nx filtration

Advanced hollow fiber membranes

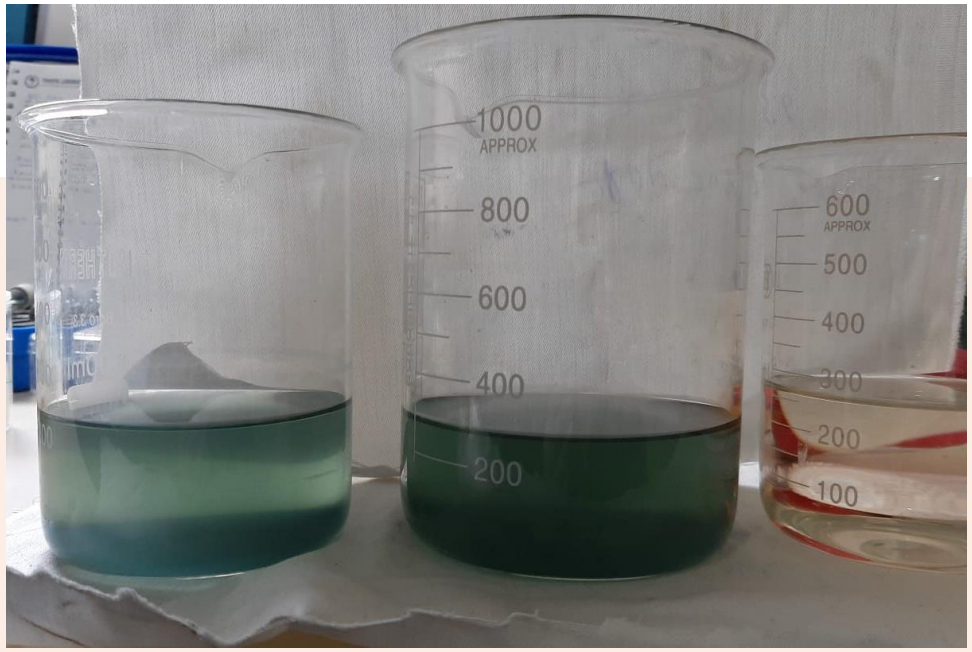
Clean and affordable water for all

Webinar – June 2023

Aguasresiduales.info

Water quality

- Organic matter (COD ≅ 1.000 ppm)
- Color
- Sulphates
- Hardness
- Heavy metals (Al, F, etc.)
- Micropollutants
  - Pesticides
  - Pharmaceuticals
  - PFAS
  - DBP precursors



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One Step Process · Energy Efficient · Green Chemistry

The NX Filtration journey started with technology developed at the University of Twente, growing to a worldwide business today

Research phase | Company founded | Operationally proven | Commercially proven | Expansionary growth

2013

Prof. Dr. Erik Roesink laid the foundation for NX Filtration with his research on **dNF technology**

UNIVERSITY OF TWENTE.

