

## Technological Advancement of SMBR – The Submerged PURON® System



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Deepak Raina



Tubular

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**SUPER-COR®**



**FEG™PLUS**



**SUPER-G®**



**ULTRA-COR®**

Tubular

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**INDUCOR™**

Tubular/Spiral

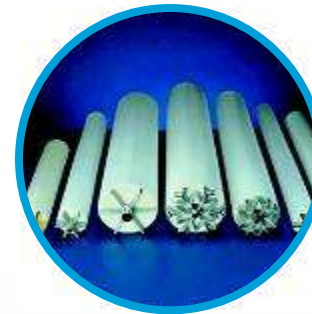
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**SeIRO®**

Spiral

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**ABCOR®**



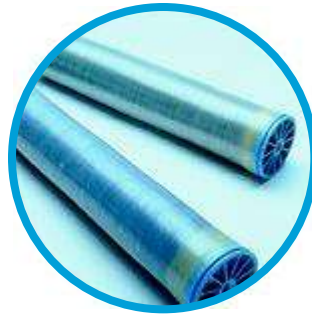
**KPAK™**

## Spiral

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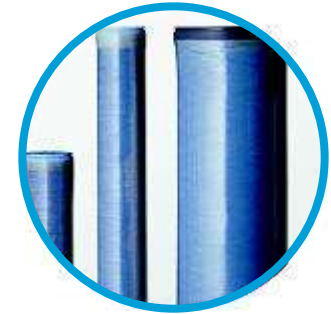
**FLUID SYSTEMS®**



**TFC®S & SR**



**MegaMagnum®**



**Magnum®**

## Hollow Fiber

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**ROMIPURE™**



**PMPW™**



**TARGA®**



**PURON®**

**Industrial Water  
& Wastewater**

**Municipal Water  
& Wastewater**

**Membranes  
for**

**Food, Dairy  
& Beverage  
Processes**

**Bio,  
Pharmaceutical  
& Chemical Processes**

- 1999-2001 Product development at university of Aachen; Sponsored by PFAU program of NRW
- 12/2001 Foundation of PURON in Aachen
- 07/2002 Financing by venture capital
- 08/2002 Move out of university – start building up a production side
- 12.2003 Order for the largest MBR plant in Belgium (industrial water reuse)
- 11.2004 **KMS acquires PURON AG**
- 03.2005 Change to KMS GmbH

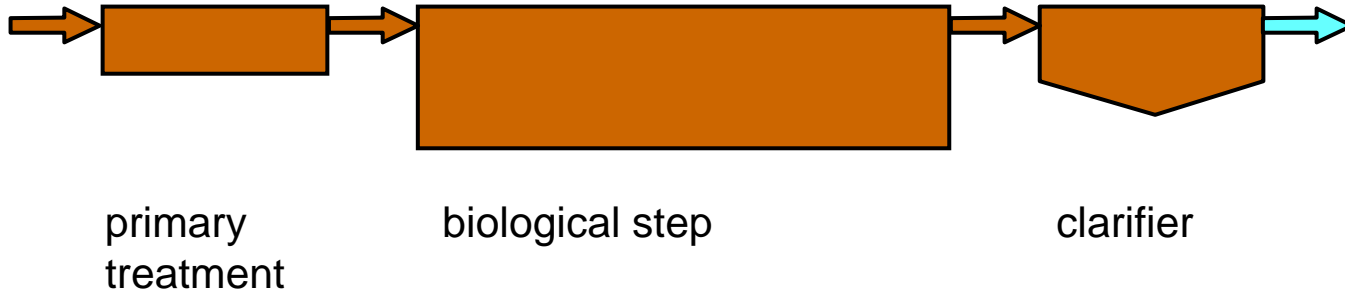


500 m<sup>2</sup> membrane area

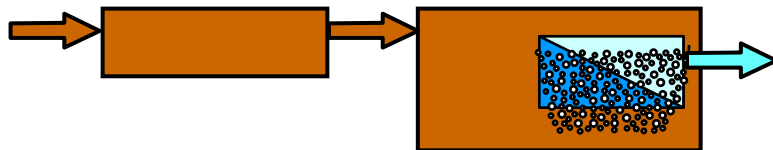


remains brand name for  
KMS submerged membrane technology

## conventional plants

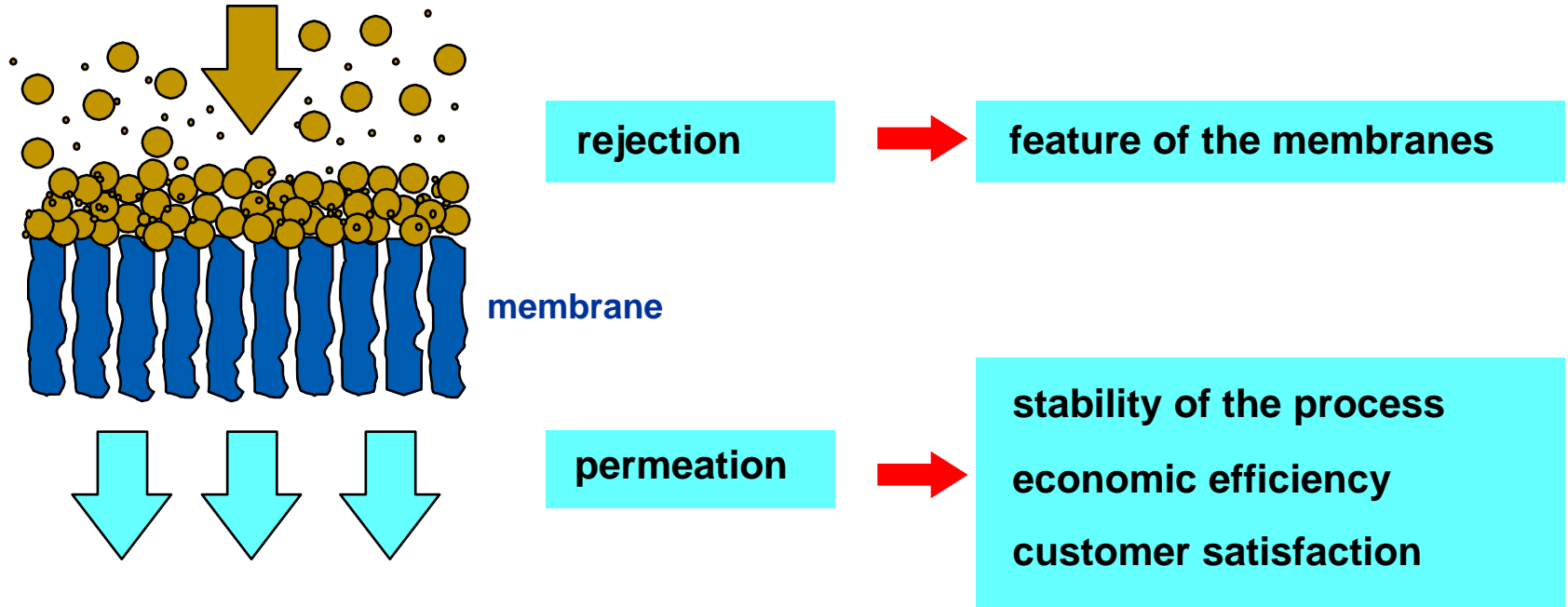


## membrane bioreactor



## Advantages:

- Considerably improved water quality
- Ability of water reuse
- Reduced footprint (approx. 50 %)
- Avoids the problem of bulking and floating sludge



central and most crucial topic to improve MBR-technology:

