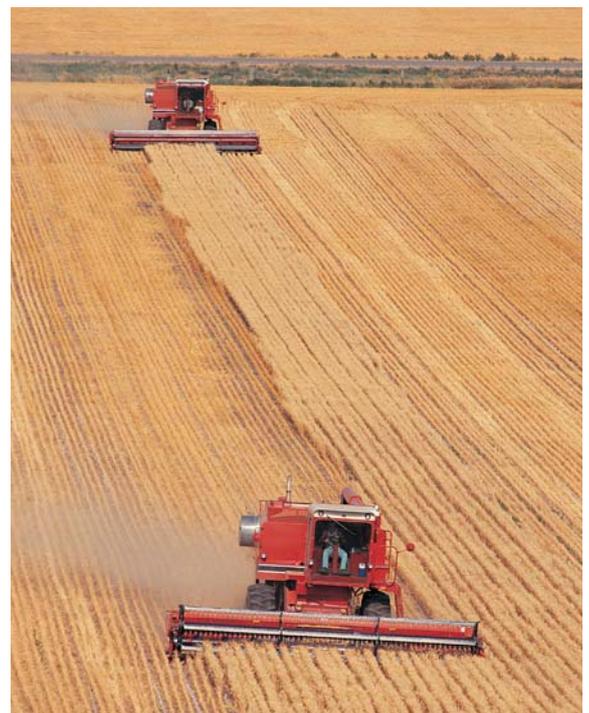
The concentration of the dissolved substances is reduced by the washing process, and this enables a particularly pure end product to be obtained; this product can be used in a wide range of applications. After the washing phase, the solids are separated in a decanter, and the soluble carbohydrate fraction is displaced into the centrate.

Following further process stages, such as homogenization and ultra-high heating, the soy protein isolate is discharged in powder form from the spray drier with a protein content of more than 90 percent.



### A focus on the essentials

- Recovery of extremely pure proteins which can be used in a wide range of applications
- Maximum yields due to special decanter configurations and protein recovery with clarifiers
- Fresh water consumption minimized by means of recycling process water
- Low BOD loads in the effluent due to a recovery stage for considerable savings in terms of effluent treatment
- Drying of insoluble proteins after extraction for use in the animal feed industry





## Decanters for Efficient Protein Recovery

The decades of experience in the field of centrifugal separation technology, intensive research and development and the related innovative ability of GEA Westfalia Separator guarantee the company's customers throughout the world the technical lead which is necessary for successfully operating in global markets. A sophisticated product is only really good if it meets all requirements for individual and customer-oriented solutions in the field of process engineering. Decanters from GEA Westfalia Separator do this in many ways.

GEA Westfalia Separator supplies decanters in a wide range of sizes and versions – they are always optimized to meet the specific processing capacity and the separating task which has to be performed. In the field of protein recovery, the decanters are used for extracting, concentrating, recovering and washing the protein. Sophisticated drive systems ensure a high degree of dry matter.

The 2-gear drive developed by GEA Westfalia Separator enables the differential speed to be smoothly adapted to the quantity of protein to be separated. This is the only way in which maximum dewatering efficiency and separating performance can be achieved. The Westfalia Separator® varipond® system – a further GEA Westfalia Separator patent – can be used for varying the pond depth of the decanter automatically while the machine is still running.

