

Evaluation of Sludge Characteristics from Advanced Primary Treatment Technologies

Himanshu Khuntia*, Onder Caliskaner*, Evan Martinez*, Yuanbin Wu*, Brian Davis#

*Caliskaner Water Technologies (CWT)

#Linda County Water Resource Recovery Facility

SEPTEMBER 2026

CWT CALISKANER WATER TECHNOLOGIES

Project Information

Duration: 2021 to 2028

Location: Linda County Water District Water Resource Recovery Facility, CA

- Provides wastewater treatment service to over 35,000 households
- Serves primarily residential and light commercial
- Disadvantaged community

Primary Funding Source: California Energy Commission (CEC)

Prime Consultant: Caliskaner Water Technologies (CWT)

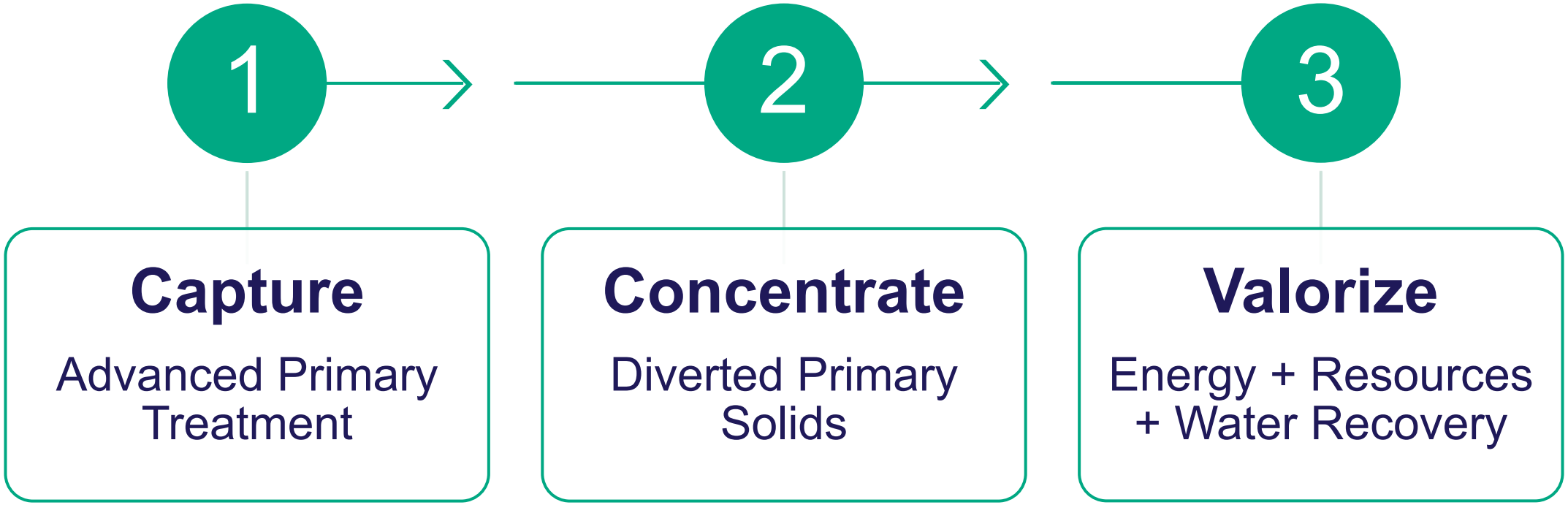


Project:

- ❑ EPC-20-044: Performance Evaluations of Full- and Pilot-scale Advanced Primary Treatment (APT) and Advanced Secondary Treatment (AST) Technologies – **Finished 2025**
- ❑ EPC-23-013: Demonstration of Advanced Sludge Separation Treatment Technologies for Decarbonization of Wastewater Treatment Plants – **Ongoing**

Project Objective & Approach

Integrated Advanced Primary Treatment, Diverted Solids Management & Resource Recovery



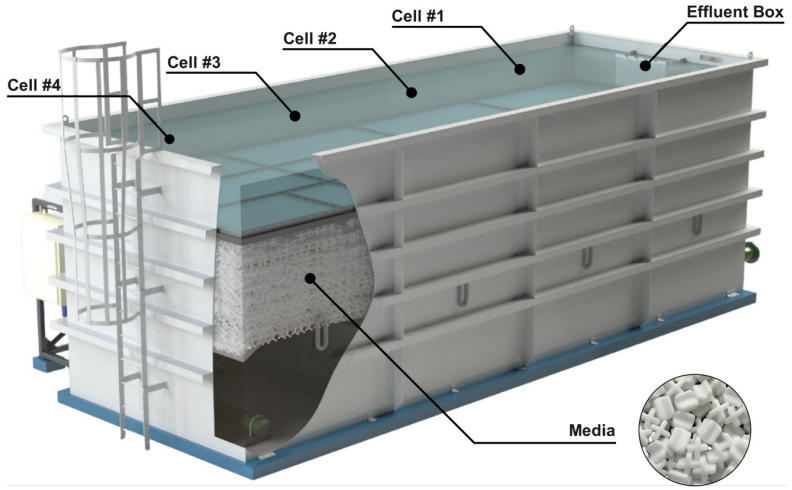
Field Evaluations of Advanced Primary Treatment Technologies

Cloth Disk Primary Filter
Aqua-Aerobic Systems, Inc



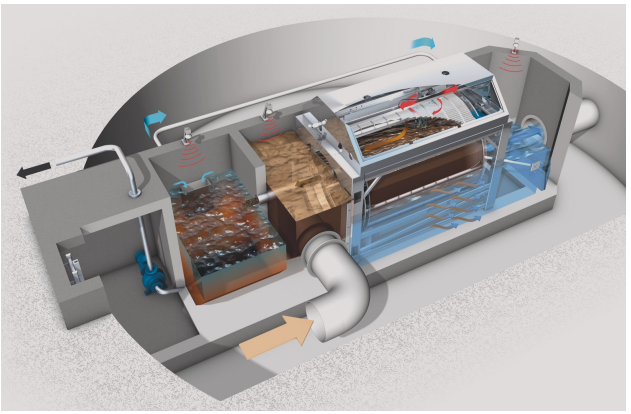
Filtration through pile cloth media (5 µm nominal)

Proteus Primary Filter
Tomorrow Water



Upflow filtration through Expanded Polypropylene (EPP) beads

MicroScreen
Huber Technology



Screening, inside-to-outside, drum screen with 200-µm stainless steel mesh.

Evaluation & Demonstration: 8–36+ months of pilot-to-full-scale operation.

Solids capture • Effluent quality • Loading capacity • Energy • Footprint • Operational reliability

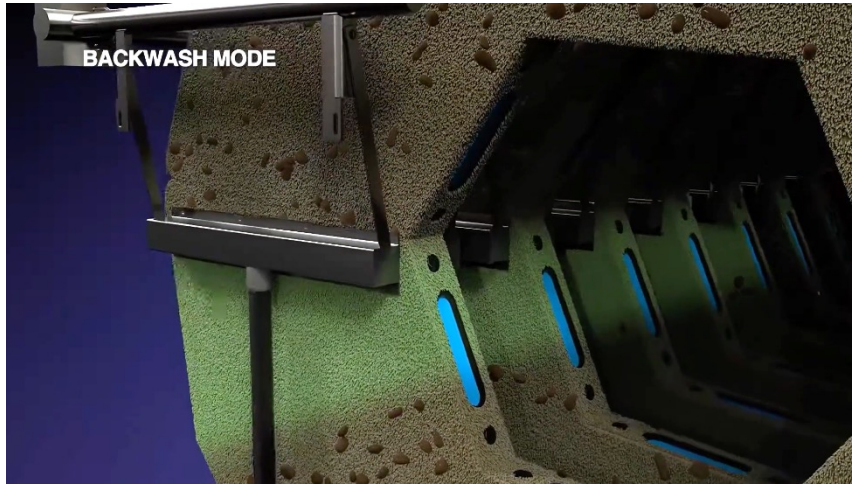
Caliskaner Water Technologies. (2025). *Demonstration of Advanced Primary and Advanced Secondary Treatment Technologies for Energy and Performance Benefits to Wastewater Treatment* . California Energy Commission.