→ increasing and stabilizing the permeate flux

## design requirements

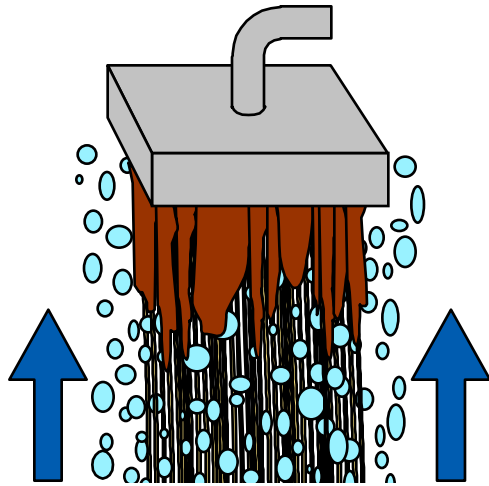
- ➔ good sludge management
- ➔ backwashing ability
- ➔ high mechanical stability
- ➔ effective air injection
- ➔ equal hydraulic load – low pressure losses

## economic requirements

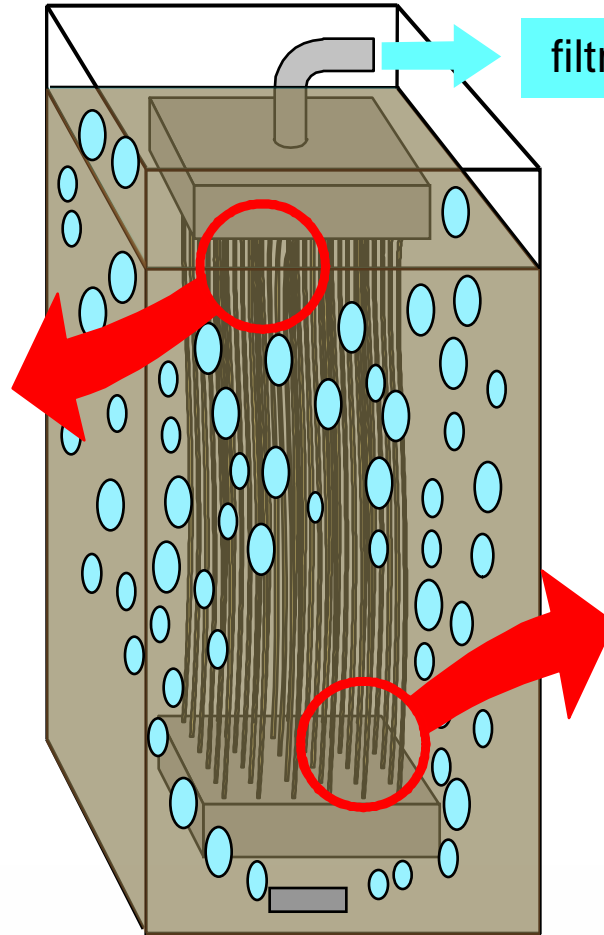
- ➔ high packing density
- ➔ cost effective assembly and replacement
- ➔ high lifetime
- ➔ low cost material – simple construction



## Clogging



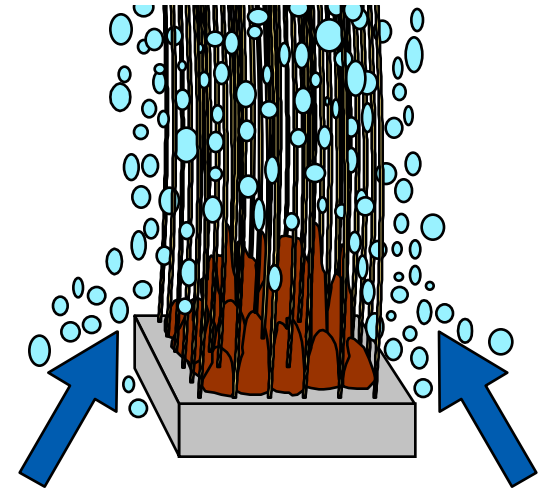
Clogging by hairs and fibrous material at the upper end



filtrate

## Sludging

Sedimentation of sludge in poorly aerated potting area



consequence: reduced filtration rate

clogging



sludging



- Reduction of permeate flux
- danger of biological growth through the membranes
- extensive pretreatment (**fine screen with  $\leq 1$  mm**)

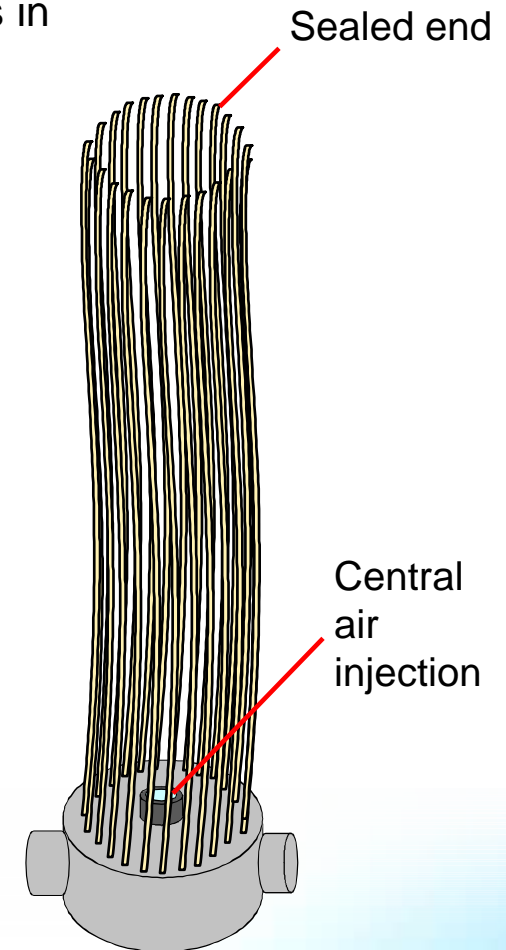
- The key factor for the technological and economical success of membrane technology is the arrangement of the membranes in a technical module

