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Webinar

A Practical Guide to Specialty Coagulant Conversion - Drinking Water Treatment

LEADERS IN CLEAN WATER SOLUTIONS

Agenda

1. USALCO Company Profile
2. Coagulant Chemistry
3. Concept - Filterability
4. Concept – Injection Point Optimization
5. Concept – Water Sample Collection for Jar Testing
6. Case Study – San Patricio MWD
7. Questions

Zero Incidents. Zero Accidents. Zero Environmental Releases

More than a nice slogan, USALCO has built a systematic framework to clarify our sustainability goals and keep us focused on progress.

This framework encourages us to carefully evaluate each facility, product and workflow in our company – from raw materials through production and delivery. As we track progress, we continue to drive deeper engagement across our company and supply chains.

Our ESG efforts don't stop at our doors.
Our technical teams engage with customers to help them:

- Use our products more efficiently
- Find new ways to improve their efficiency performance
- Reduce our joint environmental impact

VISION

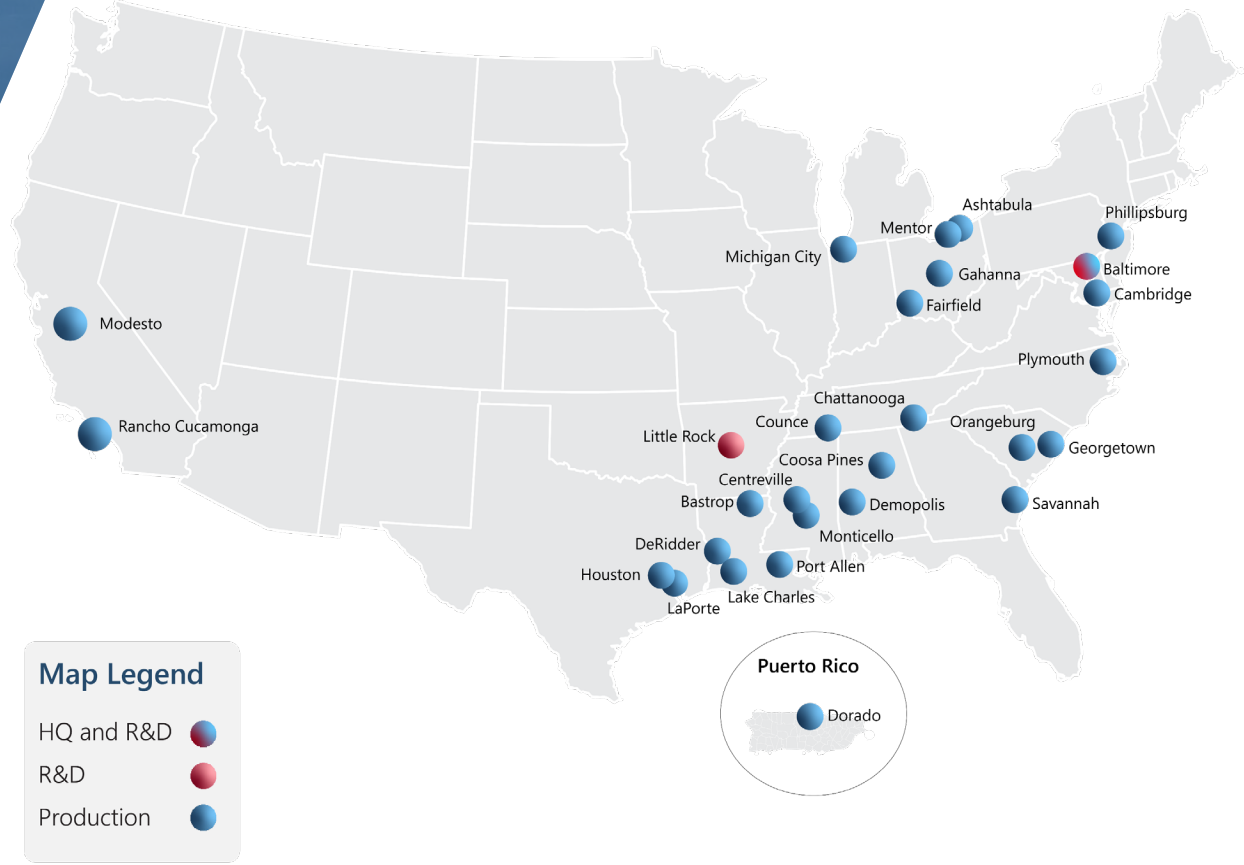
Develop, make, and deliver great water treatment solutions for a cleaner more sustainable future

MISSION

Be a force for good – enrich the lives of our stakeholders and communities by helping to address America's need for clean water

VALUES

Safety, Integrity, Customer-Focus, Teamwork, Innovation, Results, Respect for People



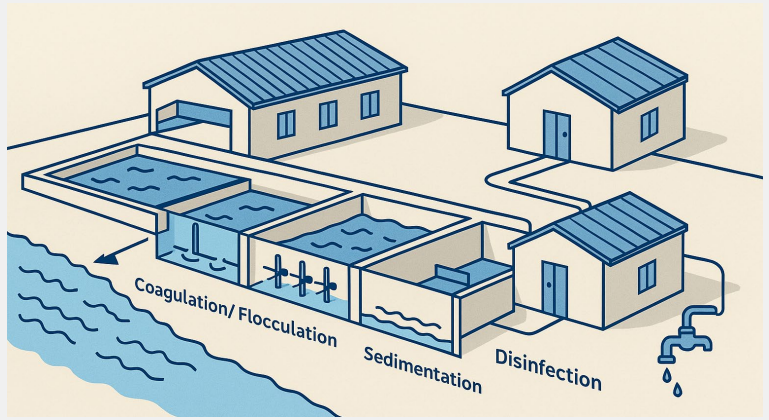
27+7
Locations

500+
Total associates

130M+
Lives impacted

70,000+
Annual deliveries

Leading Water Treatment Facilities Trust USALCO to Deliver Solutions in Coagulation, Filtration, Process Control and Expertise



Key Aspects	USALCO's Offering	Resulting In
Coagulation Filtration	Industry-leading Coagulant Portfolio Filter Media Cleaning	Maximize facility production Lower Maintenance Lower Energy Consumption Lower Sludge Disposal Costs Reduce pH control cost 24/7 Optimal dosing Reduced CO_2 from Freight Fewer deliveries Process Resiliency
Biological Nutrient Removal		
Disinfection		
Chemical Process Control Operating Personnel	CoPilot™ Automated Coagulant Dosing Tank Telemetry Expert Support and Training	

