



Ethanol

Renewable fuel from nature

Performance-driven centrifuge technology

The Evolution of Ethanol

Alcohol production can be traced far back in human history. There is evidence that as long as 8000 years ago, the Sumerians, Assyrians and Babylonians used fermentation to make beer and wine. Alcohol is still enjoyed as an ingredient in a wide range of beverages, but it has also found uses in new industrial processes.

Today, one of the most important of these is the fuel market.

A growth market: fuel alcohol (ethanol)

The use of alcohol as a fuel alternative for automobiles has been the subject of discussion ever since the car was invented. Today, it has taken on new importance as the demand for energy in the transportation sector continues to grow at exponential rates. At the same time we are faced with limited quantities of fossil fuels and an over-reliance on foreign oil. These concerns, combined with serious environmental issues about the effects of burning fossil fuels, have created increased interest in and demand for ethanol as a fuel additive.

Aside from the air pollution issues, the fuel additive methyl tertiary butyl ether (MTBE) has come under attack due to ground water contamination. Therefore, more and more petroleum producers are changing over to the additive ethyl tertiary butyl ether (ETBE).

Unlike MTBE, which is a toxic substance made from methanol (derived from crude oil), ETBE is made from ethanol and is completely safe for the environment.

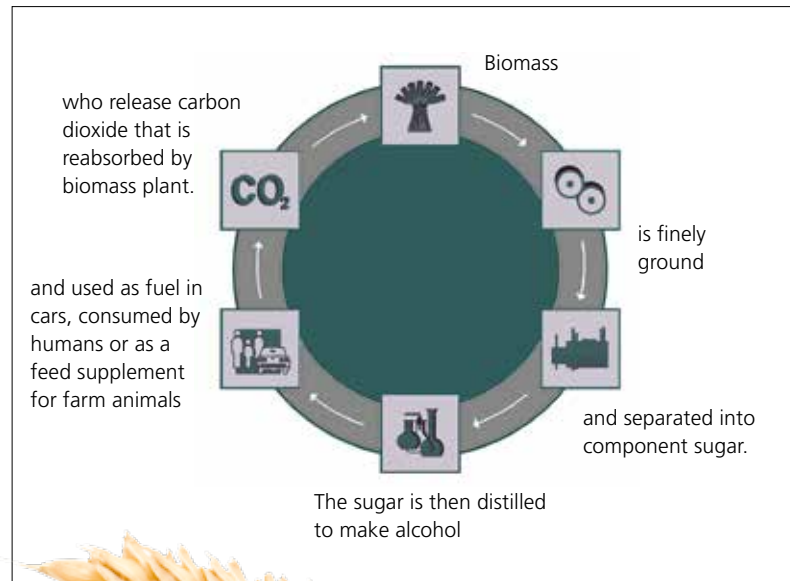
For many years, GEA Westfalia Separator Group has been successfully supporting the production of high-quality bioethanol with separators and decanters. In cooperation with science, research and industry, we are not only working towards improving the efficiency of existing processes; we are also focusing on the technical and economic utilization of renewable energies of the second and third generations, for instance biomass on the basis of cellulose.



Used throughout the world

GEA Westfalia Separator Group is one of the world's leading players in the field of centrifugal separation technology, and manufactures high g-force decanters and high speed disc centrifuges for the production of fuel, industrial and beverage alcohol. In the industrial biotechnology field, we have been instrumental in developing new manufacturing processes in partnership with our customers.

The finite nature of fossil fuels is compelling us to look for new solutions to obtain fuels and other industrial products. Our Business Line Renewable Resources provides intensive support to users who are planning new products and processes – from the initial laboratory-scale test and the pilot phases right through to the installation of industrial-scale plants.



Driving force for the future

Ethanol in Petrol and Alcohol

Ethanol is a versatile substance, and will have a successful future as a sustainable source of energy. It has already established a large share of the world market among the wide range of energy media. The addition of this alcohol to fuel will probably be one of the most interesting areas of application in the medium term. It is also used as alcohol in the beverage industry.

