

Membrane Technology



Introduction



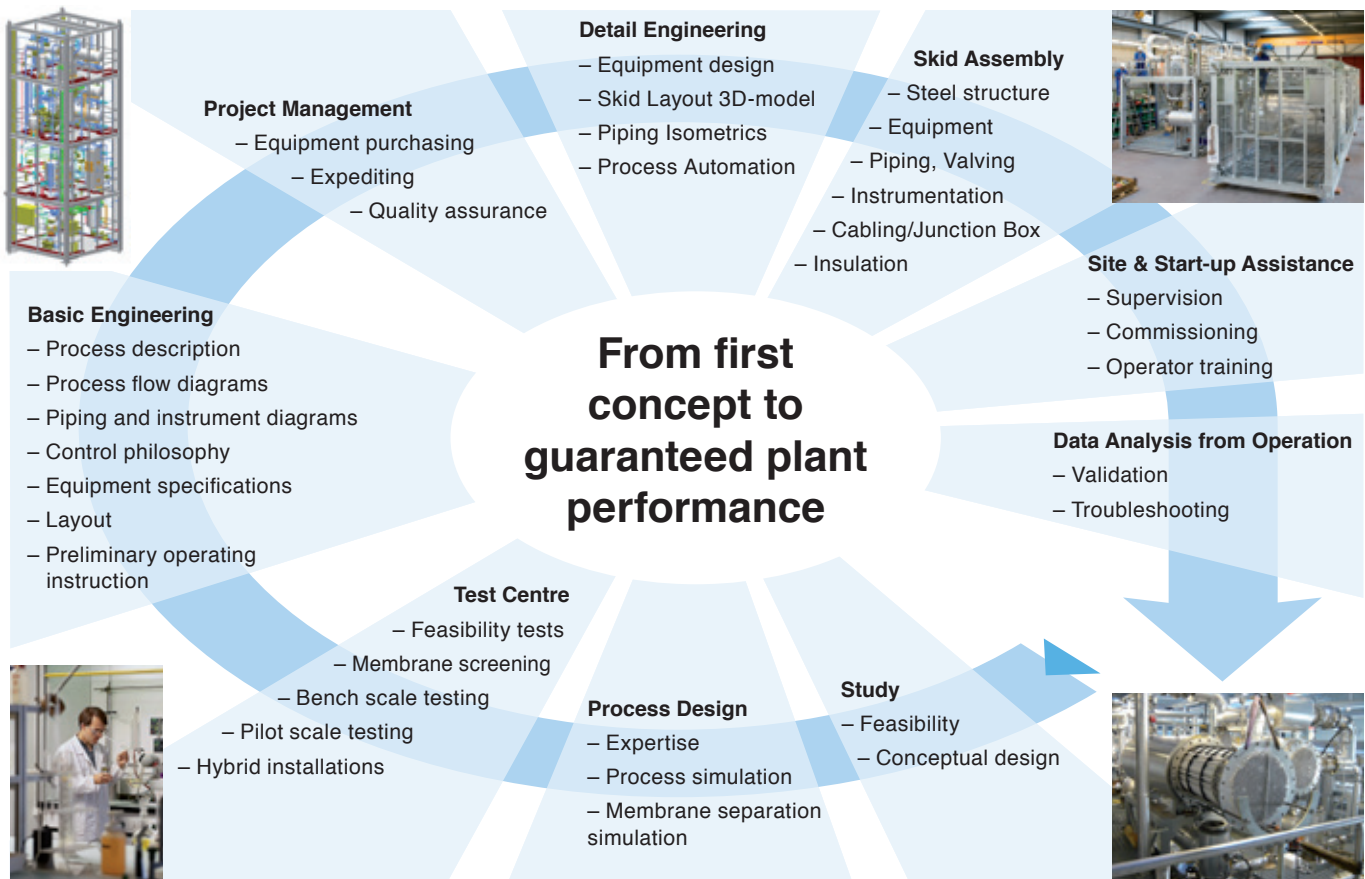
Process Technology

Sulzer Chemtech established the new business unit Process Technology in Allschwil by combining its proven process solution capabilities for distillation, membrane separation and crystallization with the activities of the recently acquired company Kühni Ltd, Allschwil, Switzerland.