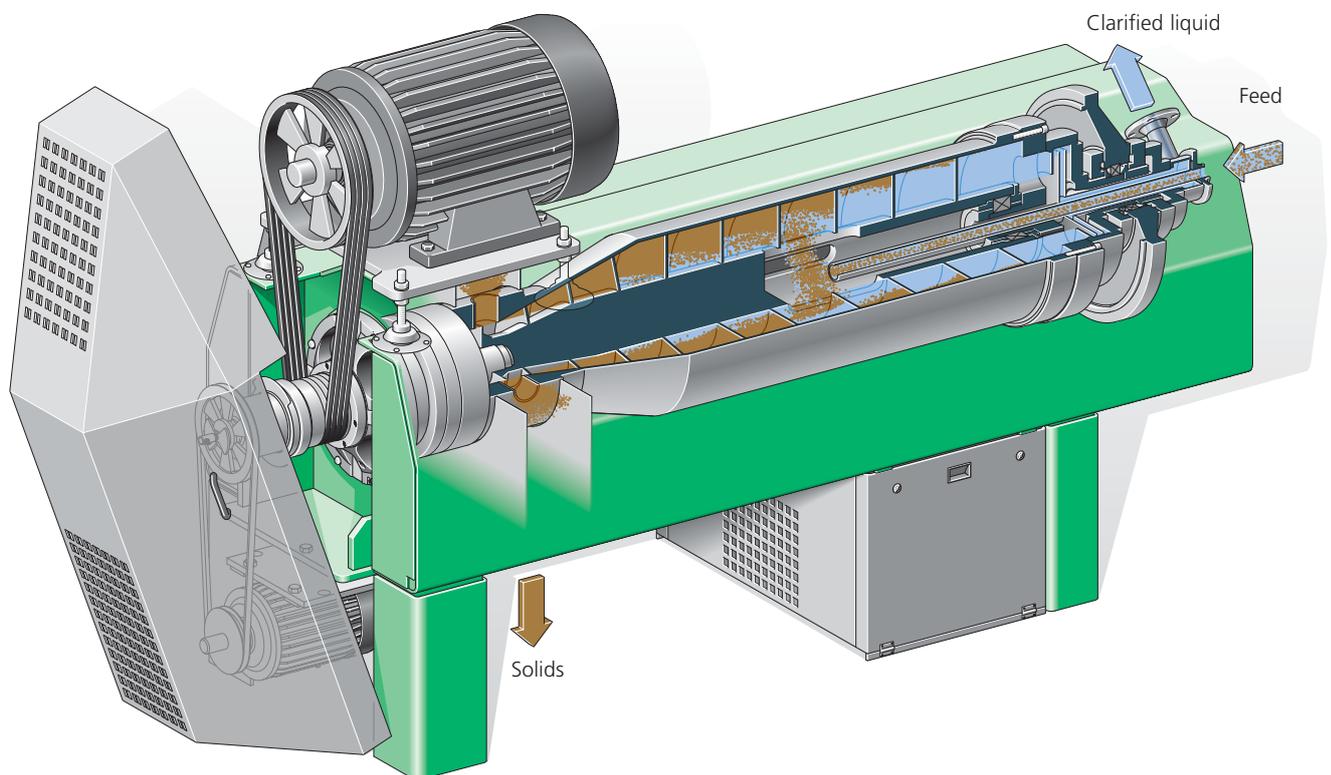
This is a huge advantage which saves a lot of time and money; if the system were not used, decanters would have to be shut down in order to enable the pond depth to be changed so as to guarantee a constant discharge concentration with fluctuating operating conditions. The smooth and optimum adjustment of the pond depth can also increase the relative clarification surface, which means that even extremely small particles can be separated and excellent separating efficiencies can be achieved.

The bowl chamber is hydrohermetically sealed due to the fact that the clarified liquid is discharged under pressure. This prevents any additional oxygen intake and in particular also avoids foaming which would result in protein losses. In line with the requirements applicable for hygienic process design, the decanters of GEA Westfalia Separator are of course CIP-capable. With the double frequency converter drive, it is possible for the machine to be operated with a low bowl speed in order to ensure that the chemical cleaning process is even more efficient. The decanters are also completely enclosed in stainless steel which means that corrosion damage cannot occur.

The automatic oil circulation lubrication facility ensures a long life and high availability of the decanters, which do not take up much space as a result of their compact design.

