Aquatech

Session #6 Wastewater
3:55 – 4:25 PM, June 14, 2023

Advancement in Minimum & Zero Liquid Discharge

Devesh Mittal
Vice President of Environmental Services, Aquatech

Membrane TECHNOLOGY FORUM®

BROUGHT TO YOU BY: Dairy FOODS, ADPI American Dairy Products Institute

- **Established: 1981** - Headquarters: Canonsburg, PA, **USA**
- **Diverse portfolio** of technology & services for the industrial & infrastructure markets
- **Pioneer** in Zero Liquid Discharge ("ZLD") and Brine Management
- One of few companies in the world with **Thermal & Membrane Desalination** capabilities
- **Delivering turnkey business solutions EPC, mobile, rental, and BOO**

Over
2,000
installations in
60 countries

Founded in
solely focused on
water treatment
1981

Cutting-Edge
Laboratory, Piloting,
and R&D Capabilities

Over **200**
Engineers

Offices in:
North America
The Middle East
Europe
India
China

Ford · Nestlé Good Food, Good Life · pepsi · ConAgra Foods Food you love · Weyerhaeuser · Heineken · Mondelēz International
MOLSON Coors · Coca-Cola · GERDAU · Cargill · AB InBev · wilmar · P&G · Unilever · Pfizer

Why MLD or ZLD?

Key reasons

- Regulatory limitations on surface or POTW discharge
- Cost drivers
  - Water paucity
  - High round trip cost of water
- Water conservation initiatives

Benefit needs to be greater than cost because

- Expensive to build
- Complex and costly to operate
- Restrictive, becomes extension of manufacturing process

Definition of MLD and ZLD

MLD

- Minimum or Modified liquid discharge
  - Limited by quantity and or quality of discharge
  - Recovered water to limit discharge can be reused
  - Generates liquid concentrate for disposal

ZLD

- Zero liquid discharge
- Must have ability to reuse the recovered water
- Generates solid cake for disposal and minimal liquid concentrate

