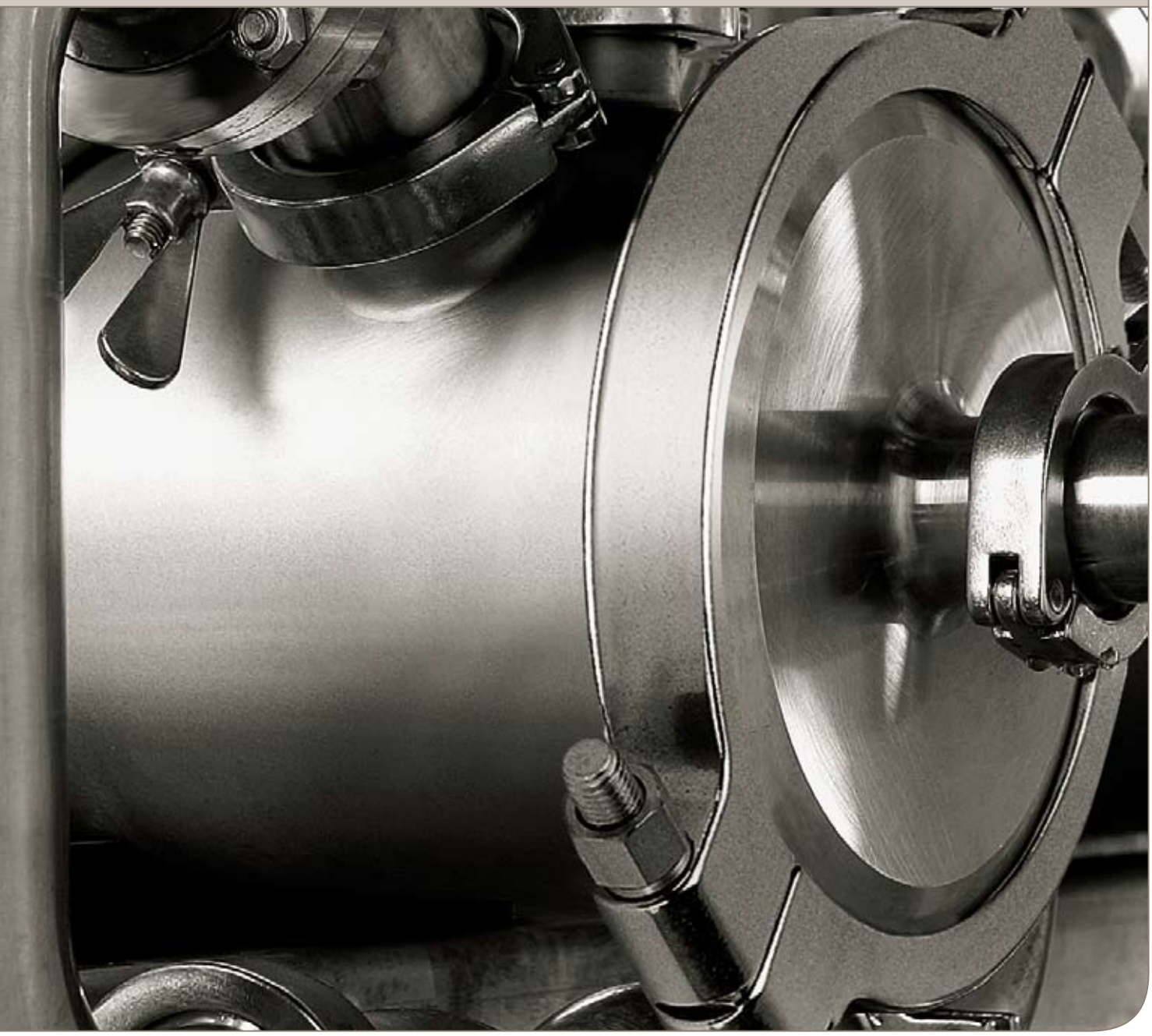
Membrane filtration for sanitary use

The complete line



Fine-tuned filtration

Alfa Laval is one of the world's major suppliers of industrial separation technologies. We have a proud tradition of providing virtually all industries with separation equipment based on centrifugal and mechanical principles.

