

Solving Industrial Water Resource Management Challenges with MBR Technology



imagination at work

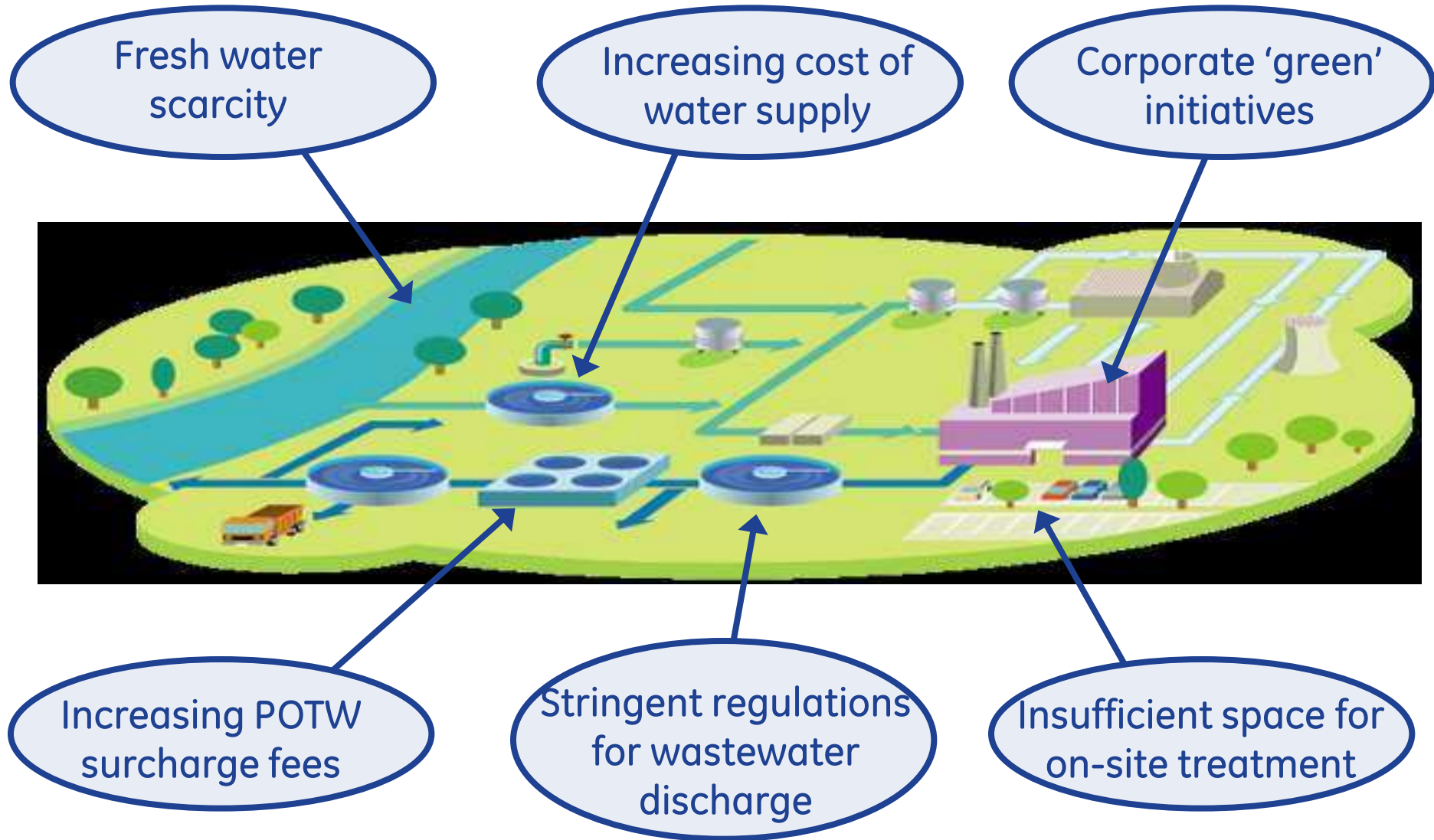
Outline

- The Challenge: Industrial Water Management
- The Solution: MBR technology
- Case Study 1: Reliable Effluent Quality for Discharge
- Case Study 2: POTW Surcharge Elimination
- Case Study 3: POTW Surcharge Elimination, Reliable Effluent Quality for Discharge or Reuse
- Summary & Conclusions

The Challenge

Industrial Water Management

Industrial Water Management Challenges



The Solution

MBR technology

Membranes for Wastewater Treatment

Introduced in the 1970s

Produce superior effluent wastewater quality

Key advantages include smaller footprints and reliable operation
Proven from small-scale to large-scale industrial projects

Technology advances and mass production have made membrane treatment cost effective