As an expert in thermal, diffusional and membrane separation technology for the separation and purification of aqueous and organic mixtures, Process Technology provides process engineering services and designs, manufactures and supplies process equipment, as well as turn-key modular plants to the process industry, with a focus on the pharmaceutical and fine chemical industry.

The main fields of activities comprise

- Engineering services such as conceptual process design, feasibility studies, plant optimizations including process validation in the test center
- Testing including process development, feasibility and scale-up in a well equipped, state-of-the-art test center
- Specialized process equipment
- Complete separation process plants, in particular modular plants (skids)



Membrane Processes

Membrane processes are common place in industrial applications; they replace evaporation and distillation at improved economics.

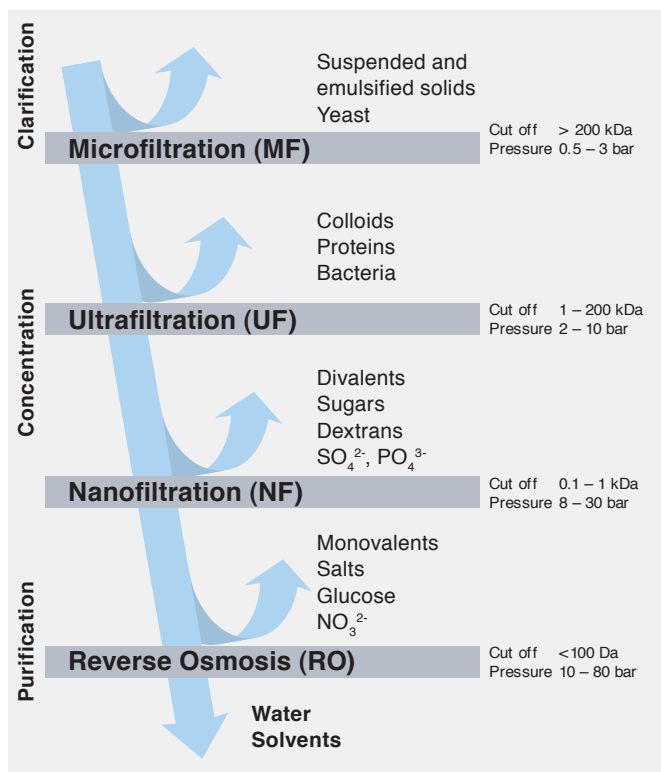
Novel hybrid separation concepts with unique overall performance characteristics are possible by combining membranes with thermal and/or extractive separation technologies. Process Technology is able to engineer and supply hybrid systems as one coherent unit using its expertise in both membrane and thermal separation technologies.

Benefits of Membrane Processes

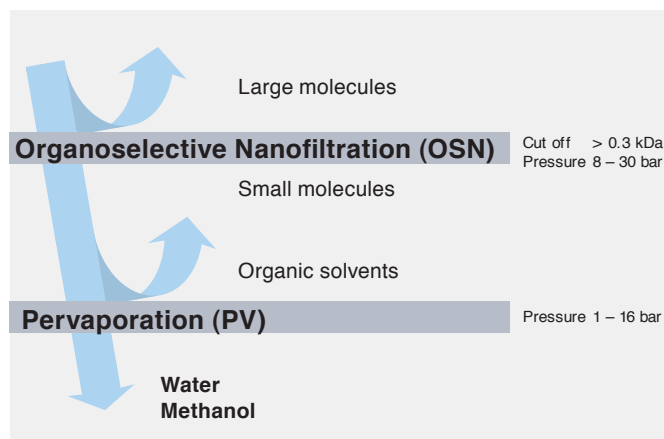
- Improved economics through
 - Low investment cost
 - Optimised operating cost
- Reduction of product degradation
- Design of novel process solutions

We offer the following membrane technologies:

Aqueous Systems

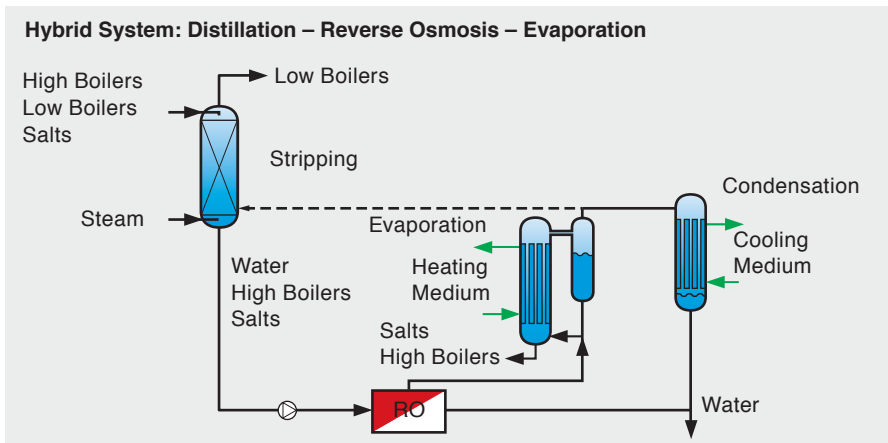


Organic Systems



Key application areas in organic systems:

- Dehydration of organic solvents like alcohols, ketones, esters, ethers, etc.
- Methanol removal from organic mixtures
- Aroma extraction
- Extraction of valuable volatiles
- Separation of higher molecular weight components from organic solvents



Pervaporation

Pervaporation is a thermal membrane separation process to remove water or methanol from organic solvents. Volatile fluids can be continuously treated – the permeate passes selectively through the membranes and is continuously removed under vacuum.

This process requires neither a regeneration step nor the introduction of an additional fluid. Therefore, further separation steps and potential environmental impacts are avoided.

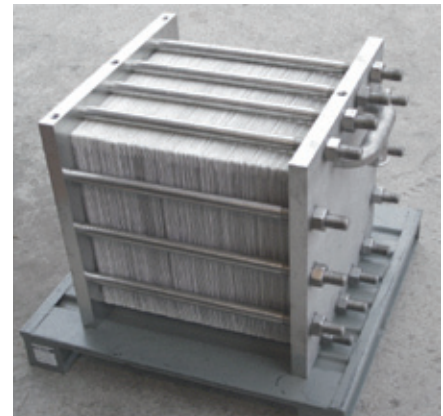
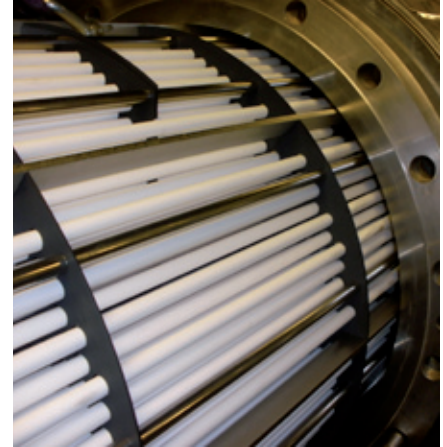
Process Technology has a proprietary range of PERVAP™ polymer composite membranes. A cooperation with Mitsui Engineering and Shipbuilding Ltd., Japan, enables us to also offer world class inorganic pervaporation membranes. This flexibility allows the implementation of the most suitable membrane type for the economic and reliable operation of your process.

Characteristics of Sulzer's PERVAP™ membranes

These membranes use an active polyvinyl alcohol separating layer, differently cross-linked to adapt the membrane separation performance.