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DelPAC® UltraPAC ® G-PAC™

Delta-Floc® UltraFLOC ®

Aluminum Coagulants

- Sulfated Polyaluminum Chloride
- Polyaluminum Chloride
- Aluminum Chlorohydrate
- Aluminum Chloride
- Aluminum Sulfate
- Dry Aluminum Sulfate
- Sodium Aluminate

Iron Coagulants

- Ferric Sulfate 10%
- Ferric Sulfate 12%
- Ferric Sulfate 13%
- Ferric Chloride 40%
- Ferrous Sulfate 5%
- Ferrous Sulfate 7%
- Ferrous Chloride

Polymers

- Melamine Resins
- Polyamine (epiamines)
- PolyDADMAC

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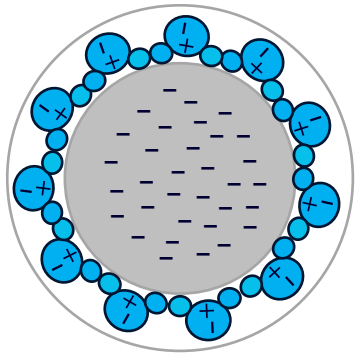
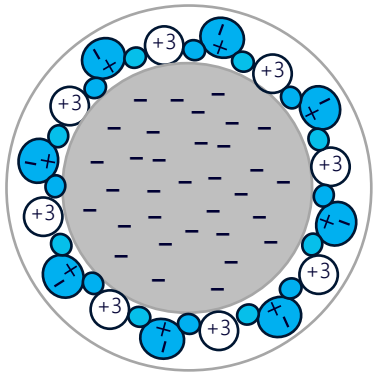
Coagulant Chemistry

Charge Neutralization

- Increasing the kinetic energy can overcome the barrier.
- Lowering or neutralizing the charge of the DDL reduces the size of the energy barrier.
- Adding ions with higher charge which are denser and take up less area allows more ions, and therefore more charge to fit into the Stern zone.

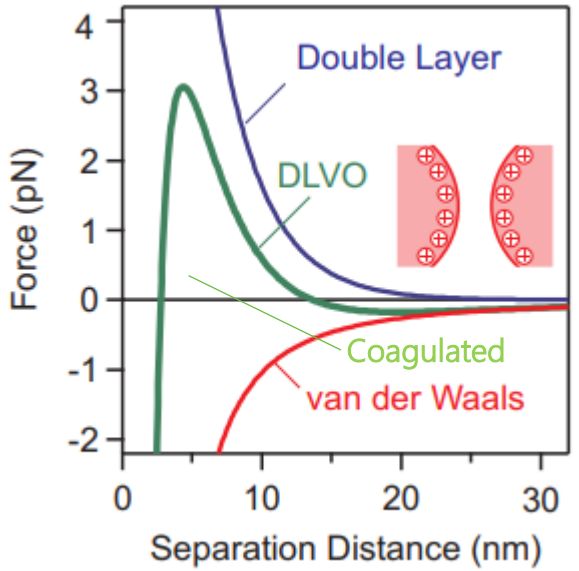




$-33+(12 \times {}^{+}\tfrac{1}{2})=-21$

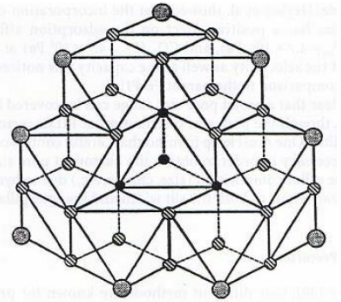
$-33+(8 \times {}^{+}3)+(8 \times {}^{+}\tfrac{1}{2})=-5$

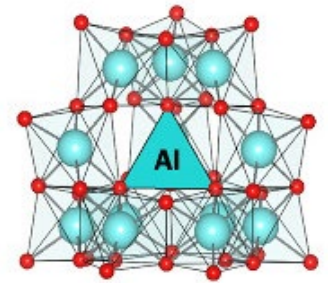
- Coagulation is the process of adding chemicals that form positive ions of high charge density to lower the surface charge of colloids and destabilize them by reducing the repulsive energy barrier of the double layer.



Overview of DLVO Theory
Gregor Trefalt and Michal Borkovec
Email. gregor.trefalt@unige.ch, michal.borkovec@unige.ch
September 29, 2014
Direct link www.colloid.ch/dlvo

Basicity and Polyaluminum Chloride (PAC) chemistry





- Basicity is the degree of hydroxide substitution on the aluminum in PAC products.
- It can be thought of as aluminum with alkalinity already added.
- PACs contain a distribution of aluminum polymer compounds which form highly charged cations like $Al_2(OH)_2^{4+}$, $Al_2(OH)_4^{2+}$, $Al_3(OH)_4^{5+}$, $Al_3(OH)_6^{3+}$, and $AlO_4Al_{12}(OH)_{24}(H_2O)_{12}^{7+}$.
- As a rule of thumb, the higher the basicity the more polymeric in nature the product is.
- Polymeric character adds structure which slows the reaction with alkalinity to form hydroxides allowing charge neutralization to occur longer.

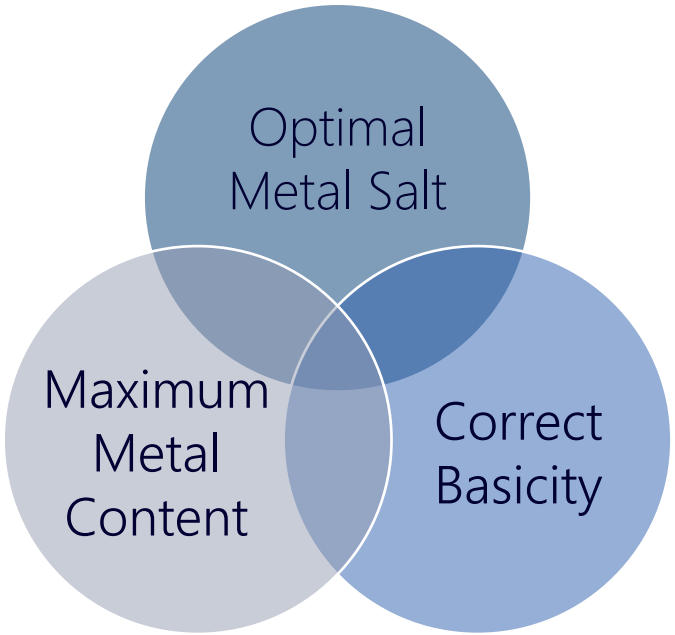
Basicity can be viewed on a horizontal scale