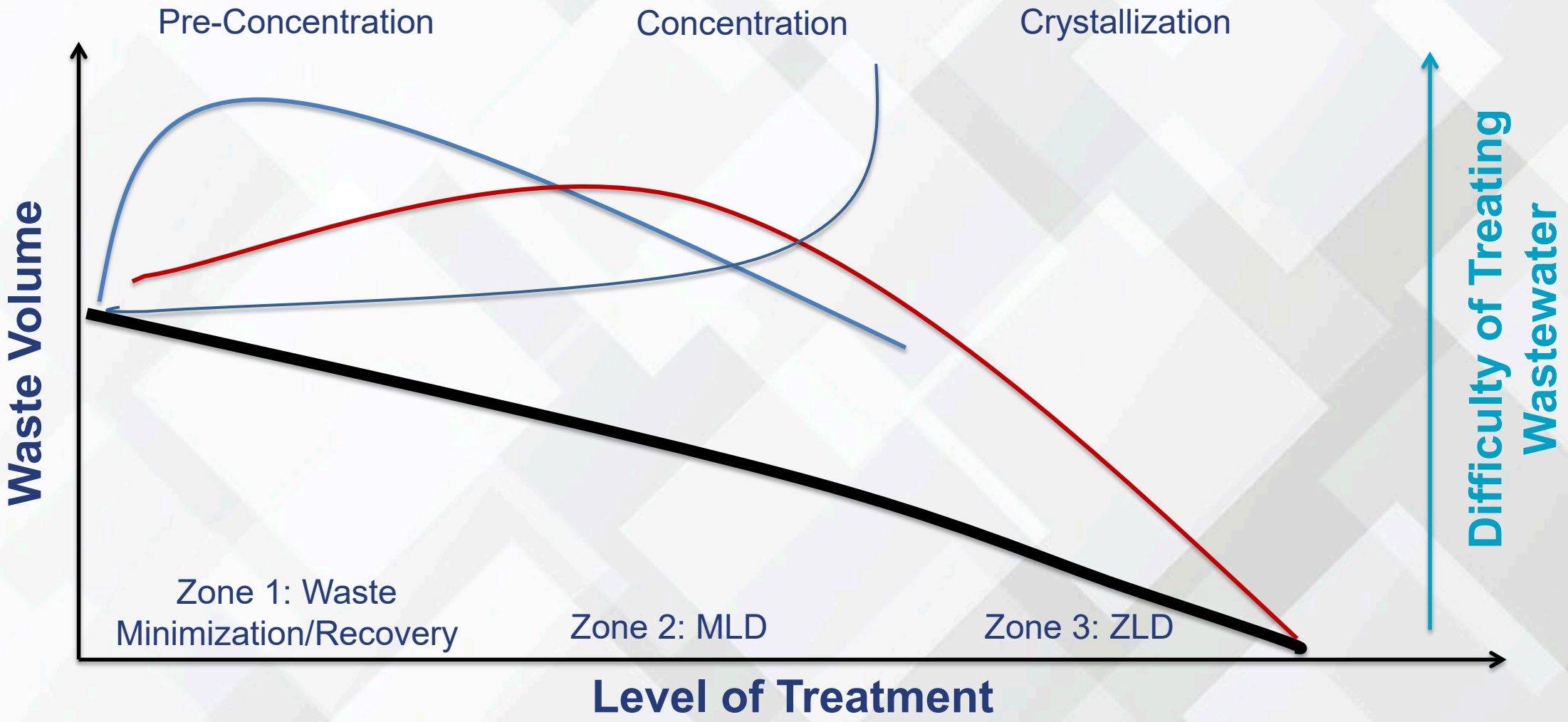
Traditional MLD / ZLD

Pre-Concentration

Concentration

Crystallization

Zones Of Complexity



How The Membranes Help?

Capex Reduction

- Relatively cost effective per gallon water recovered
- Installed sparing capacity feasible
- Modular and expandable allowing phased build
- Construction schedules significantly shorter
- Install costs significantly lower

Opex Reduction

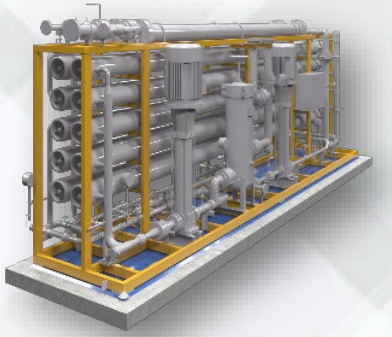
- Easier to operate and operations better understood
- Energy consumption significantly lower
- Component replacements relatively inexpensive

