
Immersed Zee Weed Membrane for Water
& Wastewater Treatment

배 중 복 부장
(주)새한 / Zenon

Immersed ZeeWeed Membrane
for
Water & Wastewater
Treatment

배종복
(주) 새한 / Zenon

What is a Hollow Fibre
Membrane ?

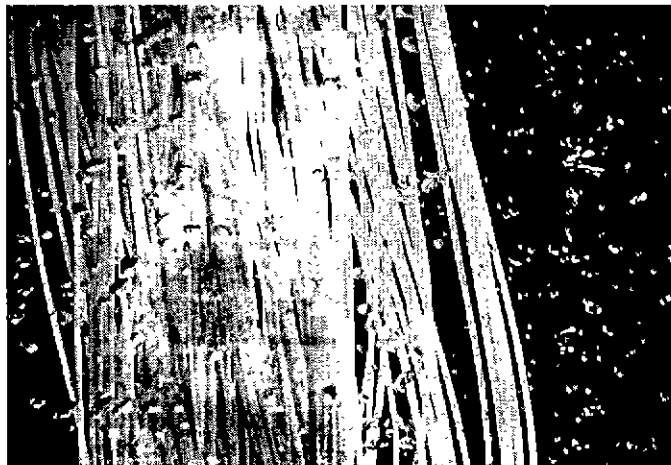
*The "Microchip" of the Fluid
Processing Industry.*



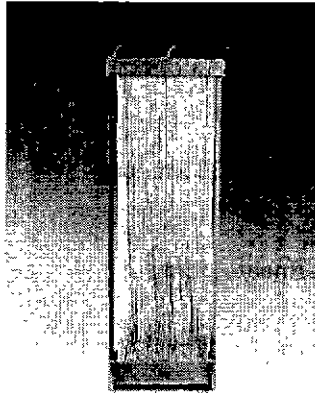
What is ZeeWeed

- **Hollow Fiber Membrane - 0.035 micron pores**
- **Outside/In membrane**
- **Driven by vacuum and not pressure (- 1 to - 6 psi)**
- **Installed inside process tank**
 - **Inside the process tank in drinking water treatment**
 - **Inside the bioreactor in wastewater treatment**
- **Oxidant resistant:**
 - **Chlorine resistant - can be disinfected for drinking water**
 - **Permanganate resistant - for Fe/Mn removal**

The ZeeWeed® Hollow Fibre

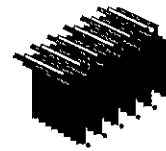
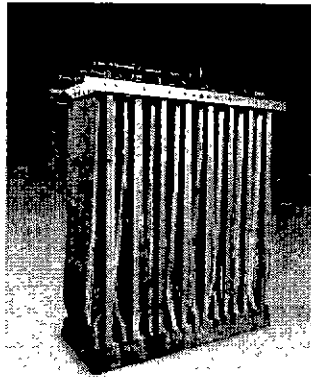