However, there are many processes in which the substances involved are too delicate to be able to withstand such treatment.

The gentle alternative

Membrane filtration separates out the different components in a feed stream on the basis of the size and shape of the micro-particles within it. And the better the filtration, the better the quality and value of your end product.

This separation takes place by pumping the feed stream across the surface of a membrane with pores so microscopic that they are measured in angstroms (1×10^{-10} m). Some components pass through – others cannot.

Membrane filtration is often used to supplement conventional centrifugal separation processes based on gravity differences. Membrane filtration can also be used for concentration prior to evaporation and spray drying.

The Alfa Laval take on membrane filtration

Alfa Laval is the world's leading supplier of filtration membranes for sanitary use.

High-hygiene Alfa Laval membranes are the preferred choice for many leading users of membrane filtration technology, as well as for OEM suppliers of membrane filtration modules and systems.

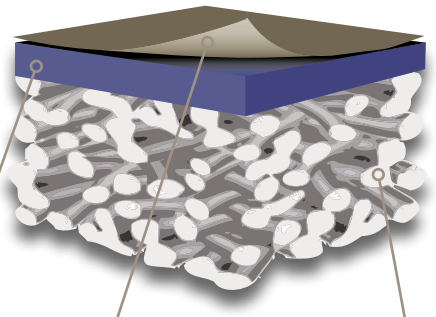
End-to-end focus

Alfa Laval is unique in mastering the full spectrum of membrane filtration know-how. In addition to manufacturing and supplying membranes, we are also responsible for developing and designing these technically advanced products.

As a result, we are in a position to apply unparalleled end-to-end quality assurance procedures that greatly benefit every membrane user.

Selecting the right type of sanitary membrane, with the most appropriate configuration and specifications, is essential for making filtration processes as effective as possible in terms of hygiene levels, operating costs and yield.

Schematic cross-section of a thin-film membrane used in reverse osmosis



Support layer
Polysulphone (PS)
Thickness 40–100 microns

Thin-film membrane layer
Polyamide (PA)
Thickness 0.25 microns

Support paper
Polyester (PE) or polypropylene (PP)
Thickness 100–200 microns

Meeting high-hygiene requirements

Membrane filtration is becoming increasingly popular in high-hygiene processes that include:

- Concentration and purification
- Clarification and fractionation
- Extraction
- Product recycling and recovery
- Product and effluent upgrading.

How membrane filtration works

The basic technology behind membrane filtration involves using a semi-permeable membrane to separate a liquid into two distinct streams.

Pumping this liquid across the surface of the membrane creates a positive trans-membrane pressure that forces any components smaller than the porosity of the membrane to pass through, forming the permeate. Any components larger than the pore size simply cannot pass through, and remain behind in what is called the retentate.

The surface of the membrane is kept free of blockages by the force of the liquid flow moving parallel to the membrane surface.

FDA compliance

Alfa Laval manufactures membranes for use in an extensive range of processes used in the food, beverage, dairy, biotech and pharmaceutical industries.

All Alfa Laval membranes – in both spiral-wound and flat-sheet designs and configurations – are therefore made to comply with the relevant FDA regulations.

This compliance also extends to the equipment and fittings related to membrane filtration operations, including items such as plate-and-frame units, element housings and pumps.

Microfiltration

Alfa Laval microfiltration (MF) membranes are extremely cost-effective to operate, largely as the result of the low energy consumption involved. They also have the advantage of eliminating the frequent replacement and disposal of the cartridges and other consumables used in traditional dead-end filtration.

Alfa Laval microfiltration membranes are extremely durable, with service lives that can extend over more than five years.

Microfiltration is used on feed streams where the aim is to remove small-diameter dispersed solids such as bacteria, fat and oil globules without affecting the balance of the components dissolved within the stream.

Ultrafiltration

Ultrafiltration (UF) uses membranes in which the pores are somewhat smaller, with a cut-off range from 1,000 to 100,000 Molecular Weight (MWCO), and where the applied pressure is relatively low.

Salts, sugars, organic acids and smaller peptides pass through the pores of the membrane, whereas proteins, fats and polysaccharides do not.

