History of Coagulation Control

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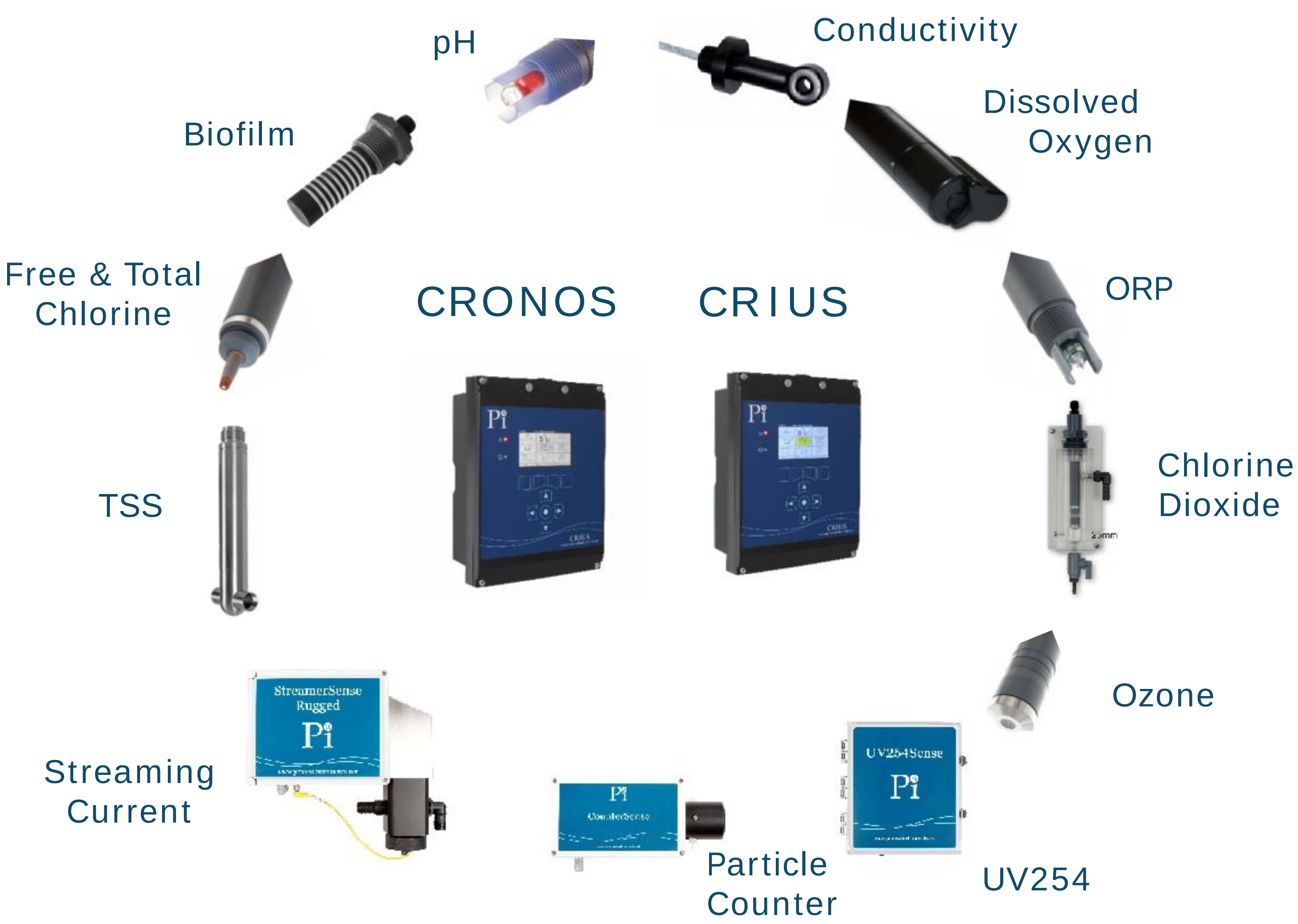
About Us


pH
Conductivity
Biofilm
Dissolved Oxygen
Free & Total Chlorine
CRONOS
CRIUS
ORP
TSS
Chlorine Dioxide
Ozone
StreamerSense Rugged
Streaming Current
CounterSense
Particle Counter
UV254Sense
UV254