ZeeWeed[®] Configuration



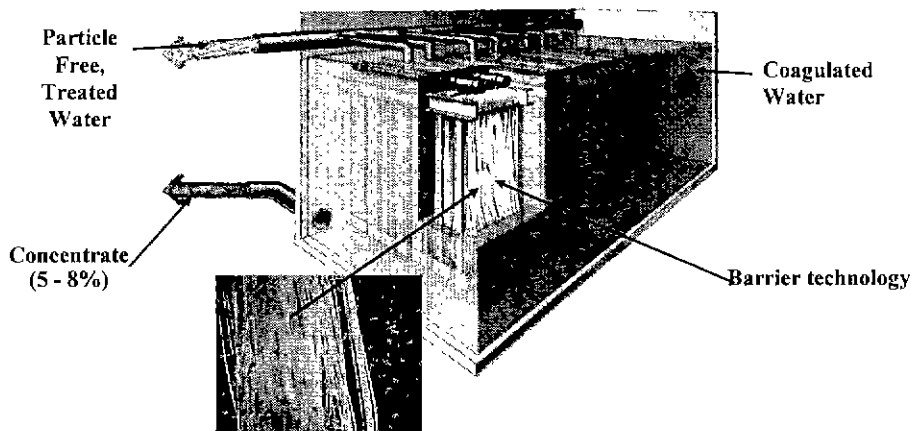
module

1 Cassette =
8 ZeeWeed Modules

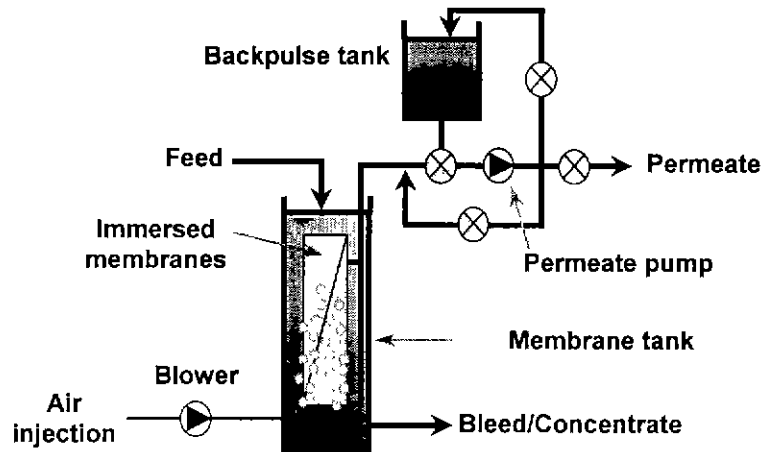


Train of
6 cassettes with
48 modules

ZeeWeed[®] Process



Typical Flow Schematic



ZeeWeed[®] Fouling Prevention

- Air scouring
- Automatic backpulse
- Maintenance cleaning
- Soak cleaning

Membrane Backpulse

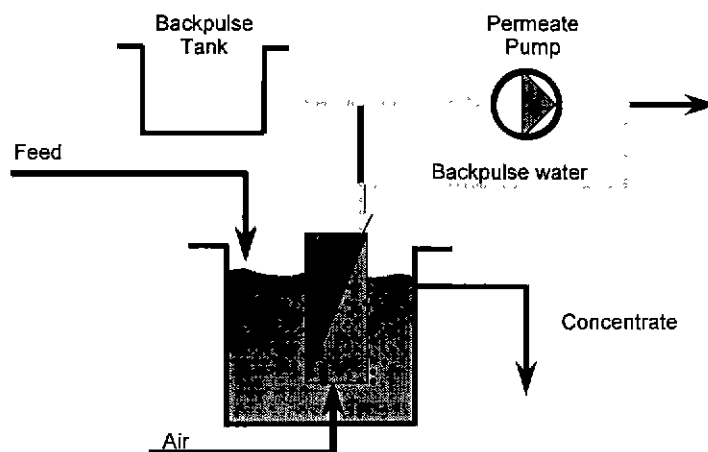
Backpulse is reverse (inside-out) permeation

Backpulse is at a flow $1.5 \times$ *instantaneous* permeate flow

Maximum backpulse pressure of 0.55 bar overrides flow criterion

Backpulse tank is refilled during production phase

Membrane Backpulse



Municipal Drinking Water

- ZeeWeed® for Drinking Water

Problems to be Addressed

- **Turbidity and Turbidity Spikes**
- **Suspended solids**
- **Organics**
- **Colour**
- **Iron and Manganese**