Al_2Cl_6	$Al_2(OH)_2Cl_4$	$Al_2(OH)_3Cl_3$	$Al_2(OH)_4Cl_2$	$Al_2(OH)_5Cl$	$Al_2(OH)_6$
0%	33%	50%	67%	83%	100%
↓	↓	↓	↓	↓	↓

ACS ----------PACs----------ACH-------$Al(OH)_3$

Treating Water Effectively Requires the right Coagulant
One size fits all approach is Inefficient

Three Key Components of Effective Coagulants



The Most Efficient Coagulant for the Application

Considered Panels of Products to Create best Overall

- Correct Basicity?
- Best Metal Salt?
- Maximize Metal Content

DelPAC®

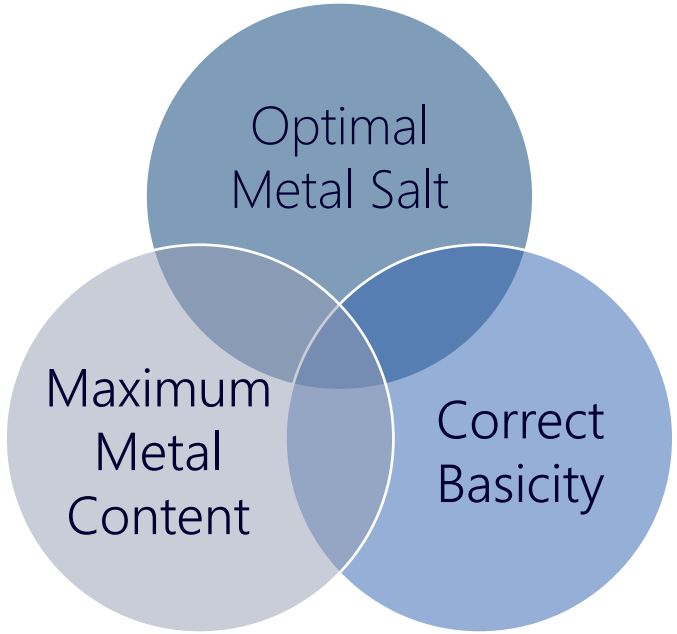
Delta-Floc®

Custom Tailored Coagulant

Core Products

Additional Components

Three Key Components of Effective Coagulants



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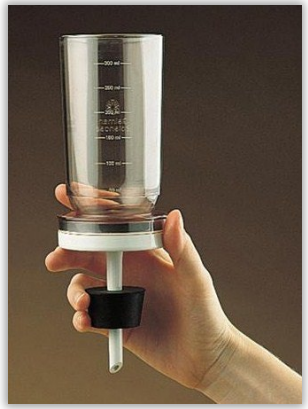
Filterability

Importance of Filterability

- What is Filterability? Scientific analysis
- Why Measure? To optimize coagulant for filtration, not only settling.
- Used to determine if filters may be over or under-charged



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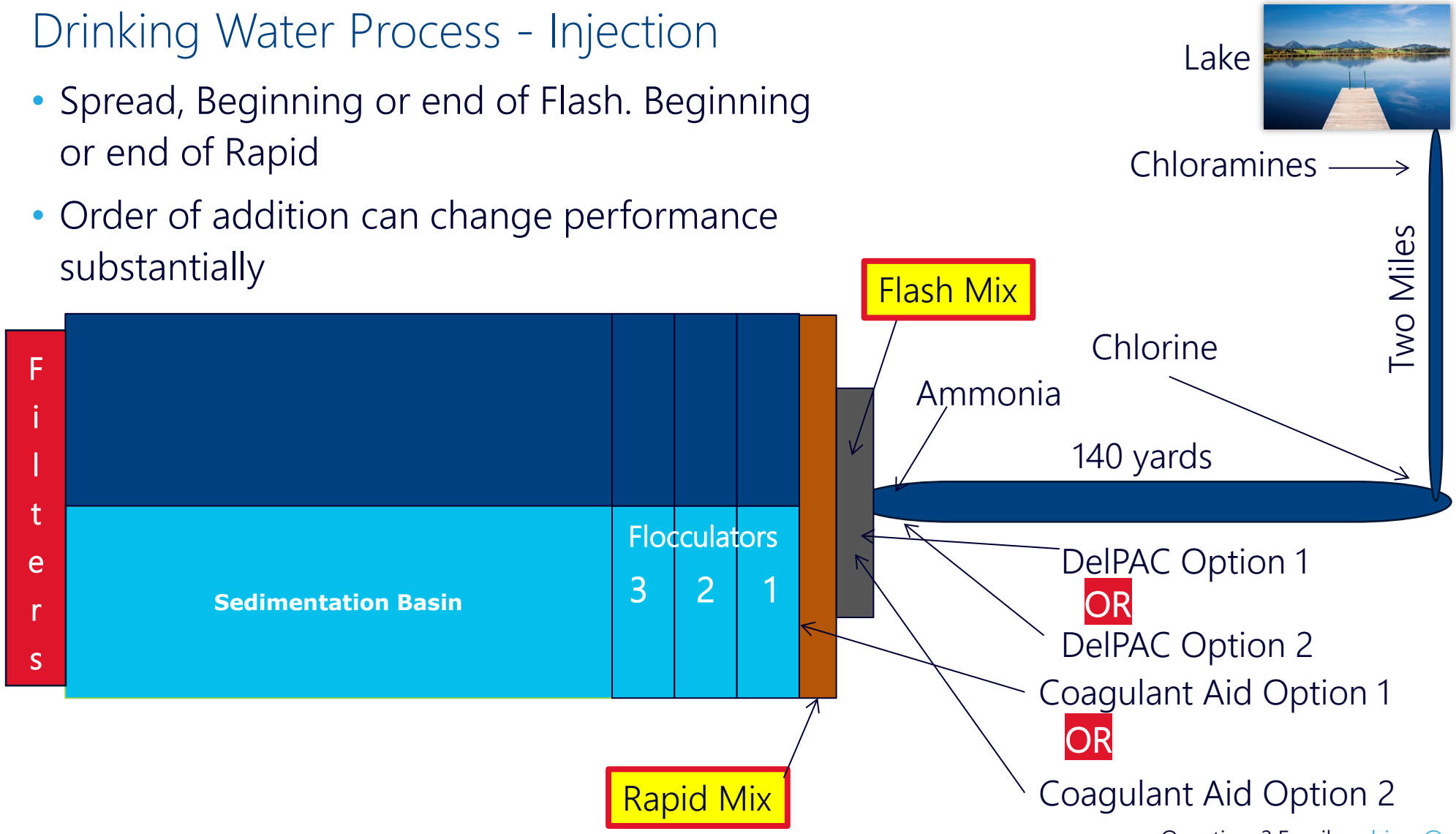
Injection Points & Sampling for Jar Testing

