

Membrane Filtration & Microparticulation



Dedicated to the dairy industry

<p>Reverse osmosis – RO</p> <ul style="list-style-type: none"> • Concentration of <ul style="list-style-type: none"> - Milk - Whey - UF permeate - Butter milk - White water (final flush water) 	<p>Ultrafiltration – UF (cont.)</p> <ul style="list-style-type: none"> • Whey processing <ul style="list-style-type: none"> - WPC 35/60/80 - WPI 90 - MWPI 90 – milk whey protein isolate • Concentration of butter milk
<p>RO polisher – RO-P</p> <ul style="list-style-type: none"> • Polishing of: <ul style="list-style-type: none"> - RO permeate - NF permeate - Evaporator condensate 	<p>Microfiltration - MF</p> <ul style="list-style-type: none"> • Bacteria and spore removal <ul style="list-style-type: none"> - Cheese milk - Market milk (ESL) - Powder milk - Cheese whey • Protein fractionation – Pro-Frac™ <ul style="list-style-type: none"> - Cheese milk - Powder milk - Market milk • Defatting of whey <ul style="list-style-type: none"> - WPI 90 • Cheese brine clarification
<p>Nanofiltration – NF</p> <ul style="list-style-type: none"> • Demineralisation and concentration of: <ul style="list-style-type: none"> - Milk - Whey - UF permeate 	<p>Microparticulation - MP</p> <ul style="list-style-type: none"> • The APV LeanCreme™ process <ul style="list-style-type: none"> - MP of WPC 60: <ul style="list-style-type: none"> · Low fat dairy and food products · Cheese · White line products · Ingredients
<p>Ultrafiltration – UF</p> <ul style="list-style-type: none"> • Protein standardisation of: <ul style="list-style-type: none"> - Cheese milk - Market milk - Powder milk • Calcium enriched milk/protein boosted milk <ul style="list-style-type: none"> - Flavoured milk drinks • Milk protein concentrate <ul style="list-style-type: none"> - Yoghurt/milk desserts - MPC 50/60/70 - MPC 80/85 - MPI 90 • UF cheese <ul style="list-style-type: none"> - Feta and Domiati type cheese - Queso Fresco/Burgos type - Fresh cultured cheese like: <ul style="list-style-type: none"> · Quarg · Skim soft cheese · Petite Suisse · Labneh · Tvorog · Mascarpone · Cream cheese 	<p>Membrane aftermarket</p> <ul style="list-style-type: none"> • Replacement membranes • Membrane spares and components • Mechanical service • Process and application service • Upgrading and redesign of used plants <p>Pilot plants</p> <ul style="list-style-type: none"> • RO/NF, UF and MF pilot plants • MP pilot plants



Membrane filtration technology

Proven systems and dedicated specialists

As a leading global provider of membrane technology to the dairy industry, APV offers a wide range of membranes, membrane systems and dairy membrane applications.

Proven membranes and systems

Membranes are available in a number of physical configurations, each offering a range of advantages in terms of technical performance, price and operating costs.

The most common membrane configurations for dairy applications are:

- RO, RO Polisher and NF: spiral-wound systems with organic polymer membranes
- UF: spiral-wound systems or plate-and-frame systems with organic polymer membranes

- MF: tubular systems with ceramic membranes as well as spiral-wound systems with organic polymer membranes

APV offers a wide range of system solutions. These comprise stand alone units, unitised and automated systems delivering optimal control and performance, and complete integrated in-line systems featuring pre- and post-treatment for integration into new and existing customer process lines.

APV membrane filtration technology is the result of many years of experience and close co-operation with world-leading manufacturers of membranes and cleaning agents. Our experience and access to a wide selection of technology options means that our

specialists can always offer the best membranes for a particular application as well as dedicated support and service.