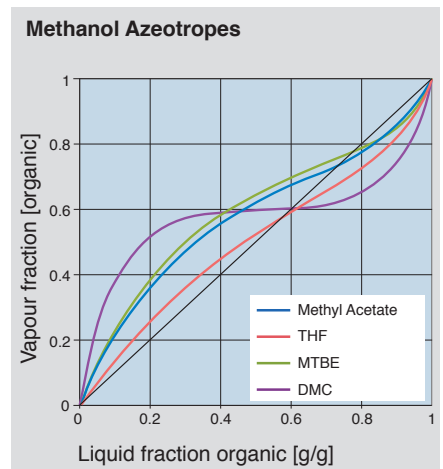
Membrane Type Typical Application

PERVAP™ 1201	A strongly crosslinked membrane used primarily for dehydration of reaction mixtures, up to 80% water
PERVAP™ 4101	A standard membrane, suitable for most dehydration applications
PERVAP™ 1210	The first high flux PERVAP™ membrane, developed for the dehydration of alcohols, esters and ethers
PERVAP™ 1510	The high flux membrane especially tailored for the dehydration of C ₃ and higher alcohols
PERVAP™ 1256	The first methanol selective membrane to remove methanol from less polar organics
PERVAP™ 1255	A membrane with tailored separation properties, suitable for simultaneous removal of water and methanol
PERVAP™ 4060	An organophilic membrane to remove VOCs and aroma from aqueous solutions



Process intensification – Separation of methanol from methyl acetate

The world's first vapor permeation unit for this application was installed in 2000, where it replaces an extractive distillation step with water as solvent.



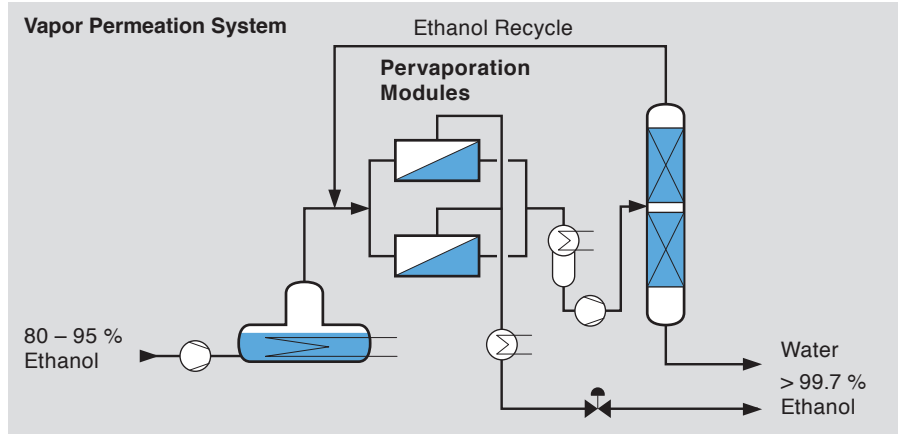
Examples for Pervaporation

Dehydration of (bio)ethanol

Dehydration of ethanol used as fuel, or as solvent in the pharmaceutical industry, is the largest application for pervaporation and vapor permeation.

Process optimisation is done according to local requirements and the available utilities.

We also make use of our long term experience with heat integrated distillation equipment.



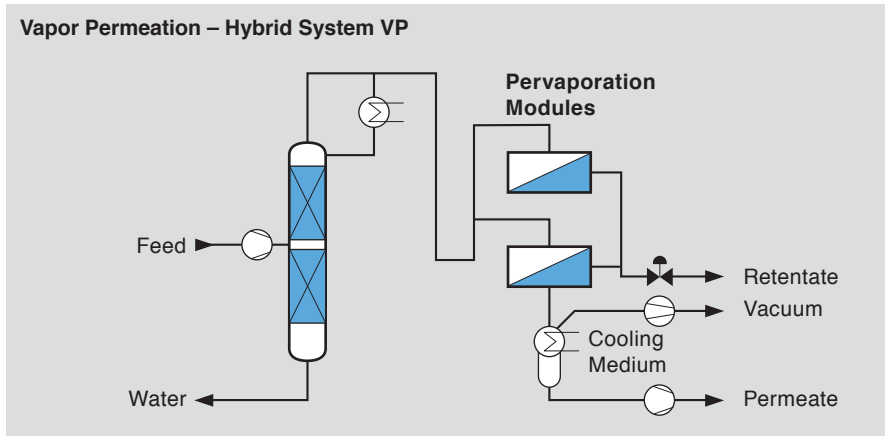
Solvent recovery

Solvents in the pharmaceutical, fine chemical, and other processes are routinely treated by pervaporation: alcohols, ethers, esters and ketones as well as mixtures thereof.