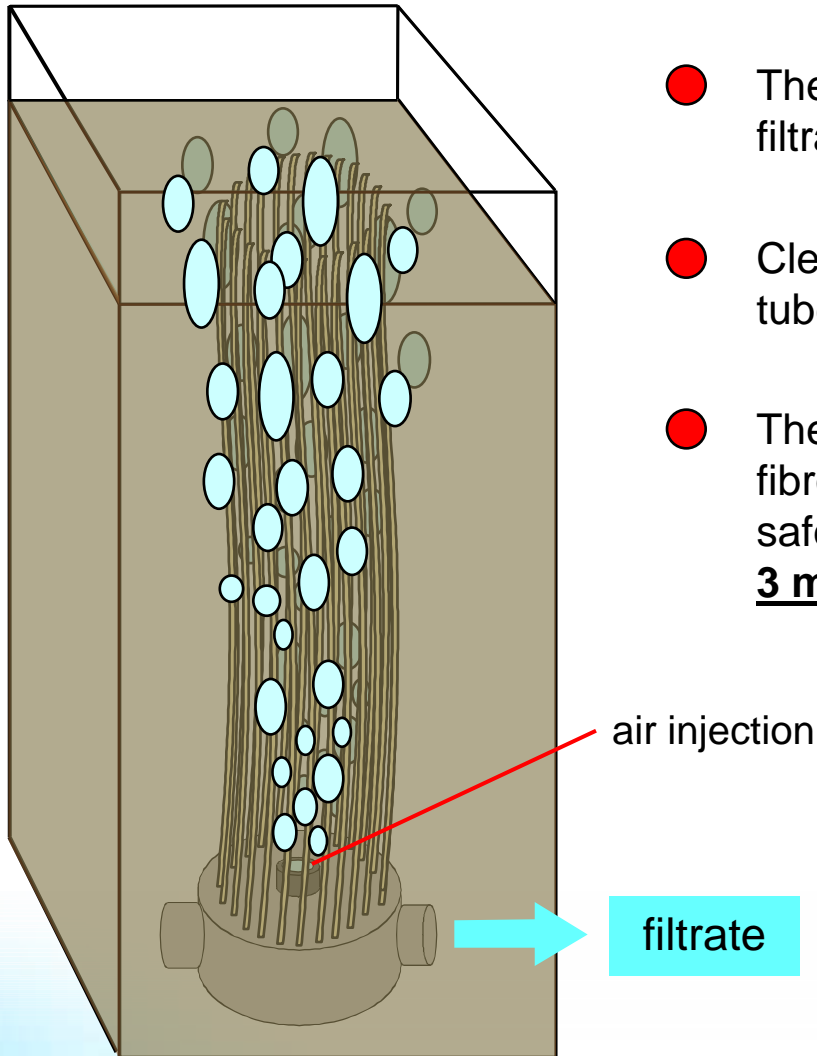
## PURON has copied its product concept from nature:

- Membrane fibers are only fixed at lower end
- Move freely in the water and filtrate as seaweed
- Upper ends of the tubes are sealed
- Cleaning of the membranes is done by injection of air into the center of the single header bundles



PURON has applied the patent for this single header concept with central air injection principle in all major countries of the world



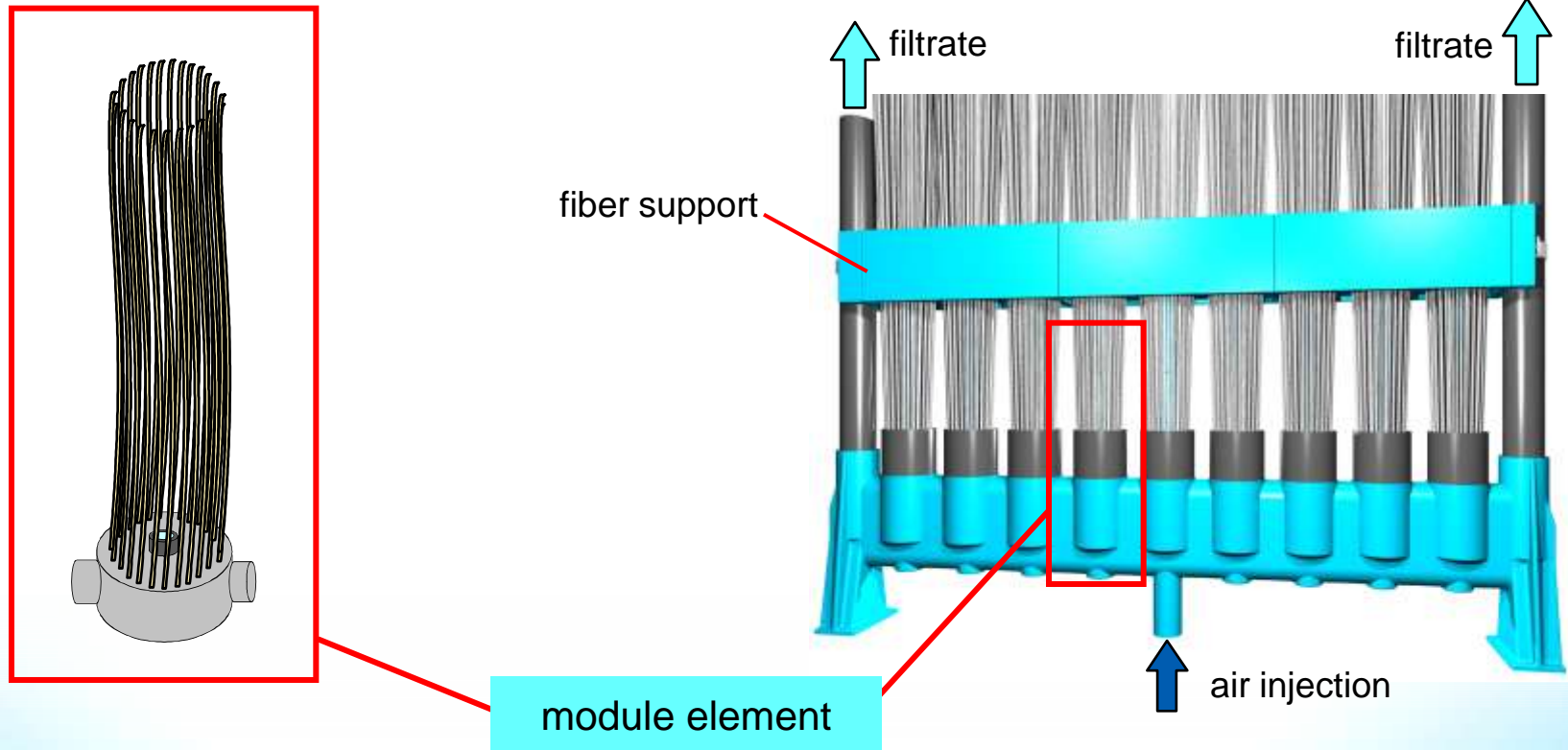


- The filters are submerged into the water to be filtrated
- Clear water is being drawn out of the membrane tubes via the lower foot element
- The single header principle ensures that hairs, fibrous substances and sludge will be removed safely out of the system, **pre-treatment is with 3 mm perforated screens**.