A dedicated team of specialists

- World-class innovation, engineering, sales and service competences
- 3 decades of experience - more than 1,100 references
- Strong know-how platform
- Pioneers in innovative dairy applications and engineering solutions
- Innovation centre and pilot plant service
- Customer service on customer terms
- World-wide expertise and local contacts

Microfiltration (MF) system

Debacterisation, fractionation and clarification with ceramic and polymer membranes



Specifications

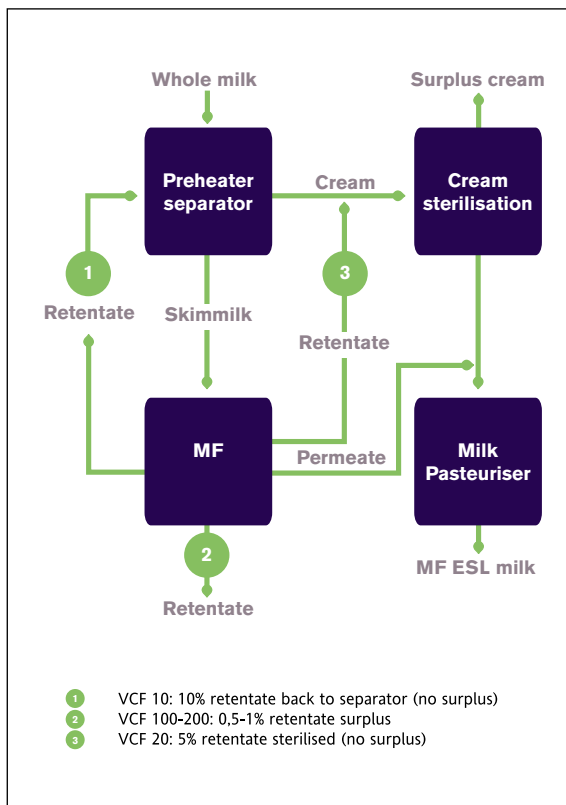
Field of application	Skim milk, whey, cheese milk, cheese brine
Description	Microfiltration is based on a membrane with a very open structure allowing most dissolved substances to pass whereas non dissolved particles, bacteria, spores and fat globules are rejected. Depending on the specific application, membranes and process parameters are chosen to secure optimal performance of the plant
Capacity	5,000 l/h - 50,000 l/h (1,300 - 13,000 U.S. g/h)
Temperature	50°C (122°F) for ceramic and 10°C (50°F) for SW

Advantages

- Proven components and system design
- Very robust ceramic membranes
- Long lifetime of the ceramic membranes
- New generation GP membranes
- Future option for SW polymer membranes
- Very high quality and reliably engineered system
- Pre-assembled in our workshop
- Operator- and maintenance-friendly

MF debacterisation

Effective removal of bacteria and spores



Specifications

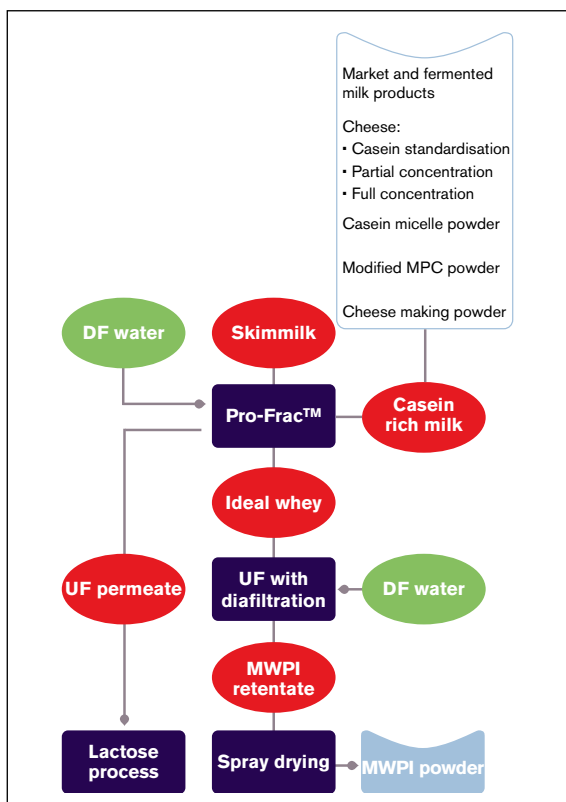
Field of application	Debacterisation of cheese milk, ESL milk and milk/whey powder. Further clarification of cheese brine using SW membranes
Description	Microfiltration for debacterisation in the dairy industry is used for reduction of bacteria and spores. In cheese milk production, microfiltration replaces the addition of nitrate. In market milk production, microfiltration is used to extend shelf life and produce value added milk, and in powder milk production, it is used to reduce the content of spores and thermophilic bacteria in the powder
Capacity	5,000 l/h - 50,000 l/h (1,300 - 13,000 U.S. g/h)
Temperature	50°C (122°F) for ceramic and 10°C (50°F) for SW (cheese brine)