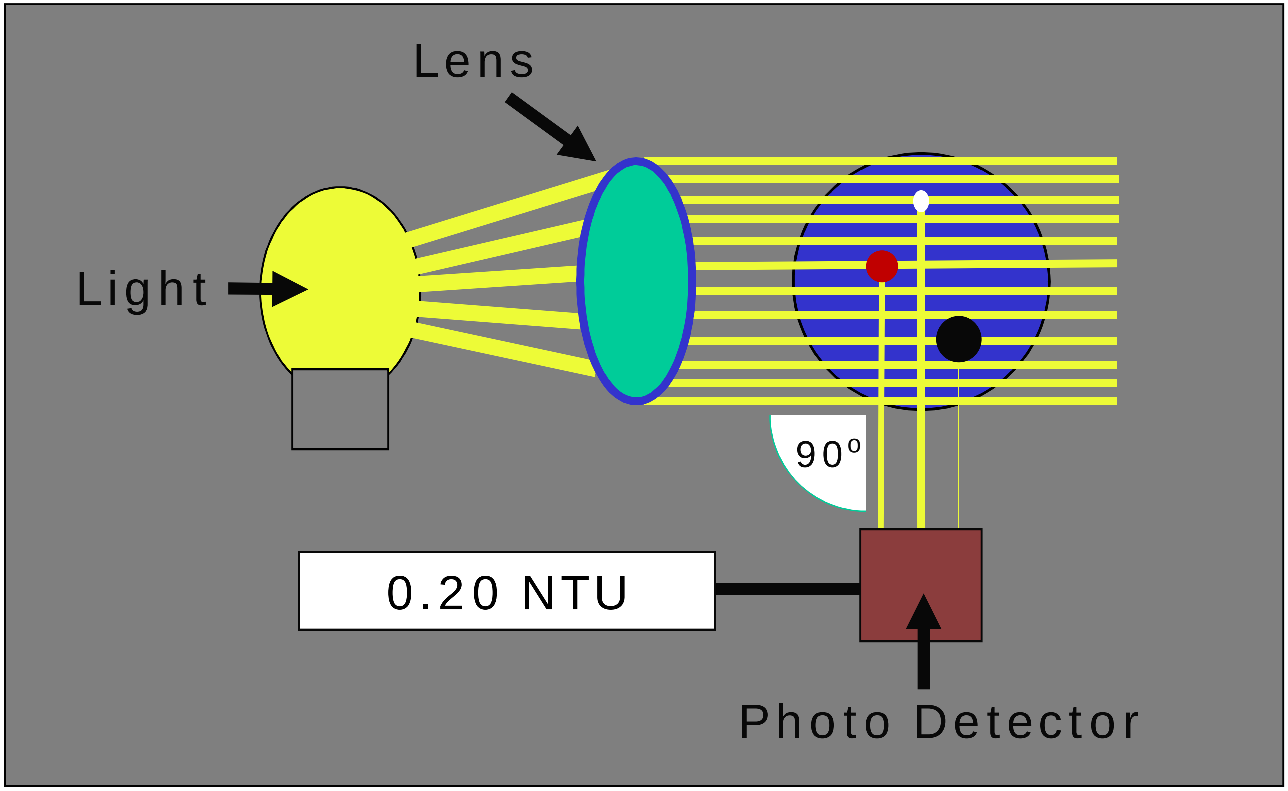
History of Coagulation Control

- Decades of experience has shown us there is no “one size fits all solution”.
- Every technology/parameter has an Achilles heel.
- To determine the best solution for a given WTP, this requires careful assessment by those knowledgeable with available control technology and who really understand the complexities of coagulation.

