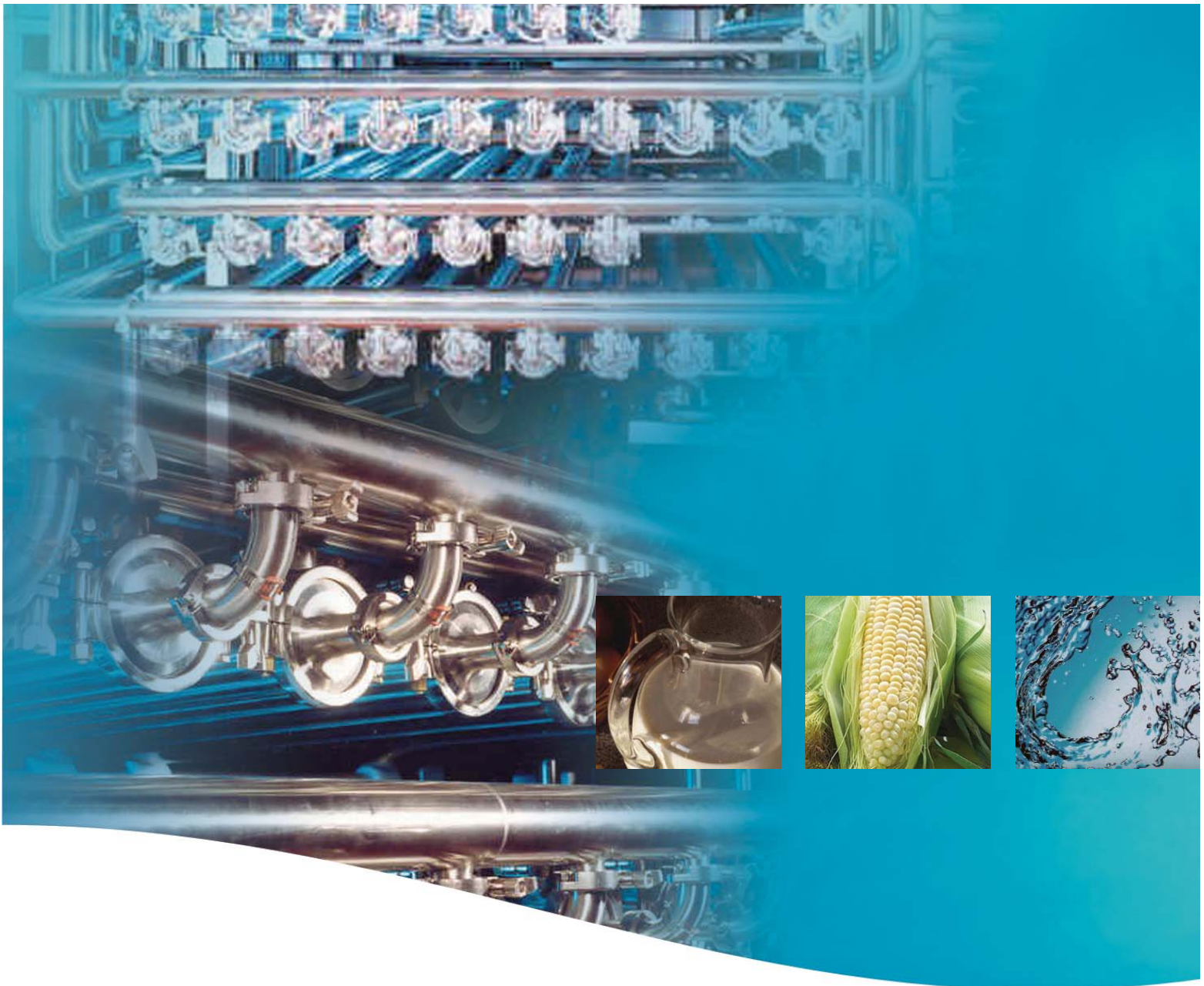


Membrane Filtration

Reverse Osmosis, Nanofiltration,
Ultrafiltration and Microfiltration



Global Experience

A Reliable Partner

GEA Filtration is part of GEA, an international process engineering leader in the life sciences industry with more than 150 companies operating worldwide. As a team member with technology leaders like GEA Niro, GEA Wiegand, GEA Liquid Processing, GEA Barr-Rosin and GEA Tuchenhausen specializing in liquid and powder processing systems, GEA Filtration is uniquely positioned to provide both customized membrane filtration plants as well as complete process lines specifically tailored to each customer's specific needs and requirements.