Membranes / Systems Used in MLD/ZLD

UF

AnMBR

ARRO™



$FTSH_2O$ FO

MBR

RO

$FTSH_2O$ OARO

AVMD™

Membranes Are Doing The Heavy Lifting

Wastewater

PRETREATMENT
Mechanical
Physical - Chemical

BioMOD™ DAF
MoTreat™
MoPress™

CORE TREATMENT
Biological Treatment

BioMOD™ EGSB
BioMOD™ AnMBR
BioMOD™ MBBR

EFFLUENT to discharge

BioMOD™ MBR

Biological POLISHING FOR REUSE

Forward Osmosis
R3MOD AVMD™
OARO
Brine Concentrator
Mobile Evaporator

EFFLUENT to Disposal Well

R3MOD CeraSoft™
R3MOD ARRO™
R3MOD AVMD™

POLISHING FOR REUSE

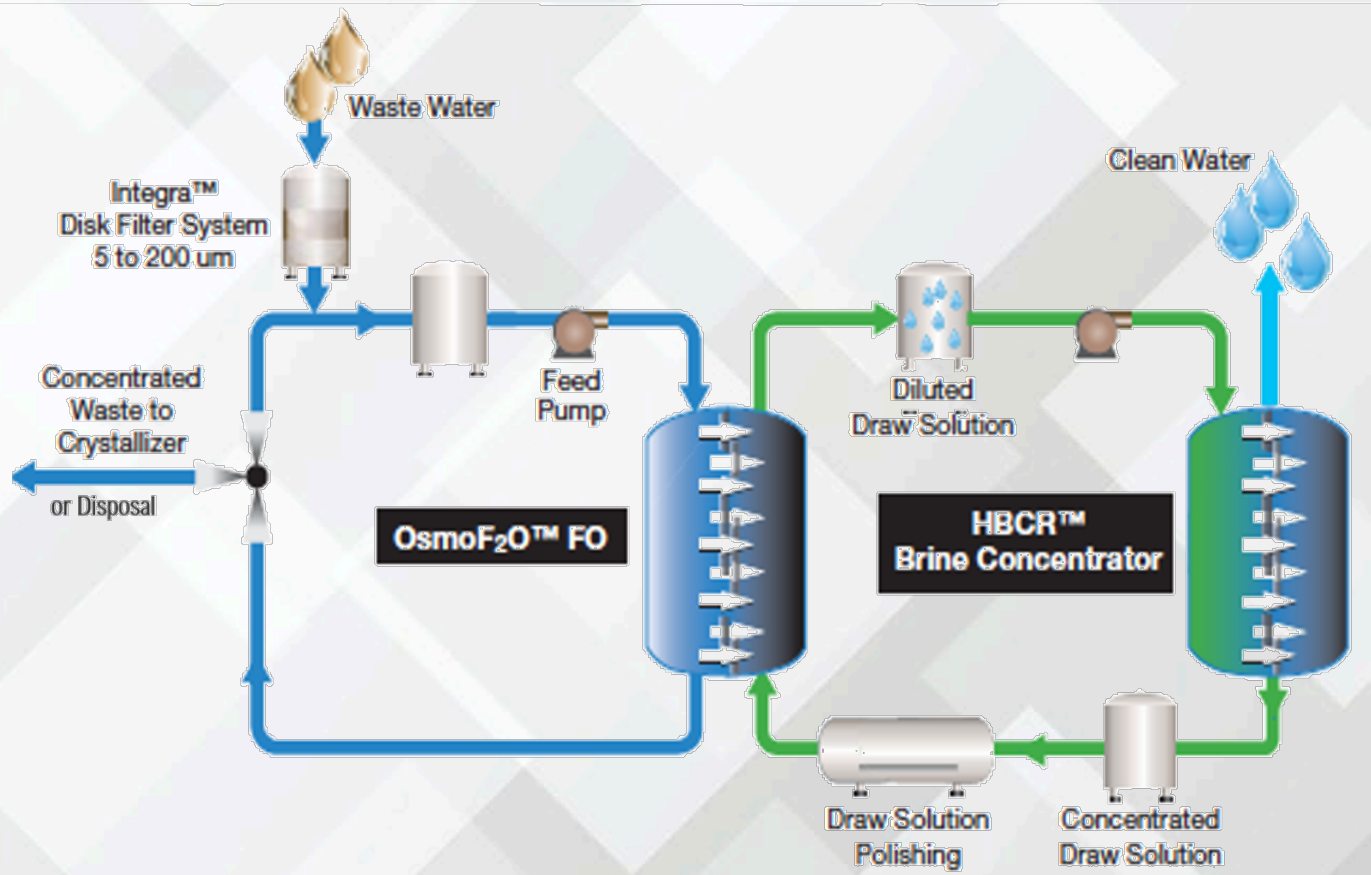
Forward Osmosis
R3MOD AVMD™
Crystallizer