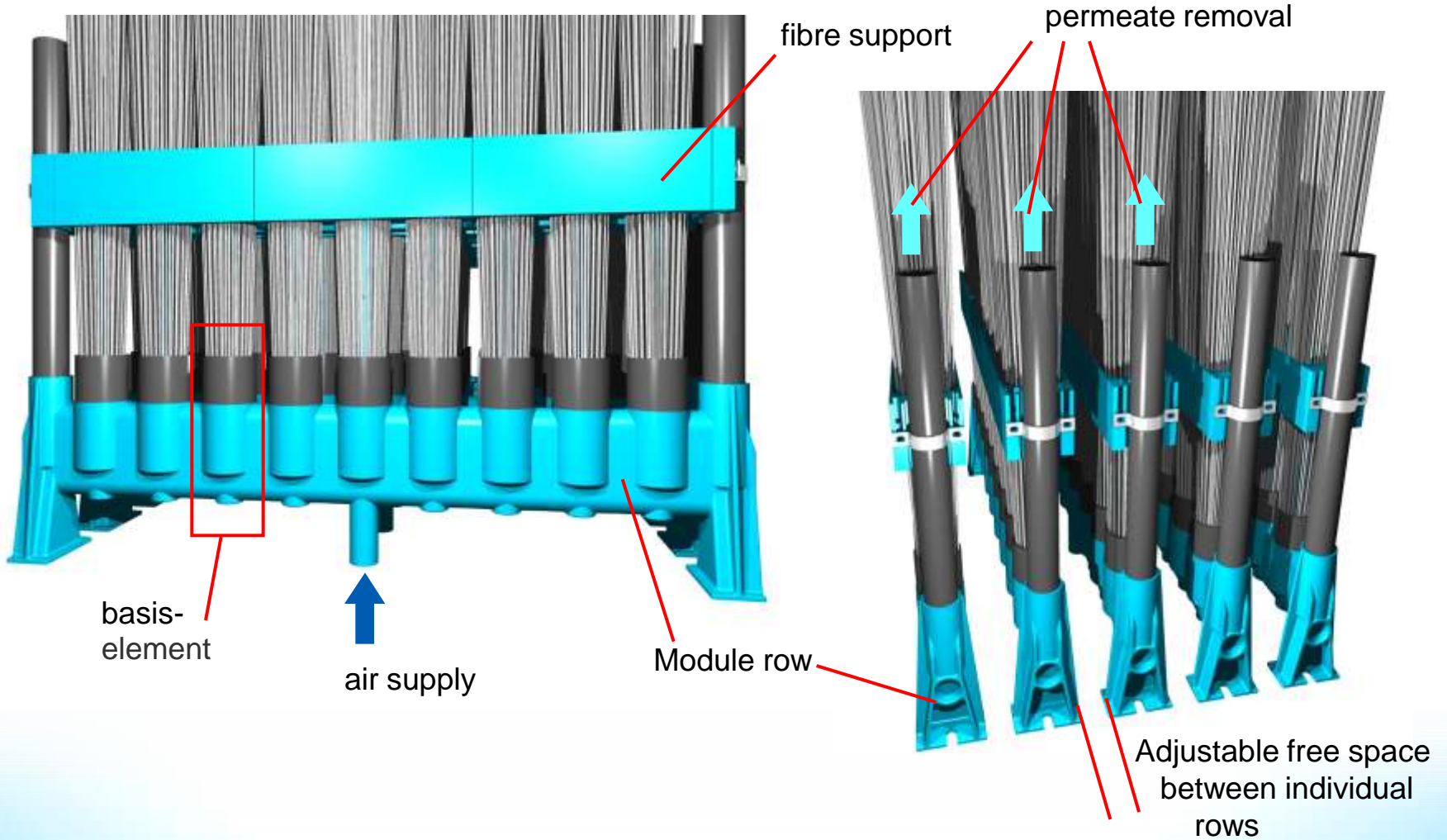
- ➔ **Stable operation with reduced risk of clogging and sludging.**
- ➔ **Low energy consumption.**
- ➔ **Low maintenance and cleaning demand.**

- Transferring the basic principle onto the PURON modules
- Cost-effective production