Beginning of long-lasting **relationship with University of Twente**

2016

Founding of nx filtration

Patents for applying hollow-fibre layer-by-layer nanocoating

2018

First production facility ready

Mexplorer pilot system introduced allowing for on-site lab-scale testing

2019

First dNF project: 31 modules in the Philippines

Strategic sales force expansion

2020

Second production facility

Acquired HYDRA cap products from Hydranautics

Mexpert pilot system fully automated testing

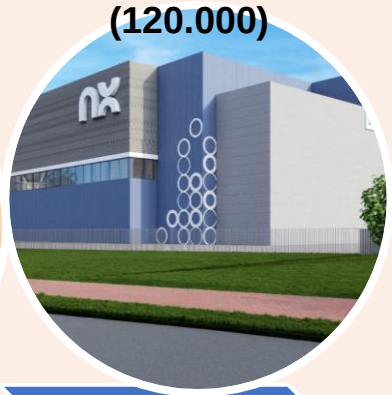
2021

IPO (AMS:NXFIL) Listed on Euronext

Strategic sales force expansion

2022

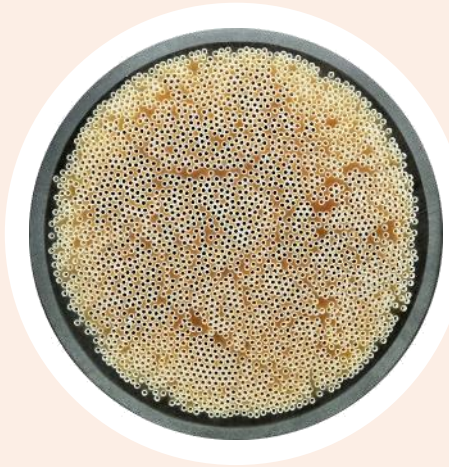
Start of new production facility (120.000)

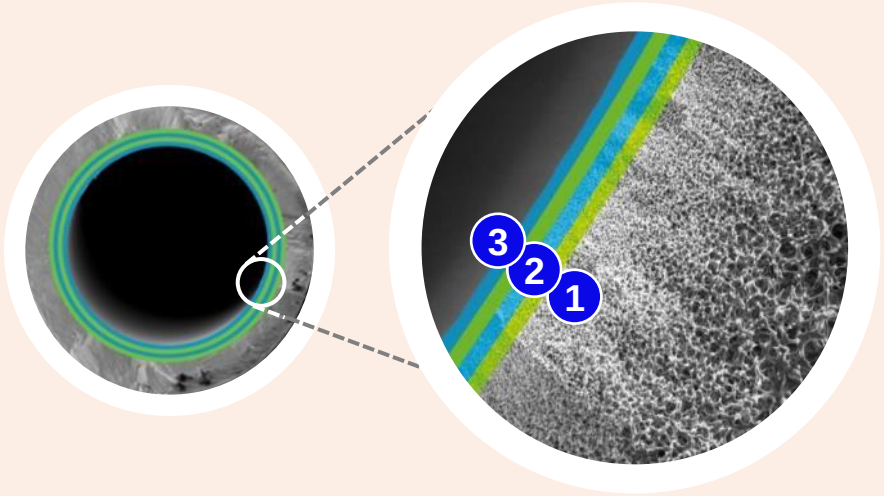


Strategic sales force expansion

NX Filtration has developed unique direct nanofiltration technology that addresses global water challenges

Direct nanofiltration (dNF) patent protected technology





1. Family of patents around **dense membrane support structure** to ensure optimal selective layer adhesion
2. Family of patents around the in-line application of a **first selective charged layer**
3. Family of patents around the **layer-by-layer** application of positively and negatively charged nanolayers, offering precise control of the membrane selectivity properties. *Ongoing nanolayer innovations aim to enable new applications, such as further penetrating RO markets*

Sustainability has been a strong focus from the outset, both in our production processes as well as during operation of our membranes

Green chemistry

Our coating process for dNF membranes applies water-based chemistry, in contrast to conventional solvent-based coating processes. Our membrane spinning process is highly energy efficient thanks to our unique in-line polymer mixing concept

Energy efficient

Our membranes require less energy and therefore realise significant CO_2 footprint reduction during operations compared to conventional technologies

Avoidance of chemicals

Our solution avoids the use of flocculants and coagulants in pre-treatment (which are required for traditional filtration processes) and requires a low cleaning frequency

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Our breakthrough dNF technology continues to be recognized by the industry

dNF membranes at Recolab, Sweden

"Recolab is the largest source-separated sanitation plant in the world using circular treatment"

"an energy-efficient, circular sanitation process […] that recycle[s] wastewater to drinking water quality."

