

# MEMBRANE BIOLOGICAL REACTOR VS. CONVENTIONAL ACTIVATED SLUDGE

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## WHAT IS MBR?

Membrane Filtration is currently the Best Available Technique (BAT) recommended by IPPC Bureau of European Union in wastewater treatment.

MBR (Membrane Biological Reactor) is the most innovative technology of biological wastewater treatment, which ensures the highest quality of treated effluent.

By combining conventional activated sludge technology (CAS) with microfiltration membranes, it enables to achieve the best parameters of treated wastewater, in terms of physiochemical and microbiological quality, regardless of settleability of sludge.

# MEMBRANE MODULES

Microfiltration membranes, which are responsible for separating treated sewage from microorganisms in the activated sludge are placed at the end of bioreactor.

## Thanks to this solution:

- Quality of treated effluent is independent from sediment quality of sludge
- There are no secondary clarifiers
- MLSS (mixed liquor suspended solids) is around 10-12 kg/m<sup>3</sup>, resulting in reduction of the tank volume several times in comparison to conventional activated sludge systems.





# HISTORY OF MBR



## 19TH CENTURY THE NOBEL PRIZE

Research on diffusion (Fick's laws on diffusion) and osmotic pressure (van't Hoff equation - the first Nobel Prize in Chemistry 1901 r.)



## 1970' – 1990' FIRST MBRs

First MBR systems are created, combining microfiltration membranes with conventional activated sludge techniques. MBRs are developed in Japan and USA.



## 2000' FURTHER GROWTH

More and more companies start to manufacture MBR products. In 2008 the technology has been implemented in more than 200 countries.

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## 1960' – 1980' GOLDEN AGE OF MEMBRANE SCIENCE

Membranes are made from different materials (also PVDF). They are being widely implemented in medicine and other sciences.



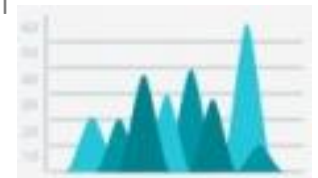
## 1997 FIRST MBR WWTP IN EUROPE

First full scale municipal MBR wastewater treatment plant in Europe - Porlock in United Kingdom



## 2010' DYNAMIC GROWTH

Further growth of MBR technology due to legislation, local water scarcity, return on investment, environmental impact and public and political acceptance.



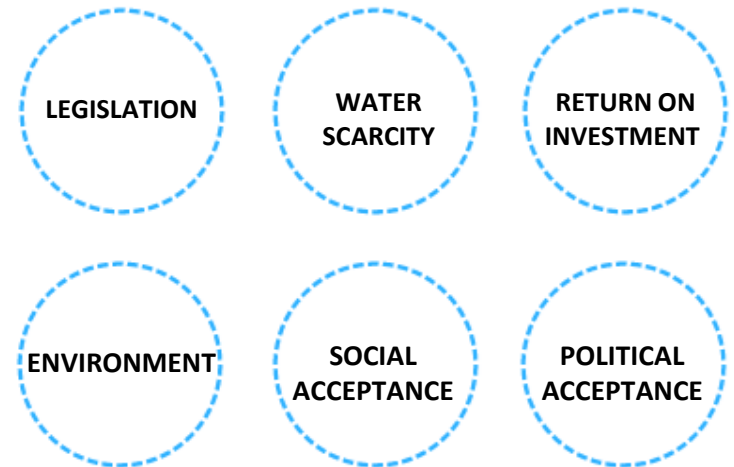
# CURRENT SITUATION

Popularity of MBR technology is rapidly increasing. Membrane Filtration is the best available technology in wastewater treatment recommended by European Union (BAT).

# FUTURE OF MBR

In the future, specialists forecast further growth of MBR technology due to more and more stringent legislation, regional water scarcity as well as social and political acceptance.

## FURTHER GROWTH OF MBR



# CONVENTIONAL ACTIVATED SLUDGE

COARSE  
SCREEN

FINE  
SCREEN

GREASE  
AND GRIT  
REMOVAL

PRIMARY  
CLARIFIERS

BIOLOGICAL  
REACTORS

SECONDARY  
CLARIFIERS

# MEMBRANE BIOLOGICAL REACTOR

VERTICAL  
SCREEN

SAND  
SEPARATOR  
WITH  
GREASE  
TRAP



BIOLOGICAL  
REACTORS

# SEASONABILITY

Reactors are insulated – no matter if it is summer or winter, the temperature of sewage in the bioreactor is around 12°C. It is of extreme importance, because when the temperature goes down below that level, nitrogen reduction processes are interrupted.