### A focus on the essentials

- Variable drives, torque-dependent differential speed regulation for constant and extremely high solids concentration even with fluctuating feed concentrations
- Patented adjusting weir – Westfalia Separator® **varipond**®: The pond depth can be adjusted while the machine is still running in order to improve separating efficiency automatically
- Adapted drive concepts: 3-phase AC motor with frequency converter for regulating the bowl speed or motor for controlled torque starting
- Automatic oil circulation lubrication: Long service life of bearings due to cooling lubrication and filtering
- Optimum pond depth for optimum dewatering and low energy consumption
- Paring disk: Hydrohermetic operation to avoid protein losses and energy saving due to small diameter
- Maximum dewatering with maximum separating efficiency
- Material and sealing systems adapted to the specific products



# High Performance Separators for Protein Recovery

Within protein recovery, clarifiers of GEA Westfalia Separator represent the recovery stage from the centrate from protein precipitation. This not only increases the yield of valuable protein; it also simultaneously reduces the COD value in the effluent. Higher yields combined with lower costs of effluent treatment – the recovery stage considerably increases the efficiency of the entire process. However, the engineering which is employed must be customized in an optimum manner to meet the needs of the product and the process stage.

## New generation of separators for protein recovery

The new SSE generation features the advantage of large equivalent clarification areas of the disk stack for optimum clarification particularly in conjunction with high throughputs.

The separators are equipped with a hydrohermetic feed in order to enable optimum advantage to be taken of these large clarifying areas. This patent avoids virtually all turbulence in the bowl.

The gentle product feed achieved in this way prevents shearing forces in the inlet area, which has an extremely positive impact on clarifying efficiency. A centripetal pump discharges the clarified liquid foam-free and under pressure, which means that there is no oxygen pickup. The solids collect in the solids holding space and are ejected at periodic intervals.

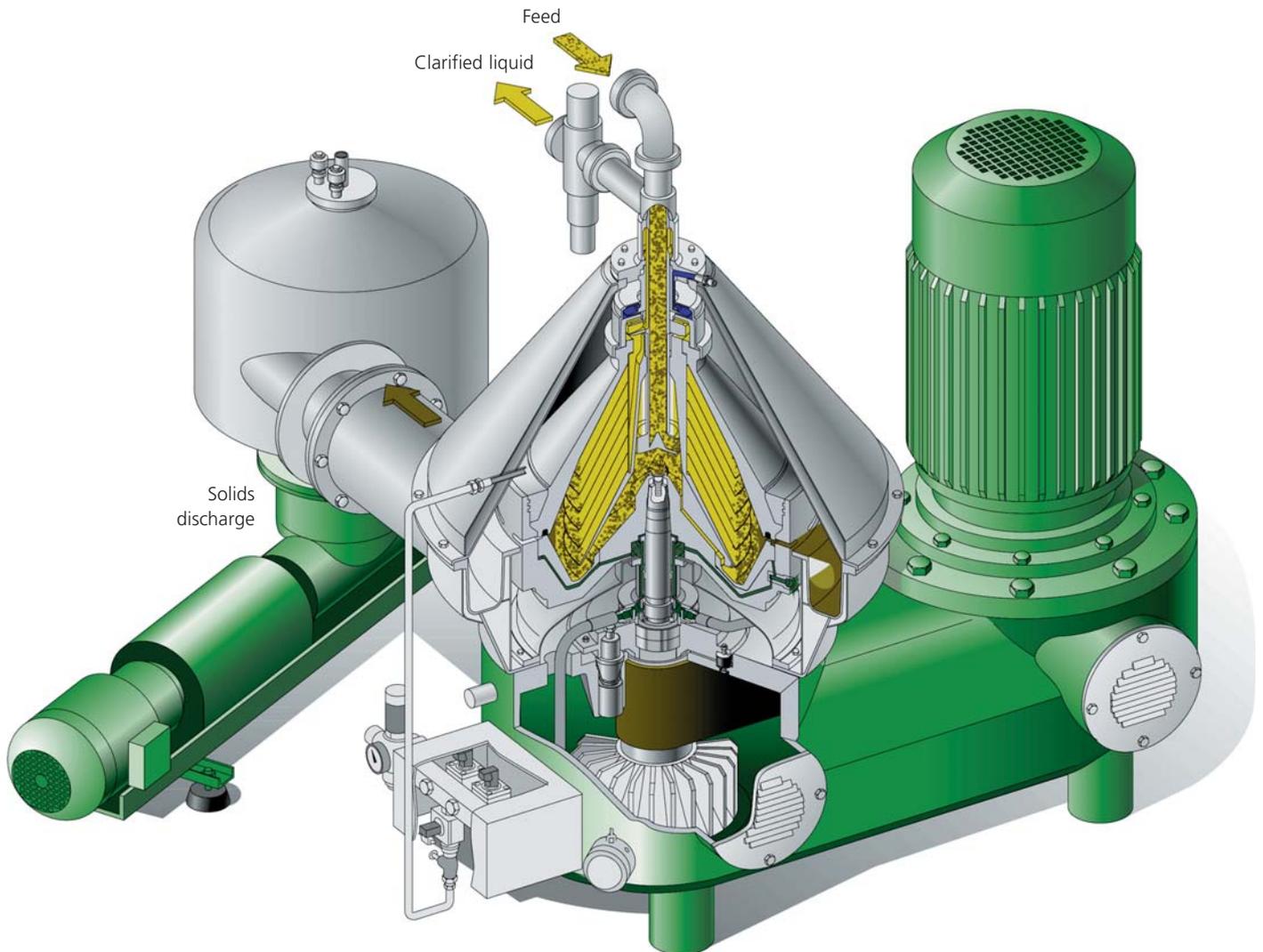
Bowl discharges are carried out automatically via the control unit. For this purpose, the clarified liquid can be monitored by means of a photoelectric cell. This discharge system not only ensures