Option #1

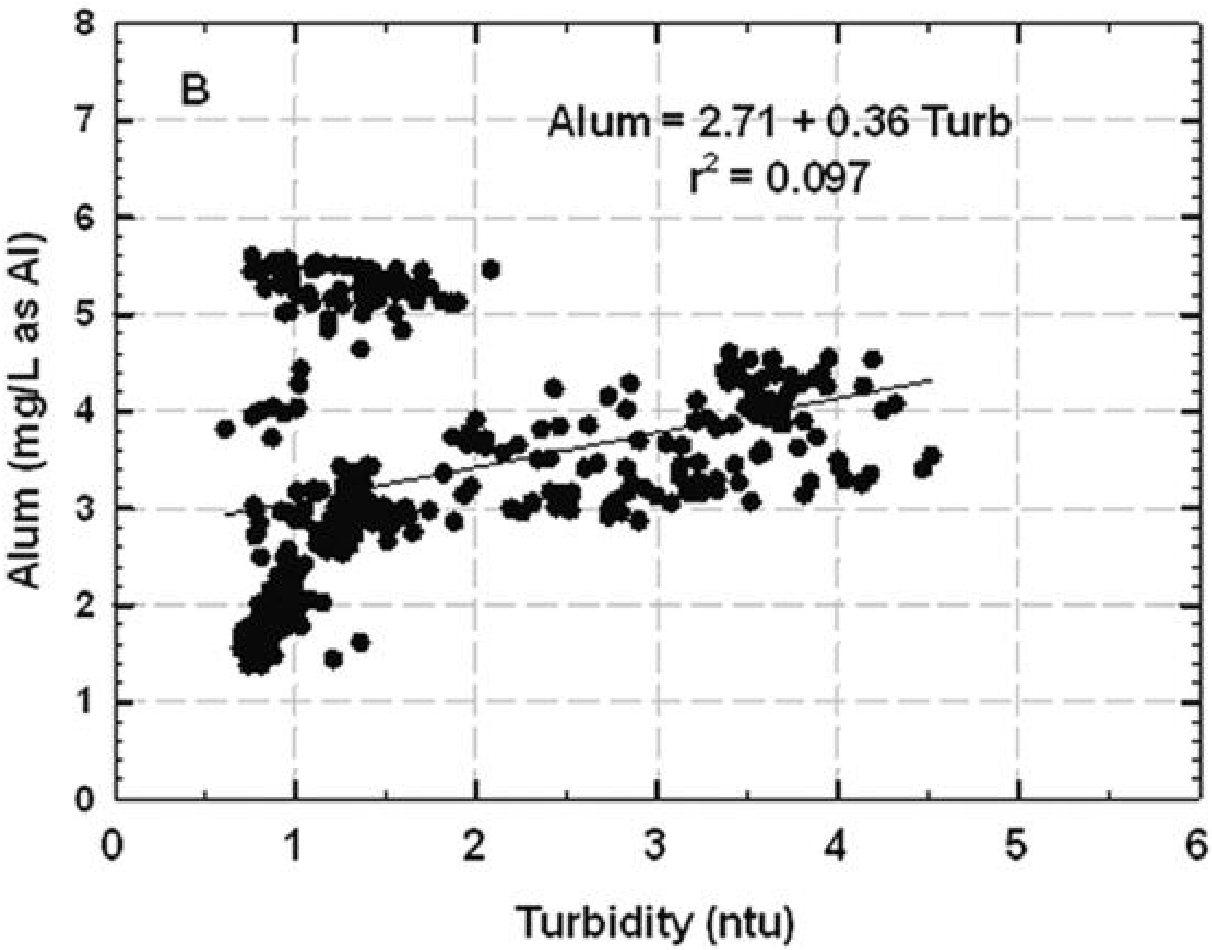
Online Turbidity

Turbidity (Light Scatter)