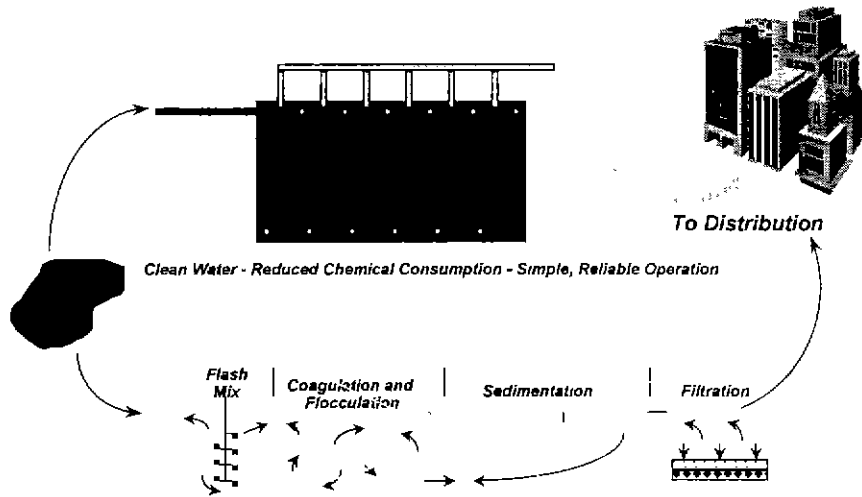
Advantages of Ultrafiltration

- Small Footprint
- Simplified operational requirements to obtain high quality water
 - Little equipment to be maintained
 - water quality is independent of operator activity
- Membrane is absolute barrier, **generating parasite free water**
- No chemical requirement for most waters
- Small chemical dosage required for coloured and organic laden waters

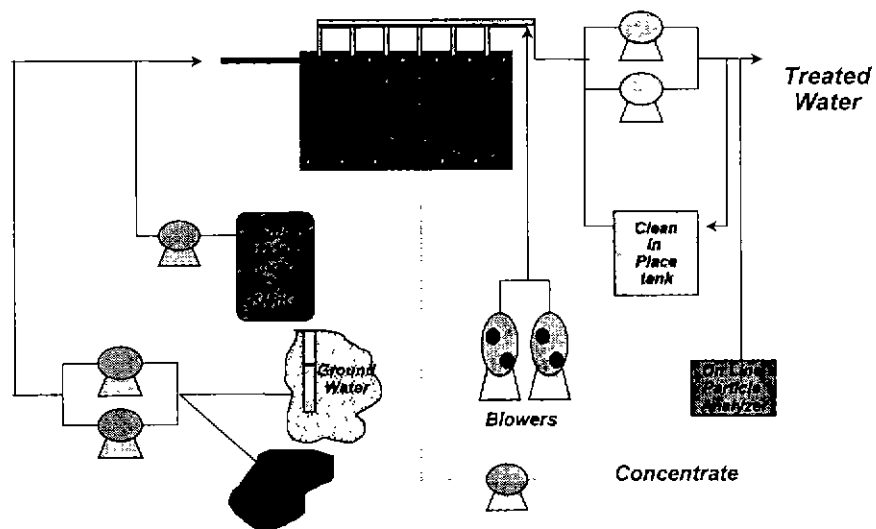
Difficulties in Oocyst Removal at Conventional Water Treatment Plants

- Oocysts are very resistant to chlorination
- Treated water must be very low in turbidity (<0.1 NTU)
- The oocysts are 4–6 microns – 100 times smaller than the .45 mm sand in the final filters.
- Each sand filter should have an in-line turbidity meter and recorder on each cell
- All unit processes must be optimized