12.5 MGD Petrochemical ZW MBR, Italy

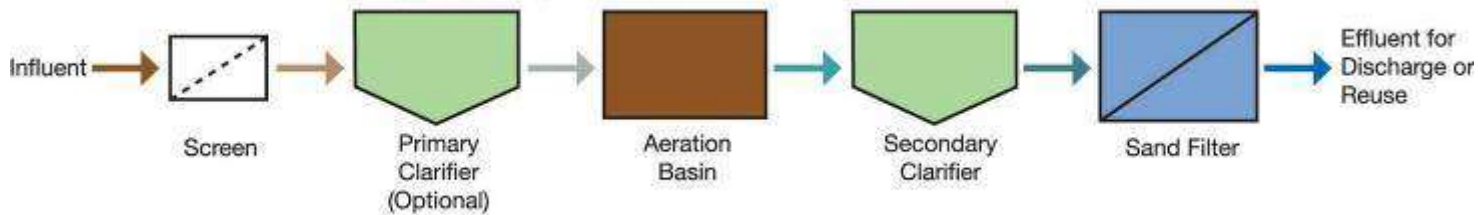


1.3 MGD Potato Processing ZW MBR, Idaho

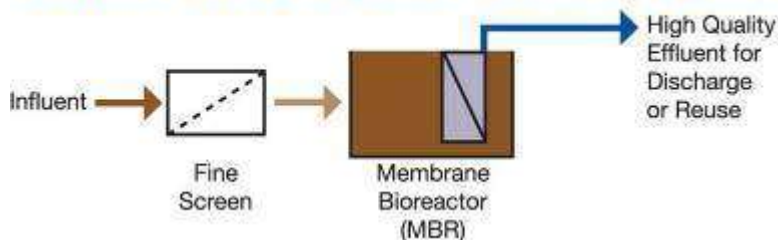
What is ZeeWeed MBR?

- Advanced technology that combines ultrafiltration (UF) membranes with biological treatment
- Brings conventional clarification, aeration and filtration together into a single step

Conventional Multi-Step Tertiary Treatment Process



ZeeWeed® MBR Simplified Treatment Process



Consistent High Quality Effluent



Activated
Sludge

Treated
Water

Achievable ZeeWeed[®] Treatment Results

BOD ₅	< 2 mg/L
TSS	< 1 mg/L
NH ₃ -N	< 1 mg/L
TN	< 3 mg/L*
TP	< 0.05 mg/L*
Turbidity	< 0.1 NTU
Fecal Coliform	< 2.2 CFU/100 mL**
SDI	< 3

* With appropriate biological design

** After disinfection

The ZeeWeed 500 UF Membrane

Immersed hollow fiber construction

Reinforced membrane structure

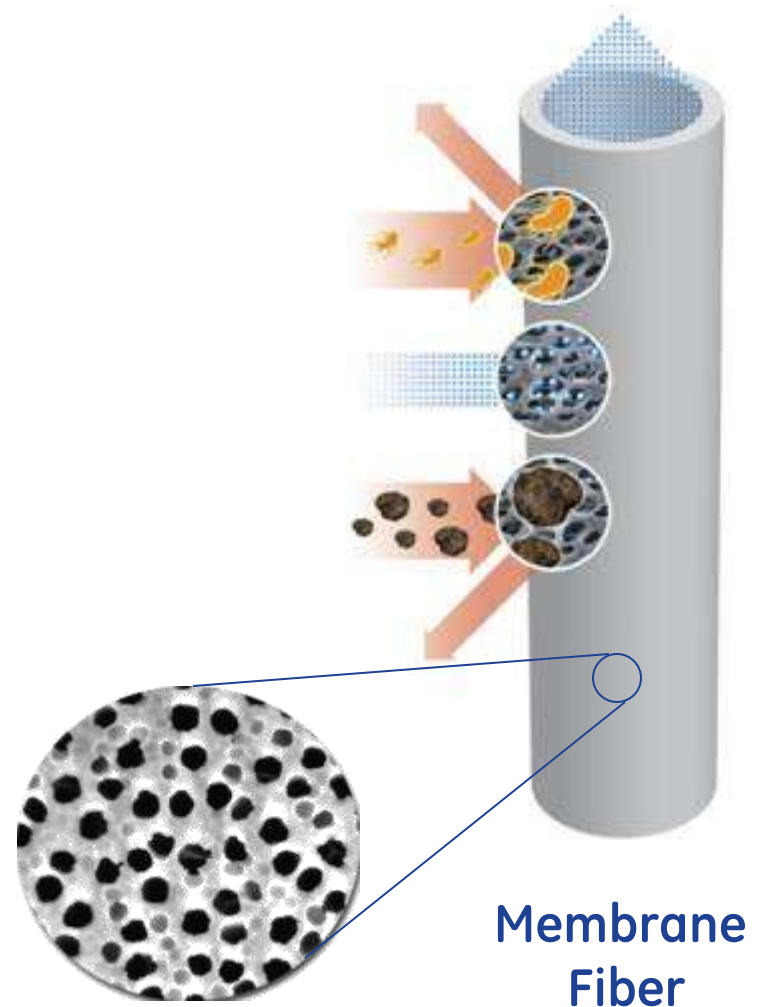
Outside-in operation

PVDF Chemistry

- Oxidant resistant
(500,000 ppm-hr Cl_2)
- Wide pH range
 - Filtration: 5 to 9.5 pH
 - Cleaning: 2 to 11 pH