*Hudson, WI,
USA*



Skanderborg, Denmark



Auckland, New Zealand



Ettlingen, Germany

A Proven Track Record

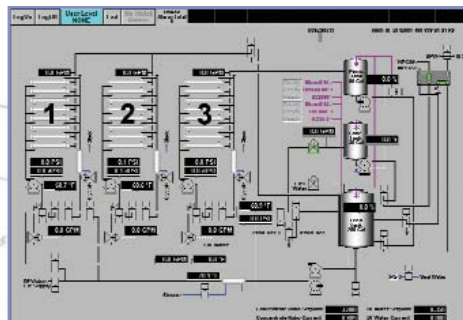
GEA Filtration is world renowned for its design of the most advanced cross-flow membrane filtration systems available. To effectively focus on the membrane filtration market, we have established dedicated regional centers in the USA, Denmark, Germany, New Zealand, Australia and China. The multi-disciplined teams at these centers provide the following value-added services:

- Pilot trials and application development
- System scale-up
- Project engineering
- Process integration
- Controls and automation
- System fabrication
- System installation and start-up
- Service and plant audits
- Replacement membrane inventory

In addition, the Membrane Filtration Center of Excellence located in Hudson, WI (USA) is responsible for development of new applications and processes to meet current and future industry needs.

These capabilities enable us to take responsibility for the complete project all the way through design, procurement, fabrication, installation and commissioning — reliably and economically. Your GEA Filtration team follows through long beyond start up with dedicated after-sales service. We can serve the industry globally with local presence, guaranteeing on-time delivery, to specification, on budget...and personalized.

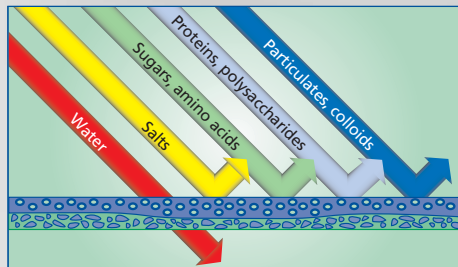
Listening to your needs and expectations, and **understanding** them, is the heart of our success. Our expertise, interactive approach and quality assurance process facilitates the value-added partnership that creates optimal solutions for you to excel in your marketplace. Simply put, you tell us your needs and we will take care of the details... anywhere around the globe, complying with local, national and international standards.



Introduction to Membrane Filtration

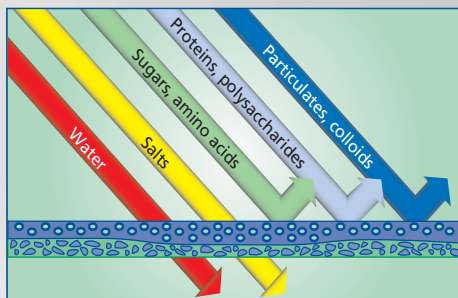
Cross-flow membrane filtration technology is quickly gaining global acceptance as an important manufacturing step in many of the process lines in the food, dairy, pharmaceutical/biotechnology and starch and sweetener industries world wide. The ability to produce very specific separations at low or ambient temperatures with no phase change can, in many applications, make membrane filtration a much more cost-effective solution than more conventional methods such as rotary vacuum filtration or filter presses.