ZeeWeed® Single Step Treatment

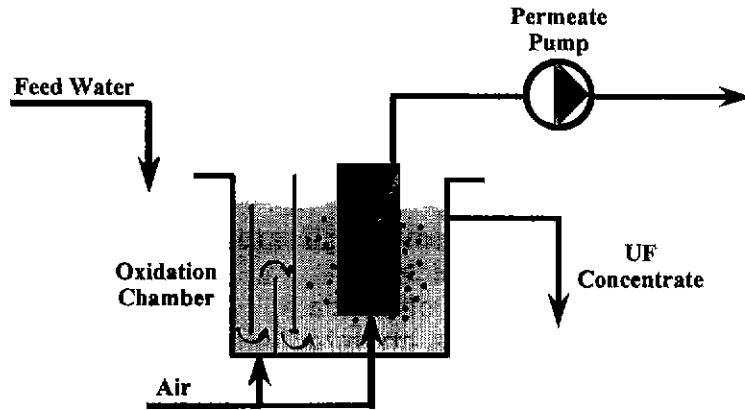


Immersed Membrane Plant Schematic

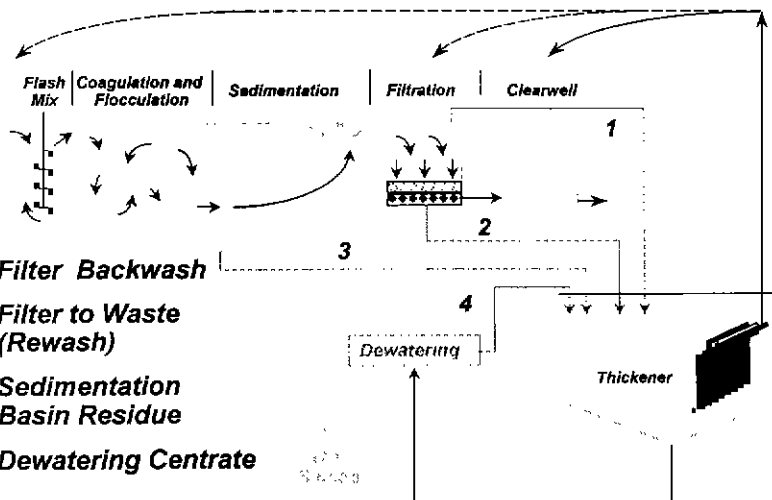


Iron & Manganese Removal

Applications: UF + Iron and Manganese Removal



ZeeWeed® Sidestream Reclamation



What is Enhanced Coagulation ?

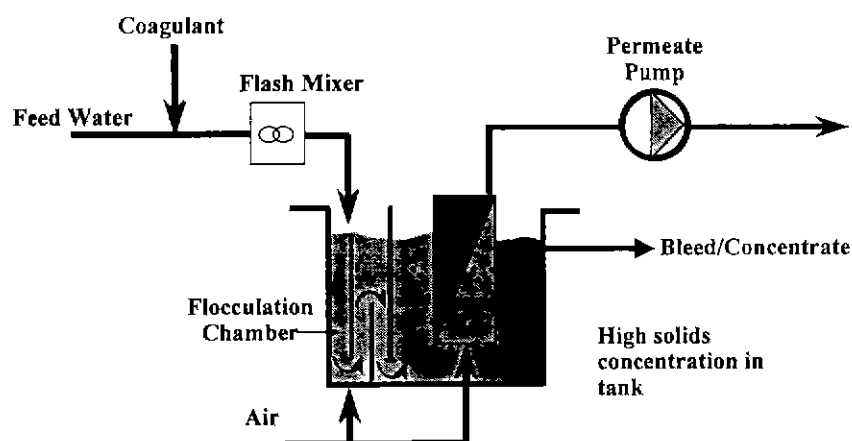
Conventional Coagulation

- conventional coagulation
- nucleation
- co-precipitation

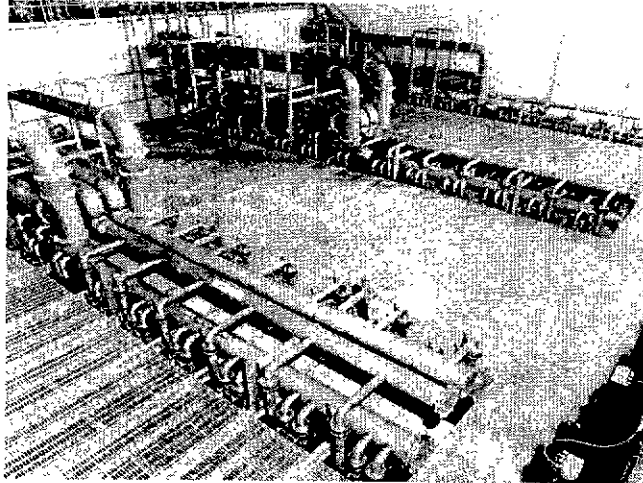
Enhanced Coagulation

- allows to achieve higher levels of TOC > 50%
- color removal > 95%
- requires less chemicals
- produces less chemical sludge for disposal

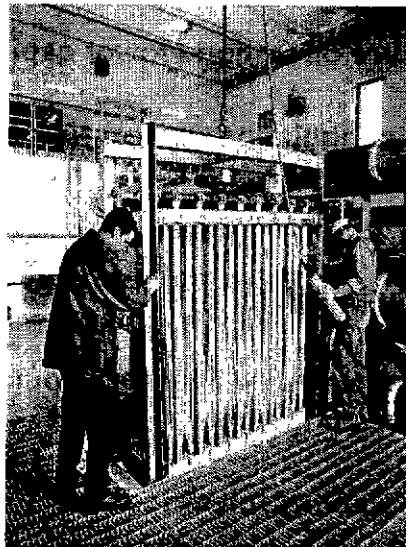
ZeeWeed[®] Enhanced Coagulation Process



**30,000 m³/day DRINKING
WATER PLANT**



**30,000 m³/day DRINKING
WATER PLANT**



Typical Treatment Data

	<u>Raw Water</u>	<u>Filtrate</u>
<u>Groundwater</u>		
<u>Surface Water</u>		

Advantages of ZeeWeed® vs. Other Membrane Technologies

- Low pressure operation - lower capital cost
- Enhanced coagulation - color, Natural Organic Matter (NOM) removal with no clarifier
- Chlorine resistant
- No need for pressure vessels - could retrofit in existing tanks
- Higher feed solids tolerance