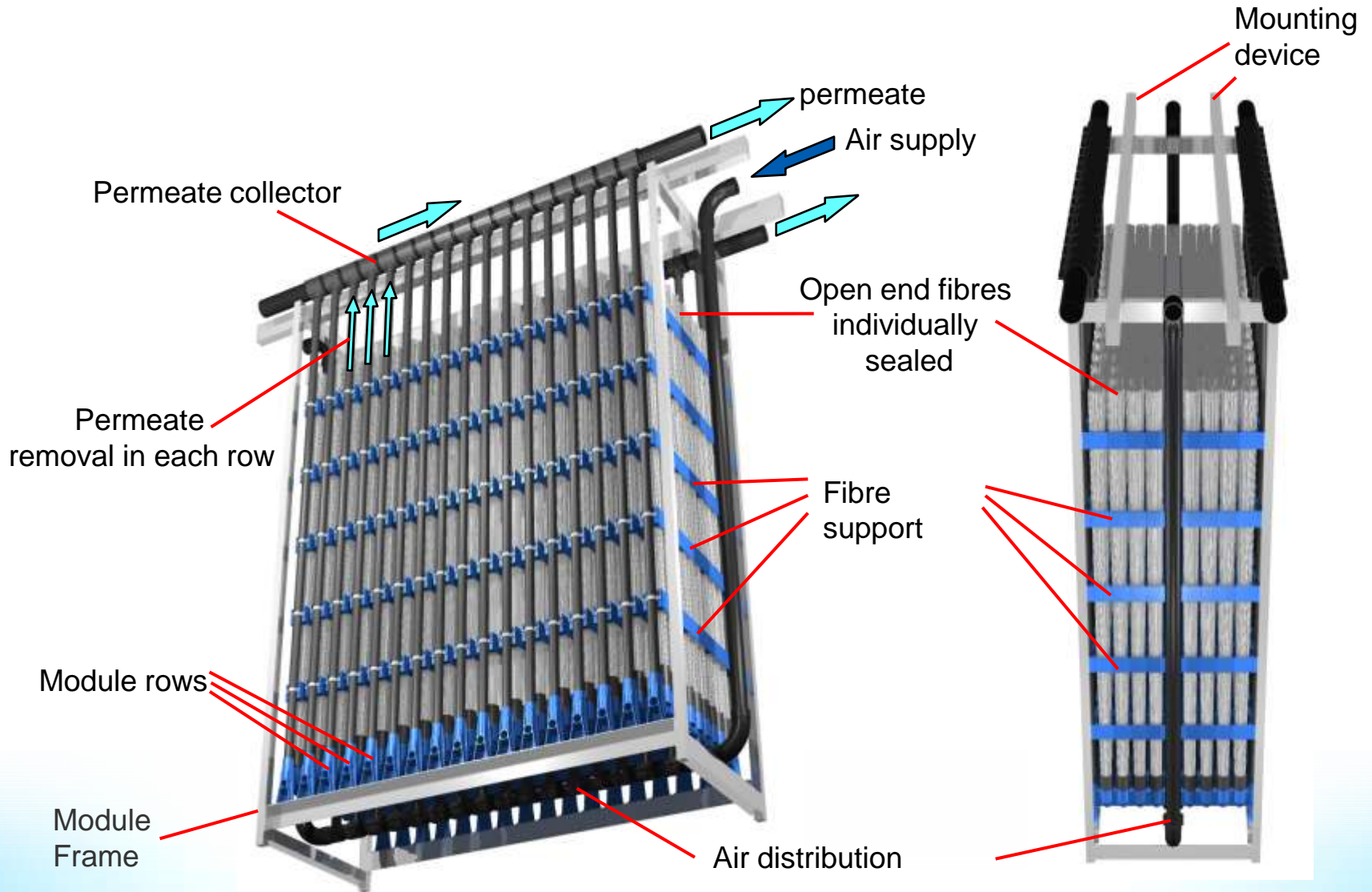
## Module row



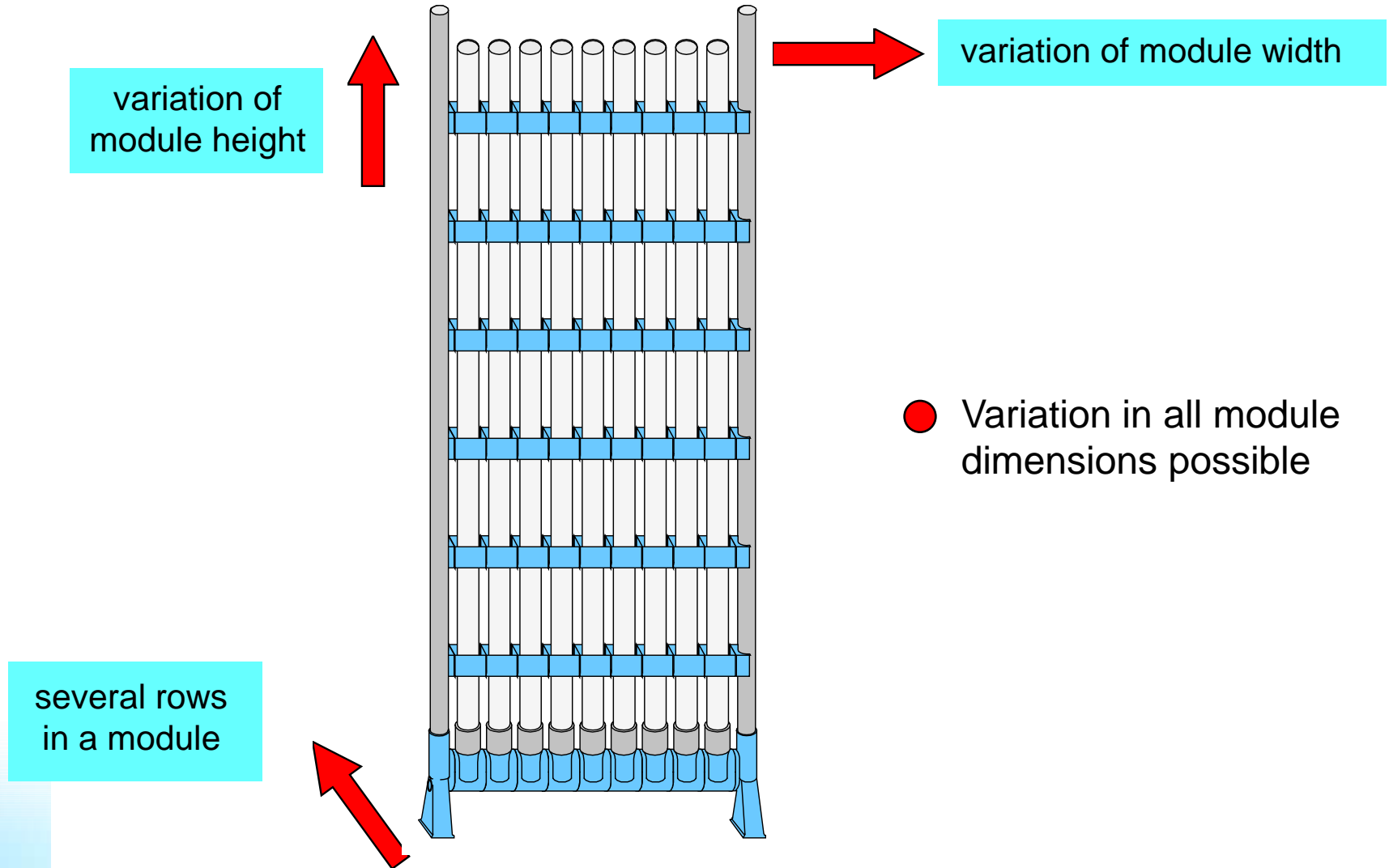
# Modular structure of PURON®-Membrane system



## View of PURON® - membrane module



## High flexibility by modular design





## Clogging within the outer fiber bundles

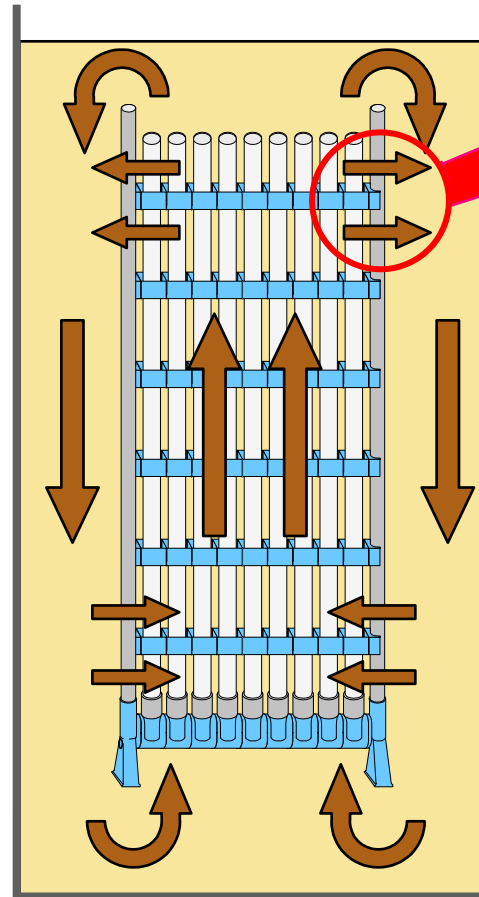
- Module aeration creates upward flow inside the module

### Problem

- This creates downward flow on the outside
- This leads to a cross flow in the outer membranes bundles