TREATED WATER to reuse

Solids To Landfill

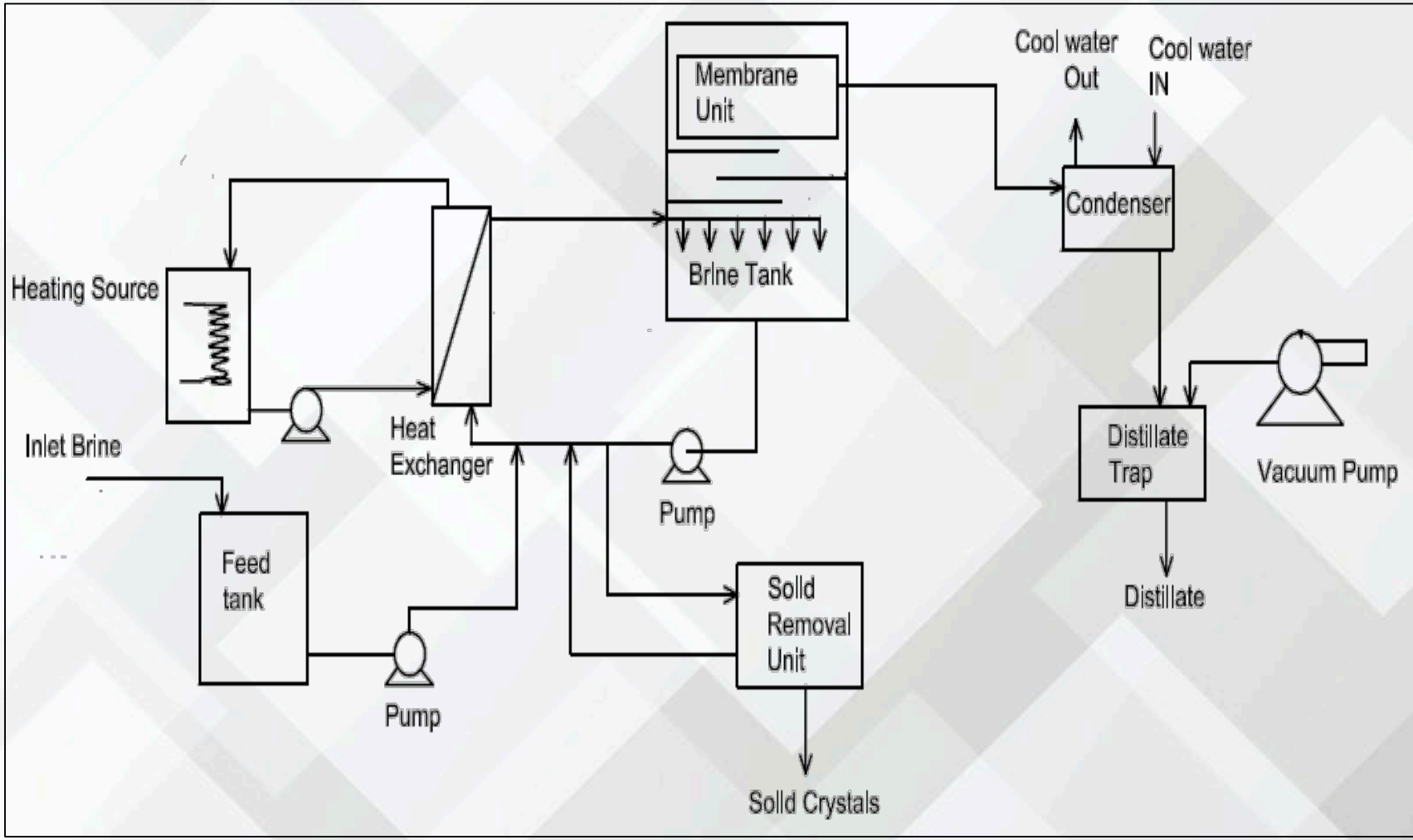
FO and OARO As Concentrators

- Minimal Pretreatment for most wastewaters (bag filter)
- Higher Recoveries 90% to 95%
- Ideal for ZLD – especially where the crystallizer is the mostly costly step
- Full recovery from feed upsets
  - Low pumping pressures of 1 bar does not imbed solids or abrade membrane surface
  - Most times, simple osmotic backwashing and flushing with just water is sufficient
- Great process for water mass transfer
- High water purity, from both the FO and HBCR – multiple passes