Membrane bioreactors (MBR) combine biological wastewater treatment with membrane filtration.

- **Broad spectrum removal**
- **Safety through physical removal**
- **Excellent / constant performance**
- **Reduced use of chemicals**
- **Reduced sludge production**
- **Compactness and modularity**

WASTEWATER TREATMENT

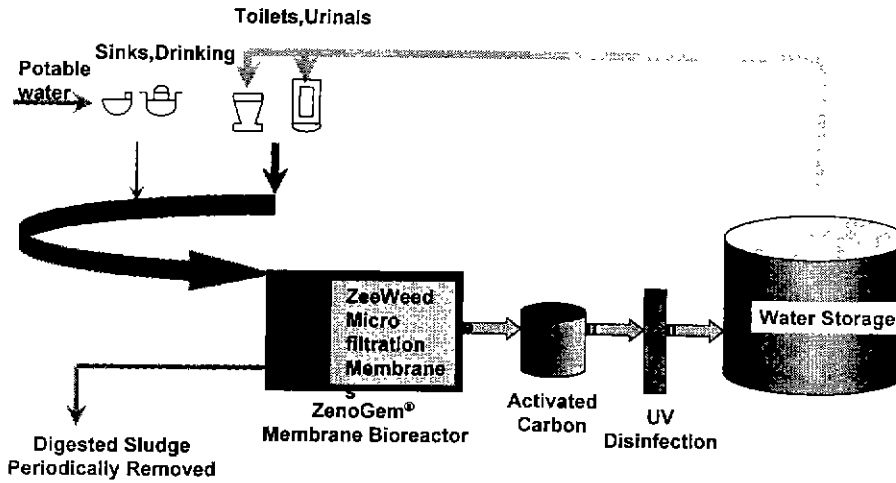
Problems to be Addressed

- **Stricter wastewater effluent standards**
- **Upgrading existing infrastructure**
- **Sludge disposal**
- **Limited space**

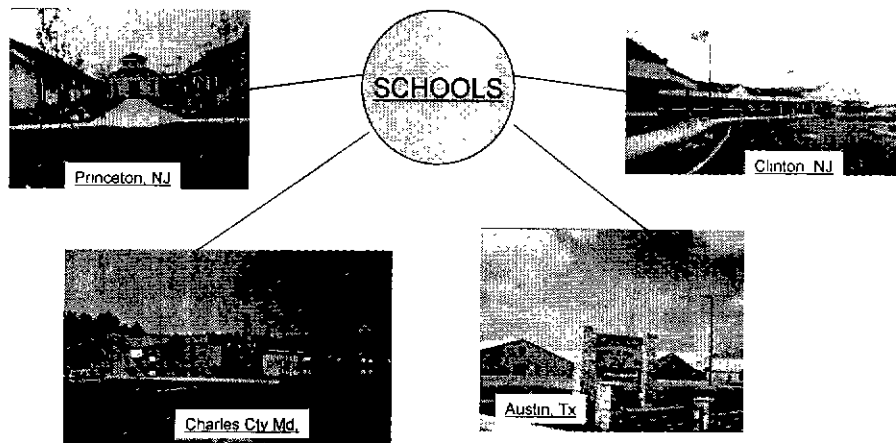
Applications of ZenoGem® / ZeeWeed®

- **Effluents with high COD concentrations**
food and chemical industry
pharmaceutical industry
- **Effluents with high ammonia content**
leachates
- **Difficult effluents for conventional activated sludge**
waste waters with high / variable salt content
- **Domestic waste waters**
quality requirement
space limitations
wastewater reuse / recycling in industry,
offices and condominiums