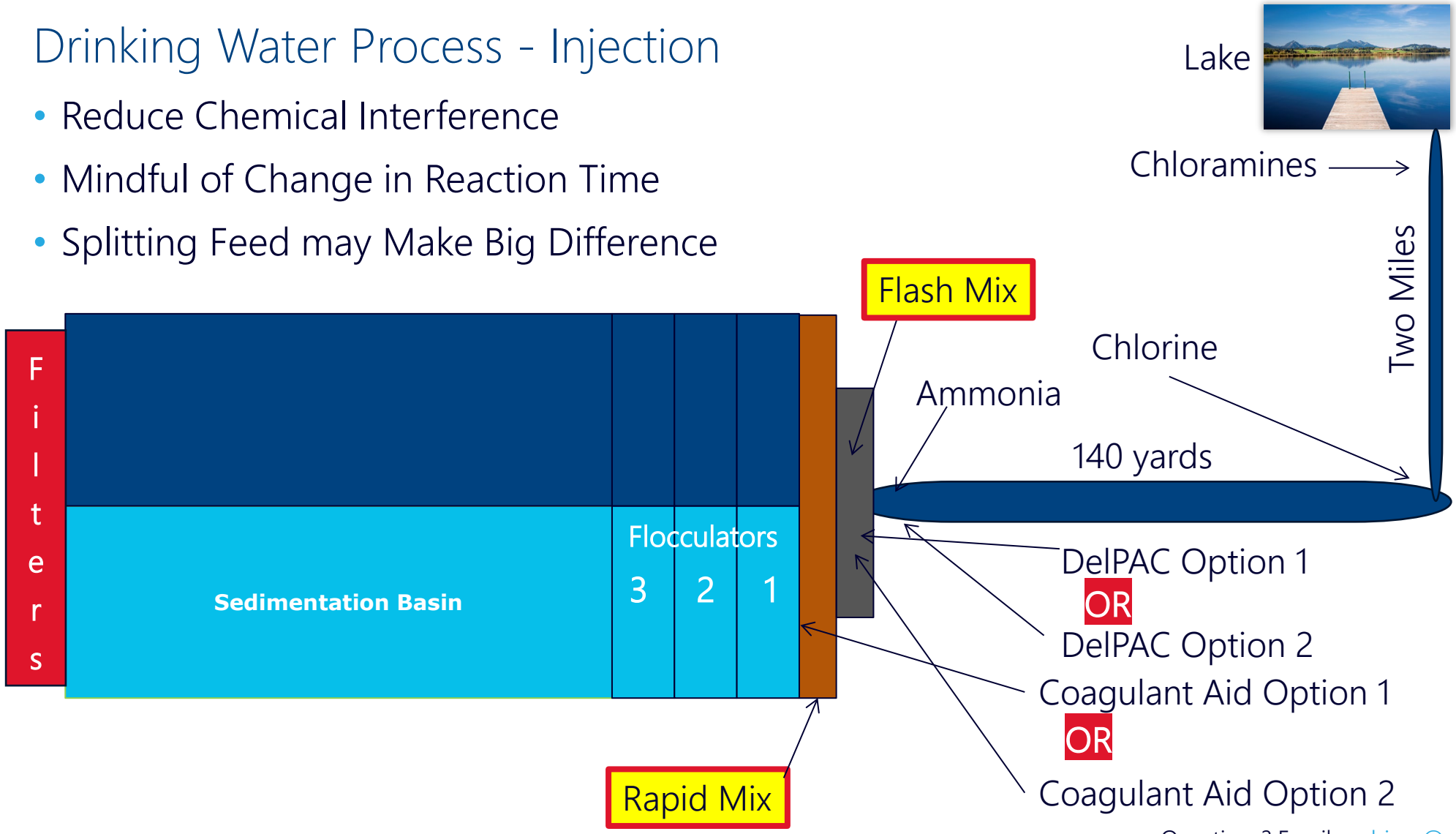
Drinking Water Process - Injection

- Spread, Beginning or end of Flash. Beginning or end of Rapid
- Order of addition can change performance substantially