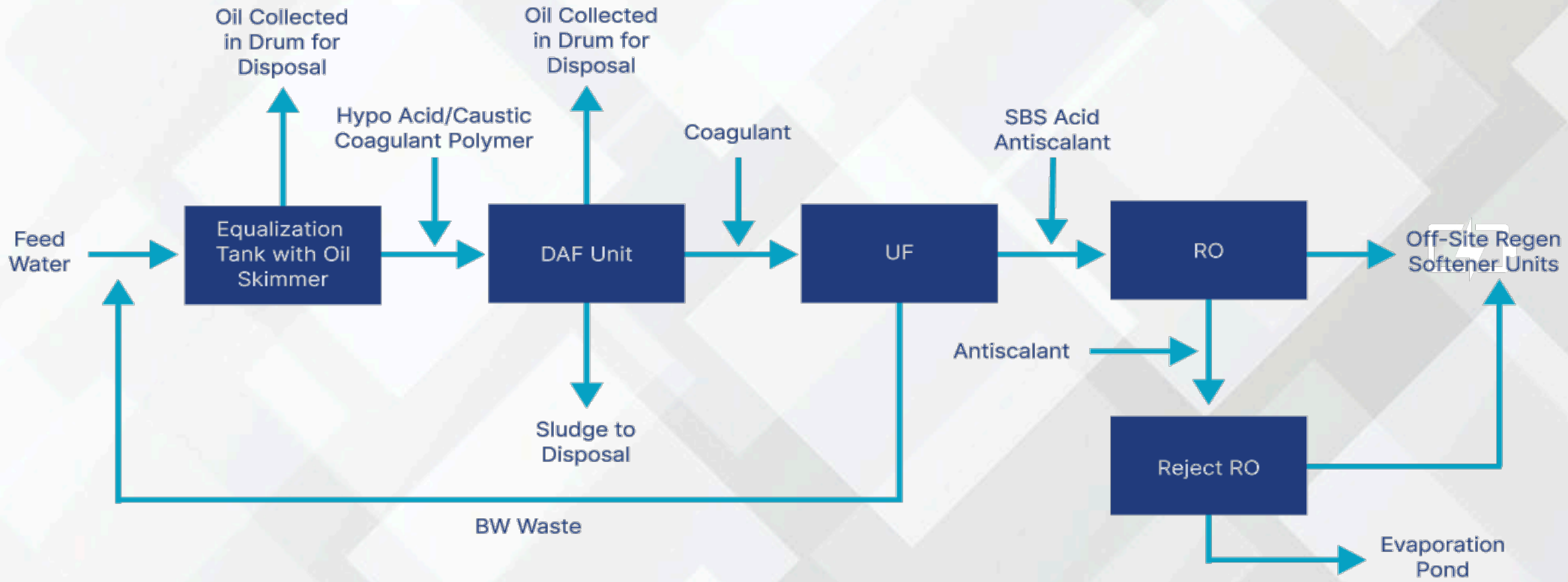
AVMD™As Concentrator

- Advanced Vacuum Membrane Distillation modules consist of specialized hydrophobic membrane envelopes.
- A vacuum is created to pull water vapor across the membranes
- Allows use of waste heat as energy source
- Cost effective for small and modular ZLD unit



Soya Facility

- **Source of effluent:** Soyabean Milling
- **Project features:**
  - 200 gpm (1,090 m3/day) feed flow
  - 98% water recovery
- **Project scope:** Recycle for reuse & ZLD