The Cycle-Let® Process



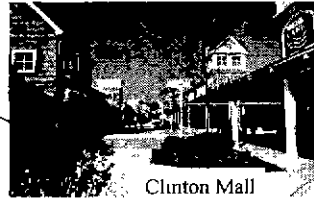
Membrane Applications



Membrane Applications

SHOPPING CENTERS

Toys R US



Clinton Mall

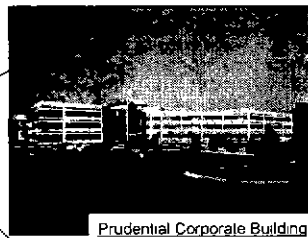
Westbrook Mall

Membrane Applications

OFFICE BUILDINGS



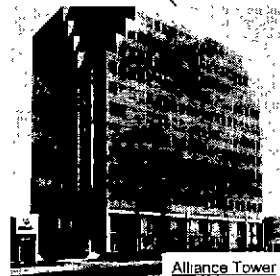
Sony Music Corporate Headquarters



Prudential Corporate Building

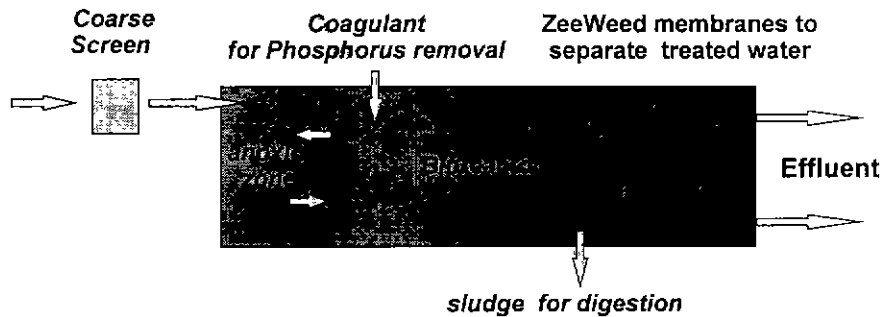


Water Gardens, Santa Monica, Calif.



Alliance Tower

Description of the ZenoGem Plant



ZenoGem - Single Step Bioreactor

ZeeWeed® ZenoGem® Operation

Membranes Contained in Frames
Within Aeration Tanks

Membrane Scouring Provided by
blower

Operating Vacuum -0.5 to -8 psi
(Greater Vacuum = Greater Flow)

Membrane Air Provides some of
Biological Requirements

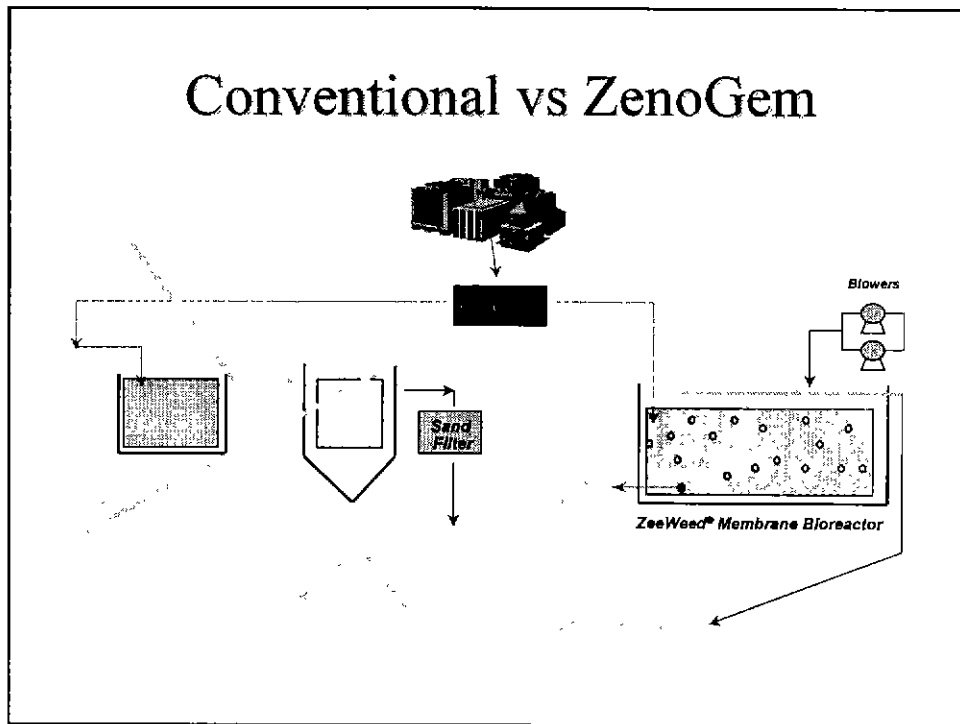
Vacuum Created By
Conventional
ANSI End Suction Pump