CWT CALISKANER WATER TECHNOLOGIES

Advanced Primary Treatment: Solids Diversion

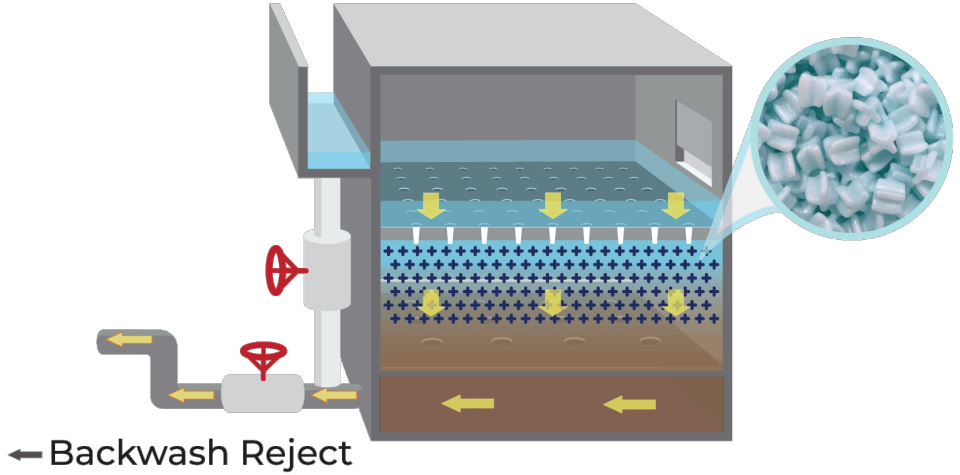
Cloth Disk Primary Filter

Backwash: Solids removed by vacuum arm



Proteus Primary Filter

Backwash: Reversing the direction of flow to flush out retained solids



- Intermittent backwash
- Backwash triggered by time or headloss

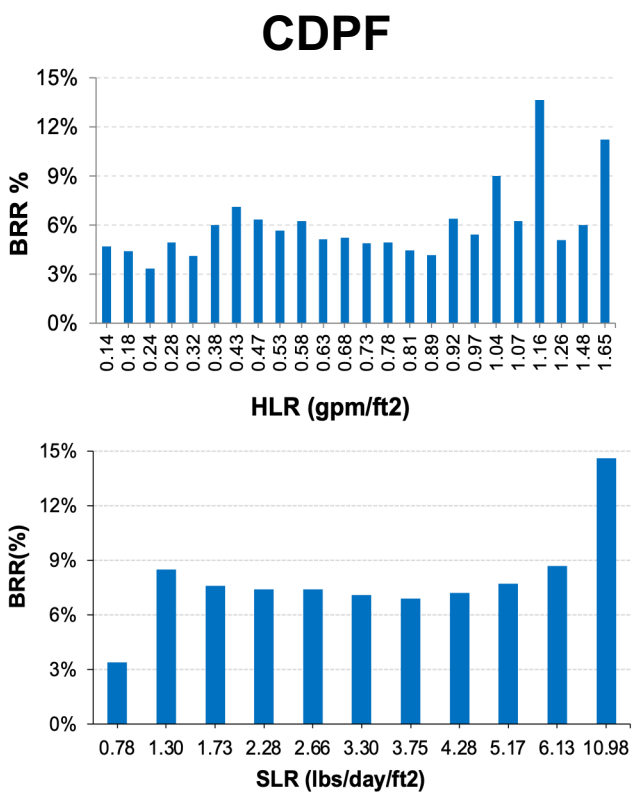
CWT CALISKANER WATER TECHNOLOGIES

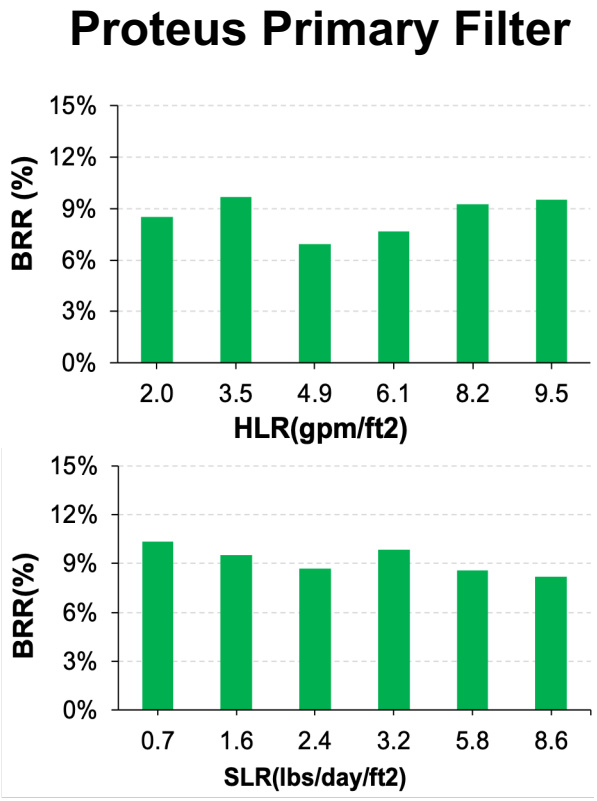
Courtesy of Aqua-Aerobic Systems, Inc

Courtesy of Tomorrow Water

Advanced Primary Treatment: Backwash Reject Characteristics

Reject ratio = Backwash or reject flow as a % of influent flow





Backwash Reject

- ❑ 0.1-0.3% TS
- ❑ 5-15% of Influent flow
- ❑ Response varies with HLR and SLR

Primary Sludge: 3-3.5% TS

Design Implications

- ❑ Variable hydraulic loading
- ❑ Peak-flow capacity required
- ❑ Thickening before downstream treatment.

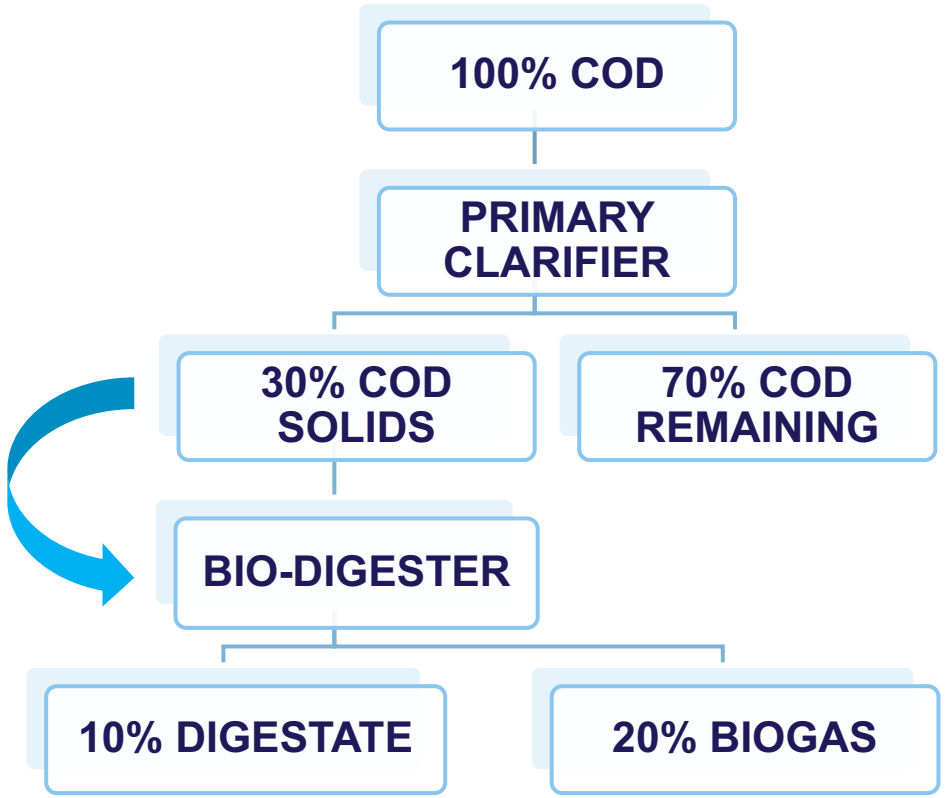
Caliskaner Water Technologies. (2025). *Demonstration of Advanced Primary and Advanced Secondary Treatment Technologies for Energy and Performance Benefits to Wastewater Treatment* . California Energy Commission.