that the separator is extremely simple to operate; it also ensures that the bowl is always discharged at the optimum time.

Product losses are accordingly reduced to an absolute minimum; nevertheless, the separator always operates with maximum separating efficiency.

The SSE separators are also CIP-capable. For cleaning purposes, they are flushed with normal media in the CIP method; the residues which are removed collect in the solids holding space of the bowl, where they are ejected. The ejection process generates an additional flushing effect in the disk stack, and this improves the efficiency of the chemical cleaning process. The double-wall hood which is designed as a cooling chamber, the solids-holding tank and the solids chute also facilitate optimum cleaning and reduce the overall noise level.



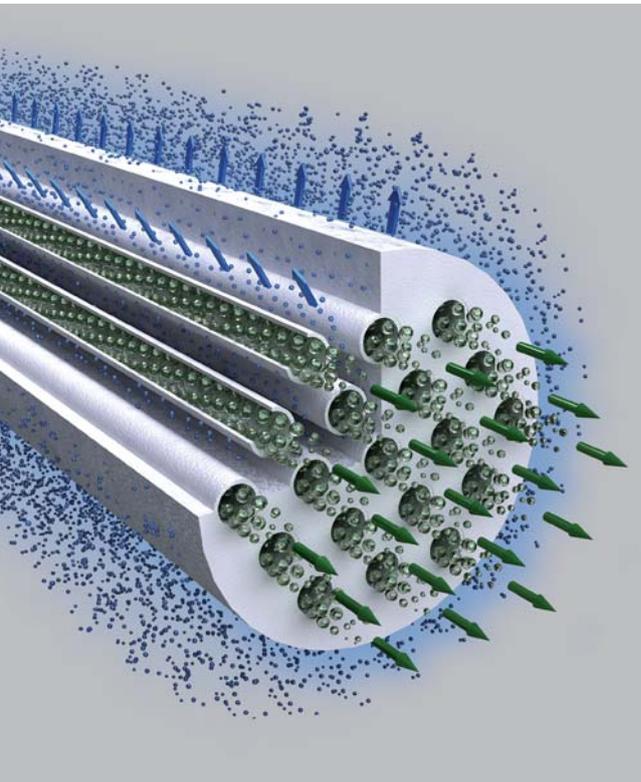


### A focus on the essentials

- Hydrohermetic feed system for gentle product treatment and maximum yield
- Prevention of oxygen intake, foaming and gas losses due to hydrohermetic seal
- Automatic control of solids ejection process via photo-electric turbidity meter for automatic selection of optimum ejection time
- Large equivalent clarifying area of disk stacks for optimum clarification even in conjunction with high throughputs
- Consistent implementation of hygienic design
- Short-spindle drive for smooth running
- Long maintenance intervals due to external oil circulation lubrication
- Low-maintenance flat-belt drive