The starting signal for stepping up production of ethanol as a fuel was fired in Brazil, at the time of the first oil crisis in 1973, which was the first time that the modern world realized the full extent of its reliance on energy. Production was also subsequently commenced in the USA, and it now plays an important role in 36 states, such as California, Illinois and Ohio. In Nebraska alone, 40% of ethanol which is manufactured is used as a fuel additive. The Clean Air Act, a program designed to keep air clean, could well double the consumption of ethanol in the USA in future.

Fuel ethanol represents an important new market for grain producers, and one that is expected to continue to grow rapidly because of the many environmental and economic advantages ethanol offers:

- Reduction of carbon dioxide emissions
- Reduction of the “greenhouse effect,” urban smog and further damage to the earth’s ozone layer
- Assurances of energy independence and a sufficient raw material base
- Reduction in crude oil imports
- A strengthening of the rural economy and the creation of new jobs and new value-added products for growers





Alcohol for beverages

The production of alcohol for the beverage industry is of equal importance as the production of ethanol for the fuel industry. A key difference between the two is in the choice of raw materials used to make the end-product. Also, potable alcohols require special purity degrees and extract contents.

The starting products for all alcohol fermentation are raw materials which contain sugar and starch, such as corn, milo, wheat, barley, rye, sugar beets, cane sugar,

molasses and a variety of fruits such as grapes. While the glucose in plants containing sugar is fermented directly, the starch in grain products must first be converted into sugar using enzyme action. There are three basic processes used, regardless of the end use of the alcohol, which are outlined in detail on the following pages.



Variety for strong solutions

Fuel from Nature

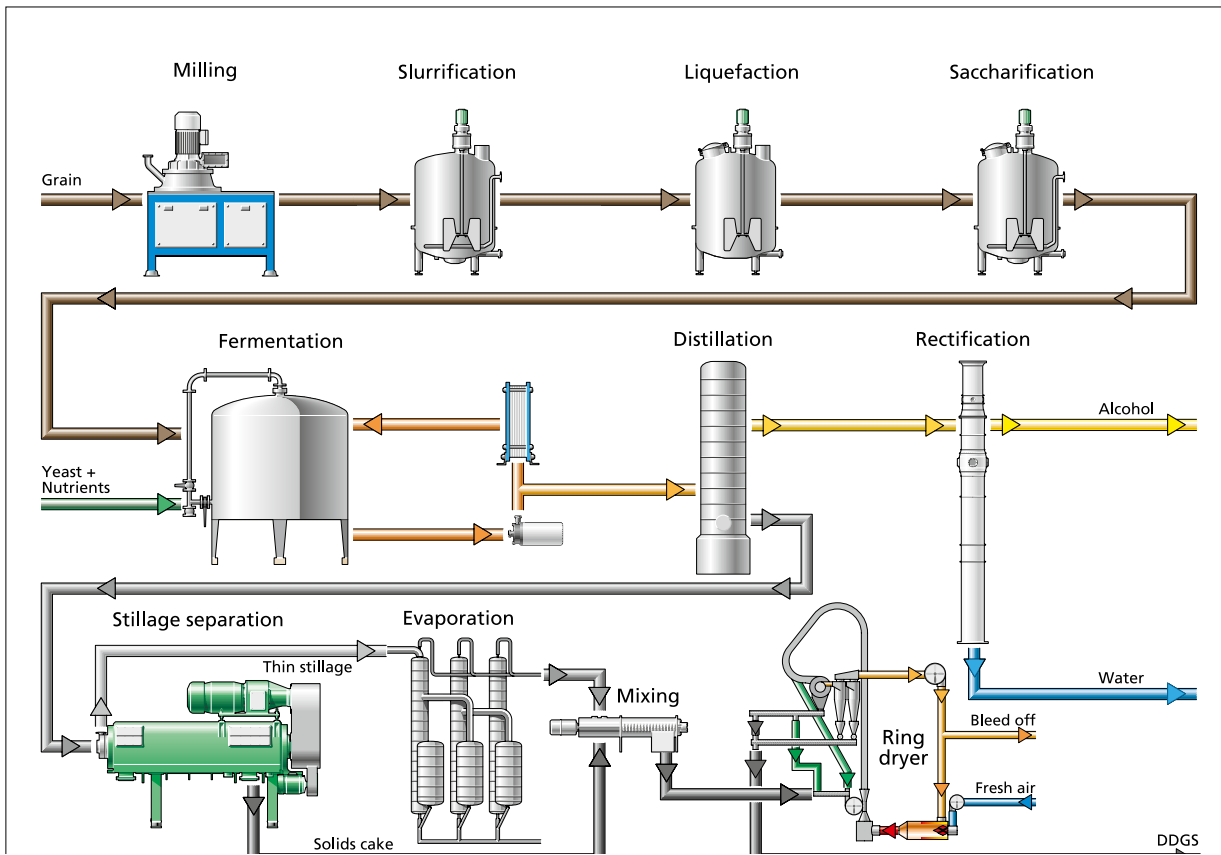
The starting products for alcohol fermentation are raw materials which contain sugar and starch, such as wheat, rye, corn, sugar beet and barley. Whereas the glucose in plants which contain sugar (sugar beet, sugar cane) is fermented directly, the starch in grain products first has to be converted into sugar by means of enzyme action. In view of the prevalence of certain crops in different regions, wheat tends to be used as the basis of this process in Europe. In the USA, corn tends to be used to a greater extent for the fermentation process.