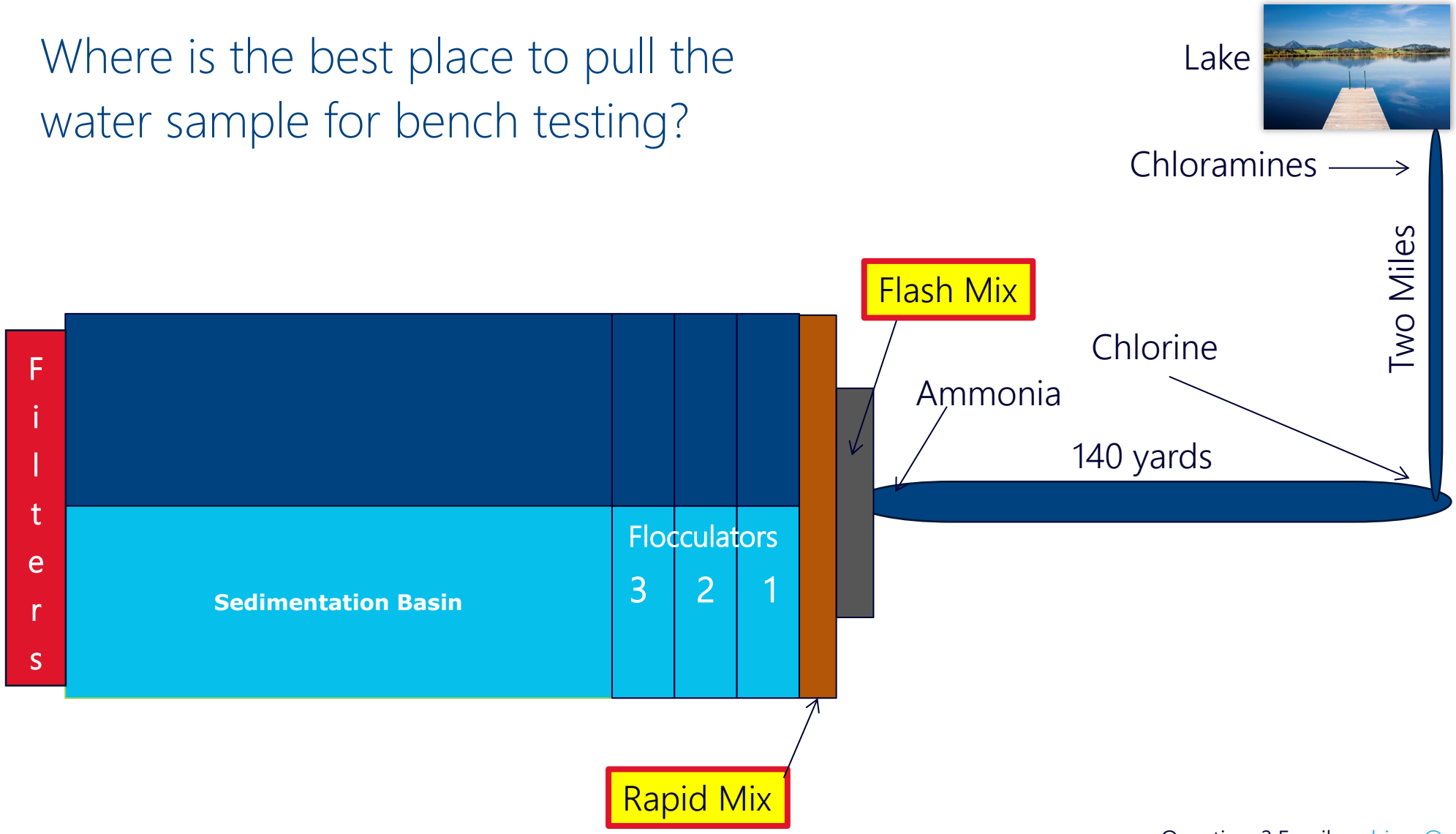


Drinking Water Process - Injection

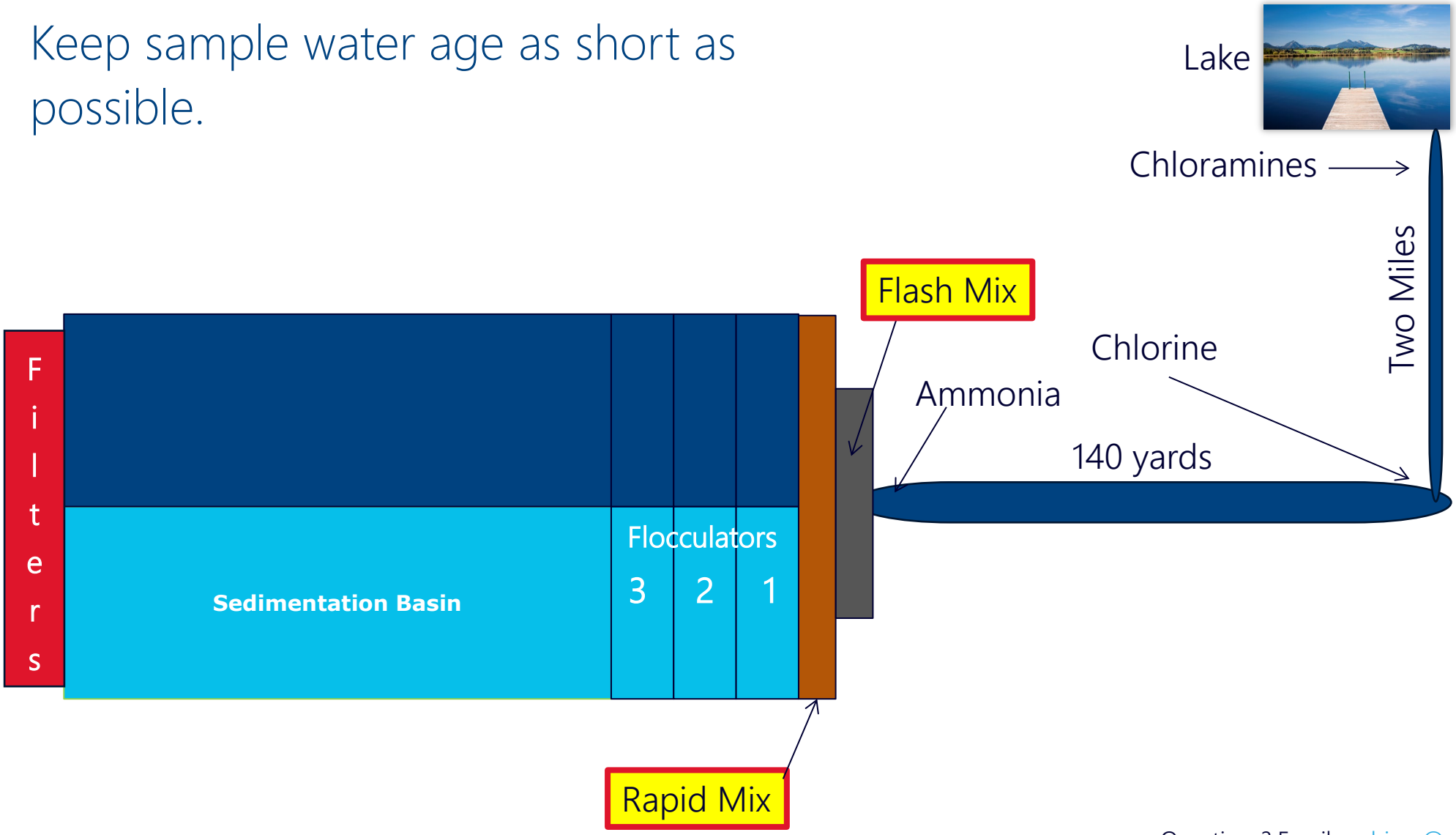
- Reduce Chemical Interference
- Mindful of Change in Reaction Time
- Splitting Feed may Make Big Difference



Where is the best place to pull the water sample for bench testing?



Keep sample water age as short as possible.