Advantages

- Optimised removal of bacteria and spores
- Various operation concepts (see diagram)
- Proven process and system design
- Nitrate-free cheese
- Long-life ESL milk
- High-quality milk/whey powder
- High-quality cheese brine
- The MF process can be implemented in various parts of the dairy industry

MF fractionation - Pro-Frac™

Extracting more value from milk



Specifications

Field of application	Protein fractionation of skim milk for: Protein/casein standardisation of cheese milk, high-casein milk powder and milk drinks
Description	The MF process for fractionation has been developed during recent years, concurrently with the development of new membranes with relevant pore sizes. The different size of whey proteins and casein makes it possible to use the membrane technology for fractionation. The purpose of fractionation is to standardise casein, e.g. in cheese making
Capacity	5,000 l/h - 50,000 l/h (1,300 - 13,000 U.S. g/h)
Temperature	50°C (122°F) for ceramic and 10°C (50°F) for SW polymer

Advantages

- Proven process and system based on ceramic membranes
- Very robust, long-life ceramic membranes
- Proven APV UTP system (uniform trans-membrane pressure) - alternative: GP membranes
- Future options for polymer membranes
- Casein standardisation of cheese milk
- High casein milk powder and milk drinks
- High-value WPI from 'Ideal whey'

Ultrafiltration (UF) SW and P & F systems

For milk and whey protein concentration



Advantages

- Proven components and system design
- Proven membranes for any dairy application
- High performance and long membrane lifetime
- High-quality engineering, standardised system
- Speed controllers on all motors
- Optimised utility consumption
- Pre-assembled in our workshop
- Operator- and maintenance-friendly

Specifications

Field of application	Protein standardisation, milk protein concentration (MPC), UF cheese and whey protein concentration (WPC)
Description	Ultrafiltration for concentration of milk or whey is widely used in the dairy industry. UF concentration is used as a concentration step in the process of making different whey or milk powder products. Also different fresh cultured cheeses like cream cheese, Feta and Queso Fresco can be produced by UF concentration with a substantially higher yield
Capacity	Flexible from 1,000 l/h (250 U.S. g/h) to more than 100,000 l/h (25,000 U.S. g/h)
Temperature	50°C (122°F), more commonly 10°C (50°F) for quality reasons

UF protein standardisation and concentration

Improving product quality and profitability



Specifications

Field of application	Cheese milk, protein milk drinks, milk powder, yoghurt and dairy desserts
Description	By means of UF whole milk or skim milk is separated into a protein rich fraction and a protein free fraction. By controlling the exact amount of protein in a certain amount of milk, the protein content can be increased or decreased
Capacity	Variable, but typically 5,000 l/h and 75,000 l/h (250 and 25,000 U.S. g/h)
Temperature	50°C (122°F), more commonly ≤10°C (50°F) for quality reasons

Advantages

- Proven system and process
- Different concepts and optimal integration
- Cheese milk: constant protein - better control of process and constant/higher cheese quality - and less rennet
- Protein and calcium enriched milk drinks
- Improvement of texture of yoghurt and desserts
- Milk powder: improved profitability and quality