In MBR, neither purification level nor quality of treated effluent is affected by seasonal temperature fluctuation. In CAS bioreactors cannot be insulated, due to specific requirements of this technology. It creates highly unfavourable conditions for nitrogen reduction in winter.



# AREA REDUCTION



**CONVENTIONAL WWTP**

At the beginning, when MBR technology was developed and commercialised, the main economic driver was footprint as it was 2-4 times smaller in comparison to conventional treatment.



**MBR WWTP**

Due to this fact, existing wastewater treatment plants, which require increasing capacity but at the same time cannot be increased in size, are perfect for retrofit using MBR technology.



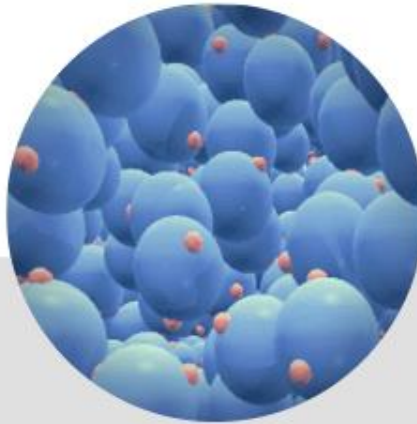


## EFFLUENT QUALITY

In MBR plants there is no risk of sludge leak, since the membrane is the definite physical barrier separating sludge from treated effluent.

In conventional activated sludge systems, sludge which has MLSS over  $4 \text{ kg/m}^3$  does not settle and it may leak from secondary clarifier, which is a common issue causing problems with meeting effluent discharge requirements in conventional wastewater treatment plants.

# TREATED EFFLUENT



There are no colloids, solids or illness-causing bacteria and viruses in treated effluent after MBR. Excess sludge, which is transported from MBR tank is partially thickened and aerobically digested.

# Effluent Quality - Example

WIELOGŁOWY WWTP, 2 500 m <sup>3</sup> /d, 25 000 RLM – Date of sampling 23 Nov 2016					
Parameter	Unit	Inlet	Outlet	Effluent Discharge Requirements in Poland	Reduction
COD	mg/l	971,0	20,2	125,00	97,92%
BOD <sub>5</sub>	mg/l	350,0	<1,5	15,00	>99,57%
Total Suspended Solids	mg/l	340,0	<2,00	35,00	>99,41%
Total Nitrogen	mg/l	36,6	1,70	15,00	95,36%
Total Phosphorus	mg/l	7,49	0,104	2,00	98,61%

In MBR wastewater treatment plants Total Phosphorus may even reach 0 mg/l, whereas the Total Nitrogen at the outlet may be freely adjusted. Conventional wastewater treatment plants are able only to reach the values close to those specified in the Effluent Discharge Requirements in Poland.