Membrane filtration is a pressure driven technology with pore sizes ranging from 100 molecular weight to 5 microns. The technologies included in membrane filtration are:



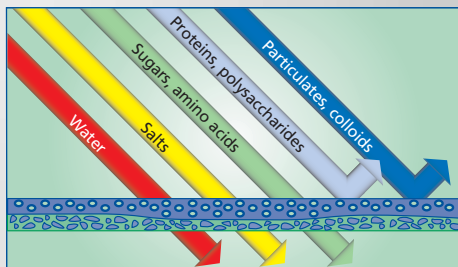
Reverse Osmosis (RO)

Reverse Osmosis is a high pressure, energy-efficient means of de-watering process streams, concentration of low molecular weight compounds or clean-up of waste effluents. Common applications include pre-concentration of dairy or food streams prior to evaporation, polishing of evaporator condensate, and purification of process water.



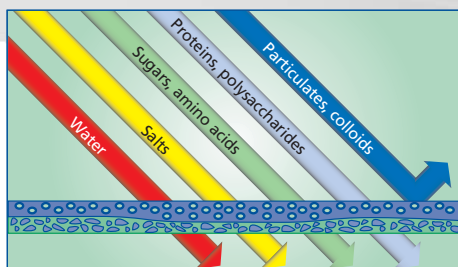
Nanofiltration (NF)

Nanofiltration is a unique filtration process in-between UF and RO designed to achieve highly specific separation of low molecular weight compounds such as minerals and salts from complex process streams. Typical applications include de-ashing of dairy products, recovery of hydrolyzed proteins, concentration of sugars and purification of soluble dyes and pigments.



Ultrafiltration (UF)

Ultrafiltration is a selective separation step used to both concentrate and purify medium to high molecular weight components such as plant and dairy proteins, carbohydrates and enzymes. Common areas of application are whey protein concentration, gelatin de-ashing and concentration, and clarification of fruit juices.



Microfiltration (MF)

Microfiltration is a low pressure means of separating large molecular weight suspended or colloidal compounds from dissolved solids. Applications include cell harvesting from fermentation broths, fractionation of milk proteins, corn syrup clarification and CIP chemical recovery.

Wide Range of Modules — Customized Designs

GEA Filtration offers a wide range of system configurations and membrane types to allow each and every customer to completely optimize their specific separation application. The range includes a number of both polymeric and inorganic membranes:



Polymeric spiral membranes



SCEPTER®, stainless steel membranes



Ceramic membranes



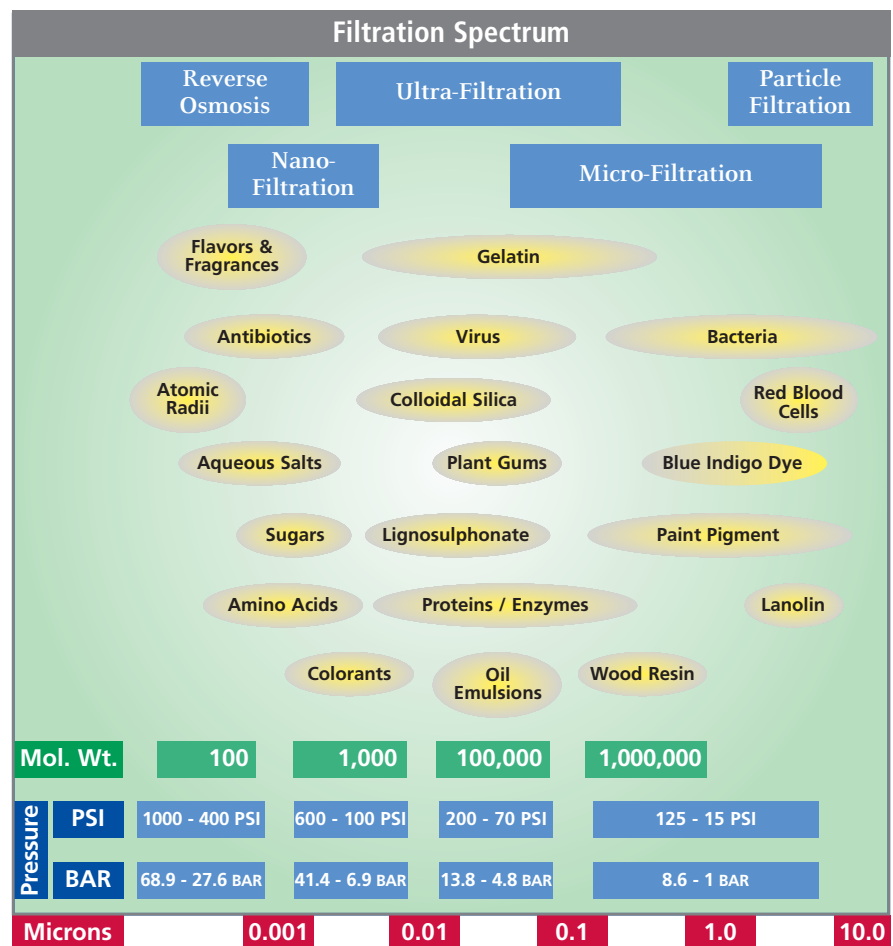
Hollow fiber membrane

Polymeric

- **Spiral** — Due to their compact layout and relatively large amount of membrane area per element, spirals are good cost-effective solutions to high volume applications with minimal or no suspended solids, with the primary advantage being both low capital investment and energy costs. They are available for all types of filtration from microfiltration to reverse osmosis.
- **Tubular** — Highly resistant to plugging, tubular membranes are typically used when the feed stream contains large amounts of suspended solids or fibrous compounds.
- **Hollow Fiber Membrane** — Extremely high packing density and open channel design; offers the possibility of backwashing from the permeate side, particularly suited for low solids liquid streams.

Inorganic

- **Ceramic** — Ideally used for value added applications such as fractionation of proteins in milk, cell harvesting etc., as well as separations of process streams at extreme pH and temperature conditions and presence of solvents.
- **Stainless Steel** — Rugged design, especially effective for demanding applications with aggressive process conditions or feed streams with elevated particulate solids or viscosity.



Membranes are a standardized product

– *your supplier doesn't have to be*

GEA Filtration has been supplying replacement organic and inorganic membranes to the process industry for just about as long as there have been membranes to supply. A pioneer of filtration technology, today we lead the field as the largest, independent source of process membranes worldwide. We supply membranes for virtually every manufacturer's filtration system and most process applications.



During the 30 years or so we've been in this business, we've learned a thing or two about our customers. For one, we realize membranes aren't usually foremost in your mind – in fact you'd probably sooner forget about them. And we also know that "forgetting about them" means different things to different dairies.

Some customers simply want a partner that can provide a dependable, economical supply of quality membranes. Others would like to subcontract some technical responsibility, and a growing number prefer to outsource the entire replacement, maintenance and optimization of their membrane-related operations.

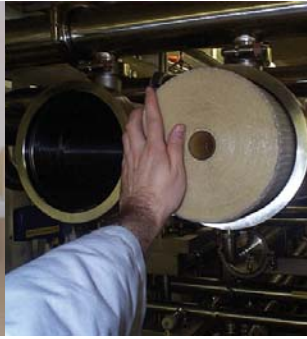
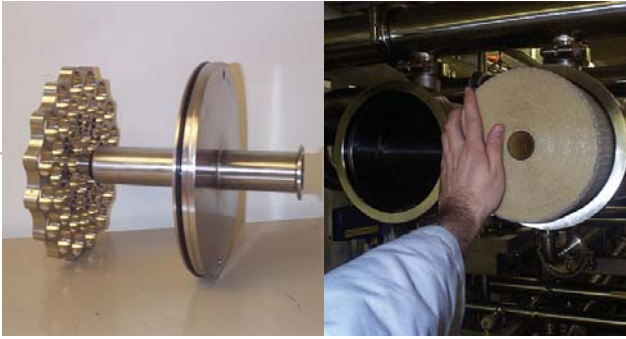
At GEA Filtration we cater to all three scenarios – and just about everything in between. Our service concept is born of an outward facing view of the world. We let you decide the nature of our partnership and adapt our services accordingly.