Combined or hybrid solutions improve the competitiveness of our pervaporation processes against classic routes in terms of economics and yield.

Typical scope of supply

- Membrane screening
- Membrane pilot testing
- Engineering, procurement and skid assembly
- Process guarantee
- Supervision during start-up
- Capacity expansion



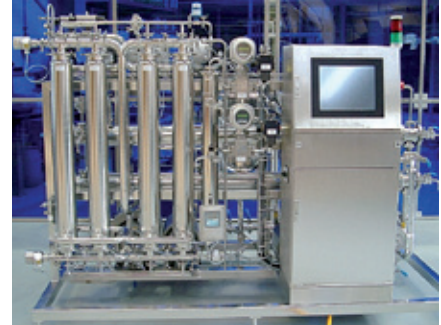
Process Technology's pervaporation systems feature

- No introduction of additional components – complete water/methanol removal irrespective of azeotrope formation
- Flexible processes – the systems can be designed to treat a variety of solvent mixtures
- The choice of continuous or batch pervaporation or vapor permeation depending on the duty
- Vapor permeation processes combined with distillation as effective hybrids to reduce capital and operational costs
- Skid assembled standardised units for fast delivery and installation in minimum hook-up time

Pressure Driven Membrane Technologies

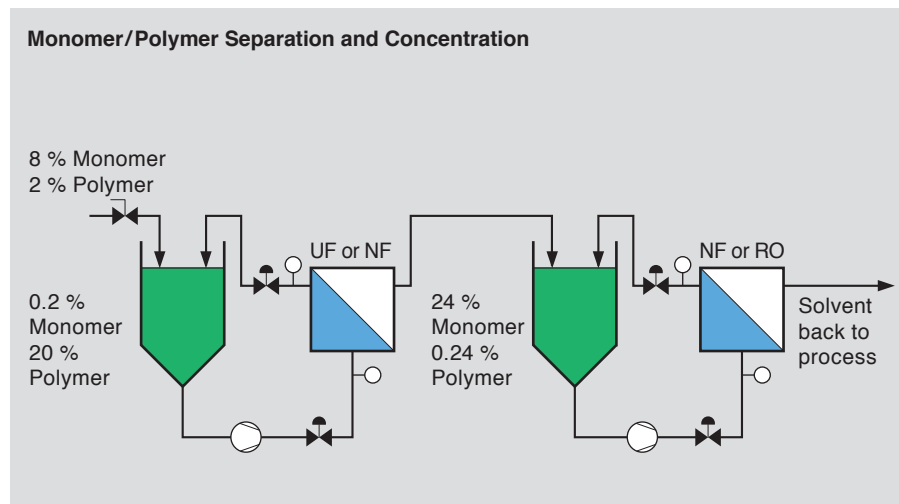
Process Technology is the expert in thermal and extractive separation technologies, and includes pressure driven membrane technologies, for the treatment of both organic solvents and water based liquids, in its core industries.

The combination of these technologies to hybrid processes with evaporation or extraction is especially attractive because of substantial energy savings, lower investment and smaller footprints.



Typical applications

- Concentration of temperature sensitive products and API
- Recovery of homogeneous and heterogeneous catalysts
- Clarification and concentration of organic and mineral acids
- Monomer/polymer separation
- Decolorisation of solvents
- Removal of unwanted components in solution or suspension
- Recovery of spent solvents
- Solvent exchange



Processes with pressure driven membranes feature

- Low energy demand
- Low processing temperature
- Separation independent of vapor liquid equilibria
- Low investment cost due to simple and compact systems
- Small footprint and low height requirements
- Easy scale-up



In order to be able to supply the most appropriate membrane and module configuration required by the different applications, Process Technology cooperates closely with major reliable membrane producers worldwide.

Services & Test Center

For the separation of mixtures a range of different membrane processes can be employed. Proper membrane selection is important since it impacts the cost of the installation, the plant performance and the membrane lifetime. Testing is required to identify the potential of a membrane process and to select the most appropriate membrane. Depending on the separation task further tests in different scales might be performed to guarantee a reliable scale-up.