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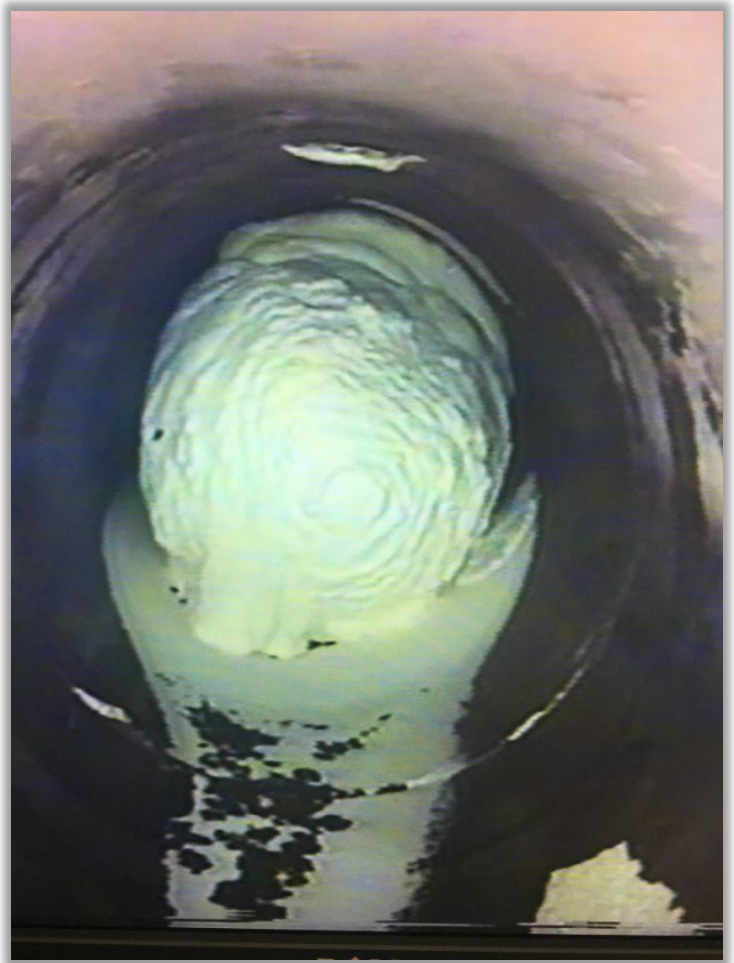
Case Study – PAC Conversion

Problem – Case Study Upgrading to a High-Performance Coagulant Reduces Caustic Soda Demand by 60%

Caustic Soda Injection

Plugging the Line



Discovery Process – Data Collection | Jar Testing

What defines a successful test?

Product needs to be equal or improve the following from current measurements

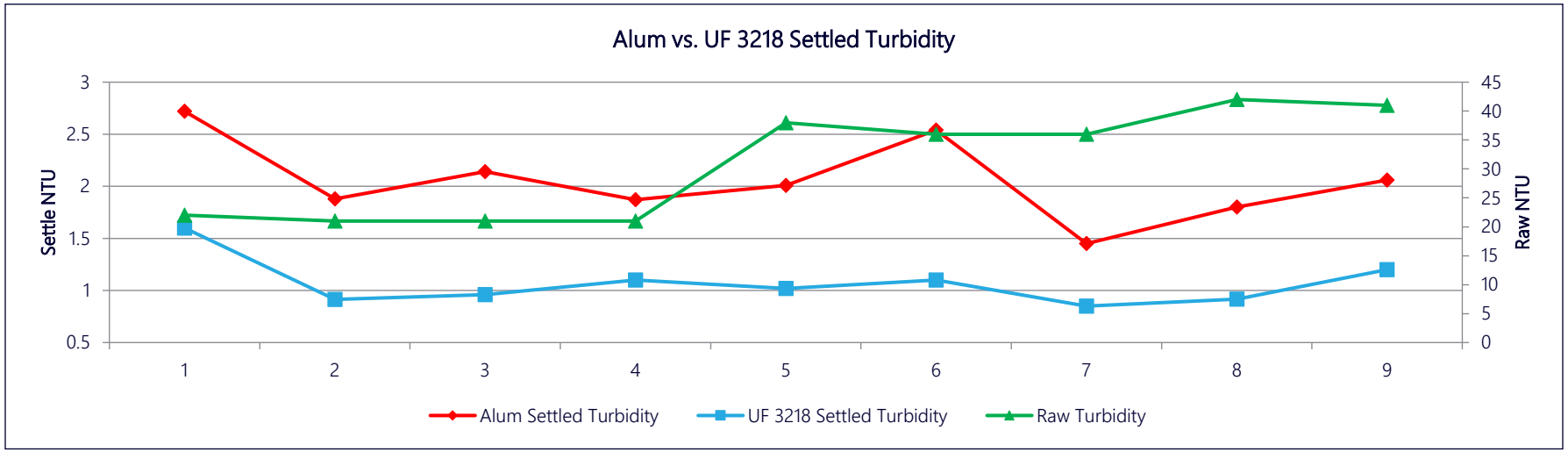
- Match current program in the Jars
- pH – Caustic Reduction
- Turbidity-NTU
- TOC Removal
- Membrane Performance
- Filter Run Time
- Sludge produced
- Safety
- Cost savings $$/MG

Which Jar is best?