The Opportunity & Challenge

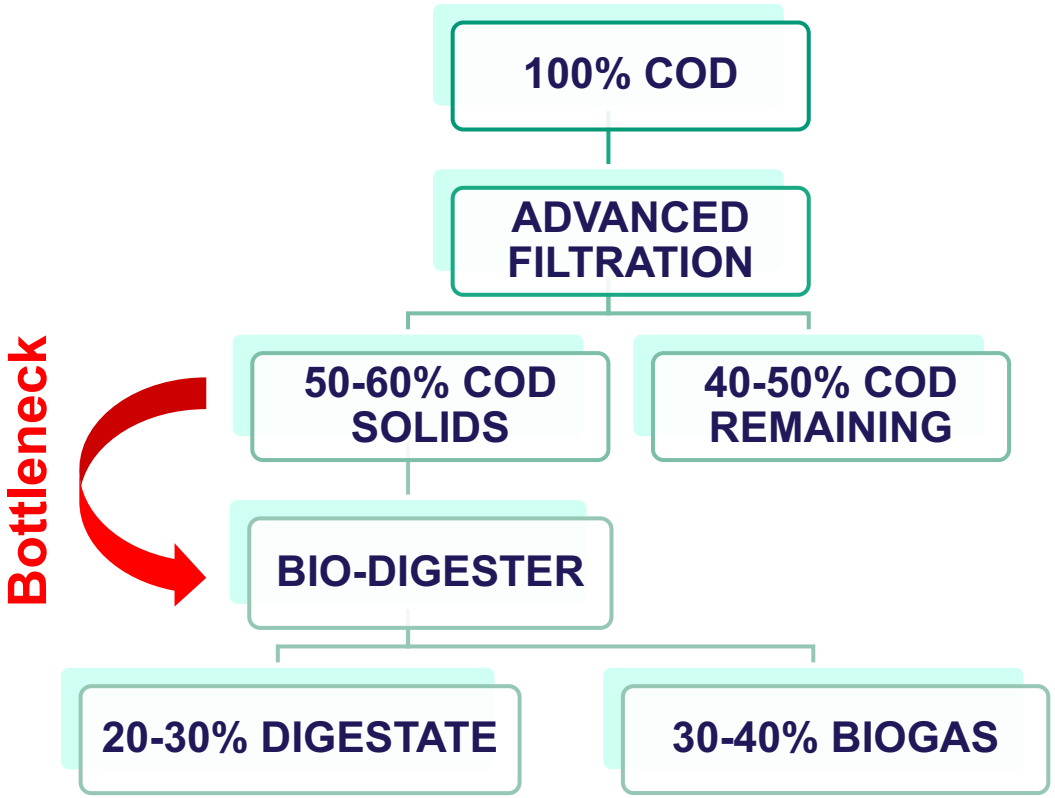
CWT CALISKANER WATER TECHNOLOGIES

❑ Advanced Primary Treatment captures more COD upstream for energy recovery

Conventional Primary Treatment



Advanced Primary Treatment



❑ Backwash reject requires thickening and appropriate hydraulic capacity

Adapted from Shewa and Dagnew (2020), COD fractions shown as % of influent COD.

Advanced Primary Solids Thickening

Thickening is the bridge between solids capture and resource recovery

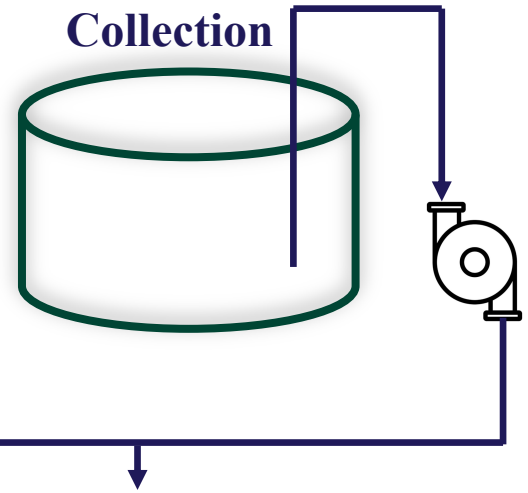
Cloth Disk Primary Filter



Solids reject stream

5-15% Influent flow

0.1-0.3% TS



Comparison Metrics

1. Solids capture
2. Solids thickening
3. Filtrate quality

Volute thickener (VT)

Process Wastewater Technologies



Suspended Air Flotation (SAF)

Komline-Heron



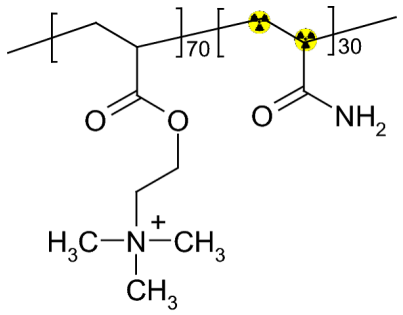
CWT CALISKANER WATER TECHNOLOGIES

Suspended Air Flotation (Mechanism)