Size and service

This flexible approach is made possible thanks to our success in uniting the benefits of quantity and quality under one roof. That's to say, on the one hand high inventory levels, purchasing muscle and logistical reach mean we're able to offer an extremely responsive, reliable supply chain and highly competitive rates. On the other hand, a vast support network and detailed understanding of process applications and membranes means we're also in a position to provide qualified advice on membrane selection and process refinement.

Flexible support

We've channeled these skills and experience into a service program that lets you decide the degree of assistance you receive. Some customers are highly versant in the finer points of membrane filtration. Others prefer to leave things to us. The only thing we insist on, is being there whenever and wherever you need us.



GEA Filtration offers the following three service packages:

A. Membrane Replacement Plan

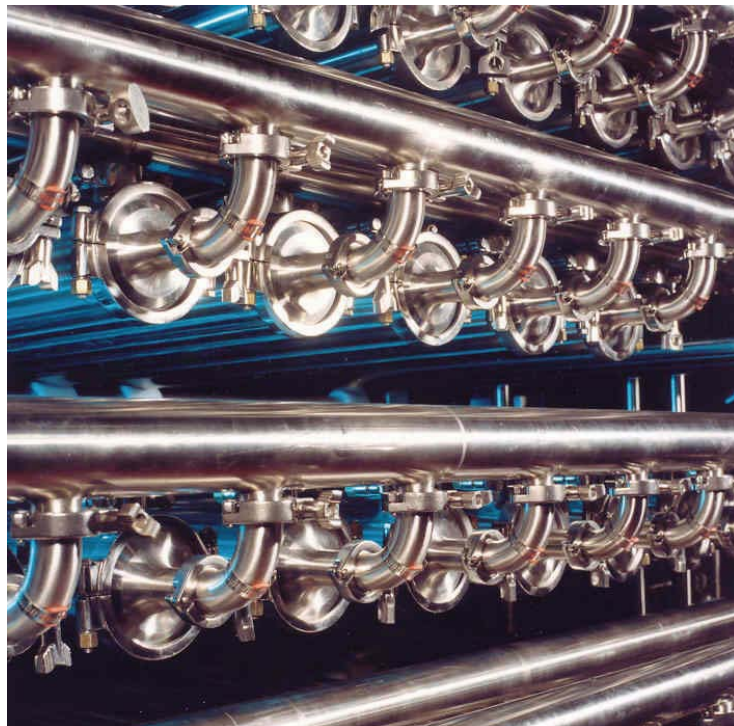
- GEAF handles all membrane stocking and availability by mutual agreement.
- GEAF recommends the best available membrane type for given applications.
- Customer benefits from GEAF's global purchasing power, short lead times and stock planning.

B. Membrane Service Agreement

- All the advantages of package A, plus a comprehensive membrane service agreement.
- GEAF conducts a plant audit and recommends processor membrane changes.
- GEAF follows up with regular plant service visits.
- Customer benefits from GEAF's know-how and resources in membranes and filtration technology.

C. Membrane Maintenance Program

- GEAF provides an integrated membrane maintenance program — including audits, service and a unique membrane rental program.
- GEAF ensures membranes are automatically replaced at predefined intervals, or before if necessary.
- GEAF guarantees agreed levels of operating cost and downtime risk.
- Customer has full support of GEAF's global network of service engineers and membrane experts.