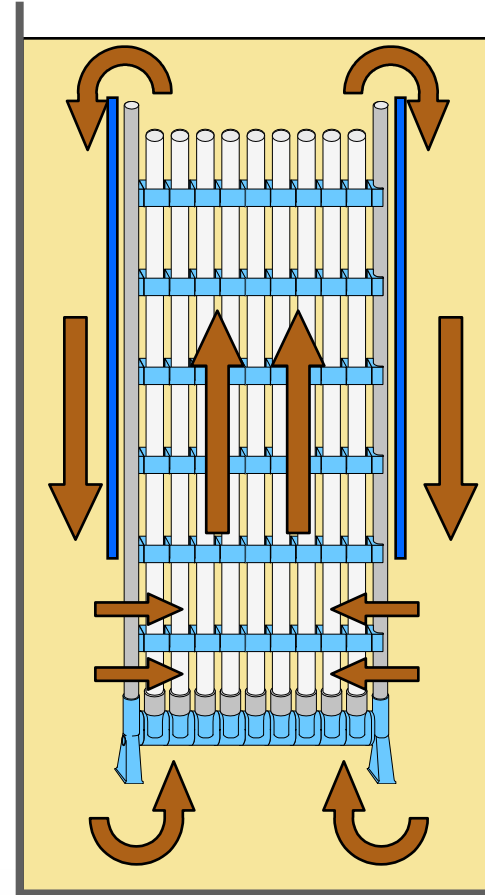


Clogging in the top area of the outer bundles of the module



**danger  
for  
clogging**

## Plates on module outside to avoid clogging of outer bundles



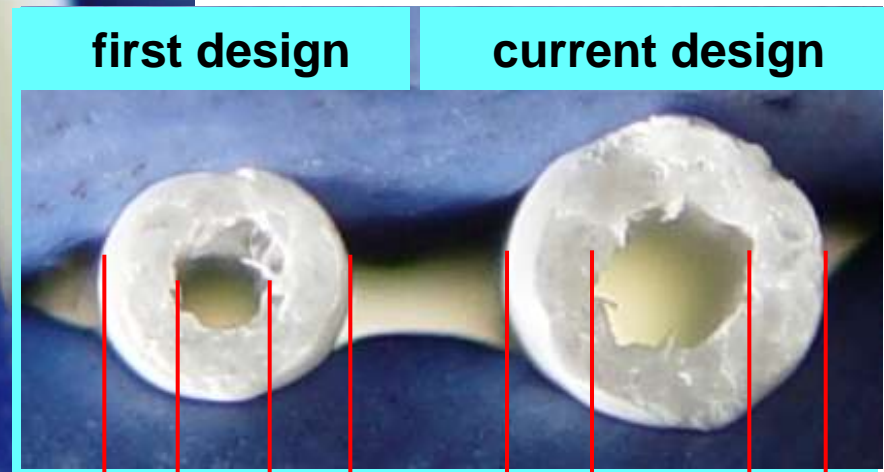
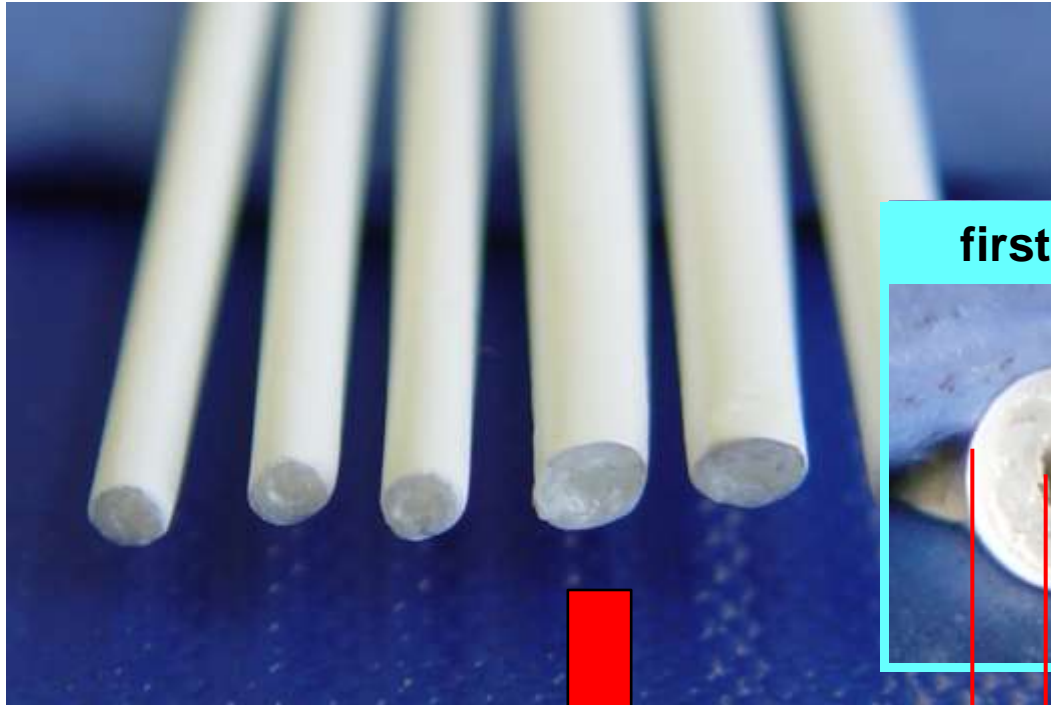
demonstration plant shows  
significant reduction of clogging



The heart of PURON products are:

- thin tubes
- made of inexpensive plastics (PES)