UF cheese systems

High yield and quality cheeses



Specifications

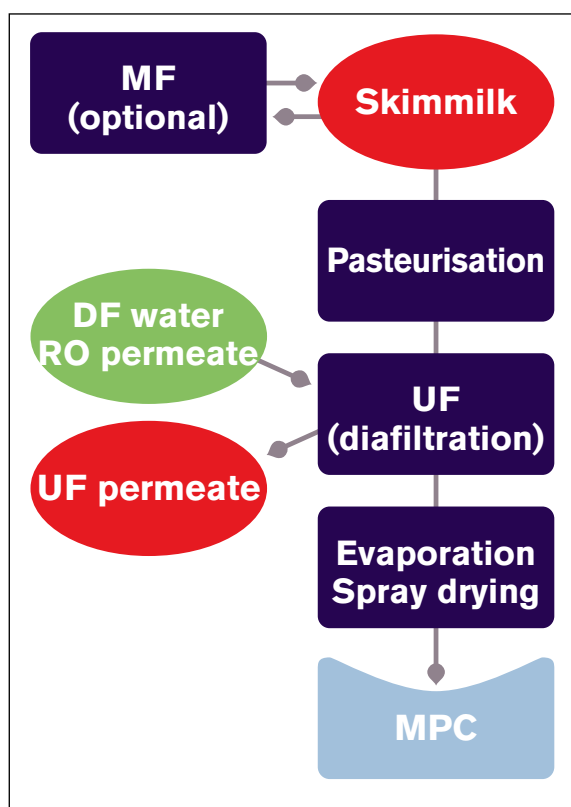
Field of application	White cheese like Feta and Domiati, Queso Fresco like Burgos, Quesillo and Panella, fresh cultured like Quarg, cream cheese etc.
Description	UF is a well-established and proven technology for a wide variety of fresh cultured cheeses. The UF based cheese process is a continuous process with increased yield compared to traditional cheese processing. The UF technology secures a more homogenous product with stabilising effect from the whey proteins. Furthermore, the process gives the flexibility of producing different kinds of cheeses on the same equipment
Capacity	Variable, but typically 3,000 l/h - 20,000 l/h (800 - 5,000 U.S. g/h)
Temperature	50°C (122°F) and 45 - 5°C (113 - 41°F) for fermented milk

Advantages

- Proven membranes for various milk applications
- High performance and long membrane lifetime
- High quality engineering, standardised system
- Proven process/UF cheese technology
- High yield and product quality
- Increased profitability
- Large number of references
- Complete line with pre-treatment and post-treatment (e.g. MF debacterisation for Feta)

UF milk protein concentrate - MPC and MPI

Tailored milk proteins for the food industry



Specifications

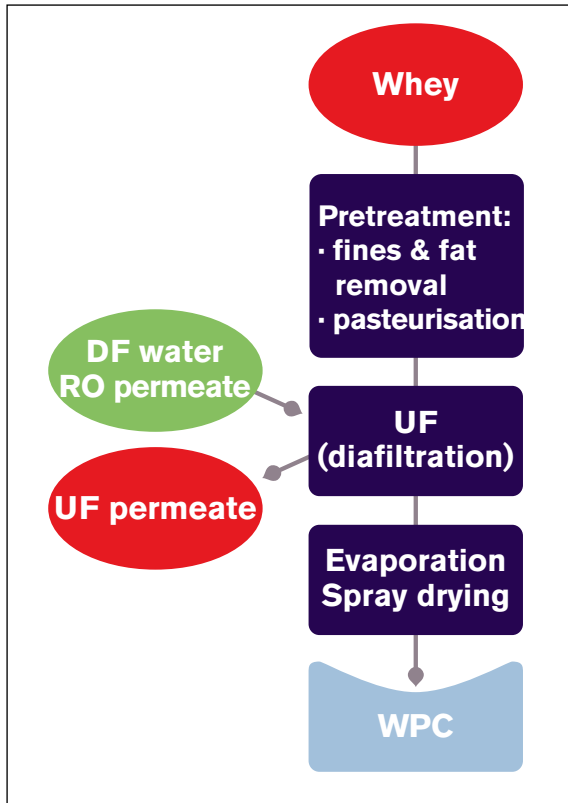
Field of application	Skim milk for: MPC 50, 60, 70, 80, 85 and MPI 90
Description	Milk protein concentrate is produced by using ultrafiltration to concentrate skim milk. The result is a product with a high content of protein and a low content of lactose and ashes. MPC and MPI are made in various grades from MPC 50 to MPI 90 and are used in for instance processed cheeses and a wide range of other food applications
Capacity	Variable, but typically 10,000 l/h - 35,000 l/h (2,500 - 10,000 U.S. g/h)
Temperature	50°C (122°F), more commonly 10°C (50°F) for quality reasons

Advantages

- Proven membranes for MPC
- High performance and long membrane lifetime
- High quality engineering, standardised system
- Proven process technology
- High degree of flexibility
- Complete line with pre-treatment and post-treatment