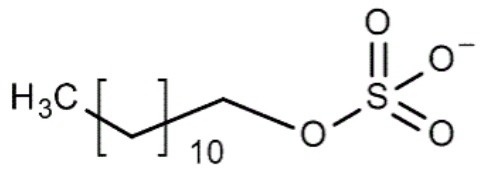
Solids stream
Weak –ve charge

$Al_2(OH)_nCl_{(6-n)}$

Poly-aluminium chloride (PAC)
Cationic Al^{3+}



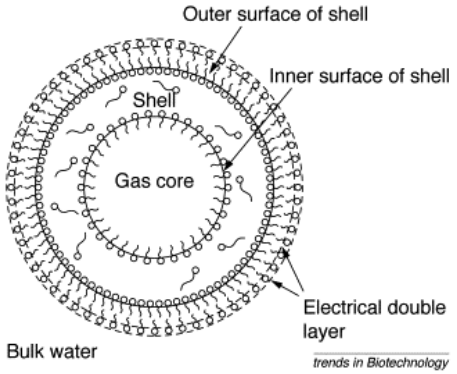
Cationic Polyacrylamide

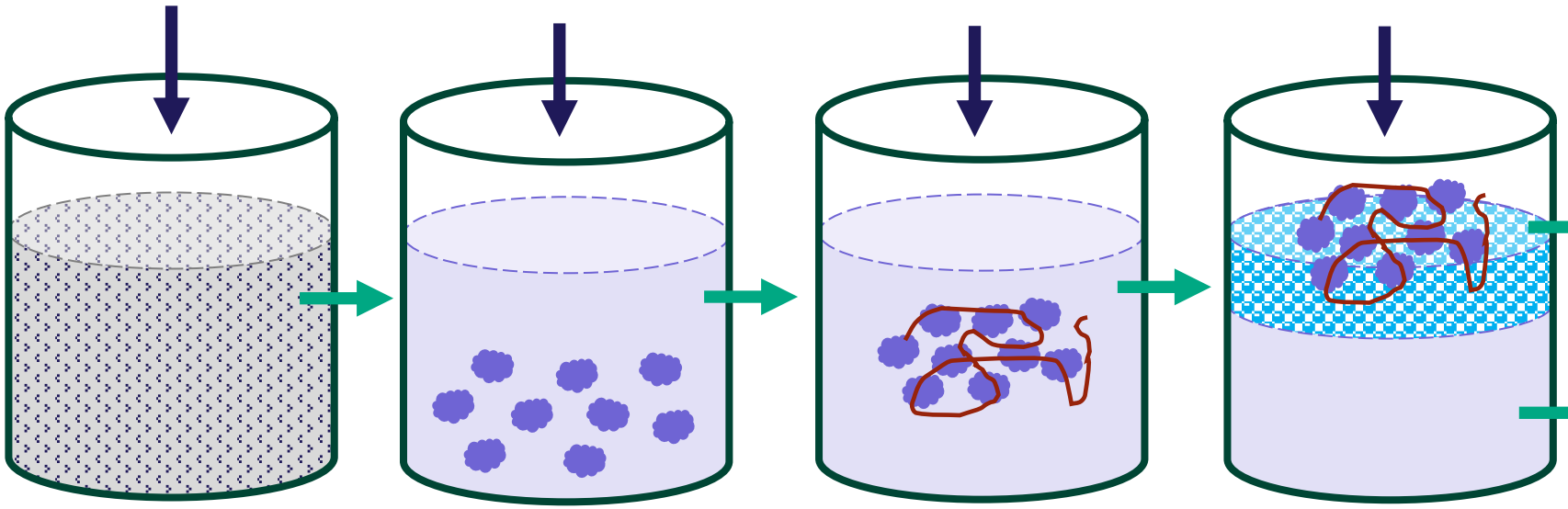


Anionic Surfactant

Air

–ve Charged Gas Aphrons





Skimmer → Thickened Solids

Filtrate

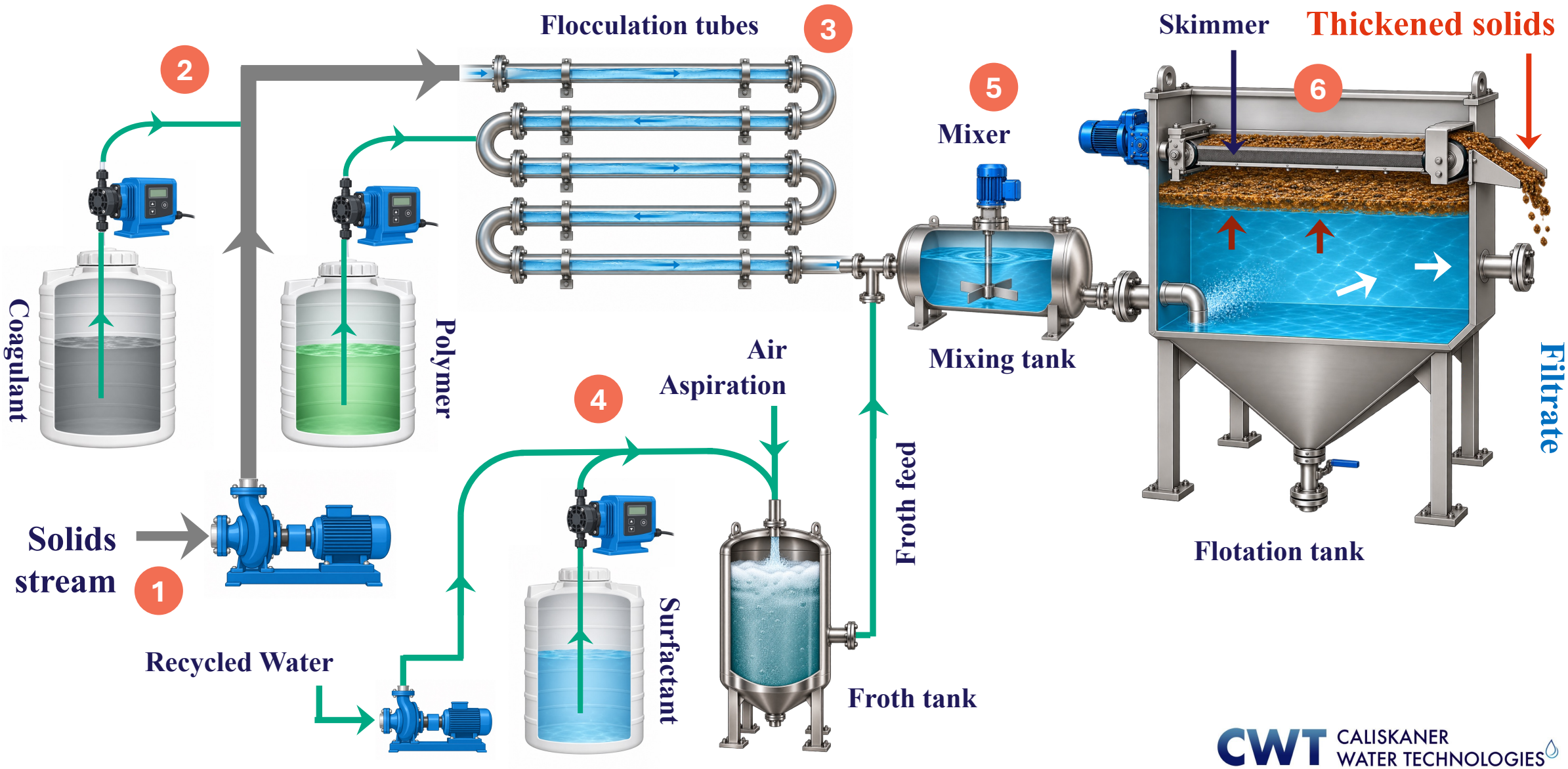
COAGULATION & SEDIMENTATION

COAGULATION & FLOCCULATION

ADSORPTION & FLOTATION

CWT CALISKANER WATER TECHNOLOGIES

Suspended Air Flotation (Flow Path)



CWT CALISKANER WATER TECHNOLOGIES

Suspended Air Flotation (Components)

FLOCCULATION TUBES

FLOTATION CHAMBER AREA 11.5 ft^2 OR 1.07 m^2

FROTH GENERATOR



COAGULANT, POLYMER, SURFACTANT

CONTROLLER

SOLIDS DISPOSAL PUMP



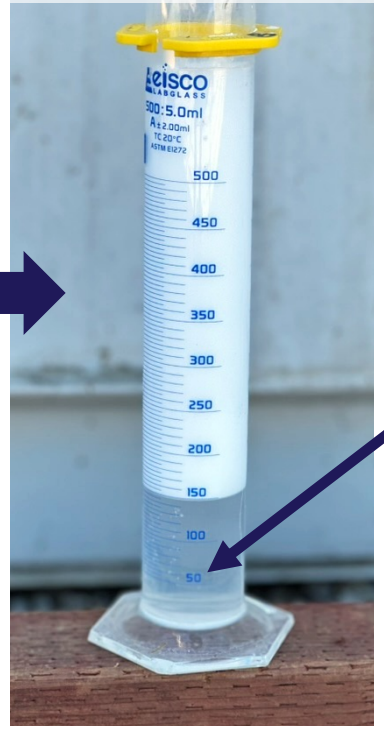
CWT CALISKANER WATER TECHNOLOGIES

Suspended Air Flotation (Mechanism)