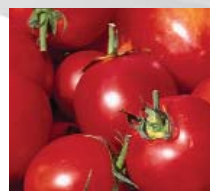
Commercial Applications



Dairy

- Milk
 - Concentration of milk
 - Protein standardization
 - Production of MPC
 - Casein — whey protein separation
 - Bacteria & spores reduction
- Cheese
 - Soft cheese
 - Quark
- Whey Products
 - Production of WPC35-WPI90
 - Concentration of whey and whey permeate
 - De-ashing of whey and whey permeate
 - De-fatting of WPC
 - Bacteria & spores reduction

- Water & Product Reclamation
 - Polishing of evaporator condensate and RO permeate
- Process Effluent Treatment
 - White water concentration
 - Clarification and recycle of salt brine
- Cleaning Chemical Recovery





Food & Beverage

- **Vegetable Products**
 - Clarification and concentration of fruit and vegetable juices
- **Grain Products**
 - Production of soy isolate, wheat proteins
- **Sugar, Starch and Sweetener**
 - Clarification, de-colorization and concentration of beet and cane sugar juice
 - Clarification of sac liquor
 - Concentration of corn syrup, such as glucose, fructose etc
- **Plant Extracts**
 - Concentration of coffee, tea and herbal extracts
- **Beverage**
 - De-alcoholization of beer and wine
 - Beer recovery from tank bottom
- **Animal Products**

- Concentration and de-ashing of blood plasma
- Concentration and de-ashing of pork, beef, fish gelatin
- Concentration of egg whites
- **Fish & Seafood Products**
 - Concentration of fish proteins
- **Bio-food**
 - Recovery of products from fermentation — e.g. organic acids, amino acids
- **Water Reclamation**
 - Recovery of starch wash water
- **Process Effluents**
 - Brine clarification to remove bacteria and for reuse

Pharmaceutical

- **Biopharmaceuticals**
 - Antibiotics, other drugs derived from fermentation processes
 - Personal Health Care Products





Industrial

- **Bio-chemicals**

- Recovery chemicals derived from fermentation processes – e.g. bio-plastics, bio-insecticides, bio-pesticides

- **Distillery Products**

- Concentration of yeast

- **Enzymes**

- Recovery and concentration of enzymes

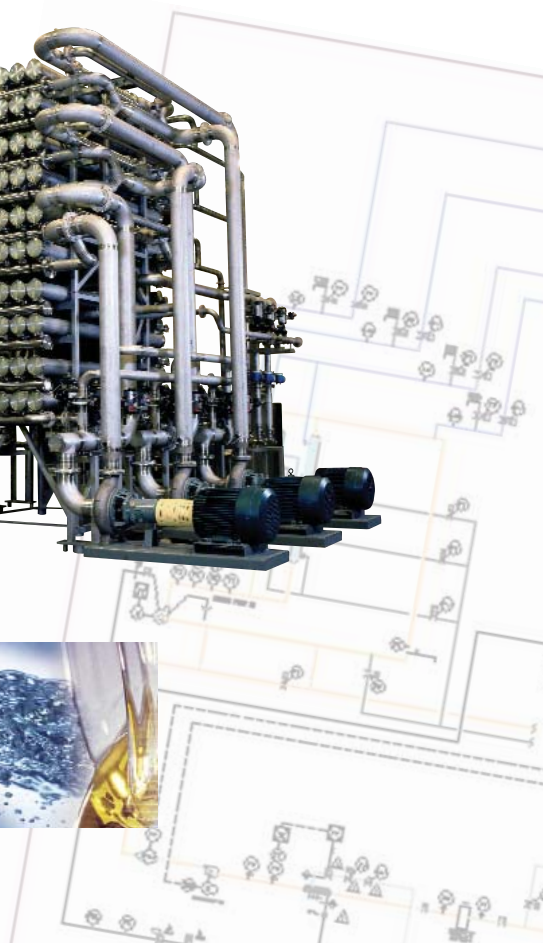
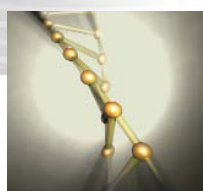
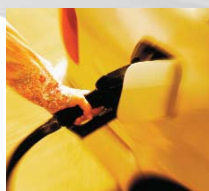
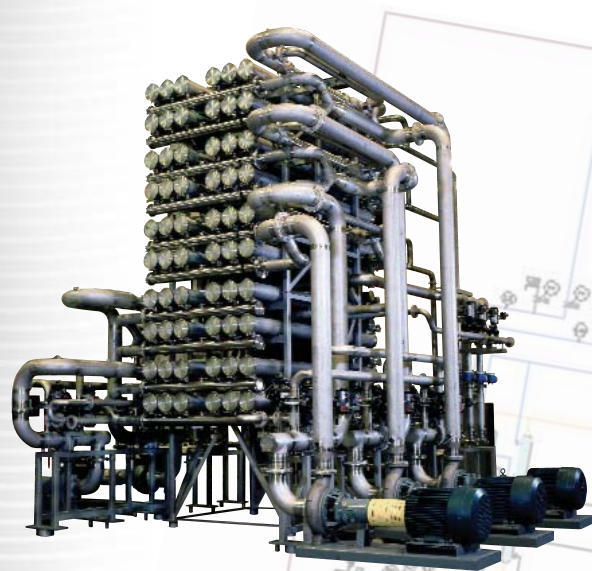
- **Pigments and dyes**