UF whey processing

Adding value to your whey



Specifications

Field of application	Sweet and acid whey for various whey protein grades from WPC 35 to 85 and WPI 90
Description	Membrane filtration is widely used when processing value added whey protein concentrates (WPC and WPI). The configuration/design of the UF systems gives the possibility of producing a wide range of WPC products on the same plant. By adding water (diafiltration) into the UF system it is possible to concentrate the whey to WPC 85, which means that 85% of the total solids is protein
Capacity	Variable - typically from 5,000 - 100,000 l/h (13,000 - 26,000 U.S. g/h)
Temperature	50°C (122°F) or more commonly 10°C (50°F) for quality reasons

Advantages

- Proven membranes for various whey types/qualities
- High performance and long membrane lifetime
- High-quality engineering, standardised system
- Proven process technology
- Optimised flexibility
- In-line process: UF, NF/RO, RO polisher
- High solids WPC
- Large number of references

Nanofiltration system (NF)

For concentration and partial demineralisation



Specifications

Field of application	Whey, UF permeate and skim milk
Description	Nanofiltration is a RO process in which a more open membrane allows small monovalent ions such as sodium and chloride to pass. This means that NF combines concentration (like RO) and partial demineralisation. The NF process can be used for a wide range of applications in the dairy industry, e.g. demineralisation of whey, milk and permeate from UF of milk or whey.
Capacity	Variable, but typically 5,000 l/h - 100,000 l/h (1,300 - 26,000 U.S. g/h)
Temperature	≈ 30°C (86°F) or more commonly 10 - 12°C (50 - 53,6°F) for quality reasons

Advantages

- Proven components and system design
- Proven membranes for NF dairy applications
- Optimised performance and long membrane lifetime
- In-line UF, NF, RO polisher
- High-quality engineering, standardised system
- Optimised utility consumptions
- Pre-assembled in our workshop
- Operator- and maintenance-friendly

Reverse osmosis (RO)

For concentration



Specifications

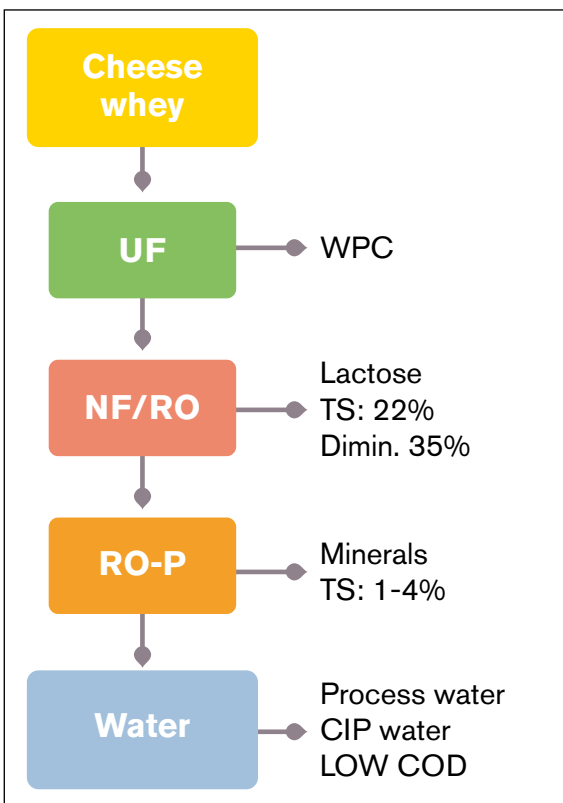
Field of application	Whey, UF permeate, skim milk, whole milk and white water, sweet buttermilk
Description	Reverse Osmosis filtration is based on a very dense membrane that rejects virtually all substances except water. This is possible due to a very high system pressure. RO is used for concentration of liquids to higher solids levels, depending on application. The purpose of RO can be to pre-concentrate prior to evaporation, to minimise transport costs or to increase capacity in different dairy processes.
Capacity	Variable, but typically 5,000 l/h - 100,000 l/h (1,300 - 26,000 U.S. g/h)
Temperature	≈ 30°C, (86°F) more commonly 10 - 12°C (50 - 57,2°F) for quality reasons