Compatible with coagulants & PAC

NSF61 certified



Electron microscope view of
membrane surface

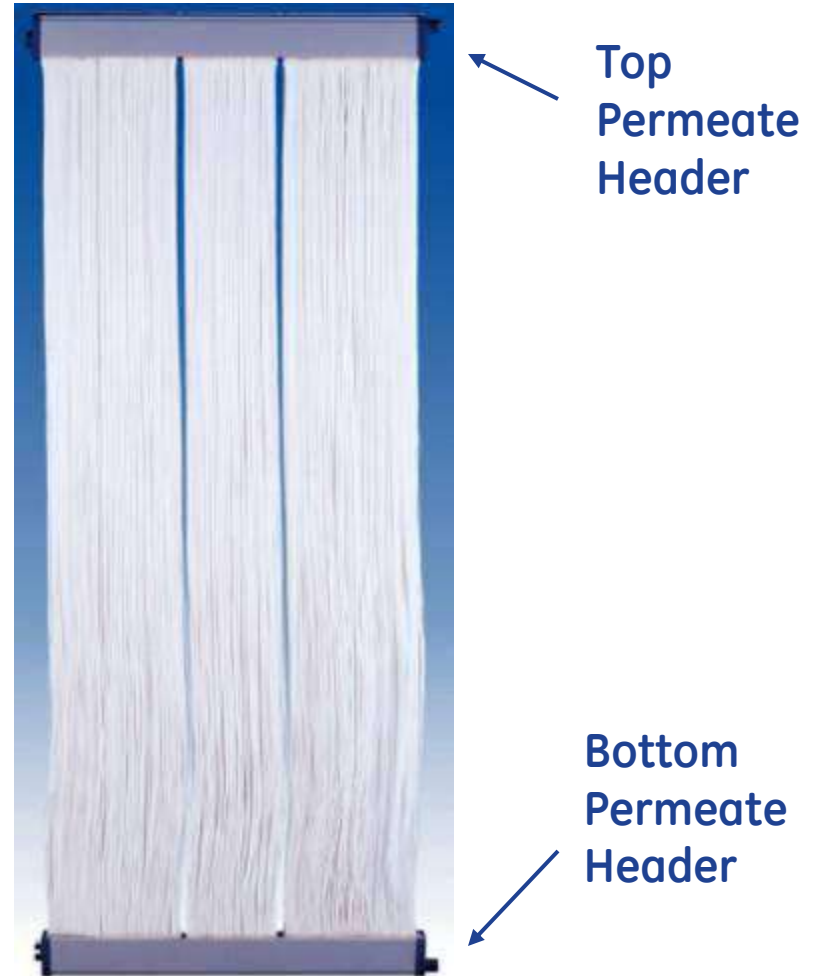
The ZeeWeed 500 Module

A cassette contains from 24 to 48 ZeeWeed® modules

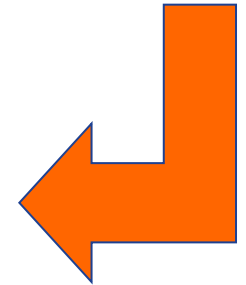
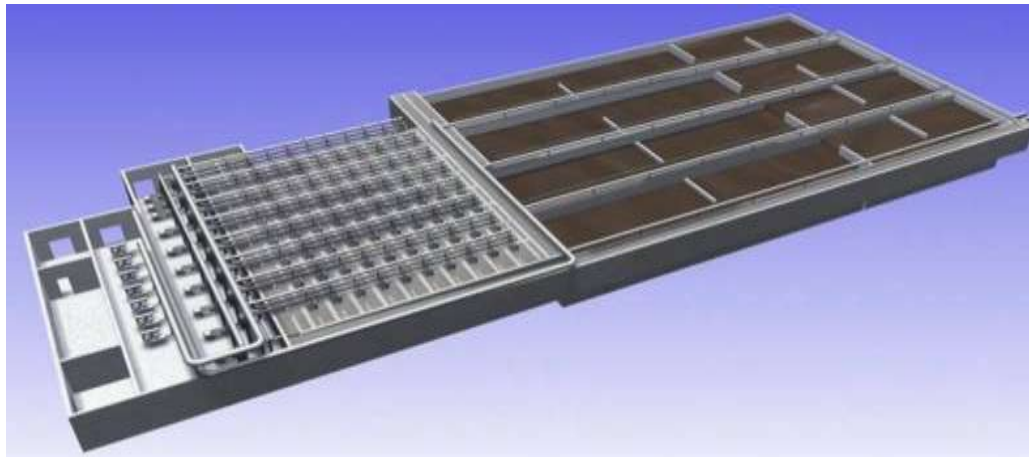
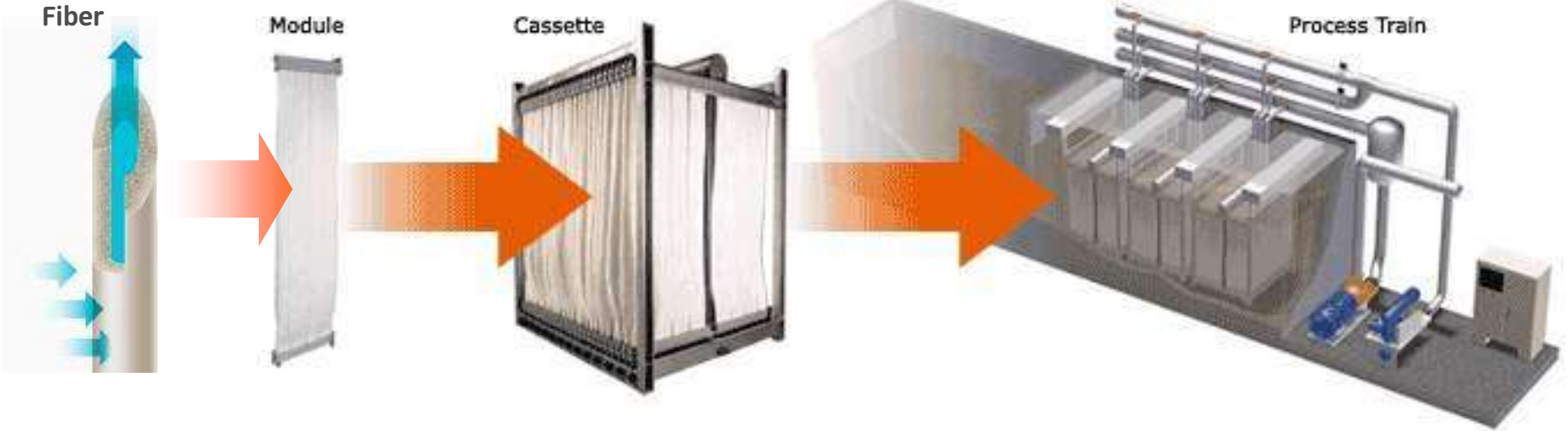
Permeate is drawn from both top & bottom header

Aerators are attached to the cassette frame, not the elements themselves

The cassette frames provide the support for the 500 modules



Building Blocks of the ZeeWeed® MBR



Full Scale - MBR

Summary of the Benefits of MBR

- A automated process that is simpler to operate
- A smaller plant footprint
- The ability to retrofit and expand treatment capacity of existing facilities
- Enhanced process control and reliability with higher Sludge concentrations and greater control of Solids Retention Times
- Secondary clarifiers are eliminated so coagulants and flocculants are not required
- Exceptional effluent quality exceeding EPA requirements
- A consistent high quality effluent free of TSS and BOD and ideal for reuse

Case Study 1:

Cheese Facility in Northern Ohio

Cheese Facility in Northern Ohio



Application:

Treatment Capacity:

Treated Water Use:

Goal:

Retrofit of Facultative Lagoons

Expand from 120,000 to 240,000 gpd

Discharge to Creek

*Expand Capacity and Produce a
Reliable Effluent Quality*

The Challenge

- A difficult to treat wastewater with high hardness and O&G levels.
- Increase treatment capacity without adding more lagoons.
- Upgrade treatment methods to resolve EPA consent order for violations of their permit. Effluent requirements were expected to become even more stringent upon permit renewal.
- A modular and expandable system was needed to allow for future expansion without increasing the footprint of their existing lagoons.