"The project sets the standard for sustainable, circular water and waste management"

BlueTech RESEARCH
Actionable Water Technology Market Intelligence™

Total BlueTruffle score: 5 out of 5

Large addressable market	1 out of 1
Strong management team	1 out of 1
Strong IP position	1 out of 1
Innovative technology	1 out of 1
BlueTech opinion	1 out of 1

Disrupt-o-Meter Breakdown

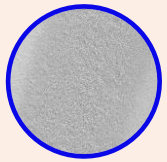
Highly disruptive

- Inclusion in the new **Euronext Tech Leaders initiative** for high-growth and leading tech companies
- **NX Filtration is the only water technology company** out of the 100+ companies included in Euronext's Tech Leaders initiative

One Step Process · Energy Efficient · Green Chemistry

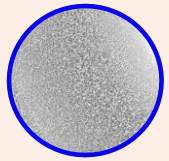
Our membrane portfolio

	Nano dNF		Ultra UF		Micro MF	
Filtration objective	dNF40	dNF80	UF010	UF150	MF100	MF500
Suspended solids and micro plastics	O	O	O	O	O	O
Bacteria	O	O	O	O	O	O
Viruses	O	O	O	O		
Protein and colloidal silica	O	O	O			
Micropollutants, color and nano plastics	O	O				
Selective salts, softening and pharmaceuticals	O					
Cut off	400Da	800Da	10kDa	150kDa	100nm	500nm
Typical Flux (l/m2h)	20-40	20-50	50-100	50-100	25-100	25-100
MgSO4 rejection (%)	90	80	n/a	n/a	n/a	n/a



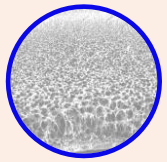
Nanofiltration

Worldwide unique nanofiltration concept, designed to remove organics from water in one single step: without pre-treatment and without the use of chemicals



Ultrafiltration

Ideally suited for high quality – low energy clarification of and viruses from water. Used for RO pre-treatment, potable water and wastewater treatment

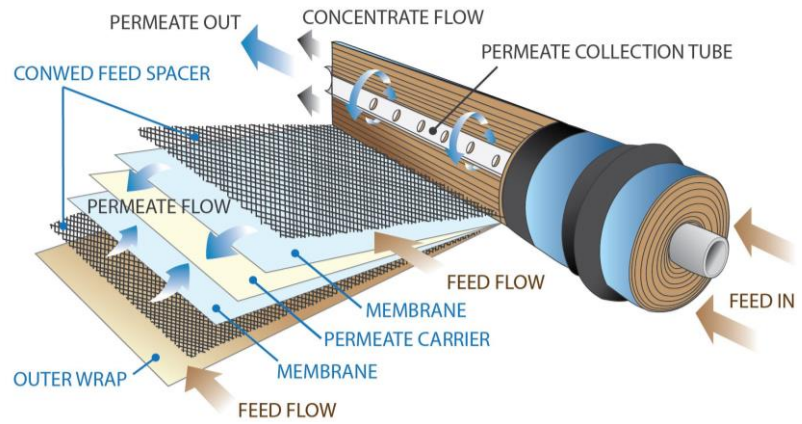


Microfiltration

The best choice for the removal of small particles, bacteria beverages, such as wine and beer, as well as for dairy and pharmaceutical applications

direct Nanofiltration – Innovative coating creates robust materials and enables simple process

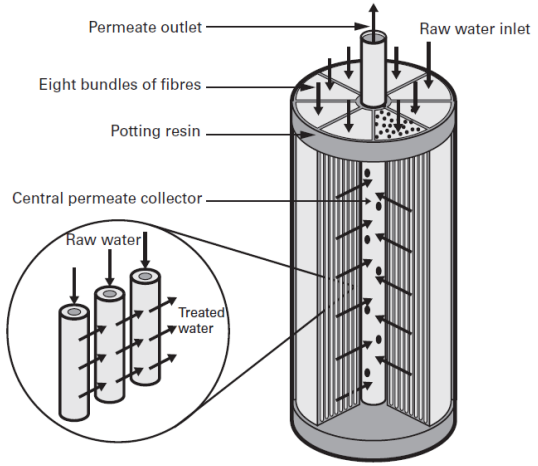
Traditional NF scheme



Feed water quality requirements

- Turbidity < 0.5 NTU (1-2 ppm TSS)
- Al, Fe, Mn < 0.05 ppm
- COD < 10 ppm
- Free Chlorine < 0.1 ppm