Advantages

- Proven components and system design
- Proven membranes for RO dairy applications
- High performance and long membrane lifetime
- In-line process: UF, RO, RO polisher
- High-quality engineering, standardised system
- Optimised utility consumptions
- Pre-assembled in our workshop
- Operator- and maintenance-friendly

RO polishing system (RO-P)

A dairy-environmental process



Specifications

Field of application	NF or RO permeate and evaporator condensate to produce process water and lower the COD level
Capacity	Variable, but typically 5,000 l/h - 80,000 l/h (1,300 - 26,000 U.S. g/h)
Temperature	≈ 30°C (86°F), more commonly 10 - 14°C (50 - 57,2°F) for quality reasons

Advantages

- Proven components and system design
- Proven 8" membranes for RO-P dairy applications
- Optimised performance and long membrane lifetime
- In-line process: UF, NF/RO, RO Polisher
- High-quality water - low COD level
- High-quality engineering, standardised system
- Optimised utility consumption
- Pre-assembled in our workshop
- Operator- and maintenance-friendly

Microparticulation of whey



Advantages

- A unique new process ensuring optimal distribution of particle size
- Ensures superior taste in low-fat products
- Excellent functional properties
- Ability to vary particle sizes
- Fast pay-back, high ROI
- Proven, high-quality system design
- Evaporation and spray-dry options
- Increased yield

Specifications

Field of application	WPC 35, 60 and 80 from sweet whey, lactic acid and HCl casein whey
Description	The APV LeanCreme™ process is a combined thermal and mechanical process using a shear agglomerator to produce LeanCreme™ (particulate). APV LeanCreme™ is based on a UF process for concentration of whey. The concentrated whey is then microparticulated by the shear agglomerator and a product with a unique particle size distribution and excellent functionality is "formed". The LeanCreme™ is a natural ingredient which can be used in various dairy and food applications, especially for low fat products, with improved quality and profitability as a result
Capacity	500 - 3,000 l/h (130 - 800 U.S. g/h)

Membrane and after market service

Maximising uptime, minimising costs



Specifications

Field of application	APV's established base of membrane plants
Description	The membrane is the heart of the filtration process and decisive for the performance and the profitability of the process. APV can support you with membrane replacement, membranes and on-site service
Capacity	Spiral wound (SW) 8", spiral wound 6", spiral wound 4", hollow fibre (HF), plate and frame, ceramic tubular, tubular organic

Advantages

- Expert advice on choice of membrane type
- Fast delivery of replacement membranes
- Regular service visits
- Troubleshooting
- Cleaning procedures
- Operator training, practical and theoretical
- Process optimisation

Applications in typical dairy segments

For value-added products

Dairy segments Applications	Market milk/ fresh products, drinks, yoghurt, dessert	Cheese: Fresh, soft.....to hard	Ingredients: Milk/whey	Butter
MF debacterisation	X	X	X	-
UF protein standardisation	X	X	X	-
MF protein fractionation Pro-Frac™	(X)	X	X	-
UF milk concentration	Yoghurt, dessert	Fresh cheese, feta etc.	MPC 50/85	Butter milk
Microparticulation (MP) APV LeanCreme™ process	MP of WPC	MP of WPC	MP of WPC	-
UF whey concentration	-	WPC 35/60	WPC 35/60/80 WPI 90/95	-
NF Concentration/De- mineralisation	(Demineralised milk)	Whey/permeate	Whey/permeate	-
RO concentration	(Milk transport)	Whey/permeate	Whey/permeate Milk (transport)	Butter milk
RO polishing	(X)	RO/NF permeate	RO/NF permeate + condensate	-
RO white water	X	X	X	-
MF brine purification	-	X	-	-



Research and development

The APV Innovation Centre and Pilot Plant rental service



APV LeanCreme Pilot Plant for microparticulation of whey

> The APV Innovation Centre in Silkeborg, Denmark, offers short-term agreements to pilot your innovative dairy process and products.

APV's process engineers are available with expert advice under full confidentiality during trials at our Innovation Centre. Alternatively, we can provide you with a pilot plant for testing at your own production facility.

Our specialist team is also available to work with you to find cost-effective solutions to the ever-changing challenges of today's marketplace, thus assuring you of the consistency and quality of your end-product well before it is launched.





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For more information about our worldwide locations, approvals, certifications, and local representatives, please visit www.apv.com.

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