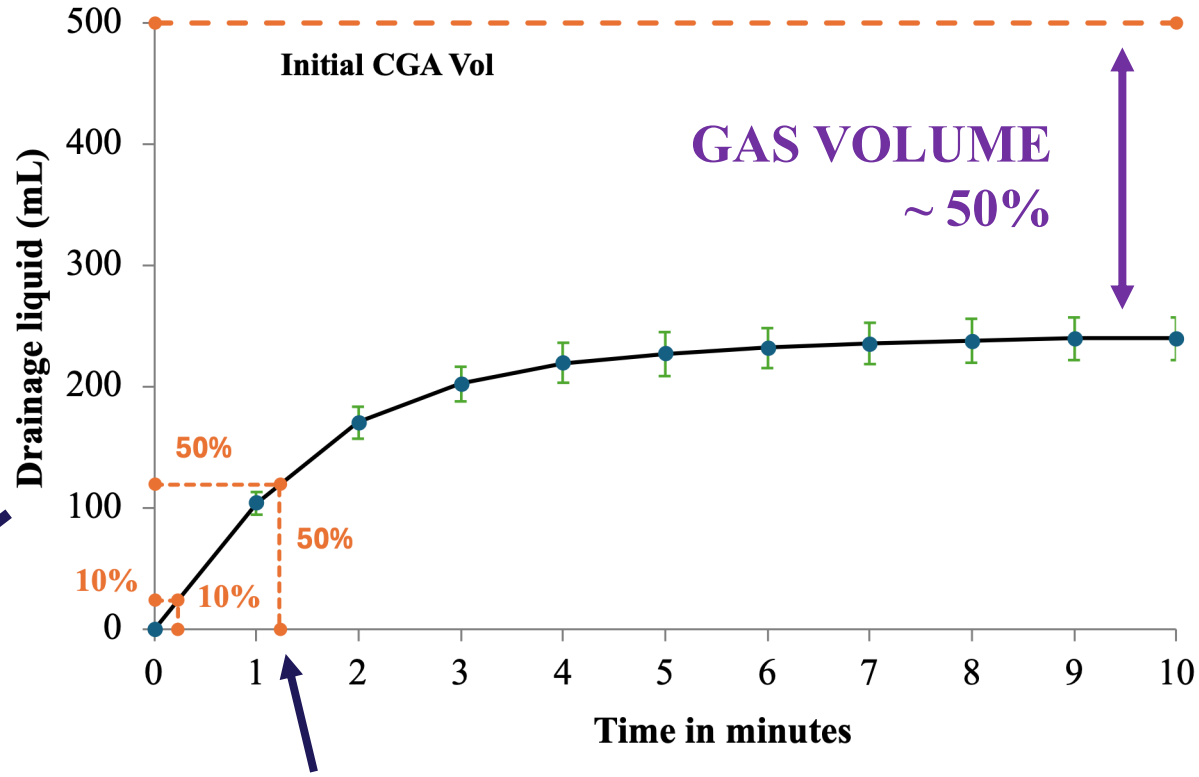
SAF
FROTH GENERATOR



COLLOIDAL
GAS APHRONS
10-100 µm



COLLOIDAL GAS APHRONS



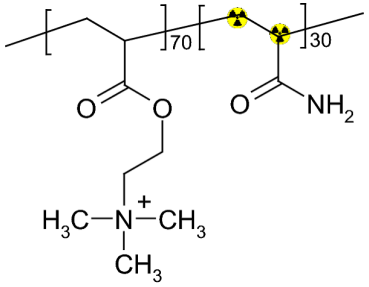
Indicator of Aphron Stability & Longevity

Flotation Time and Flotation Tank Retention Time

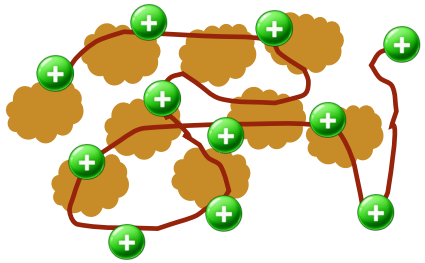
CWT CALISKANER WATER TECHNOLOGIES

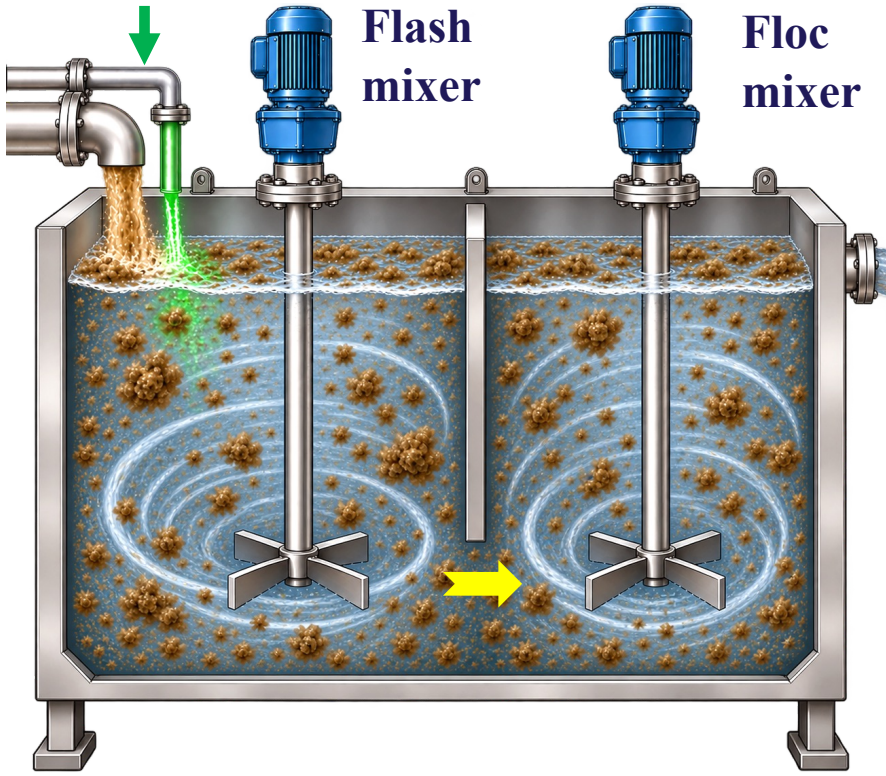
Volute thickener (Mechanism)