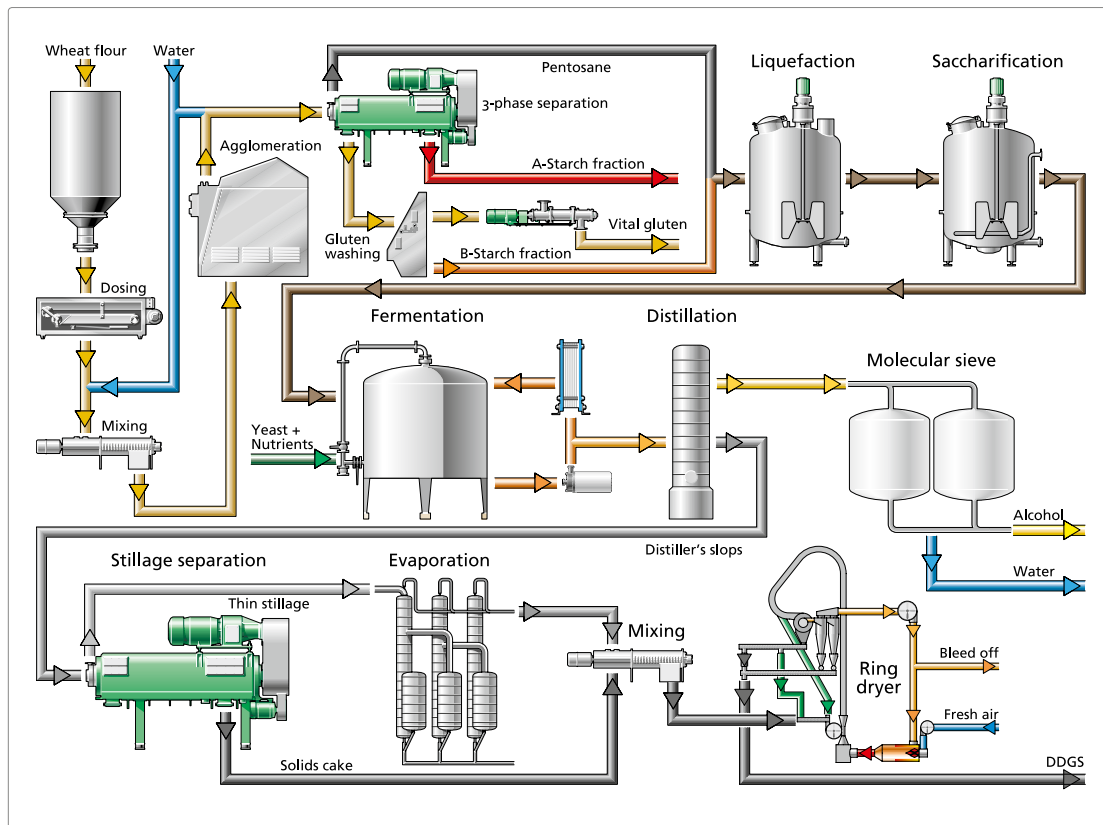
The dry milling process

In the dry milling process, the whole grain is ground and mixed with water, the pH value is adjusted and enzymes are added which convert the starch to simple sugars. This sugar mixture is fermented with yeast and alcohol is produced. The fermentation broth passes through a distillation column in which raw alcohol is distilled off. This raw alcohol is then used in the process of making ethanol.

The non-fermentable solids from this process are also a valuable by-product. The distillation bottoms (stillage) are clarified in a decanter. Thin stillage is the

centrate from the decanter and contains protein and microfibrils, a portion of which can be returned back (backset) to the fermenter. The solids discharge from the decanter consists of a solids cake which contains the coarse constituents of the grain. The centrate (thin stillage) with proteins, yeast and microfibrils, is evaporated to form a syrup. The syrup is then mixed with the decanter solids and dried to form DDGS “dry distiller’s grain with solubles,” which is sold as animal feed.