first design

current design

~ 0,6 mm

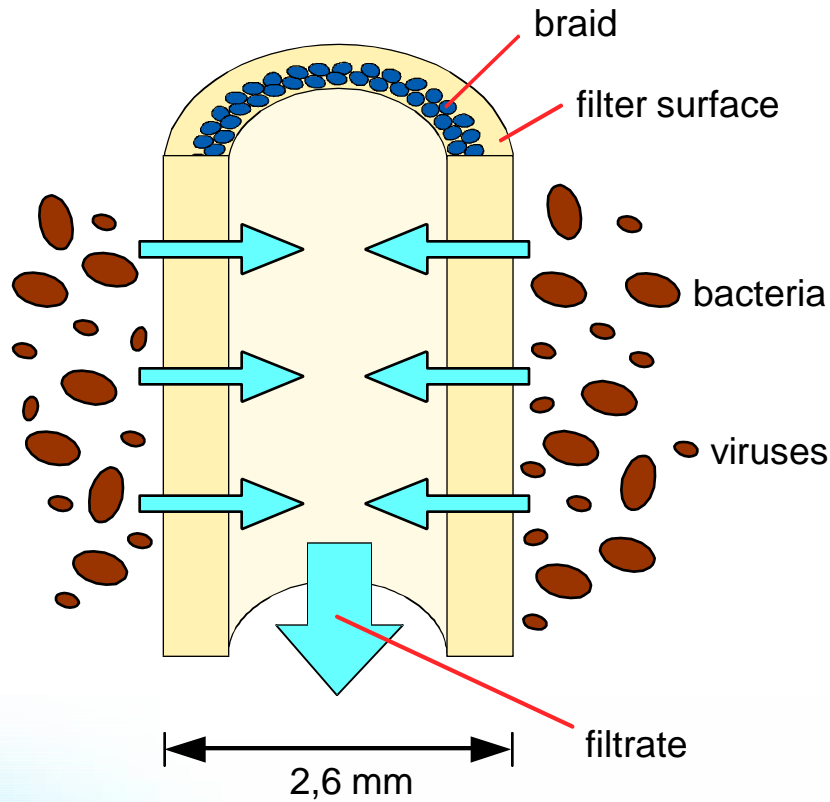
~ 1,2 mm

~ 1,9 mm

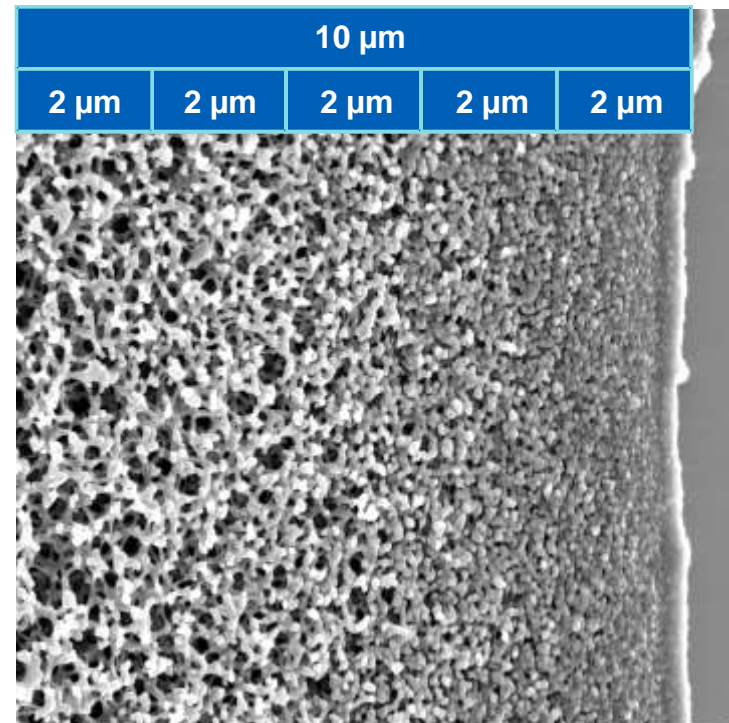
~ 2,6 mm

reduced hydraulic pressure  
loss inside the membrane fibre

**braided hollow fiber membrane**



**outer cross section of membrane**



**PURON – hollow fiber membrane**



**10, 5 kg**



**10 liter bucket  
filled with water**

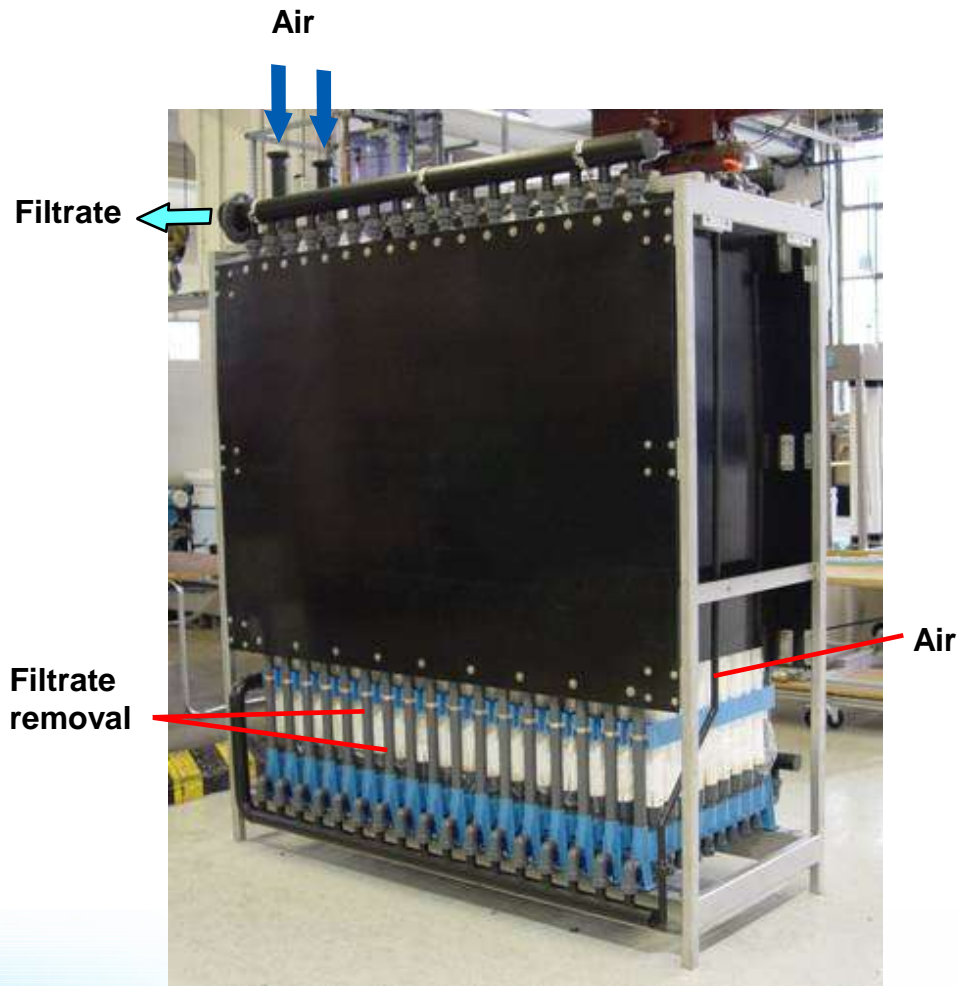
- No fiber breakage during operation
- Long membrane lifetime

## Feet-elements are welded together





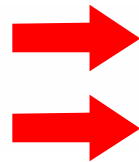
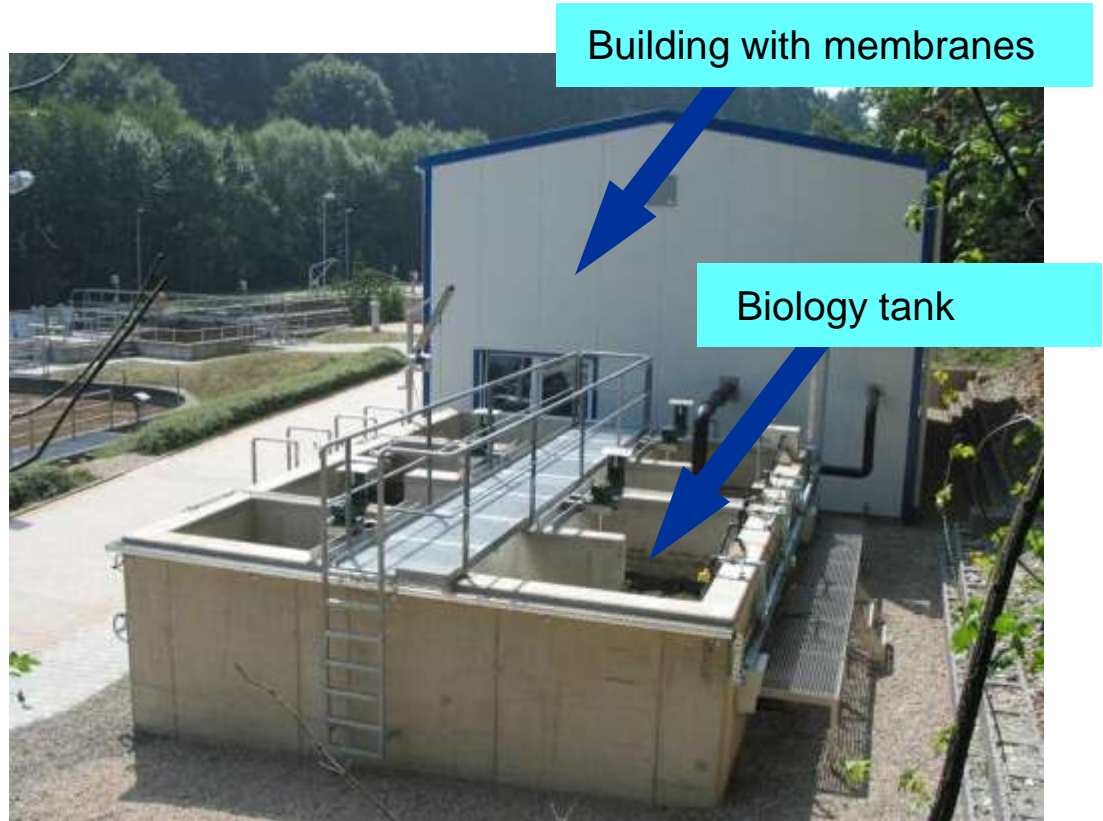
## Membrane Module Dimensions



### Data of a membrane module

Length	200 cm
Width	100 cm
Height without mounting device	250 cm
Number of fiber bundles per row	9
Effective fiber length	1,8 m
Membrane area	500 m <sup>2</sup>
Permeate connection	DN 80
Air connection	DN 50

# PURON® demonstration plant in Simmerath Municipal Treatment Plant (Germany)



Foundation by the NRW-Government with 1.5 Mio. €

Commissioning **March 2003**





### Largest industrial MBR in Belgium (8.000 m<sup>2</sup> membrane area)



- Shipment of modules: June 2004
- Commissioning: October 2004

## Sobelgra MBR – Maltery



Parameter	Influent [mg/l]	Load [kg/day]	Effluent [mg/l]
<b>COD</b>	1880–2100	4000	100 – 200
<b>BOD</b>	700 – 930	2000	2 – 5
<b>Suspended solids</b>	330 – 460	800	0
<b>N<sub>total</sub></b>	35 – 50	100	1 – 2
<b>P<sub>total</sub></b>	13 – 15	30	< 1