The Solution

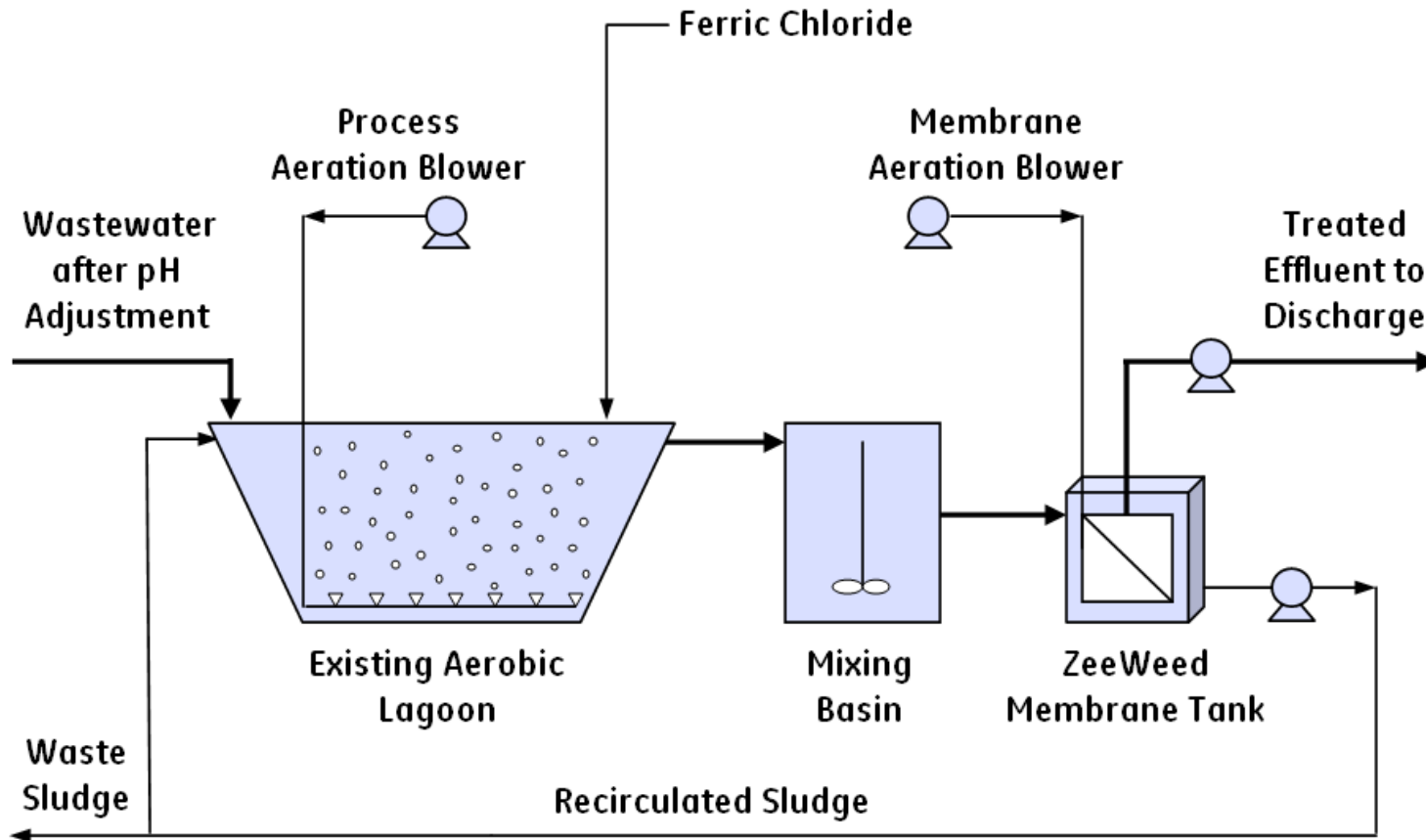
- Upgrade existing lagoon system to a MBR to exceed NPDES requirements and accommodate an increase in treatment capacity.

Cheese Facility in Northern Ohio

Parameter	Wastewater Influent	ZeeWeed MBR Effluent Quality
Flow (gpd)	240,000	-
BOD5 (mg/L)	6,000	< 5
COD (mg/L)	8,500	< 300
FOG (mg/L)	50 – 400	< 5
TSS (mg/L)	1,250	< 0.5
TKN (mg/L)	250	< 2 (winter) < 1 (summer)
Phosphorous (mg/L)	90	< 0.5 *
Turbidity (NTU)	-	< 1
Bioreactor MLSS (mg/L)	10,000	-
SRT (days)	100	-

* Phosphorous removal achieved using a coagulant

Cheese Facility in Northern Ohio



Cheese Facility in Northern Ohio



Concrete (In Ground) Membrane Tanks

Cheese Facility in Northern Ohio

An Update:

- The MBR was commissioned in 2003 based on a flowrate of up to 240,000. In 2006, the Membrane system was expanded from 2 to 3 cassettes per train. The system now treats up to 300,000 gpd of wastewater.
- In 2008, $\frac{1}{4}$ of the membranes were replaced (5 years). The remaining membranes are still in operation (7+ years).
- Maintaining DO levels is often a challenge for the fine bubble diffusers. Despite this and other challenges the operator has done an excellent job recovering from the occasional upset condition and complying with their NPDES permit.
- Expected that there will be future discharge permit requirements to reduce TDS, as well.

Case Study 2 :

Soft Drink Syrup Facility in Columbus

Soft Drink Syrup Facility in Columbus



Application:	<i>Greenfield Wastewater Treatment Plant</i>
Treatment Capacity:	<i>250,000 gpd</i>
Treated Water:	<i>Discharge to City Sewer</i>
Goal:	<i>POTW Surcharge Elimination</i>

The Challenge

- Effluent must exceed the sewer discharge requirements and eliminate POTW surcharges.
- Footprint should be minimized.
- Reliably handle the variations in organic loading without upset, loss of biomass or diminished effluent quality.
- Must not produce noise or odors and blend into the surrounding residential area.
- Automated controls to minimize operator requirements.