The wet milling process

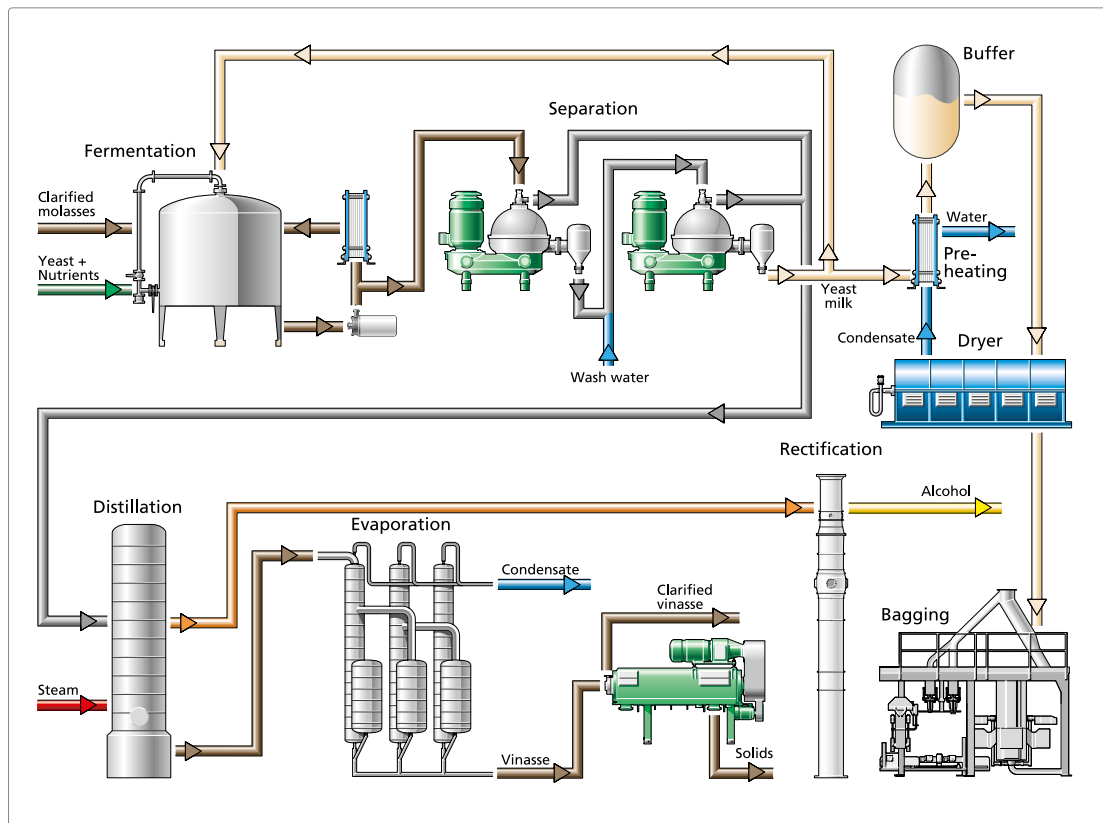
The wet milling process

Compared with the dry milling process, the wet milling process enables several products to be obtained. Water is added to freshly ground grain and mixed to form a mash. This mash is conveyed by a positive displacement pump to a homogenizer, where the mechanical forces cause the gluten particles to agglomerate. The shearing forces which occur in the process break down the gluten-starch matrix. This is a critical step to ensure the quantity and quality of the end products.

Then the dough is conveyed via a buffer tank to the decanter, which operates with the patented 3-phase technology, combining three process stages: washing, classifying and concentrating. This technology was developed by GEA Westfalia Separator Group, and enables the product to be separated into starch and other flour constituents directly in the initial process stage.

A-starch and gluten are extracted separately and can be processed into other end products, while pentosane and B-starch are used for ethanol production.

There are some plants that convert all the starches into ethanol. The process stages for recovering ethanol that follow are the same as those used in the dry milling process.



Recovering alcohol from molasses

Recovering alcohol from molasses

Molasses is what remains in the sugar production process after as much sugar as possible has been economically removed. However, molasses still contains up to 50 % fermentable sugar and this is sought after material for the fermentation industry. However, due to the large quantities of impurities in the molasses, treatment with centrifuges prior to fermentation is necessary.

The raw molasses is heated and diluted with water. Acid is then added to reduce the pH value. Those components which do not contain sugar and which would hinder the fermentation process precipitate out in the form of sediment. Separators and decanters can then be used to remove the solids from the molasses. The molasses which are clarified in this way are then sterilized, cooled for storage, and sent to the fermentation process. Micro-organisms convert the fermentable sugar into alcohol.

After the fermentation process has been completed, the fermentation broth is clarified with nozzle-type separators and the micro-organisms are removed before the distillation process begins. The concentrate which has been separated out can be recycled or processed into animal feed.

The overflow of the separator is distilled in order to obtain alcohol. Molecular sieves are used for rectification and concentration of the alcohol. Crystals are separated from the concentrate (vinasse) with a decanter, and used as fertilizer. The clarified vinasse in the overflow of the decanter is used as an additive in animal feed.