Fine Bubble Aeration
Supplements Membrane Aeration

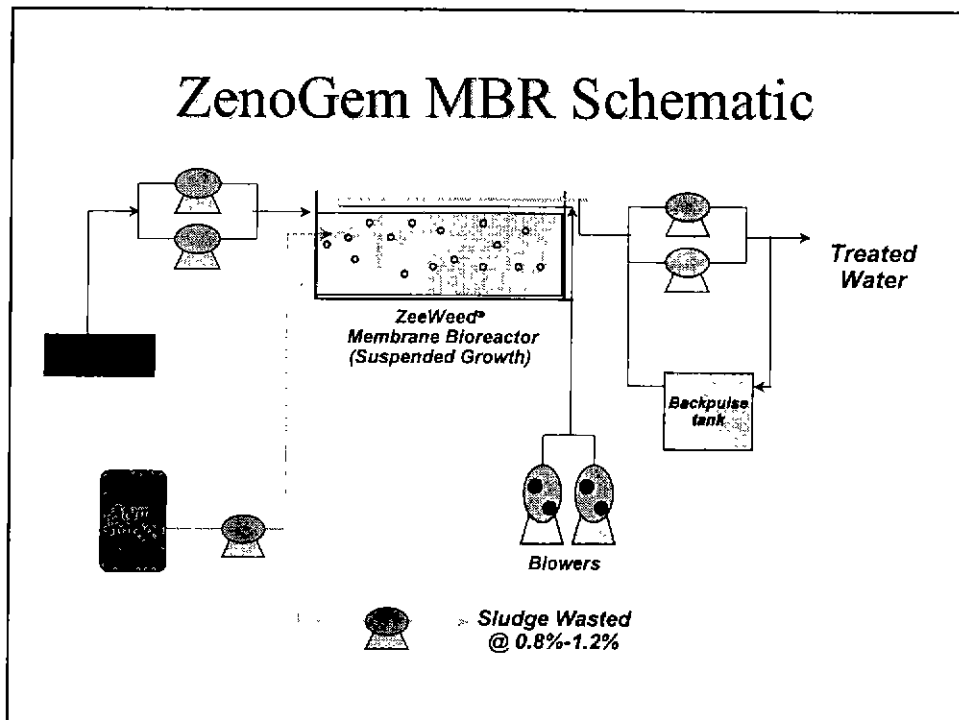
Pumping Rate Controlled By VFD
Based on Aeration Tank Level

Fully Automated Backpulse (20
seconds every 15 minutes)

Conventional vs ZenoGem



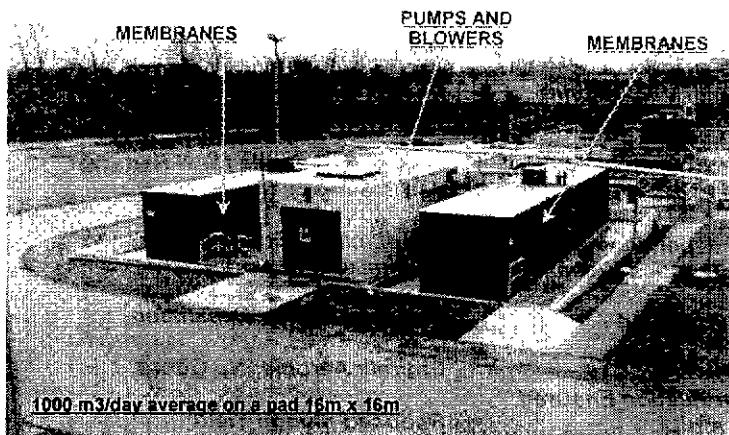
ZenoGem MBR Schematic



Advantages of ZeeWeed®

- Suitable for recycling water through an R-O
- High solids tolerance
- Flexibility to adapt to existing vessels and bioreactors
- Can be used as a microfilter or an integrated bioreactor treatment system
- Resistant to chlorine and other oxidants
- Produces one of the lowest turbidities