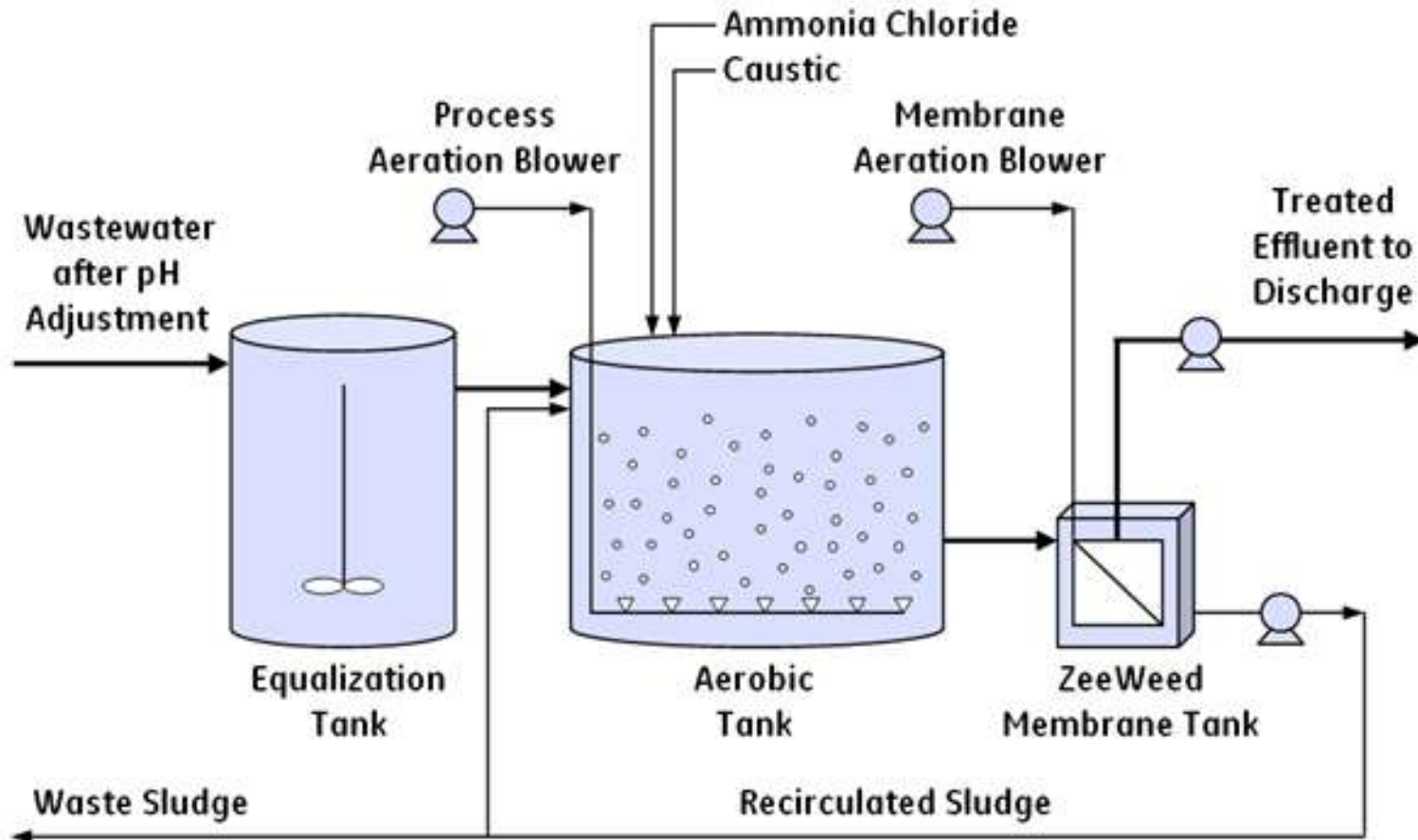
The Solution

- Install a MBR system to generate water suitable for direct discharge or reuse and eliminate POTW surcharges.

Soft Drink Syrup Facility in Columbus

Parameter	Wastewater Influent	ZeeWeed® MBR Effluent Quality
Flow (gpd)	250,000	-
COD (mg/L)	5,000 – 7,000	< 100
BOD5 (mg/L)	3,000 – 4,000	< 30
TSS (mg/L)	50 – 100	< 5
Bioreactor MLSS (mg/L)	10,000 – 13,000	-
SRT (days)	>17	-

Soft Drink Syrup Facility in Columbus



Soft Drink Syrup Facility in Columbus



Membrane Bioreactor System

Soft Drink Syrup Facility in Columbus



Equipment Building

Soft Drink Syrup Facility in Columbus



Steel (Above Ground) Membrane Tank

Soft Drink Syrup Facility in Columbus

An Update:

- The MBR was commissioned in 2005. It is estimated that over \$5 Million in surcharges have been saved so far.
- The MBR continues to operate with its original set of membranes (5+ years) despite the fact that the system often runs at temperatures well above the recommended limits for the biological reactor and membranes (max temp = 104F).
- Providing adequate equalization has been an issue for the plant. An internal coating issue in the tank lead to corrosion problems. In 2009, a second EQ tank was installed to provide redundancy and additional EQ volume to minimize swings in pH, temperature and organic loading.