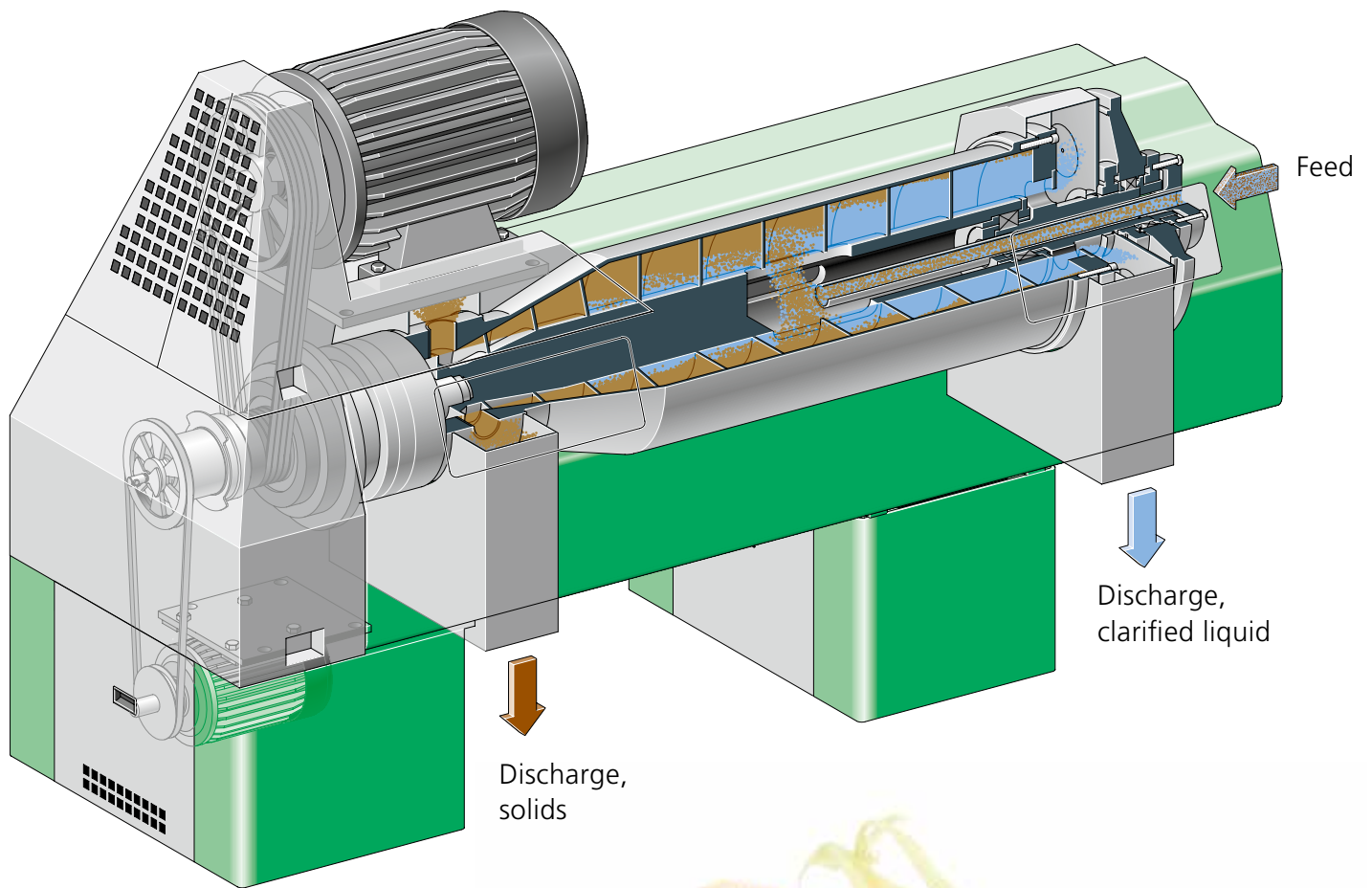
The difference is better technology

Fine-Tuning for Maximum Dewatering

GEA Westfalia Separator supplies decanters in a wide range of sizes and designs – always customized for the specific processing capacity and the separating task in hand.

- High g-force and optimum pond depth for maximum dewatering/drier wet grain (>35 % DS)
- Reduced power consumption for cost-efficient operations
- Pressure discharge of the thin stillage via centripetal pumps, resulting in a closed process; no need for pumps, tanks, and other auxiliary equipment
- Patented 2-gear drive – torque-dependent differential speed regulation for constant and extremely high concentration of solids, even in the case of fluctuating feed concentrations
- Frequency converters for soft start and regulating bowl speed
- Patented adjustable GEA Westfalia Separator **varipond**® senses variations in product conditions and adjusts the pond depth accordingly to maximize efficiency
- Oil lubricated gear box and main bearings for extended service life
- Longer inspection and maintenance intervals
- Modular drive for more user-friendly maintenance

These decanters are available from 200 to 1000 mm bowl size, with optional gravity or pressure discharge, and with material and sealing systems to meet each customer's requirements.