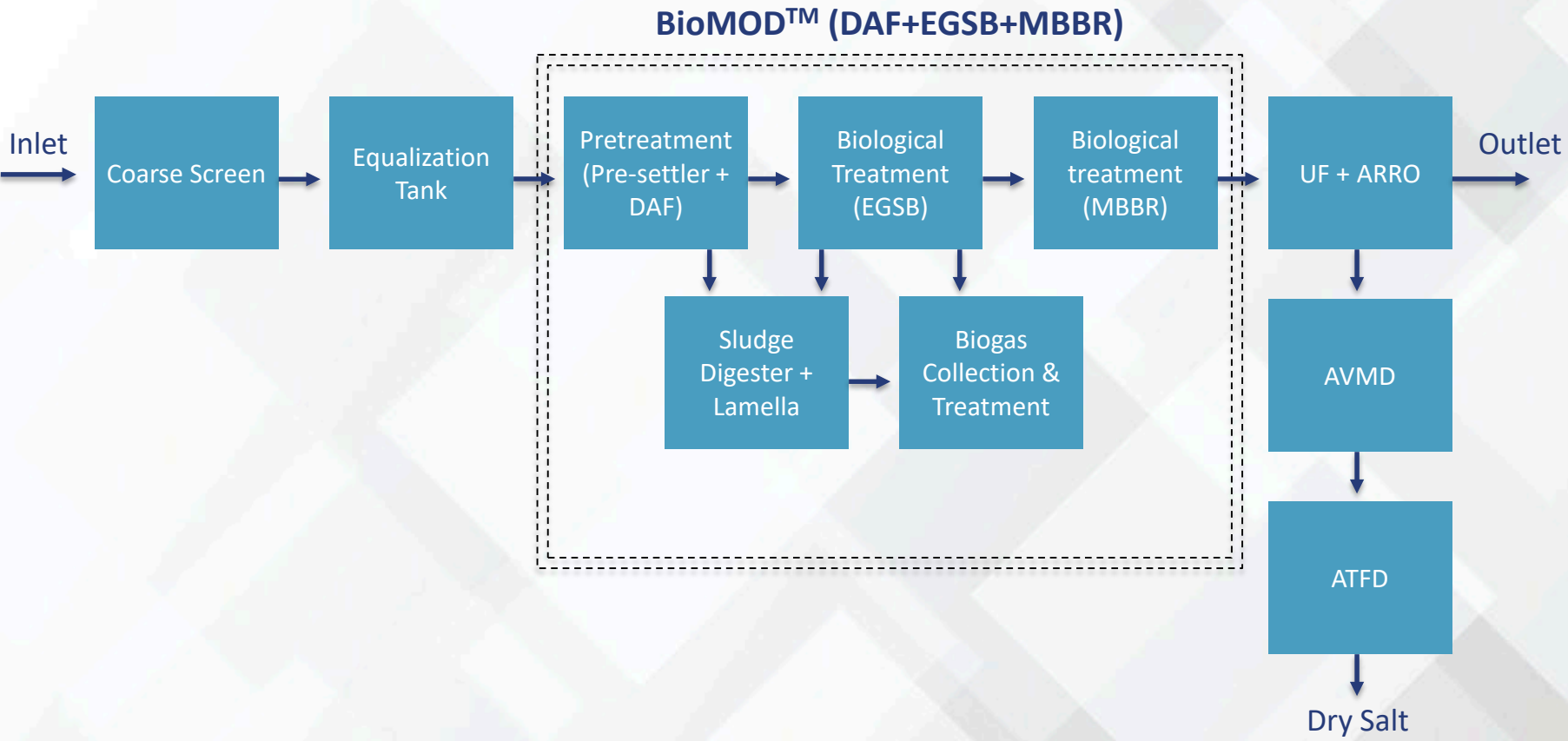
Simple case for dairy (1/2)

- **Source of effluent:** milk processing
- **Plant capacity:**
  - 185 gpm (1000 m3/day)
  - COD 2000 ppm
  - TDS 1500 ppm
- **Project scope:** wastewater treatment, recycle and ZLD

Stage Wise Parameters

Sr. No.	Parameters	Inlet	After EGSB	After MBBR	After UF, ARRO	After AVMD, ATFD
1	**Flow, m3/day**	1000			880 + 90 = 970	
2	**Fat and Grease, ppm**	500	-	<10	-	--
3	**TSS, ppm**	1000	-	<100	-	-
4	**COD, ppm**	2000	400 (80% reduction)	60 (85% reduction)	Nil	Nil
5	**BOD, ppm**	1000	200 (80% reduction)	30 (85% reduction)	Nil	Nil
6	**TDS, ppm**	1500	-	-	<100	<200

Simple case for dairy (2/2)



VALUE PROPOSITION

- Key enabler to achieve **sustainability goals**.
- BioMOD EGSB degrades BOD & COD with no power consumption and also generates **GREEN ENERGY** through methane production.
- R3MOD ARRO technology recycle/recover **> 90% of water,** which can be used in cooling tower/ process.
- R3MOD AVMD technology helps achieve ZLD requirement with **Lower Opex.**

Aquatech

Takeaways from today

- Membranes have lowered the cost footprint of MLD/ZLD
- FO, OARO and AVMD™ have started to replace conventional brine concentrators and crystallizers
- Membranes have allowed modular systems for smaller flows
- Waste minimization is cost and operation burden
- Explore all alternate options before implementing program

CONTACT CORPORATE:

Devesh Mittal

EMAIL ADDRESS
Mittald@aquatech.com

PHONE
(281) 794 - 3113

website
www.aquatech.com/