Equipment

- Bench scale units for pervaporation and pressure-driven membrane processes
- Pilot units for pressure-driven membrane processes
- Pilot units for pervaporation/vapour permeation (combining distillation or evaporation)

Process Technology offers the following services:

- Process development/feasibility studies
- Feasibility tests
- Membrane screening
- Bench scale testing
- Pilot scale testing
- Production of test samples for validation by client

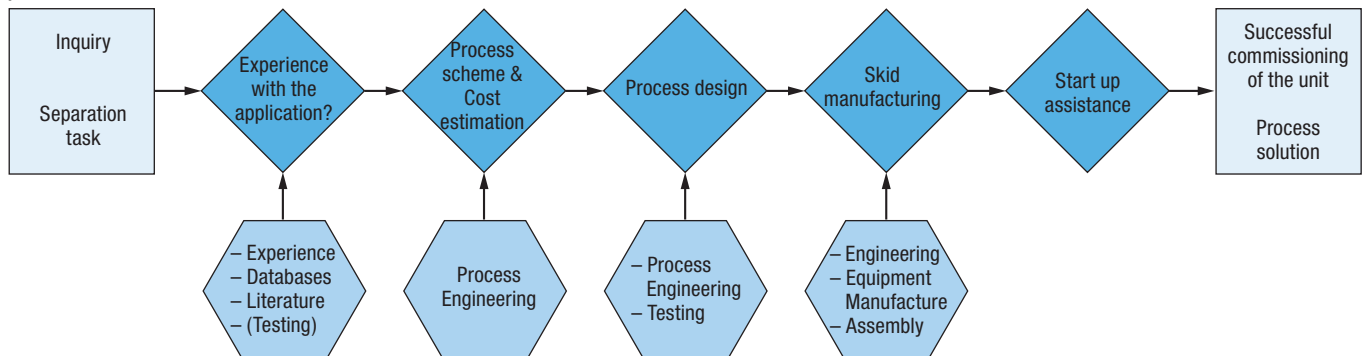
Bench scale units and pilot scale equipment are available for rent or purchase.

Furthermore Process Technology offers testing facilities for distillation, absorption, liquid-liquid extraction, crystallisation, and film evaporation processes.



Complete process solution

Process Technology covers the entire value chain to offer a complete process solution. We are the right partner to help you to further develop your ideas into a reliable process:



Process Technology is able to offer a performance guarantee upon successful completion of test runs.

Process Technology**Headquarters**

Sulzer Chemtech Ltd
Gewerbstrasse 28
4123 Allschwil 2
Switzerland
Phone +41 61 486 37 37
Fax +41 61 486 37 77
contactpt@sulzer.com

North & South America

Sulzer Chemtech, USA, Inc.
1 Sulzer Way
Tulsa, OK 74131
USA
Phone +1 918 446 6672
Fax +1 918 446 5321

Asia Pacific

Sulzer Chemtech Pte. Ltd.
10 Benoi Sector
Singapore 629845
Phone +65 6515 5500
Fax +65 6862 7563
ctsg@sulzer.com

Sulzer Chemtech Ltd, a member of the Sulzer Corporation, with headquarters in Winterthur, Switzerland, is active in the field of process engineering and employs some 2500 persons worldwide.

Sulzer Chemtech is represented in all important industrial countries and sets standards in the field of mass transfer and static mixing with its advanced and economical solutions.

The activity program comprises:

- Process components such as fractionation trays, structured and random packings, liquid and gas distributors, gas-liquid separators, and internals for separation columns
- Engineering services for separation and reaction technology such as conceptual process design, feasibility studies, plant optimizations including process validation in the test center
- Recovery of virtually any solvents used by the pharmaceutical and chemical industry, or difficult separations requiring the combination of special technologies, such as thin film/short-path evaporation, distillation under high vacuum, liquid-liquid extraction, membrane technology or crystallization
- Complete separation process plants, in particular modular plants (skids)
- Tower field services performing tray and packing installation, tower and column maintenance, vessel welding, and plant turnaround projects
- Mixing and reaction technology with static mixers
- Cartridge-based metering, mixing and dispensing systems, and disposable mixers for reactive multi-component material

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