ZENON Wastewater System



ZenoGem Advantages

- 1) Reduced footprint
- 2) Enhanced Phosphorus Removal
- 3) Reliable Performance
- 4) Disinfection Capability
- 5) Reduced Sludge Yield
- 6) Modular design and expansion
- 7) Simple operation
- 8) Continuous operation during construction

ZenoGem[®] MBR Benefits

Membranes immersed within bioreactor

Absolute barrier to particulate discharge

Compact Footprint (no clarifiers or filters)

Minimal Effluent P with Coagulant Addition (TP < 0.1 mg/L)

Membranes allow high (8,000 mg/L to 12,000 mg/L) MLSS operation

Readily Adaptable for N Removal (TN < 3 mg/L)

Performance Independent of Sludge Settling Characteristics (Reliability!)

Adaptable to Existing Tanks (minimize civil works)

Elevated SRTs Achieved (if required)

Ideal For Staged Expansion

Year Round Nitrification Ensured (Ammonia < 1 mg/L)

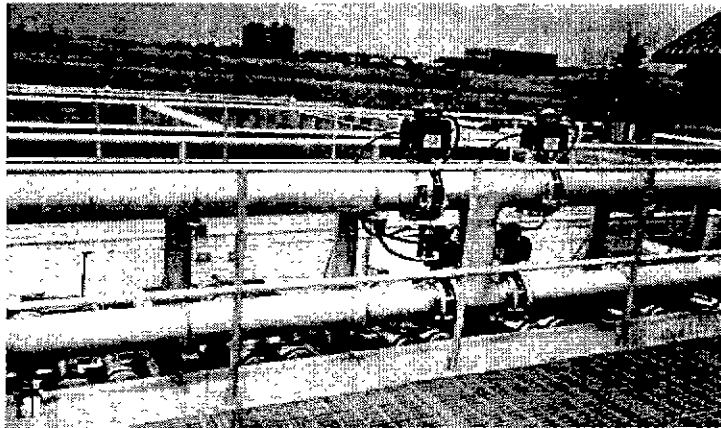
Entirely Aerobic; No Odors

Reduced Sludge Yield

Achievable Effluent Quality

- BOD < 5.0 mg/L
- TSS < 2.0 mg/L
- Ammonia-N < 1.0 mg/L
- TP < 0.1 mg/L
- TN < 10 mg/L (moderate climate)
- TN < 3.0 mg/L (hot climate)
- SDI < 3.0

Arapahoe, USA



Bioreactor #1 converted to ZenoGem from 4,000 – 6,000 m³/d – 1998
Bioreactor #2 converted to ZenoGem from 4,000 – 6,000 m³/d – 1999
Treated to 5, 5, 10, 0.1

Arapahoe - Typical Results

(1 year of operation)

	<i>Criteria to meet</i>	<i>Average Results</i>
BOD (mg/L)	5 mg/L	< 2 mg/L
SS (mg/L)	5 mg/L	< 2 mg/L
Nitrogen total (mg/L)	10 mg/L	<7 mg/L
Phosphorus total (mg/L)	0.1 mg/L	< 0.1 mg/L

ZenoGem - Comparative Analysis

Pretreatment	Same + 3mm screen
Bioreactor	1/3 smaller, @ 1.2% MLSS
Secondary clarifier	Membrane in tank, ZeeWeed
Aeration	Same
Sand Filters	None
Alum for P.	Reduced, pin floc P.
Nitrification	Very efficient
Footprint	as small as 1/6 the size
Manpower	1/2 to 1/4

Advantages of the ZenoGem Process

- Able to upgrade an existing plant, avoiding land purchase and major civil construction costs;
- Improve effluent quality within a smaller footprint;
- Modular allows for stepwise expansion as the tax base increases;
- Plant upsets will not result in poorer effluent quality – no effect of bulking plant;
- Easy to operate plant– requires little supervision;
- Lower operational costs (manpower, sludge disposal, chemicals).