Case Study 3:

Oil and Shortening Facility in Cincinnati

Oil and Shortening Facility in Cincinnati



Application:	<i>Greenfield Wastewater Treatment</i>
Treatment Capacity:	<i>870,000 gpd</i>
Treated Water Use:	<i>Discharge to City Sewer with Plans to Reuse Water and/or Discharge to Creek</i>
Goal:	<i>POTW Surcharge Elimination</i>

The Challenge

- Eliminate POTW surcharges as they were expected to increase by 12.5% annually for each of the next 25-30 years and impact the plant's profitability.
- This facility was unfamiliar with wastewater treatment and required a simple, automated, easy to operate system
- A difficult to treat wastewater high in FOG, BOD, TSS, and TP.
- Require ability to expand treatment capacity in future.

The Solution

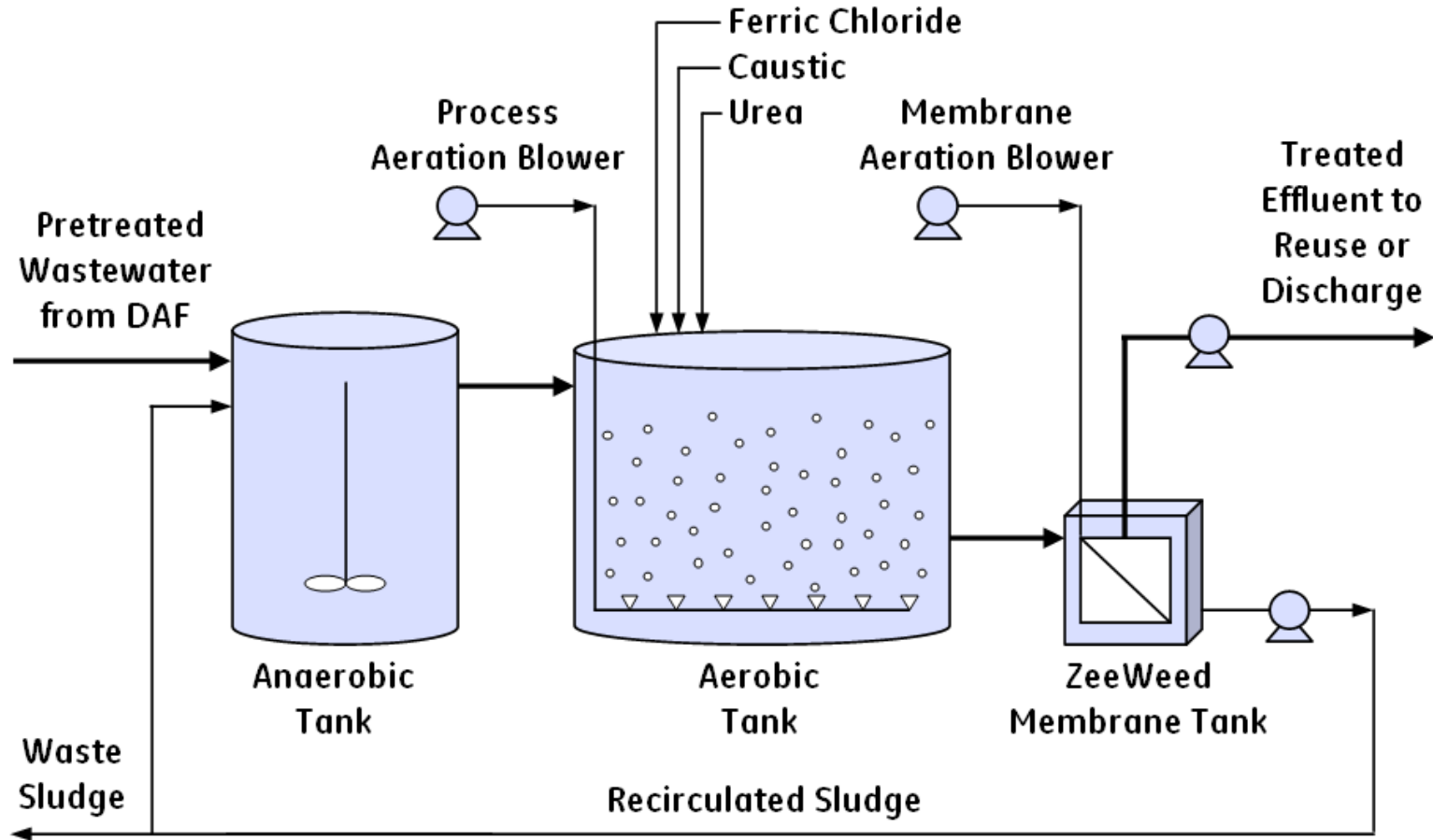
- Install a MBR system that was automated and could reliably treat their wastewater and eliminate POTW surcharges.