Hollow fiber dNF scheme



Feed water quality requirements

- Turbidity < 150 NTU (300 ppm TSS)
- Chemically stable with Fe, Al , Mn
- COD : 100-1000 ppm
- Chlorine resistant < 500 ppm, 250,000 ppm-hours

Direct nanofiltration with no pretreatment can remove contaminants that UF can´t and RO requieres intense pretreatment

dNF

- Solids
- Bacteria
- Virus
- Organic matter (80-90%)
- Color (80-90%)
- Turbidity
- Sulphates (>90%)
- Hardenss (50%)
- Micropollutants
- Divalent ions

UF

- Solids
- Turbidity
- Bacteria
- Virus

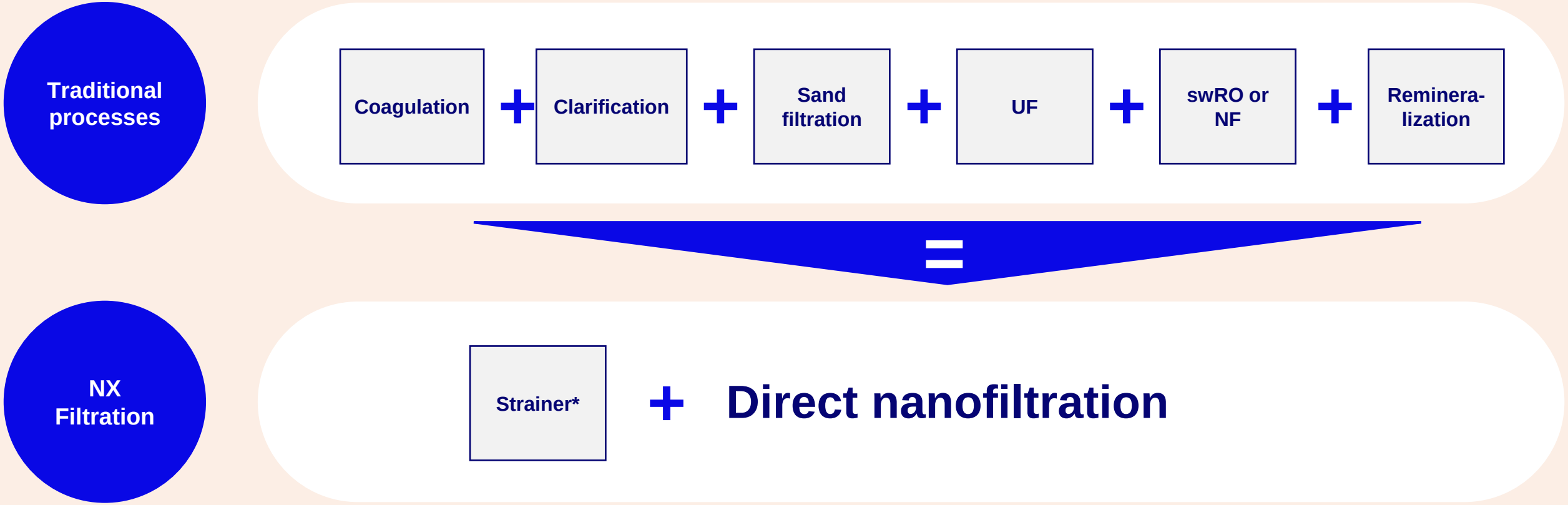
UF + swNF

- Suphates
- Hardness
- Micropollutants
- Organic matter
- Color

UF + RO

- Sodium
- Chloride
- Nitrate
- Amonia
- Monovalent ions

Hollow fiber nanofiltration as one-step alternative for other technologies



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One Step Process · Energy Efficient · Green Chemistry