The difference is better technology

Modern Yeast Separators

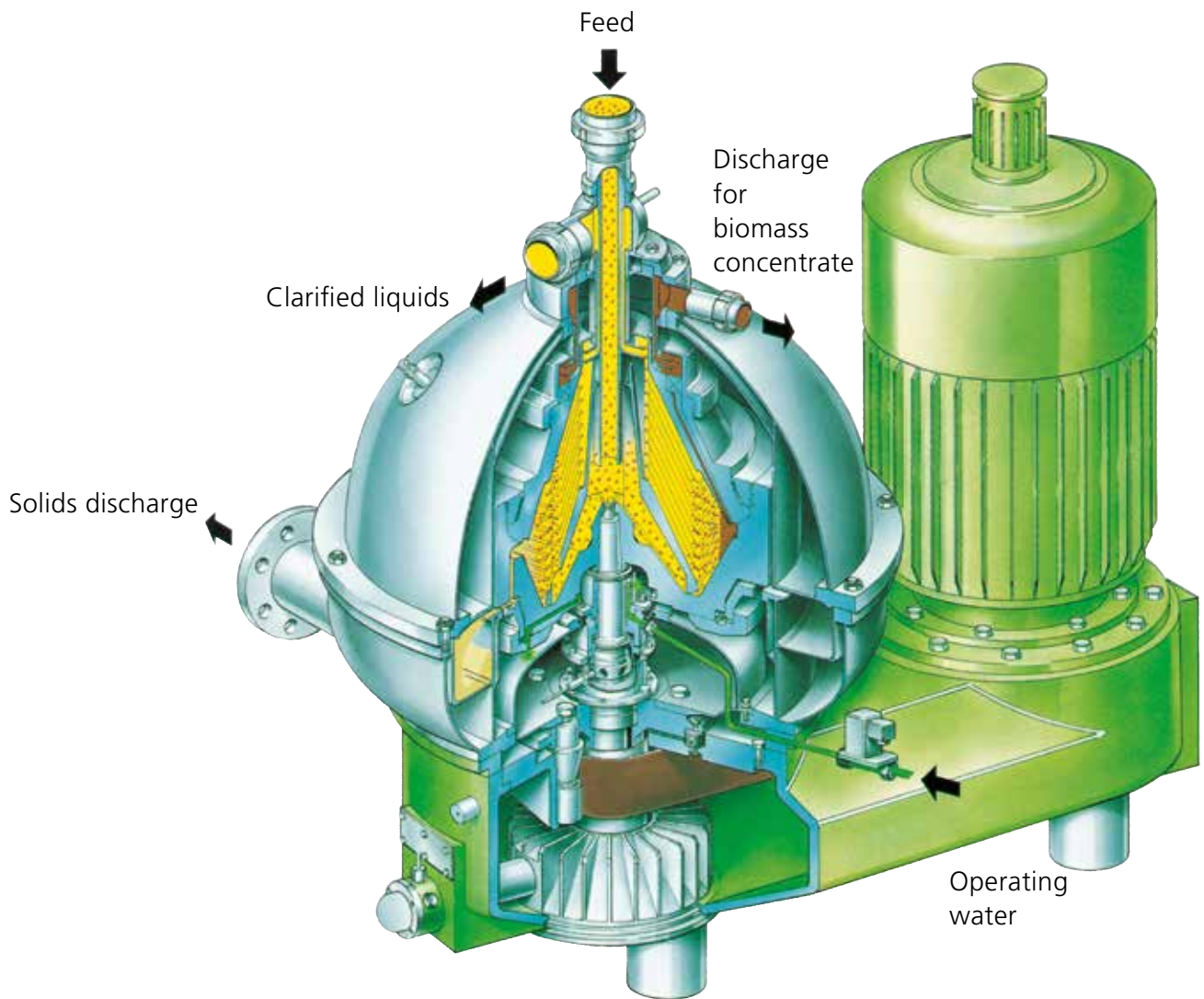
GEA Westfalia Separator has also been a leader in the development of separators for the processing of yeast. The special nozzle separators with the GEA Westfalia Separator **viscon**[®] system were designed with this in mind – they automatically optimize the discharge concentration of the yeast cream and enable the product to be discharged under pressure.