Using appropriate ultrafiltration membranes also makes it possible to fractionate a feed stream into two distinct streams. Each contains dissolved components with different molecular weights.

Nanofiltration

Nanofiltration (NF) uses membranes with pores that are even smaller – down to 300 daltons. Operating at pressures of up to 50 bar, small ions pass through, whereas larger ions and most organic components do not.

Alfa Laval nanofiltration elements are used for the high-yield concentration and demineralization of products such as whey and ultrafiltration permeate. These special membranes are used for filtering out large salts with a divalence in excess of 2, while small monovalent salts pass into the permeate. They can also be used in producing low-alcohol beverages, because the alcohol component passes through the membrane, while the colour and aroma remain in the retentate.

Reverse osmosis

Reverse osmosis (RO) uses membranes with pores so minute that only small fractions of salts can pass through, along with the water that is the prime component of the permeate.

Certain organic compounds with low molecular weights can also pass through – but only to a limited extent. However, it is impossible for any other components suspended or dissolved within the liquid flow (salts, sugars, etc.) to do so.

Alfa Laval reverse osmosis membranes are used for the high-flux concentration of either the direct feed stream, or permeates from ultrafiltration and nanofiltration.

Cleanability

Most types of membranes are cast onto a backing material made of polyester.

Certain special membranes are available using polypropylene instead, making them capable of withstanding high temperatures and high pH values.

These so-called pHt membrane types can operate continuously at high temperatures and also withstand high-temperature (60°C) cleaning with pH values in the range 1–12.5. They can also be sanitized using water at temperatures as high as 90°C.

Spiral-wound membranes

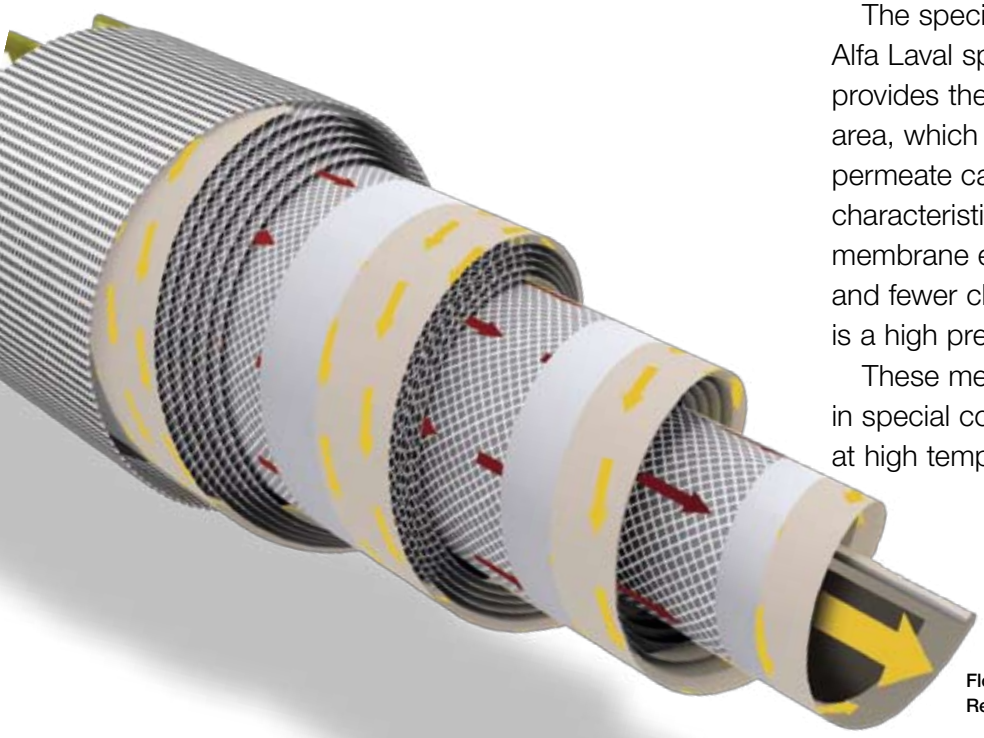
The unique design of Alfa Laval spiral-wound membrane elements makes sure the feed stream passes through the element under the best possible flow conditions. This ensures the most efficient separation and superior flux, and that each element has a long service life and is easy to clean.