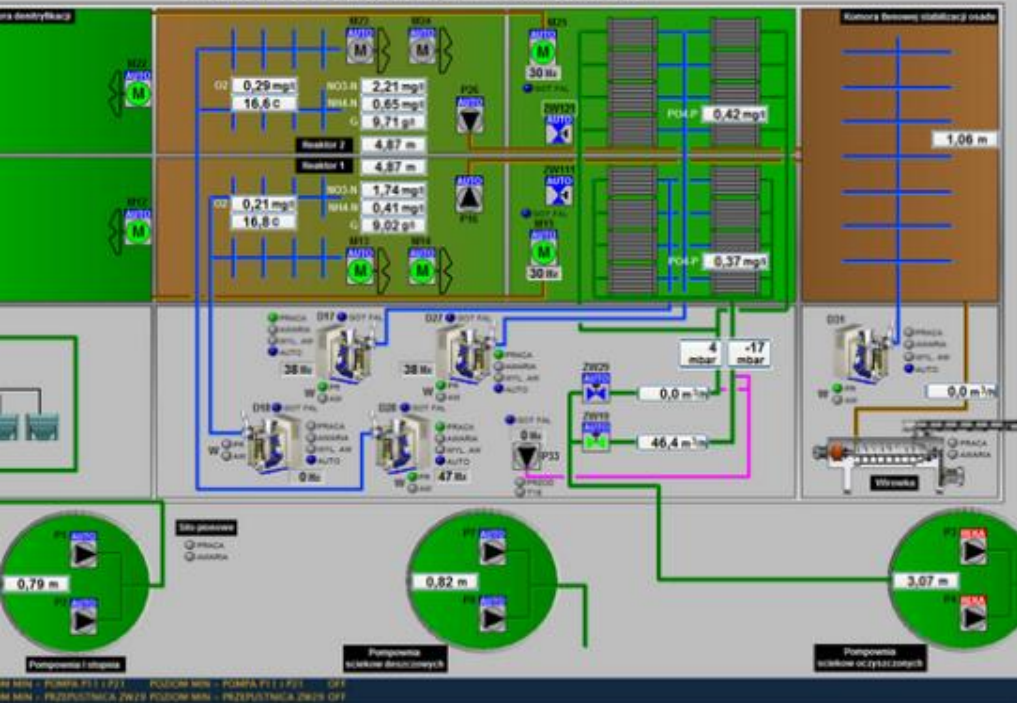
## ENVIRONMENTAL IMPACT

The impact of MBR wastewater treatment plant is contained within the building. MBR plants have no influence on adjacent property.

In MBR all processes are fully hermetised due to implementation of deodorisation systems. When it comes to CAS, hermetically sealed tanks cannot be used due to the specific requirements of this technology.

Another advantage of hermetically covered tanks is that MBR wastewater treatment plants do not have negative impact on fauna and flora, because this solution prevents birds from bathing in clarifiers and reactors. What is more, in MBR wastewater treatment plants, unlike in conventional plants, the phenomenon of eutrophication of receiving water bodies is not observed.





## PERSONNEL COSTS

## EMPLOYEES

Every MBR wastewater treatment plant designed by Schwander Polska® is equipped with Real Time Control system, which enables precise measurements due to complete system of probes and controllers.

Each irregularity is immediately reported to the supervisor of the plant. What is more, the system automatically adopts preventive measures.

This solution enables to reduce the number of employees and ensures immediate reaction in case of emergency, eliminating the factor of human error.



## ONLINE SUPERVISION



Easily managed  
from any place  
in the world

All of wastewater treatment plants designed and constructed by Schwander Polska® are fully automated, which ensures permanent monitoring system, easily managed by any web-enabled devices, such as computers or smartphones. This solution eliminates the need for permanent human supervision.

For example, at Schwander Polska, **9 wastewater treatment plants** are supervised by **2 employees**. We also offer complete training programme and continuous guidance. In this way, operator of the plant or his employee may supervise the plant on their own.



## ENERGY COSTS

# ENERGY CONSUMPTION REDUCED BY 40%

In the past, the main disadvantage of MBR technology was high energy consumption, due to vast amounts of scouring air used for membrane cleaning.

Schwander Polska<sup>®</sup>, in cooperation with the supplier of membrane modules has developed innovative aeration system, which enables significant reduction of energy consumption without compromising the efficiency.

Furthermore, thanks to gravity-driven systems and unique structure of buildings, it is possible to eliminate vast number of valves, bolts, pumps and mixers.

The energy consumption for the whole plant is around **0,7 kWh/m<sup>3</sup>**, which is the lowest rate on MBR market.

# REDUCTION OF MAIN COSTS



## PERSONNEL COSTS

Personnel costs and energy costs are the highest operating costs borne by the operator of the plant.



## ENERGY COSTS

At Schwander Polska, we reduced these two expenditures to minimum, which makes our plants extremely cost-effective.





# CHEMICALS

MBR systems are based on biological wastewater treatment. Systems responsible for dosing chemicals are installed solely for handling emergency situations.

In case of conventional wastewater treatment plants, complete elimination of chemicals is not possible, which results in much higher consumption of dosed chemicals.

# 40%

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Technological advancements enabled reduction of energy consumption by forty percent.

## S T A T I S T I C S

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Wastewater treatment efficiency for MBR technology is estimated to be more than ninety nine percent.

# 99%

## WATER REUSE

Permeate (filtrate) may be reused as industrial water, for agricultural purposes and irrigation (eg. of golf courses) or cleaning of streets and markets.



## FILTRATE & DISINFECTION

After additional UV or chemical disinfection, filtrate may be utilised for different purposes connected with sanitation and cleaning, industry or irrigation of green areas.



## CONVENTIONAL WASTEWATER TREATMENT

After conventional activated sludge treatment water cannot be reused, because it contains bacterial flora.