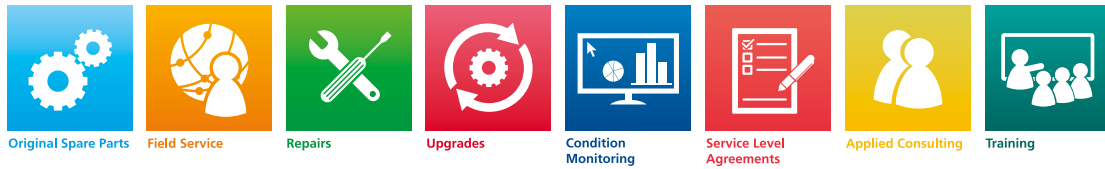
This generation is available in various sizes, handling throughput capacities up to 130 m³/h. They can also be supplied in explosion-proof and sterilizable designs.

Advantages of these separators include:

- Clarifying bowl with closed feed and discharge of product phases
- Clarified liquid and concentrate discharged under pressure by means of centripetal pumps
- Special nozzles – **viscon**[®] – for viscosity-dependent concentration regulation providing constant biomass concentration even in the presence of fluctuating feed concentrations
- Automatic partial and total ejections during the separating process
- Separate discharge of product and operating water
- Hydraulic solids ejection mechanism for CIP
- Double-jacketed and cooled hood and solids chute promotes noise abatement (<80 dBA)
- Hood flushing
- Flat belt and short-spindle drive for smoother running and reduced vibrations
- Speed monitoring







Your Partner for Reliability, Budget Control and Efficiency

serv&care is the GEA Westfalia Separator Group service philosophy reflecting your needs and covering all common activities from the Business Area Service International and all service organizations in the subsidiaries of GEA Westfalia Separator Group.





This service philosophy should be understood as the overall common service understanding, supporting the values, vision, mission and strategy of the GEA and the Business Unit GEA Mechanical Separation.

The name serv&care combines two aspects of the modern service world

“serv” stands for service, meaning concrete actions to help in any way to maintain your equipment. Whether it is for Spare Parts supply, assistance using our excellent Field Service Engineers or our factory authorized comprehensive repairs, all are covering your requirements. The main values of these services are speed and quality. Our worldwide service network serves as a basis to allow us to fulfill your requirement. GEA Westfalia Separator Group offers on-time delivery of spare parts through our logistic hubs, local stock levels and a global network of highly trained and experienced Field Service Engineers and also having the specialized machinery in our Authorized Workshops for comprehensive and safe repairs that only we can provide. “care” stands for the driving force of our service organization to be an innovative and reliable partner. Together with you we strive to find optimum solutions that fulfill and exceed your expectations. We are not only servicing the equipment, we offer solutions that satisfy the central task to increase the reliability of your equipment, operates efficient processes and ensure that you meet your own corporate mandates for total quality.

Our motivation is to supply complete and timely support that is “one step ahead” of your support requirements. “care-thinking” is the basis of our self-understanding as the market leader and being recognized as your first choice service provider.

Customer benefit orientated service product solutions from GEA Westfalia Separator Group

Your maintenance needs and requirements can be drawn together from our comprehensive service portfolio. Every individual service plays a vital role in securing the reliability, cost control and efficiency of your centrifugal equipment.

The serv&care service products

- Spare Parts – for protecting your investments
- Field Service – always nearby waiting to assist you, 24 hours a day, 365 days a year
- Repairs – care, precision and responsibility from the manufacturer
- Rental Bowls/Exchange Parts – keep downtimes to a minimum
- Upgrades/Modernization – latest design parts and components engineered specifically for your machine
- Condition Monitoring – reliable information for optimizing the installation availability and avoiding unscheduled downtime
- Service Level Agreements – service packages for higher availability together with full budget certainty
- Customer Training – modern training approaches with the aim of dealing with your own practical situations
- Factory Rebuilt Machines – used separators and decanters in First-Class quality
- Applied Consulting – optimizing and adjusting operations with the latest technical knowledge

More information:
www.westfalia-separator.com/service/original-manufacturer-service.html





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

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