# Ceramic Membrane Filtration – Ultra-Fine Clarification for Nano Particles

GEA Westfalia Separator has achieved a new dimension of ultra-fine clarification with hybrid solutions comprising a centrifugal separation system and filtration technology



## Westfalia Separator® hybrid

Westfalia Separator® hybrid boosts the efficiency of the overall installation by means of an intelligent combination of centrifugation and membrane filtration in an innovative Westfalia Separator® hybrid solution.

In addition to centrifugal separation systems, GEA Westfalia Separator also has an expert command of membrane filtration with ceramic elements for ultra-fine clarification of particles with a size of up to one nanometer. The company is accordingly able to significantly expand product clarification within a process chain. The intelligent combination of centrifugation and membrane filtration in an innovative Westfalia Separator® hybrid solution further improves the efficiency of the overall installation.



## Individual specifications

The ceramic membrane installations continuously supply a clear filtrate with the specified degree of clarification and the desired performance. The ceramic membrane forms a mechanical barrier with a defined pore size. GEA Westfalia Separator provides a wide range of ceramic membrane modules in the pore size range of 1 to 1400 nanometers and with different membrane materials. The modules are mainly standardised, with variable channel diameters, element lengths and pore sizes. This membrane installation downstream of the separator permits extremely fine clarification of particles with a diameter of  $< 1$  micrometer.

## A focus on the essentials

- Westfalia Separator® hybrid solutions comprising centrifugation and membrane filtration
- Everything from a single source
- Intelligent harmonising of all components enhances process efficiency
- Ultra-fine clarification for particles of up to 1 nanometer
- Wide range of ceramic membrane modules
- Individual configuration according to specific requirements



# Central Process Technology – the Reliable Basis for Decision-Making

Customer-specific test series in Central Process Technology provide a reliable basis for decision-making for all investments in mechanical separation technology.

No product to be separated is identical with another. In many cases, it is therefore necessary to perform test series before the correct decision can be taken for a specific installation. GEA Westfalia Separator has set up the Central Process Technology department (CPT) for this purpose.

Depending on the specific task involved, test series can be run with the original product of the customer in a mobile pilot installation on site or in the laboratory at GEA Westfalia Separator. The specification of the customer with operating temperature, throughput capacity, clarifying or separating efficiency and other factors constitute additional important information necessary to enable a representative and reliable analysis.

After every test series, the customer receives informative documentation in which the technical and economic data are detailed.

## Focus on investment protection

The results of Central Process Technology can be used to precisely identify what machine type and what model from GEA Westfalia Separator are most suitable for the specific task. This procedure avoids poor investments right from the very beginning. The customer achieves a reliable basis on which he can take the correct investment decision.

## A focus on the essentials

- Test series with the original products of the customer
- Practical and representative
- In the laboratory of GEA Westfalia Separator or in pilot installations on site
- Detailed test documentation
- Specific machine recommendation
- Detailed mass balance
- Total cost analyses





- Beverage Technology
- Dairy Technology
- Renewable Resources
- Chemical/Pharmaceutical Technology
- Marine
- Energy
- Oil & Gas
- Environmental Technology
- Engineering
- Second Hand Machinery
- Original Manufacturer Service

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Binding information, in particular relating to capacity data and suitability for specific applications, can only be provided within the framework of concrete inquiries.

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GEA Mechanical Equipment

**GEA Westfalia Separator**

Werner-Habig-Straße 1 · 59302 Oelde (Germany)  
Phone +49 2522 77-0 · Fax +49 2522 77-1794  
[www.westfalia-separator.com](http://www.westfalia-separator.com)