Oil and Shortening Facility in Cincinnati

Parameter	Wastewater Influent	ZeeWeed® MBR Effluent Quality
Flow (gpd)	864,000	-
Future Flow (gpd)	1,440,000	-
COD (mg/L)	800 - 2,000	-
BOD5 (mg/L)	600 - 1,000	< 10
TSS (mg/L)	70 - 200	< 5
TP (mg/L)	30 - 50	< 0.5 *
FOG (mg/L)	50 - 150	< 10
Temperature (deg F)	70	-
Turbidity (NTU)	-	< 1
Bioreactor MLSS (mg/L)	10,000	-
SRT (days)	20	-

* Phosphorous reduction through combination of biological and chemical P removal

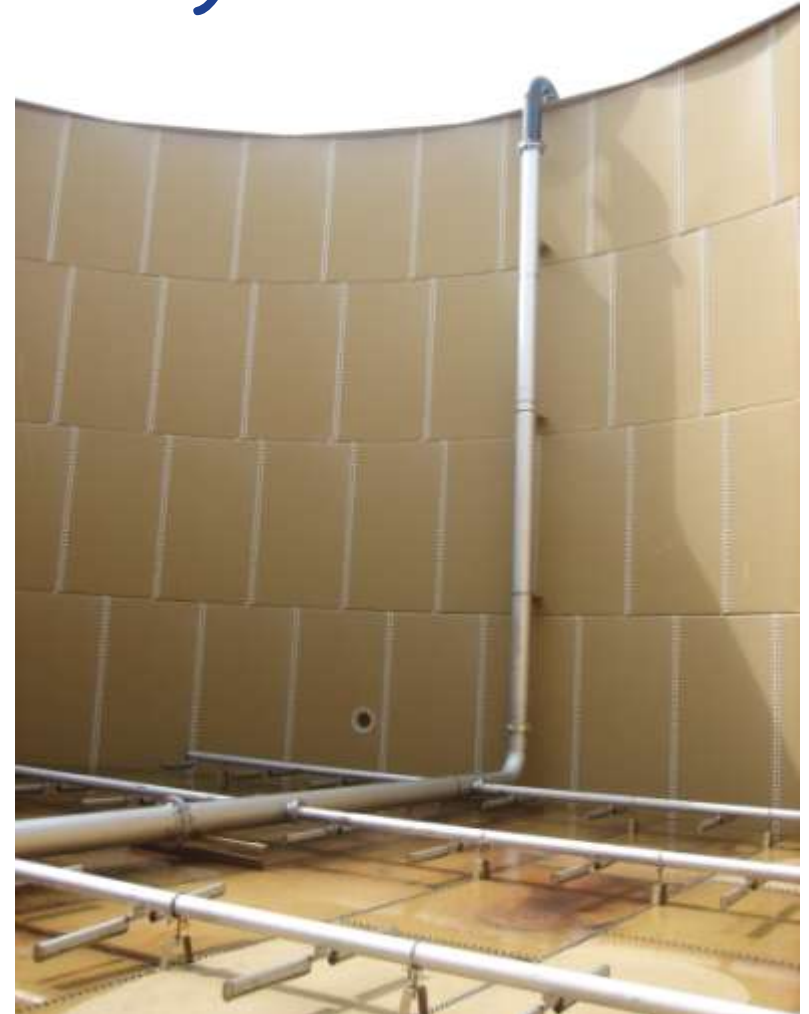
Oil and Shortening Facility in Cincinnati



Oil and Shortening Facility in Cincinnati



Anaerobic and Aerobic
Bioreactor Tanks



Coarse Bubble Diffusers

Oil and Shortening Facility in Cincinnati



Steel (Above Ground) Membrane tanks

Oil and Shortening Facility in Cincinnati



Belt press

Oil and Shortening Facility in Cincinnati

An Update:

- The MBR was commissioned in 2009. It is estimated that over \$4 Million in surcharges have been saved so far.
- The facility has installed piping for water reuse and plans to reuse the MBR effluent as cooling water make up.
- Higher oil and grease levels in the plant's wastewater can overwhelm the DAF system at times; however, carryover from the DAF is contained within the MBR and has little or no effect on the plant's effluent quality. The ZeeWeed membranes continue to perform reliably.
- The MBR effluent quality currently meets all NPDES permit requirements except for TP. Commissioning of the Biological and Chemical P removal systems is ongoing.

Summary & Conclusions

Summary & Conclusions

Sustainable water and wastewater management is becoming more important to the fiscal success of industry.

MBR technology has enabled industry to solve critical water and wastewater management challenges:

- Exceptional effluent quality for reliable water reuse and/or safe direct discharge
- Expansion of plant treatment capacity within existing footprint
- Enhanced performance resistant to biological upsets
- Simple and automated process with reduced operator requirements

Questions?