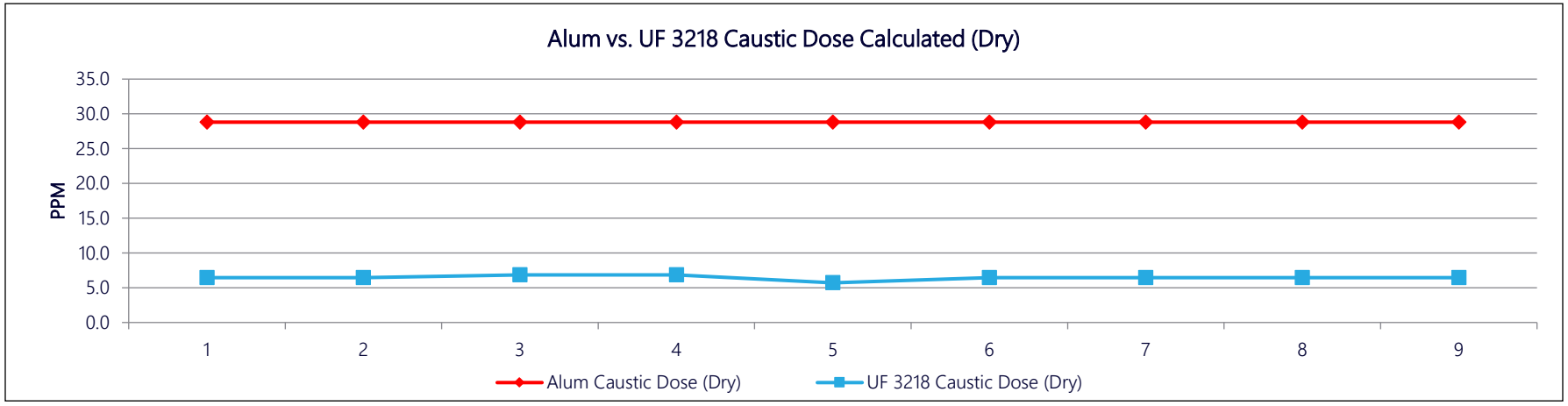
Alum, 2-minute settling

UF 3218, 2-minute settling

Jar Test Results

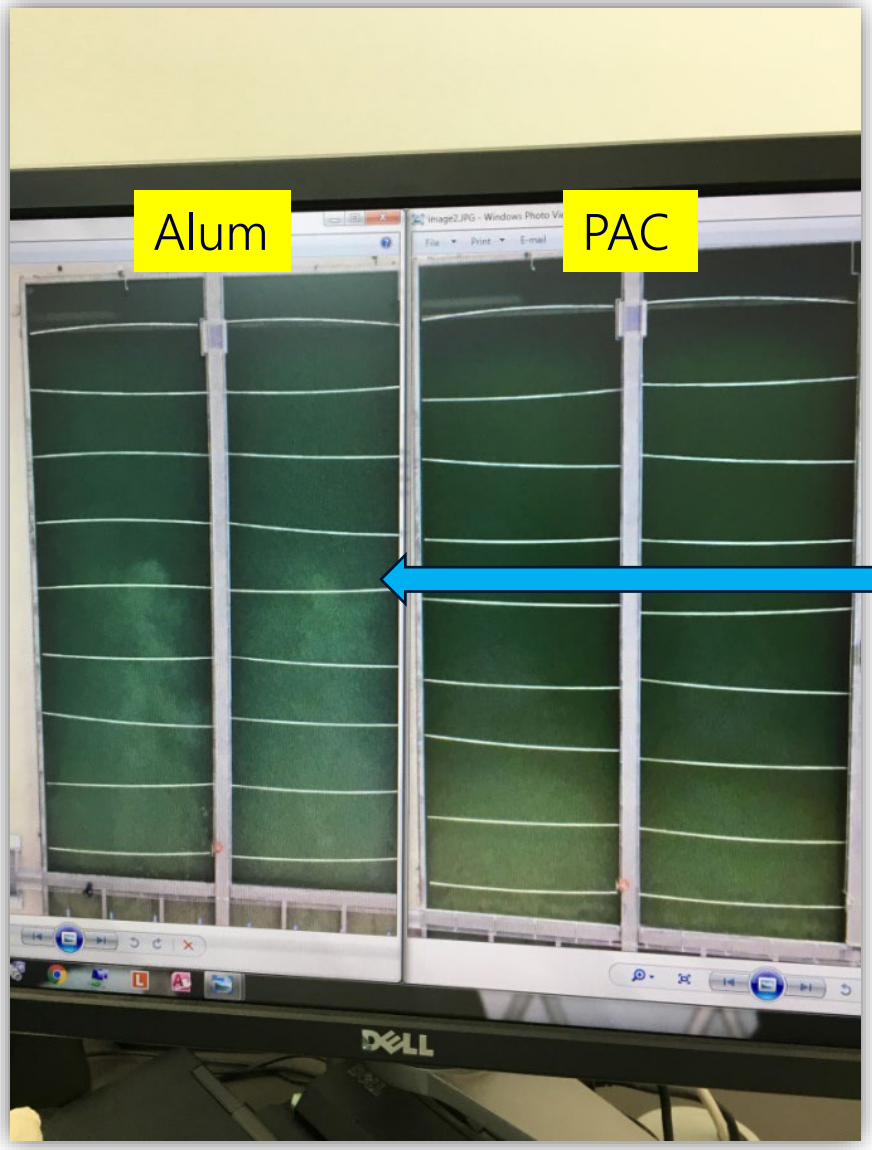


- Reduced Coagulant feed by 55% or a 15% reduction in Al2O3



- Reduced Caustic feed by 60%

Trial Results
Drone Aerial



Sedimentation Phase

Alum Settling

PAC Settling

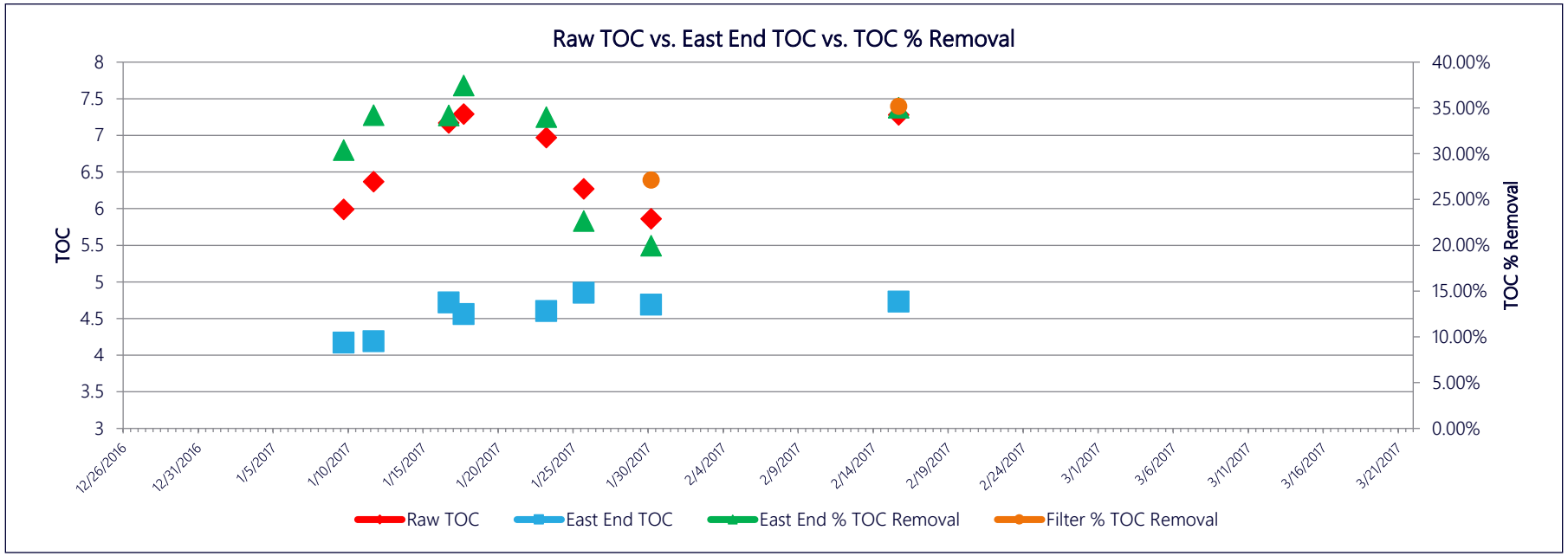
Flocculators

Trial Results - Increased flows and lower dosages were changed throughout the trial to imitate different scenarios