Mexplorer™ Pilot Unit

- Lab-scale / table-top
- Proof of concept
- Permeate flow: Up to 2 l/hr (3.7 gal/hr)
- 1 x MP025 module

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Mexpert Pilot Unit

- Full-scale pilot unit
- Continuous, fully-automatic operation
- Remote monitoring and control
- Permeate flow: 600-2400 l/h (3.5 - 13.2 gpm)
- 1 or 2 x WMC200 module(s)
- Can be containerized

filtration

How do we work?

1 Projection Tool

2 Mexplorer

3 Mexpert

4 Final proposal

Projection report from initial water análisis.
Estimation
- **Nº of modules**
- **Permeate water quality**
- **Recovery**
- **Energy consumption**

Proof of concept.
- **Real permeate water quality**
- **Quick and easy test**
- **1-2 days can obtain water samples**

Precise information
- **Permeate water quality**
- **Recovery**
- **Cleaning frequency**
- **Energy consumption**
- **Chemical consumption**

Final projection report
- **Nº of modules**
- **Arrangement**
- **Water quality (permeate and reject)**
- **P&ID**
- **Equipment list**

Direct surface water treatment to produce potable water in Dumai

The customer’s query

The customer, a municipal drinking water company, was looking for a simple and robust solution to remove color (humic acids) and micropollutants which are accumulated in the Masjid river during its flow through the rainforest. This water source can be used to produce drinking water to the city of Dumai.

Our approach

We applied our dNF80 nanofiltration membranes, providing a unique one-step solution resulting in a product water flow of up to 4,000 m^3/d (0.8 MGD) from the Masjid river.

Results

Our dNF80 modules are operated in a Once-through arrangement to achieve maximum recovery.

1 step solution, no pre-treatment required

>95% Color Removal

80% Recovery

0% Anti-scalant injection

Reco Lab: recovering nutrients from an urban waste stream in Sweden

The customer's query

The City of Helsingborg together with NSVA (Northwest Skåne Water and Wastewater) and NSR (Nordvästra Skånes Renhållnings) were seeking to recover nutrients from separated urban waste streams (grey and black water) from the new residential area Oceanhamnen (the Ocean Harbour) in Helsingborg.

Our approach

We applied our dNF40 nanofiltration membranes for the removal of micropollutants (amongst other pharmaceuticals, estrogens, micro plastics, antibiotics, and personal care products) from greywater and recovery of nutrients, producing water for reuse. For this project, NX Filtration partnered with DeSaH (process design) and Jotem (membrane skid).

>80% Micropollutant removal

>80% recovery

70% Energy savings

85% Chemical savings

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Wastewater reuse project for multinational soft drinks producer in Canada

The customer's query

As part of its sustainability goals, a soft drinks plant in Canada was looking for a solution to reduce Biological Oxygen Demand in a sugary wastewater to cut wastewater discharge costs and enable use of the sugary concentrate in feedstock.

Our approach

- We applied our dNF40 nanofiltration membranes after a self-cleaning strainer directly on the wastewater discharge without the use of any coagulation chemicals.

Results

The dNF40 unit has a single pass Christmas tree arrangement. The unit is operating at a recovery of more than 75%. Producing a concentrate stream containing 10,000 ppm BOD and a product water with 600 ppm BOD from a 2700 ppm BOD feed water at a flow of 90 gpm (20 m^3/h).

1 Single pass process for minimum energy usage

>75% recovery

>75% BOD rejection

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Reducing water footprint of a brewery by treating RO concentrate with dNF membranes in Spain

Water scarcity

Driven by water scarcity a Spainsh Brewery is actively seeking ways to reduce their water footprint. The reduction of waste water streams by recovering clean and save water from various process water streams has proven to be an effective method. But the brewery was looking for new and advanced ways to optimize even further.