The core of each spiral element is a perforated central tube, with large membrane pockets attached. Each of these contains a spacer net that transports the permeate out of the membrane pocket and into the central tube.

Different thicknesses of spacer net between each pocket make sure the feed is evenly distributed over the entire surface of the membrane.

The special tight-rolling technique used in Alfa Laval spiral-wound membrane elements provides the maximum possible active membrane area, which provides correspondingly high permeate capacity. The exceptional firmness characteristics of Alfa Laval spiral-wound membrane elements ensure long service life and fewer channelling problems, even if there is a high pressure drop across the element.

These membrane elements are also available in special configurations that withstand cleaning at high temperatures and extreme pH values.



Flow pattern in a spiral-wound membrane element. Red is feed/retentate. Yellow is permeate.

Plate-and-frame membranes

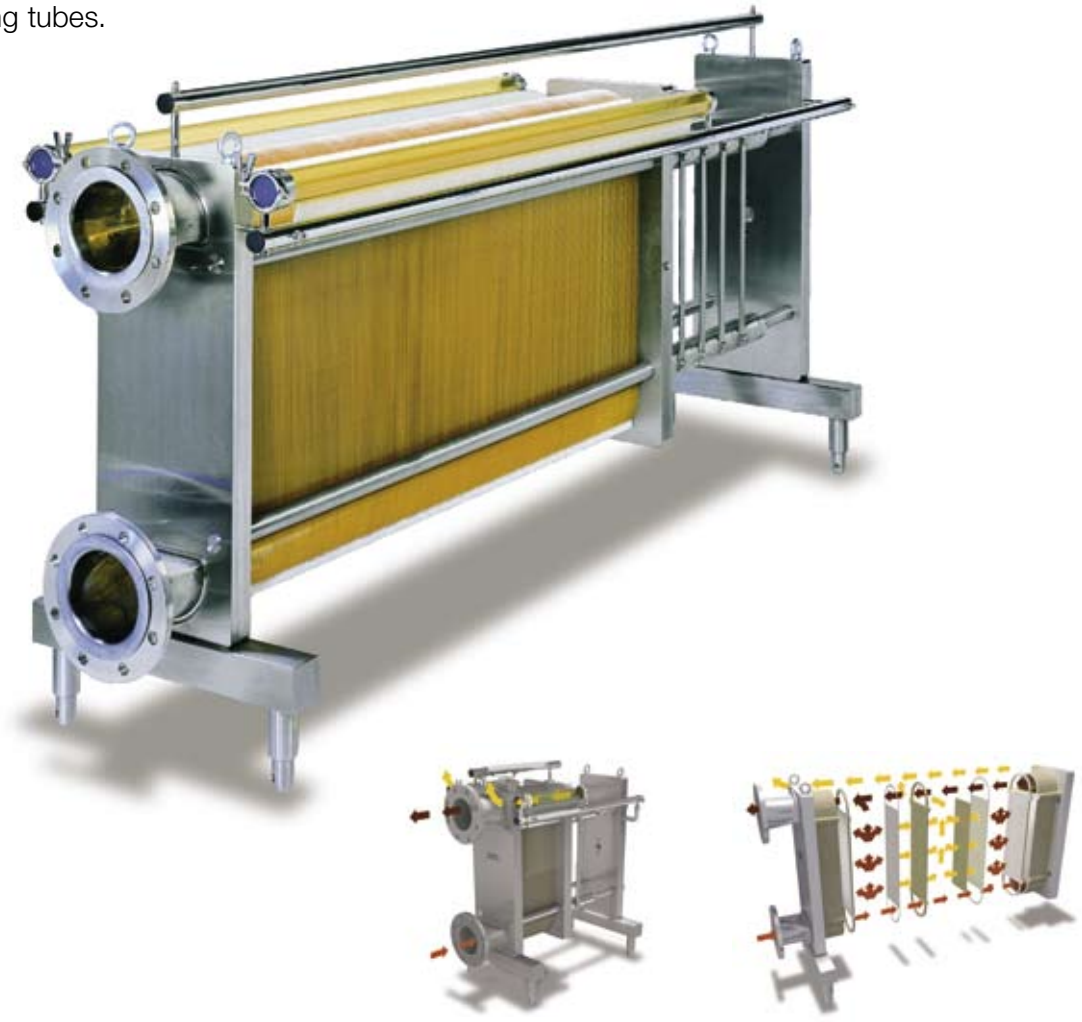
Basic membrane filtration principles are the same regardless of whether the membrane is rolled into a spiral element or cut into flat sections to fit into plate-and-frame units.