CWT CALISKANER WATER TECHNOLOGIES

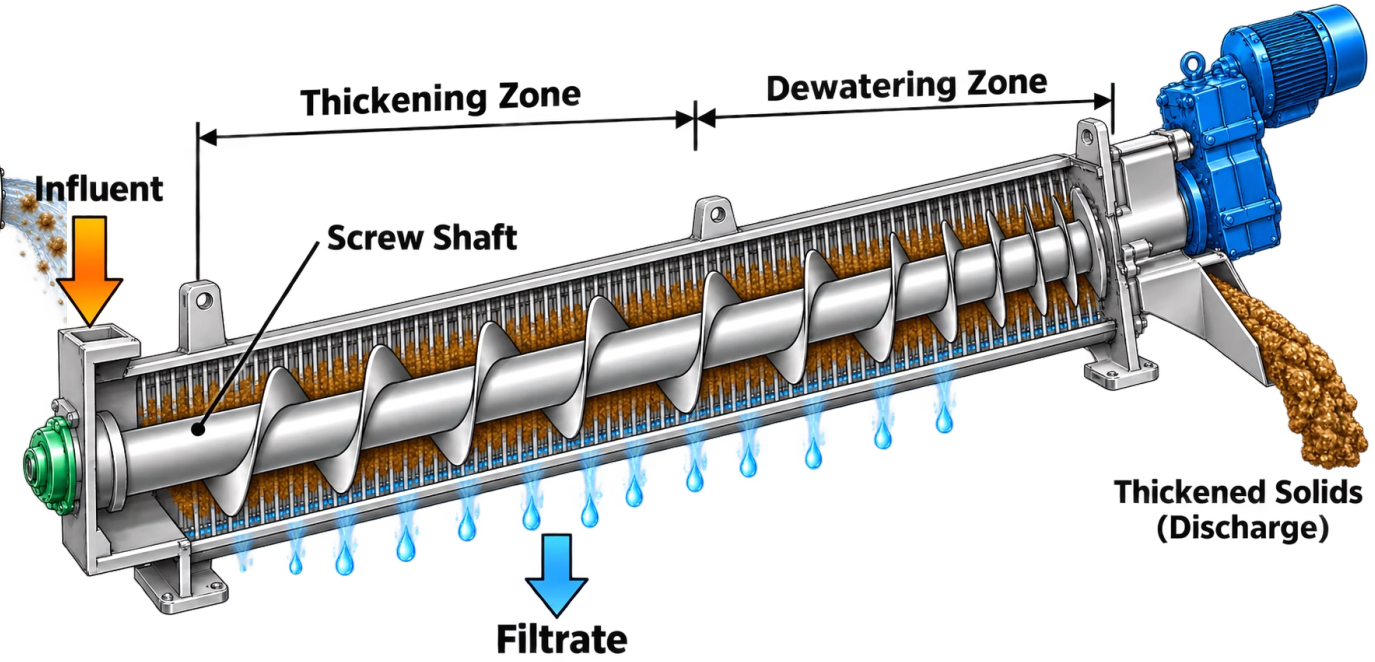


Cationic Polyacrylamide



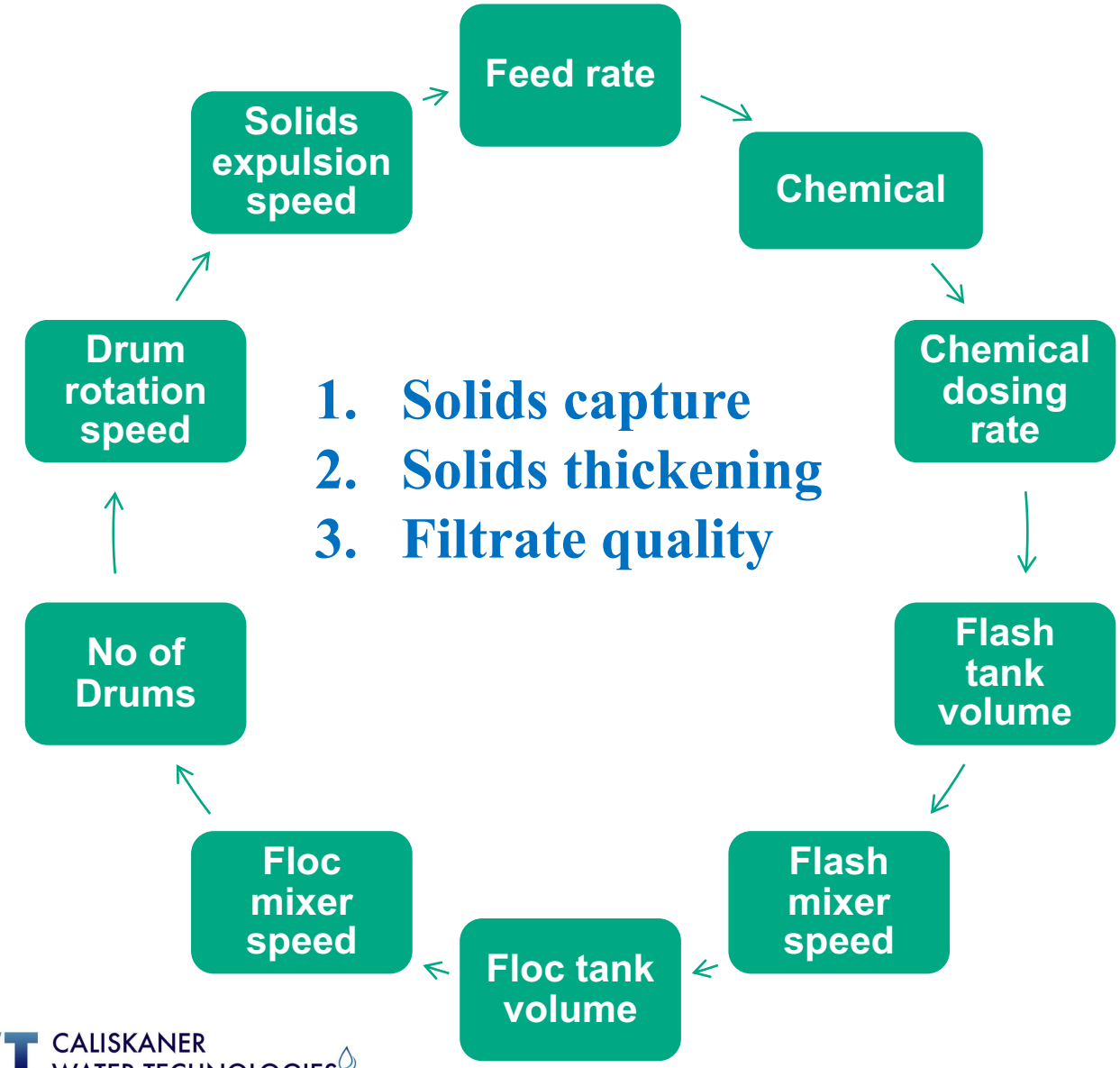


COAGULATION & FLOCCULATION



SCREENING, GRAVITY DRAINAGE, THICKENING, DEWATERING, PROGRESSIVE COMPRESSION

Volute thickener (Optimization)