Our approach

We applied our low fouling and low scaling dNF40 nanofiltration membranes to treat the concentrate of the existing RO installation to recover fresh water for use in various processes

Results

Due to their unique separation characteristics our dNF40 membranes were able to enhance the system recovery from 50% (RO) up to 75% (RO + dNF)

75% Recovery of RO + dNF system

70% Hardness reduction

>90% Rejection of divalent anions (e.g. sulphates)

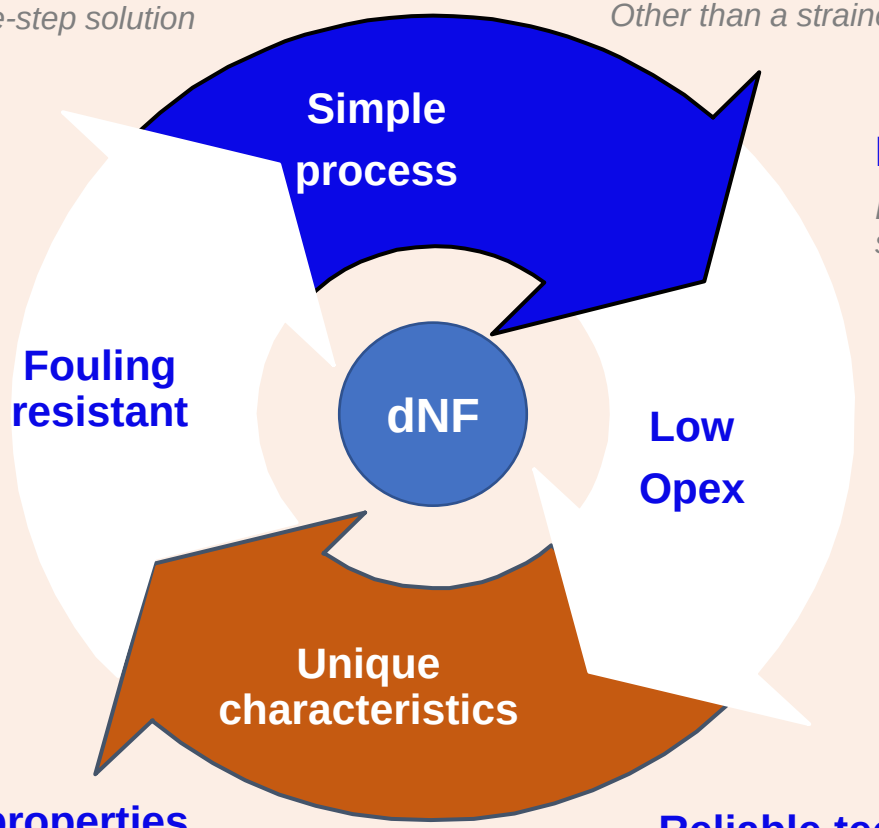
>40% TDS reduction

Unique features of our dNF technology

Small footprint
One-step solution

No pretreatment
Other than a strainer, typically no pretreatment required

Low fouling
Low biofouling and low scaling



Favorable operating costs
Energy efficient, chemical free and reduced system complexity – TCO: 0.2 - 0.3 €/m³

Chlorine tolerant
Cleanability in the pH range of 1 to 13
Chlorine resistance 250000 ppm-hrs @ pH >10

Energy efficient
< 0.3 kWh/m3 treated water
Up to 70% energy savings compared to UF+RO

Back-washable
In contrast to spiral wound NF membranes

Chemical free
No use of flocculants and coagulants, very low chemical cleaning frequency

Unique separation properties
High organics retention and high salt passage

Reliable technology
High log removal viruses & bacteria
Ability for integrity testing

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Thank you!

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