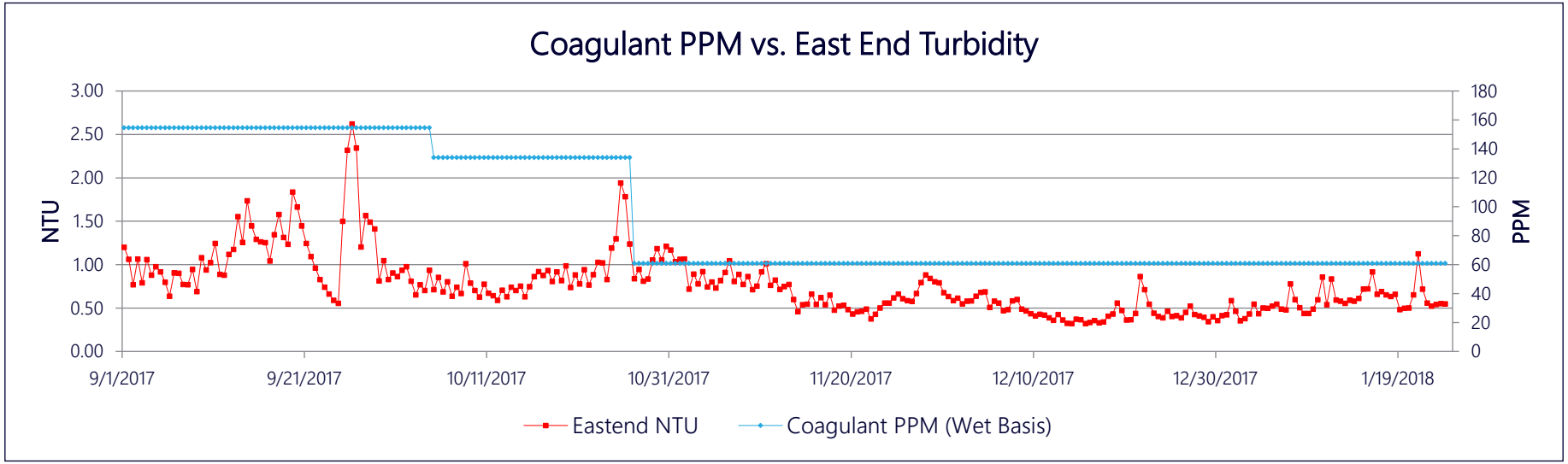
- Reduced caustic within 24 hrs
- Reduced settled water turbidity
- Lowered coagulant dose
- Exceeded TOC removal
- Lowered total treatment cost per MG

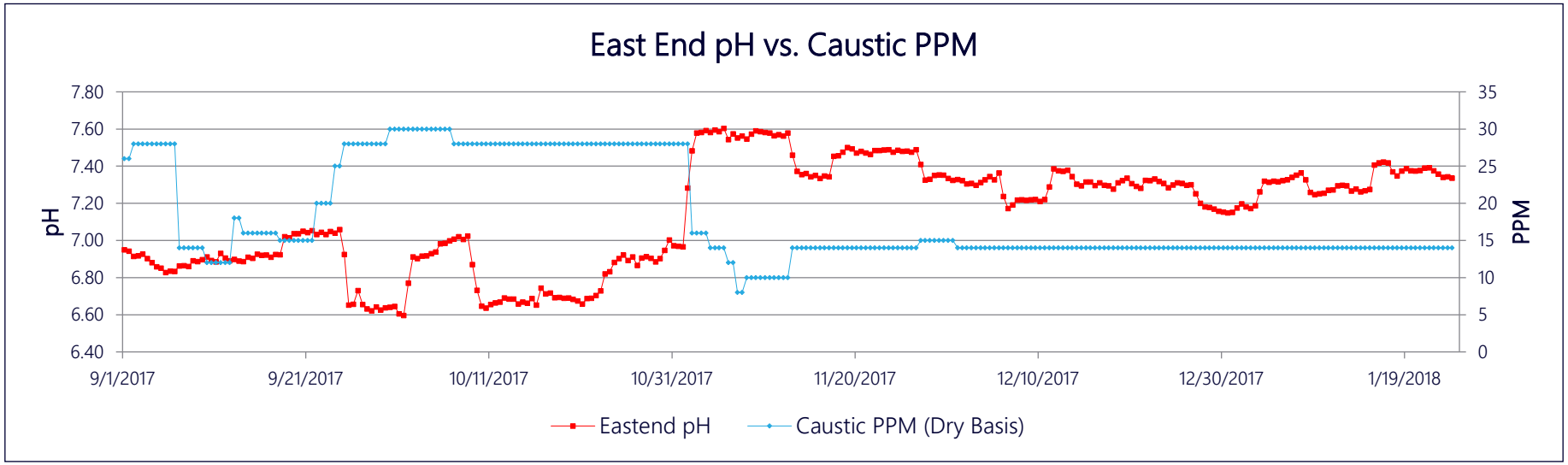
Trial Rental Tank

Organics Removal Performance



- The PAC met or beat the current Alum program
- The dose was continually lowered to see what the minimum required dose would be to meet EPA requirements
- Data shows on 1/30 that the TOC grabbed after the filters will beat the required removal at lower incoming raw TOC


Coagulant PPM vs. East End Turbidity
NTU
PPM
3.00
2.50
2.00
1.50
1.00
0.50
0.00
180
160
140
120
100
80
60
40
20
0
9/1/2017
9/21/2017
10/11/2017
10/31/2017
11/20/2017
12/10/2017
12/30/2017
1/19/2018
Eastend NTU
Coagulant PPM (Wet Basis)


East End pH vs. Caustic PPM
pH
PPM
7.80
7.60
7.40
7.20
7.00
6.80
6.60
6.40
35
30
25
20
15
10
5
0
9/1/2017
9/21/2017
10/11/2017
10/31/2017
11/20/2017
12/10/2017
12/30/2017
1/19/2018
Eastend pH
Caustic PPM (Dry Basis)

Following the Conversion PAC:

- Reduced Caustic feed by 60%
- Reduced settled water turbidity
- Reduced Coagulant feed by 55%
- Reduced metal salts/sludge generation by 15%+
- Met EPA required TOC removal by beating the current Alum program
- Reduced costs
- Affiliated

Thank You for Tuning In!

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