The types of membranes used for spiral-wound elements are therefore also available as flat membranes for use in the unique plate-and-frame units manufactured by Alfa Laval. Such units are most appropriate when the retentate has a high viscosity.

A plate-and-frame unit is designed with open channels across the membrane surface. The feed stream/retentate flows through these. The membrane itself is supported by hollow plates with numerous slots that allow the permeate to collect and be removed from the unit via the permeate collecting tubes.

Plate-and-frame units use the membrane itself, aided by lock rings or strips, to seal off the feed/retentate from mixing into the permeate channels. This also prevents any leaks from the plate stack itself.

A plate-and-frame installation normally has a higher permeate capacity per unit of membrane area compared with what can be achieved using spiral-wound membrane elements. Industrial-scale plate-and-frame units have active membrane surface areas that range from 1.65 sq m to 60 sq m. These can in turn be combined into larger systems using several units placed either in series or parallel to achieve the required capacity.



Flow pattern in a plate-and-frame unit. Red is feed/retentate. Yellow is permeate.

Getting the pressure right

The efficiency of membrane filtration systems depends heavily on the reliable, uninterrupted application of consistent pressure. High-pressure pumps make the feed stream flow across the surface of the membrane and through its microscopic pores at a consistent rate, boosting both reliability and efficiency. Such pumps also have to maintain exceptional levels of hygiene.

Alfa Laval is unique in being able to also provide our customers with a wide selection of high-pressure pumps of sanitary standard as well as a comprehensive range of other sanitary equipment. This includes valves, membrane housings, installation material, tank equipment, heat exchangers and control instruments.

You benefit from efficient logistics, from all the components dovetailing perfectly, and the advantages of purchasing the full spectrum of sanitary equipment and fittings from one single expert source.

LKH-Multistage Pump

Specifically designed for high outlet pressures, and used as feed pumps in reverse osmosis and nanofiltration installations. Pressure range up to 40 bar.

Used in both spiral and plate-and-frame filtration installations.

LKHP-High Pressure Pump

Used as feed and recirculation pumps in installations requiring both high pressures and high flow rates, such as reverse osmosis and nanofiltration. Pressure range up to 40 bar.

Used in both spiral and plate-and-frame filtration installations.

LKH Centrifugal Pump

Used as feed and recirculation pumps in both spiral and plate-and-frame filtration installations. Ideal for when combinations of low pressures and high flow rates are required, as in microfiltration and ultrafiltration. Pressure range up to 10 bar.

SRU Rotary Lobe Pump

Used as feed and recirculation pumps for filtration of high-viscosity products.

Used in conjunction with microfiltration and ultrafiltration in plate-and-frame filtration installations. Pressure range up to 20 bar.

SX Rotary Lobe Pump

For use in conjunction with processes that require absolutely sterile conditions, including many pharmaceutical applications.

Used as feed and recirculation pumps for filtering high-viscosity products. Used for microfiltration and ultrafiltration in plate-and-frame installations. Pressure range up to 20 bar.

OptiLobe Pump

OptiLobe is a rotary lobe pump for general applications. Available in an optimized range with fewer options. It combines cost-effective simplicity with Alfa Laval quality and reliability. Pressure range up to 8 bar.

Everything you need for a complete membrane system

Alfa Laval also provides a wide range of the special ancillary equipment, fittings and accessories needed for installing the membranes used in spiral-wound and plate-and-frame systems, and for operating them safely and efficiently.