- Concentration and de-ashing of dyes

- **Fine Chemicals**

- **Process Effluents**

- Concentration and dewatering of minerals such as kaolin clay



Pilot Plant Capabilities

GEA Filtration has fully equipped process development laboratories at regional centers that are available for everything from small volume feasibility evaluations to large scale optimization trials.

GEA Filtration also has a wide selection of pilot plants in all membrane types available for on-site trials at the customer's location, from bench top lab models to continuous, semi-automated pilot plants designed for large flow scale-up capability.

GEA Filtration's well experienced process and technical staff can help with everything from membrane selection to final system design.

For more details on the specifications for each of these pilot units, please go to our web site www.geafiltration.com.



MF and UF pilot plant for tests with ceramic membranes



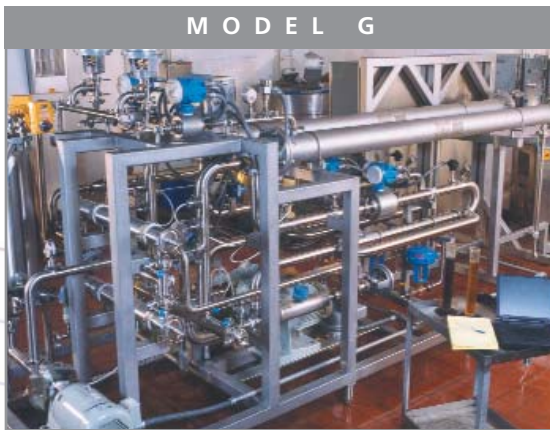
Laboratory scale system for pharmaceutical and biotechnology cGMP processing and application development.



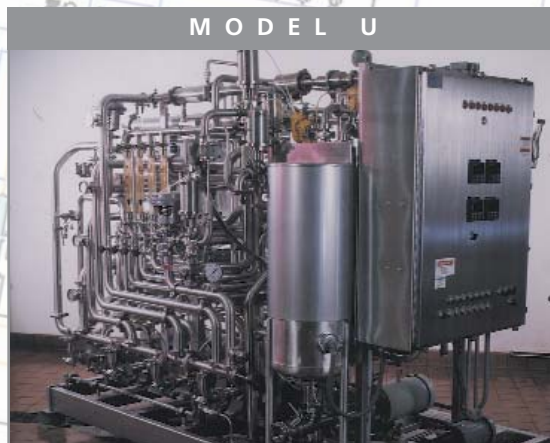
RO, NF, UF, MF laboratory unit



Laboratory-scale feasibility study of ceramic, spiral or hollow fiber MF or UF



Stainless Steel MF pilot plant



Multi-stage, continuous RO, UF pilot plant



Spiral, Ceramic or Stainless Steel RO, UF pilot unit



Precision controlled ceramic MF separations and process optimization

For more information on the products and services provided by GEA Filtration, access our web site www.geafiltration.com.



Process Engineering

GEA Filtration

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