### Industrial Water Reuse

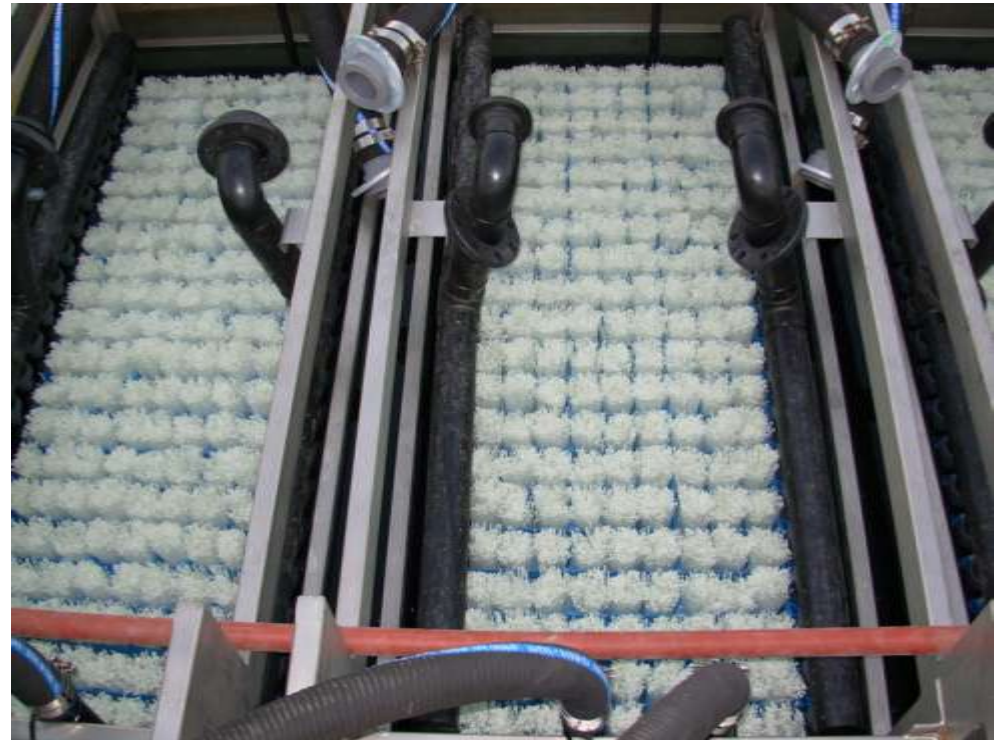
- PURON® MBR + MegaMagnum® RO
- Malting company
- Construction of a new WWTP due to expansion of malting facility







Installation of PURON® modules



MegaMagnum® RO skid mounted system



- 3 MegaMagnum® pressure vessels
- Commissioning: May 2006

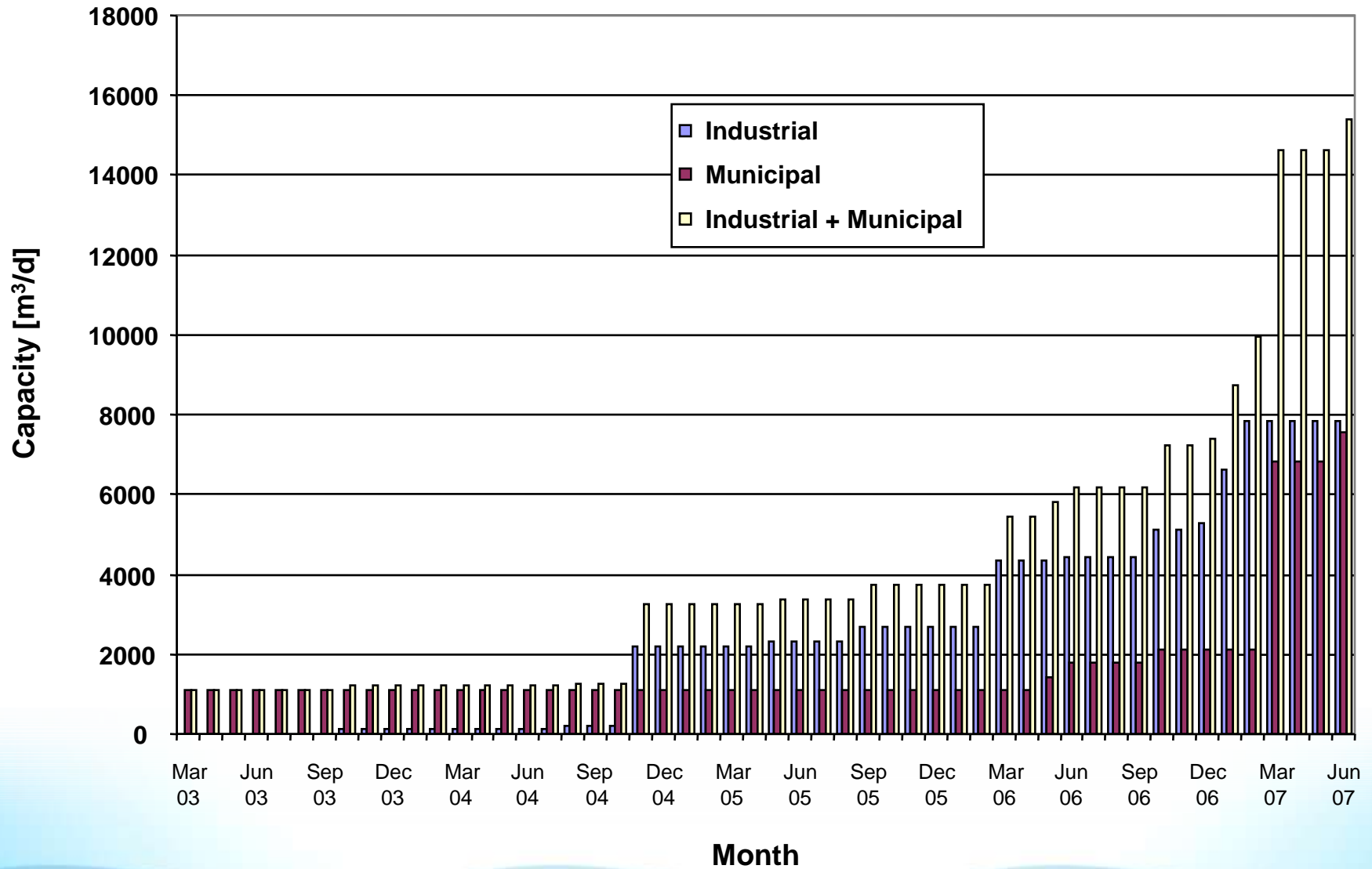






**Simple, low cost installation**

## PURON® MBR Installed Capacity



### PURON - Membrane and module development

- Higher permeate fluxes
- Optimized sludge management (reduced clogging and sludging)
- Less energy consumption
- Reduced chemical demand
- Lower maintenance
- Longer membrane lifetime – lower membrane replacement costs
- Decrease of membrane costs



**PURON® technology contributes actively to MBR development**

## Conclusion - The vision of MBR-technology



**PURON**

by using MBR-technology the future generation of wastewater treatment plants is supposed to supply

- a better water quality
- with half the amount of footprint
- at equal or even lower lifecycle costs



the market is on the threshold to a sustained long-term growth



**key component to this market**



there is still a high potential for optimization



we are currently at the beginning of a very promising future

*Thanks  
for your  
attention !*