These items must be approved for pressure classifications of as much as 60 bar in cases where the membrane filtration process requires high operating pressures.

All these components are also designed to maintain the best possible hygiene conditions, and to comply in full with FDA and EU regulations, as well as 3A sanitary standards and USDA requirements.

Make the connection

Special couplers are needed to install a membrane element in its housing, to link individual elements and to connect these elements to the permeate outlet on the housing. These Alfa Laval ATD couplers also prevent the elements from telescoping due to the pressure created by the cross-flow feed stream passing through the element.

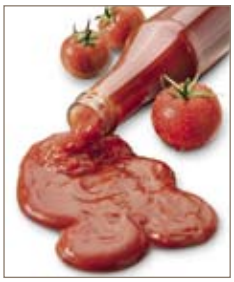
A special ESA coupler is used to ensure that the elements in a housing achieve the tight fit required for maximum efficiency. This coupler uses a peripheral seal ring to minimize any bypass around the element, while also making sure the appropriate sanitary and hygienic conditions are maintained at all times.

An important additional benefit of using ESA couplers is that they provide reductions of up to 30% on the energy consumption of the recirculation pumps.

Solutions for your application

Alfa Laval provides high-hygiene membranes for all needs, from microfiltration to reverse osmosis. Every type ensures you an efficient, reliable product that does its job effectively and for a long time. Our experience extends over many different industries in which sanitary standards and exceptional levels of hygiene are important.

We can supply both general-duty membranes and solutions designed to tackle specialist assignments. And we have both the know-how and the products to provide you with the best solution across a wide spectrum of viscosities, pH values and temperatures.



Food and beverages

The gentle separation that Alfa Laval membranes provide helps preserve the natural flavours and delicate aromas of foods and beverages.

Their exceptional levels of hygiene help you maintain the high quality of your products, while their efficiency helps keep costs down.

Dairy products

Exceptionally high levels of hygiene are essential when processing dairy products, and it is vital that the membranes are easy to clean and keep clean.

Alfa Laval membrane filtration equipment enables you to maintain these high standards, and special units are available that can be sanitized with hot water at temperatures of up to 90°C.

Biotech and pharmaceuticals

Using Alfa Laval membrane filtration equipment makes it easy to comply with the stringent hygiene standards and certification requirements that characterize the biotech and pharmaceutical industries.

In addition to providing sterility, these sanitary-standard products safeguard your installation against cross-contamination.

Service that boosts efficiency

We have most types of membrane – for both spiral and plate-and-frame installations – in stock at all times. This means rapid dispatch and short delivery times.

Easy and straightforward

Purchasing Alfa Laval membranes is an easy, rapid and straightforward process. A specialist sales team deals promptly with any enquiries you may have. This gives you direct, easy access to the advice and in-depth know-how crucial in helping you run your membrane filtration operations efficiently.

You can contact us directly for advice, and order via our special web-based e-Channel catalogue for sanitary parts and equipment.

Single-source purchasing

We can also provide all the fittings, ancillary equipment, accessories and consumables you need to set up and operate membrane filtration facilities, or to revamp, retrofit and extend existing systems.

A single-source purchasing strategy provides you with rapid return on investment because:

- Fewer engineering hours are needed
- Procurement is cheaper and faster, with lower logistics costs
- Using one single supplier ensures well-coordinated efficiency
- Sourcing all sanitary products from the same manufacturer makes sure they all fit together
- All documentation and certification are coordinated and standardized.

We also provide service visits to carry out re-membraning, to help you optimize your membrane filtration processes and for troubleshooting any specific problems you may have. We can also provide any operator training you might require.

Alfa Laval in brief

Alfa Laval is a leading global provider of specialized products and engineered solutions. Our equipment, systems and services are dedicated to helping customers to optimize the performance of their processes. Time and time again.

We help our customers to heat, cool, separate and transport products such as oil, water, chemicals, beverages, foodstuffs, starch and pharmaceuticals.

Our worldwide organization works closely with customers in almost 100 countries to help them stay ahead.

How to contact Alfa Laval

Up-to-date Alfa Laval contact details for all countries are always available on our website at www.alfalaval.com

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