# CLOSED CIRCULATION

We specialise in creating closed circulation systems, which enable both recovery of water and water reuse.

This solution is especially profitable in the industrial sector.



# EXAMPLES OF OUR WATER REUSE SYSTEMS



**Golf courses irrigation**

**Closed circulation for company dyeing fabrics**

**Wastewater treatment plant integrated into the ski slope  
and reuse of treated effluent for artificial snowmaking**



# INVESTMENT COSTS

Construction costs of MBR wastewater treatment plants are lower than construction costs conventional wastewater treatment plant due to:

- Significant reduction of the size of the buildings
- Lower prices of membrane filtration modules
- Increased availability of membrane filtration modules

Additionally, there is a possibility of using materials of highest quality, which results in reduction of operating costs.

# WWTP EXPANSION – How is it handled?



## **FLEXIBILITY**

MBR WWTPs are very flexible when it comes to future expansion.



## **SIMPLICITY**

Usually increasing MBR WWTP capacity is done by changing settings of the software, which has the option of choosing different operating modes depending on the inflow.



## **MONEY-SAVING**

On the contrary, in case of conventional activated sludge plants, WWTP expansion can be achieved only by increasing the volume of the tanks, which is extremely time and money consuming.



## **COMPATIBILITY WITH ULTRAMODERN TECHNOLOGY**

MBR wastewater treatment plants are compatible with advanced Real Time Control (RTC) systems.



# SUMMING UP



## MAIN DIFFERENCE

The main difference between Conventional Activated Sludge technology and Membrane Biological Reactor is the use of membrane, which constitutes a definite physical barrier between wastewater treatment plant and environment, retaining every substance other than water (filtrate) in the bioreactor.



# BENEFITS



## FOOTPRINT

Compactness and modularity are the best assets of MBR technology.



## VIABILITY

Reduction of both investment and operating costs.



## REMOVAL OF BIOGENIC SUBSTANCES

Total Phosphorus may even reach 0 mg/l. Total Nitrogen at the outlet may be freely adjusted.

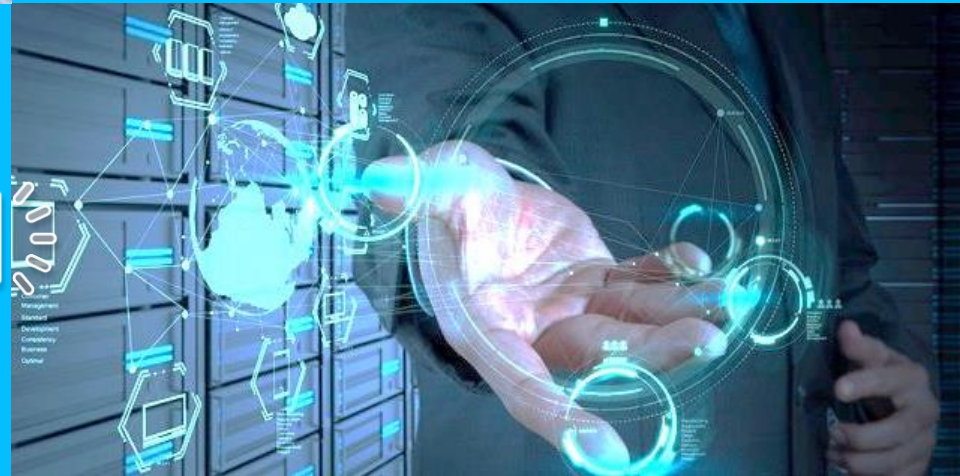


## HIGH EFFICIENCY

Technological advances over the past 10 years have brought MBR costs down dramatically and no other wastewater treatment process is as efficient and effective.

## INNOVATIVE TECHNOLOGY

From retrofits to new plants, MBR wastewater treatment plants are a versatile treatment platforms that may help change perception and transform wastewater into a viable resource.



## BEST INVESTMENT

When looking into advanced water reuse applications, MBR wastewater treatment plants represent the best overall investment a plant owner can make.

# CONTACT US



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The background image shows a modern building with a green roof. A set of concrete stairs with metal railings leads up to the roof level. The building has a dark blue tiled roof and a light-colored facade. In the background, there are other buildings and a clear blue sky. A semi-transparent blue overlay covers the middle portion of the image, and the text "Thank you" is centered within it.

# Thank you

[www.schwander.pl](http://www.schwander.pl)