Drum 1



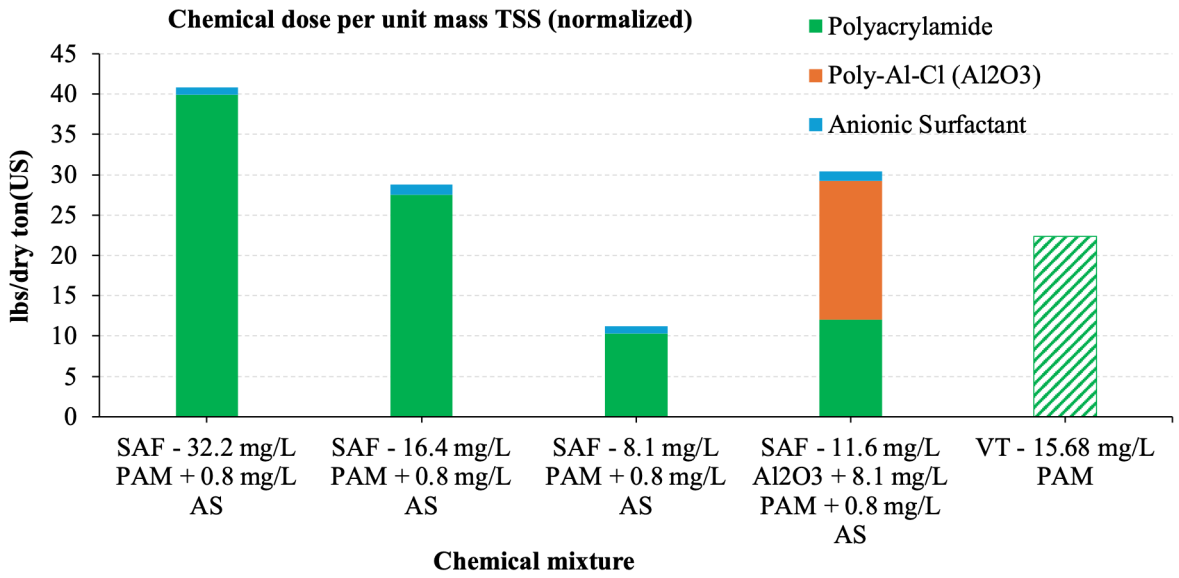
Drum 2

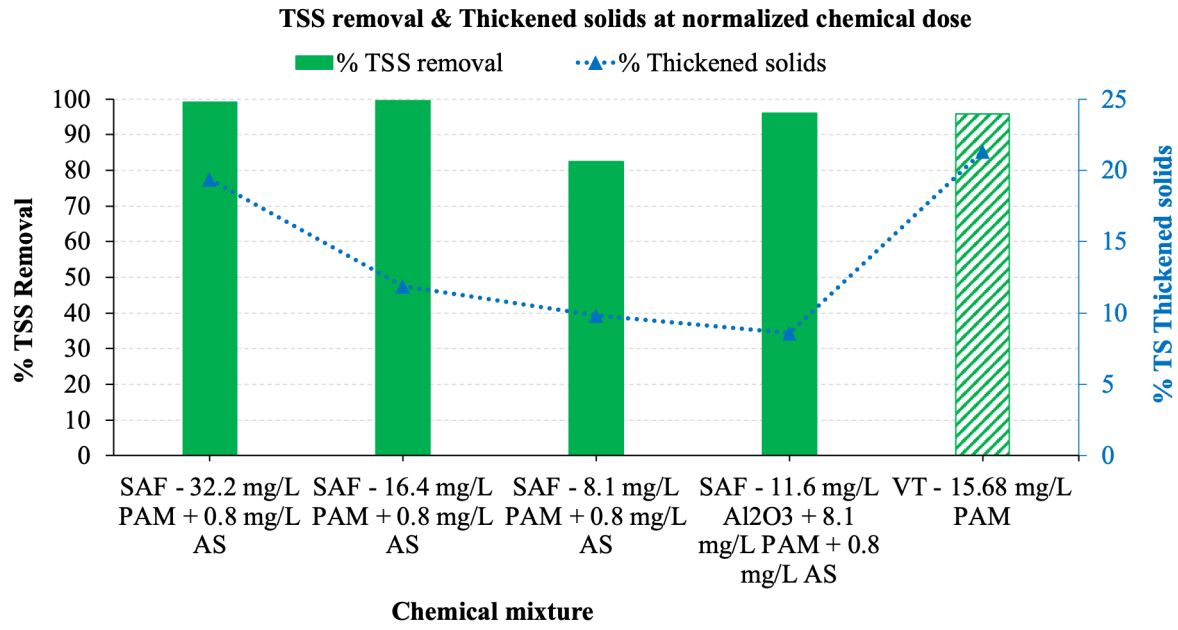


Volute Thickener

CWT CALISKANER WATER TECHNOLOGIES

FIELD RESULTS: SAF & VT



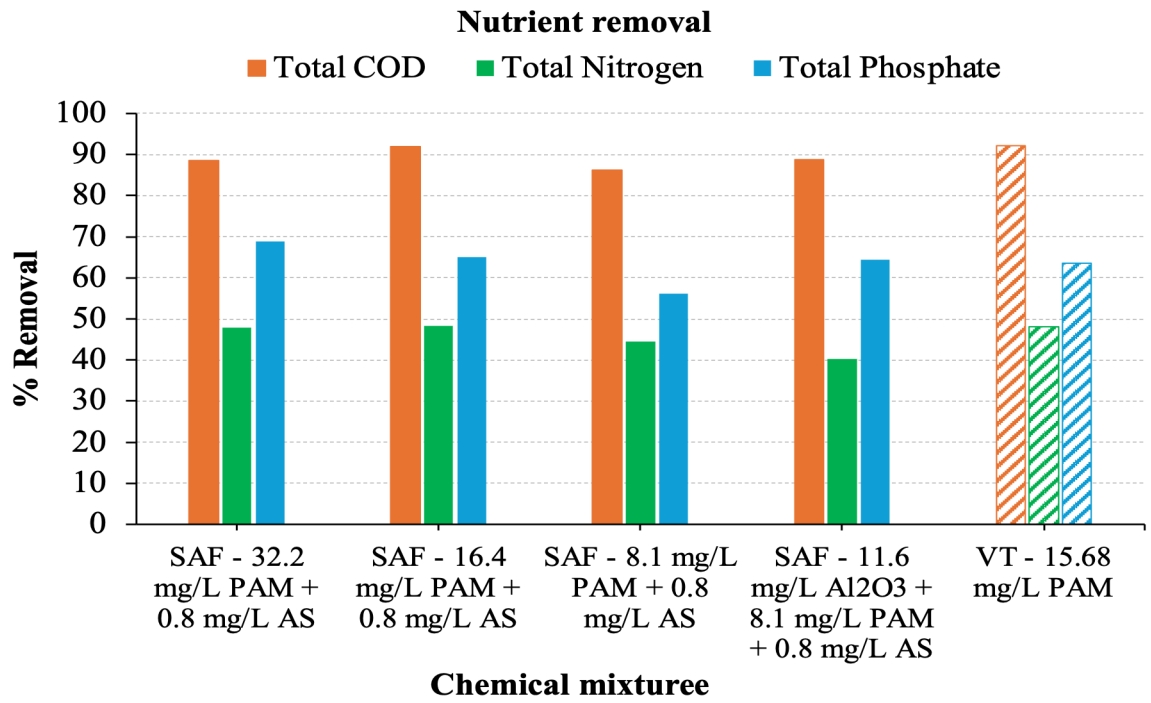


Dosage combinations tested

Polymer (CPAM mg/L) – 32.2, 16.4, 8.1

Poly aluminium chloride (Al_2O_3 mg/L) – 11.6

Anionic Surfactant (AS mg/L) – 0.8



CWT CALISKANER WATER TECHNOLOGIES

CWT CALISKANER WATER TECHNOLOGIES

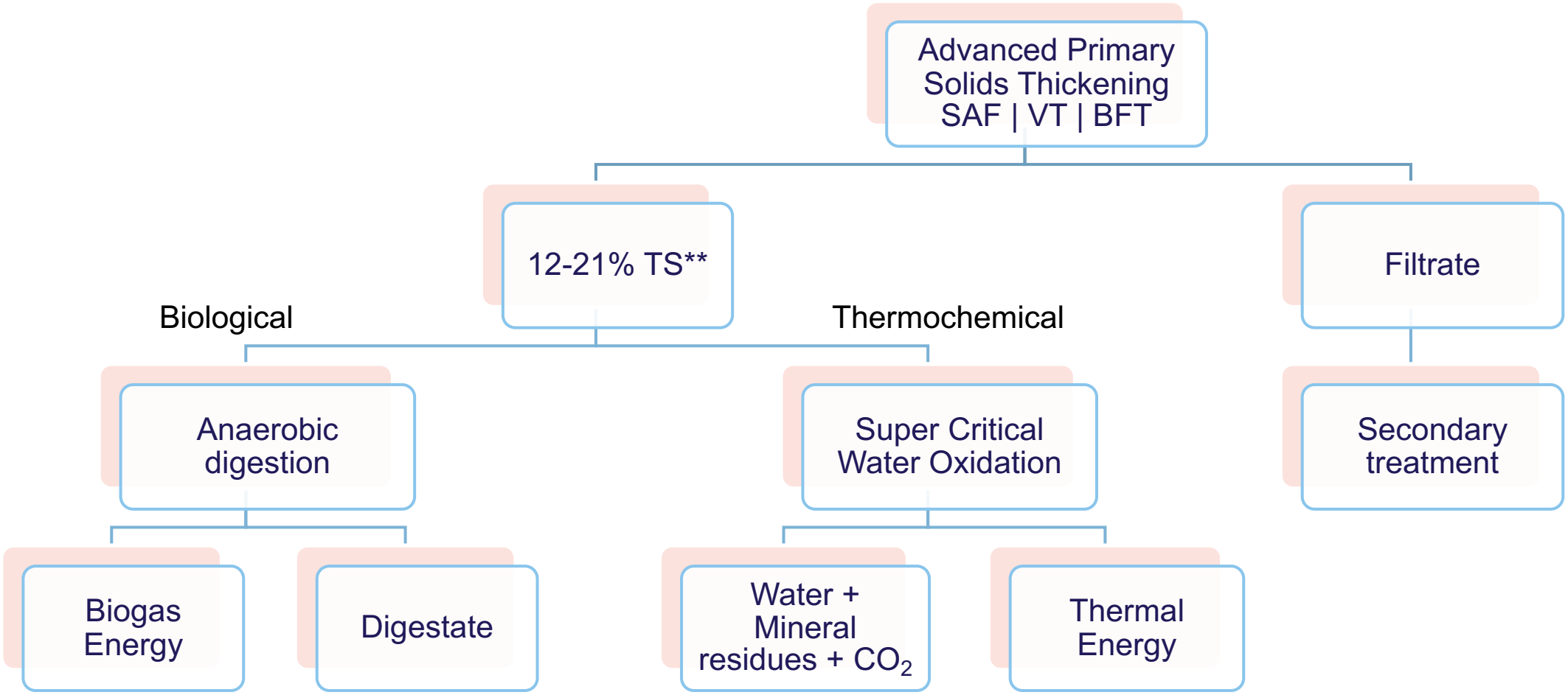
FIELD RESULTS: SAF & VT

Parameters	Suspended Air Flotation (SAF)	Volute thickener (VT)	Key Take Away
Solids loading rate	Current: 87 lbs/d/ft², Planned: 150 lbs/d/ft²	Current: 1683 lbs/d/drum Planned: 2020 lbs/d/drum	
Solids capture (%)	99.5	95.8	**High capture rate**
Thickened solids (%)	11.9	21.4	**High thickening**
Polymer (CPAM) lbs/dry ton(US)	27	22	**Chemical use process dependent**
Surfactant lbs/dry ton(US)	1.3	Nil	
Filtrate TSS (mg/L) average	5	58	**Filtrate quality suitable for secondary treatment**
Filtrate COD (mg/L) average	222	273	
Filtrate TN (mg/L) average	44	53	
Filtrate TP (mg/L) average	17	16	

- ❑ Optimization of coagulation and flocculation is vital for success in froth flotation in SAF or progressive compression in VT.
- ❑ High-rate solids separation & reduced footprint compared with conventional settling

From Solids Thickening to Treatment & Resource Recovery

- **Thickening Advanced Primary Solids enables downstream treatment and resource recovery**



** Range across technologies/operating conditions.

CWT CALISKANER WATER TECHNOLOGIES

Anaerobic Digestion of Advanced Primary Solids

Resource Recovery Opportunity

↑ Higher biodegradable carbon → ↑ Biogas ↑ Energy ↑ (30-40%)

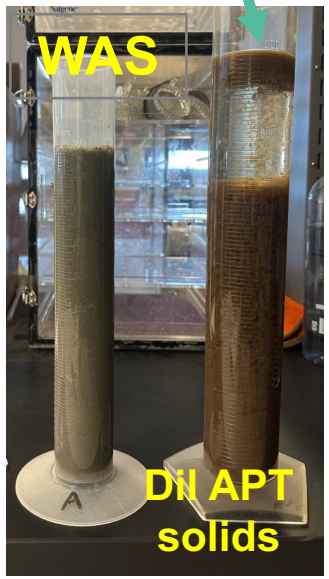


Dilution & conditioning

4-6% TS



Digestate Dewatering, Drying, Hauling, Landfill

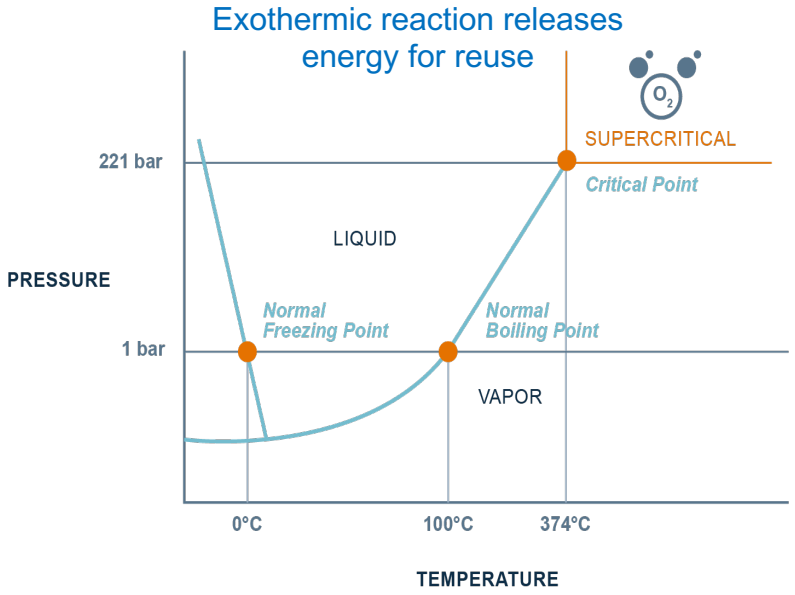


Key Challenges	Design Considerations
Higher TS and heterogeneous solids	Dilution, maceration, homogenization
Chemical conditioning toxicity	Acclimation, longer SRT, optimum SLR
Phase separation & stratification	Enhanced mixing & solids recirculation
Foaming and floating scum	Foam & scum management

CWT CALISKANER WATER TECHNOLOGIES

Supercritical Water Oxidation (SCWO)

Onsite Solids Destruction | Thermal Energy Recovery | Reduced Landfill Disposal

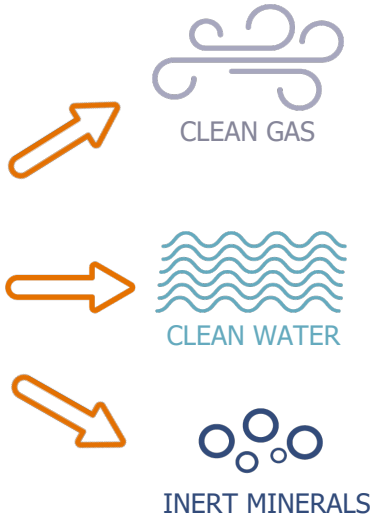




10-20% TS



Beyond The Dome (BTD) Inc



Ongoing Study

1. Reduces sludge volume and hauling costs by >90%
2. Destroys >99.9% of PFAS, plus microplastics, drugs, other toxins
3. Separates clean water and returns it to the plant
4. Exothermic oxidation enables thermal energy recovery for self-sufficient operation

CWT CALISKANER WATER TECHNOLOGIES

Courtesy Beyond The Dome (BTD) Inc

Key Takeaway

CAPTURE	CONCENTRATE	RECOVER	DECARBONIZE
Advanced Primary treatment Increases carbon & solids diversion Reduces OLR on bioreactors Reduces aeration energy	**Advanced solids thickening** Increases solids capture Higher filtrate quality, fit for secondary treatment	**Anaerobic Digestion / Supercritical Water Oxidation** Energy & resource recovery Reduces Landfill	**Lower energy & GHGs** Reduces emissions

Capture more carbon upstream → Concentrate solids efficiently → Recover energy and resources → Reduce energy demand and GHG emissions

CWT CALISKANER WATER TECHNOLOGIES

Acknowledgements

CALIFORNIA ENERGY COMMISSION

Linda County Water District

Committed to Providing Clean, Safe Water for All Our Residents

Technology Providers

AQUA-AEROBIC SYSTEMS, INC. A Metawater Company

TOMORROWATER

HUBER TECHNOLOGY WASTE WATER Solutions

PWTech PROCESS WASTEWATER TECHNOLOGIES LLC

SUMO dynamita PROCESS MODELING

beyond the dome

Komline Heron

Utility Partners

LOS ANGELES COUNTY SANITATION DISTRICTS *Converting Waste Into Resources*

SVCW Silicon Valley Clean Water

San Francisco Water Power Sewer Services of the San Francisco Public Utilities Commission

BACWA BAY AREA CLEAN WATER AGENCIES

Subject Matter Experts

AECOM

THE Water Research FOUNDATION

Prof. George Tchobanoglous (UC Davis)

Dr Harold Levrenz (UC Davis)

Prof. Diego Rosso (UC Irvine)



Thank you

Contact:

Himanshu Khuntia: himanshu@cwatertech.com

Onder Caliskaner: onder@cwatertech.com

SEPTEMBER 2026

CWT CALISKANER WATER TECHNOLOGIES