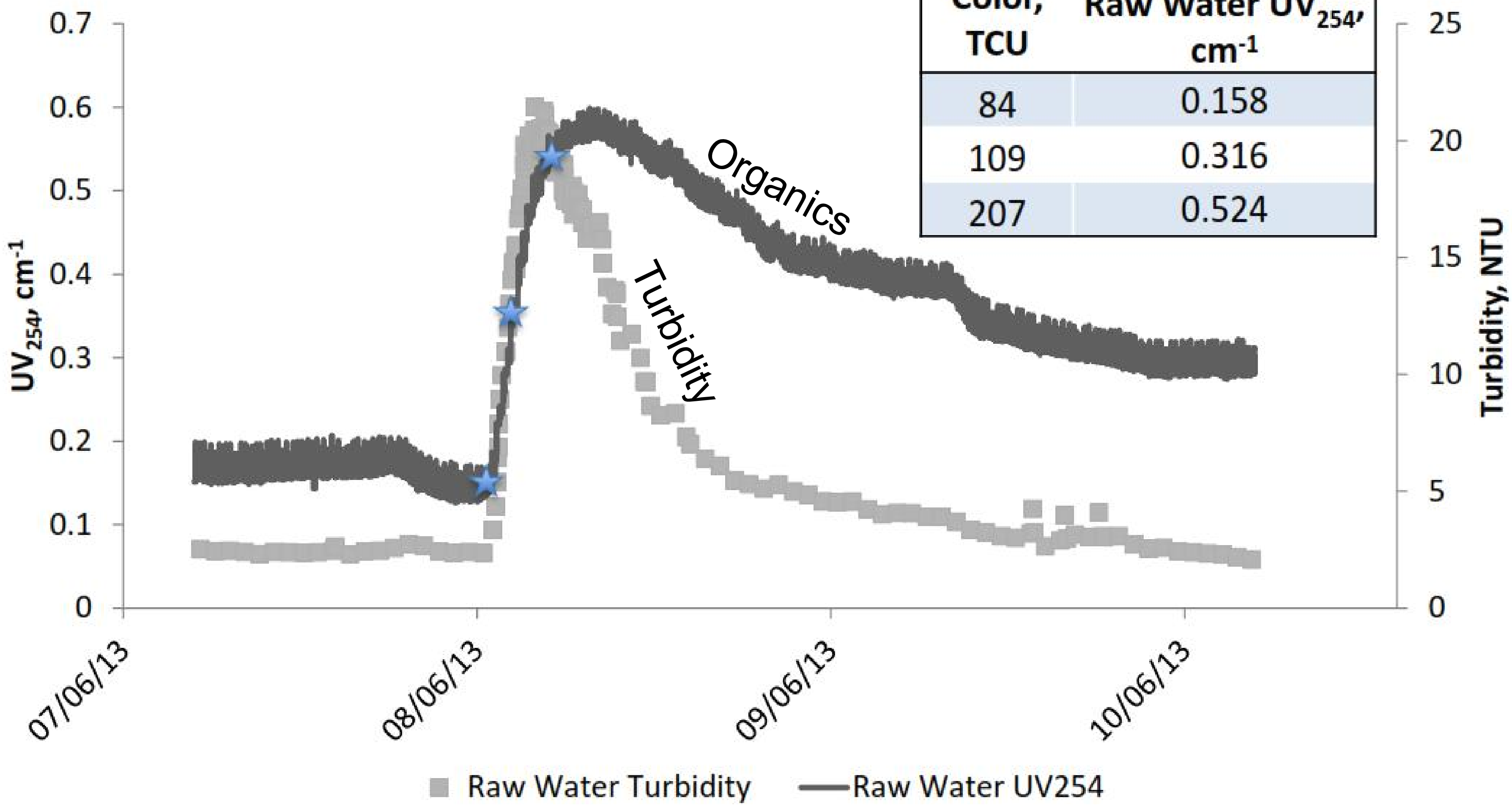


Turbidity

- Correlations between raw water NTU and coagulant dosage typically not reliable



Turbidity & Organics Don't Go Hand In Hand



Color, TCU	Raw Water UV_{254}, cm^{-1}
84	0.158
109	0.316
207	0.524

Turbidity

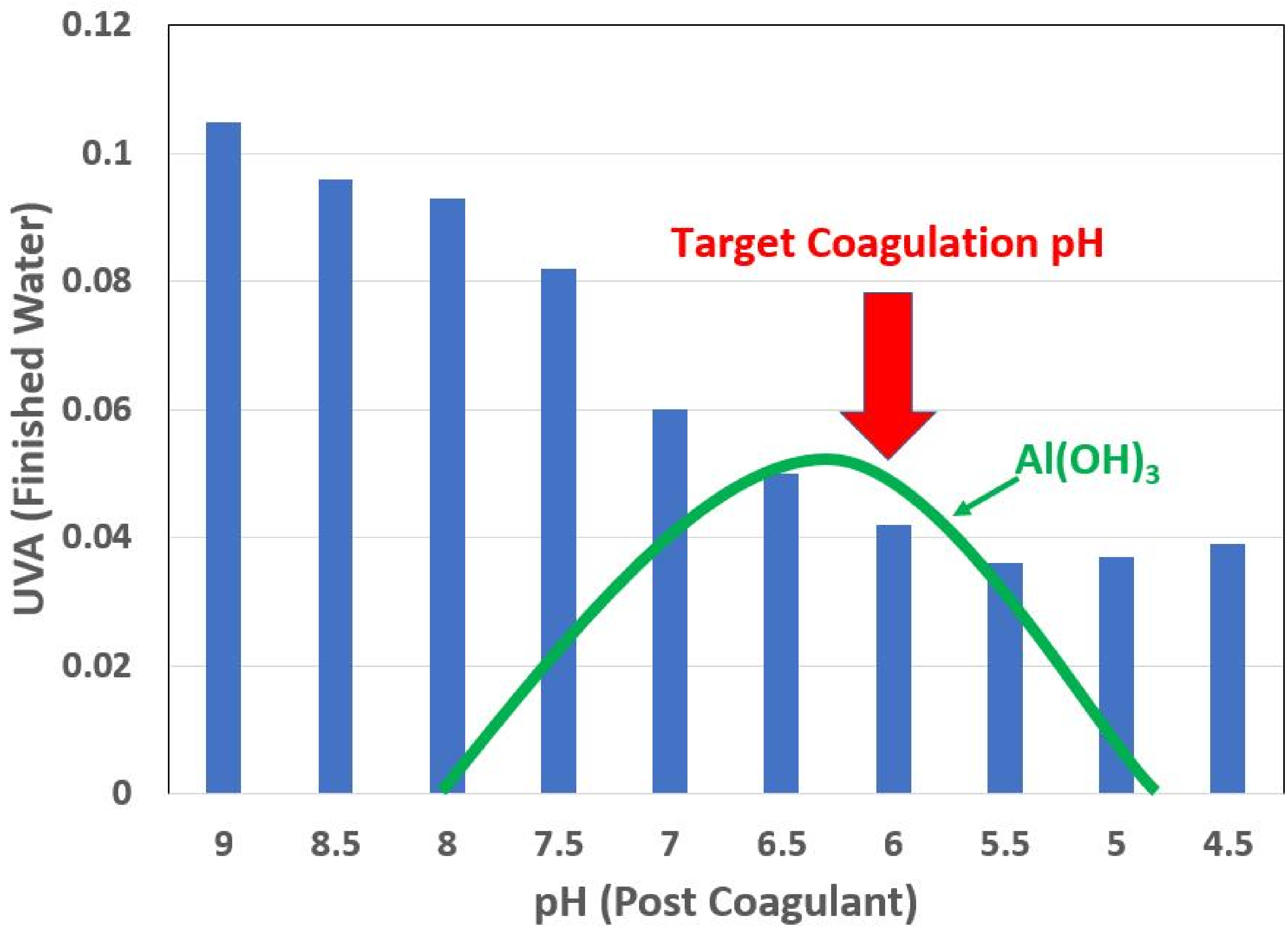
- Correlations between raw water turbidity and coagulant dosage have rarely proven reliable because Organics (TOC) bigger factor in many cases.

- Potentially suitable for low TOC waters or applications not concerned with organics reduction.

Option #2

Online pH

pH for Coagulant Control?



pH for Coagulant Control?

- pH is very important to good coagulation outcomes, but can't be used to determine "optimum" dosage.
- Coagulant demand determined by other factors that don't follow raw water pH and alkalinity (e.g. TOC and Turbidity).
- Can lead to excessive overfeed and sludge generation, higher residual Aluminium, and shorter filter run times.

Option #3

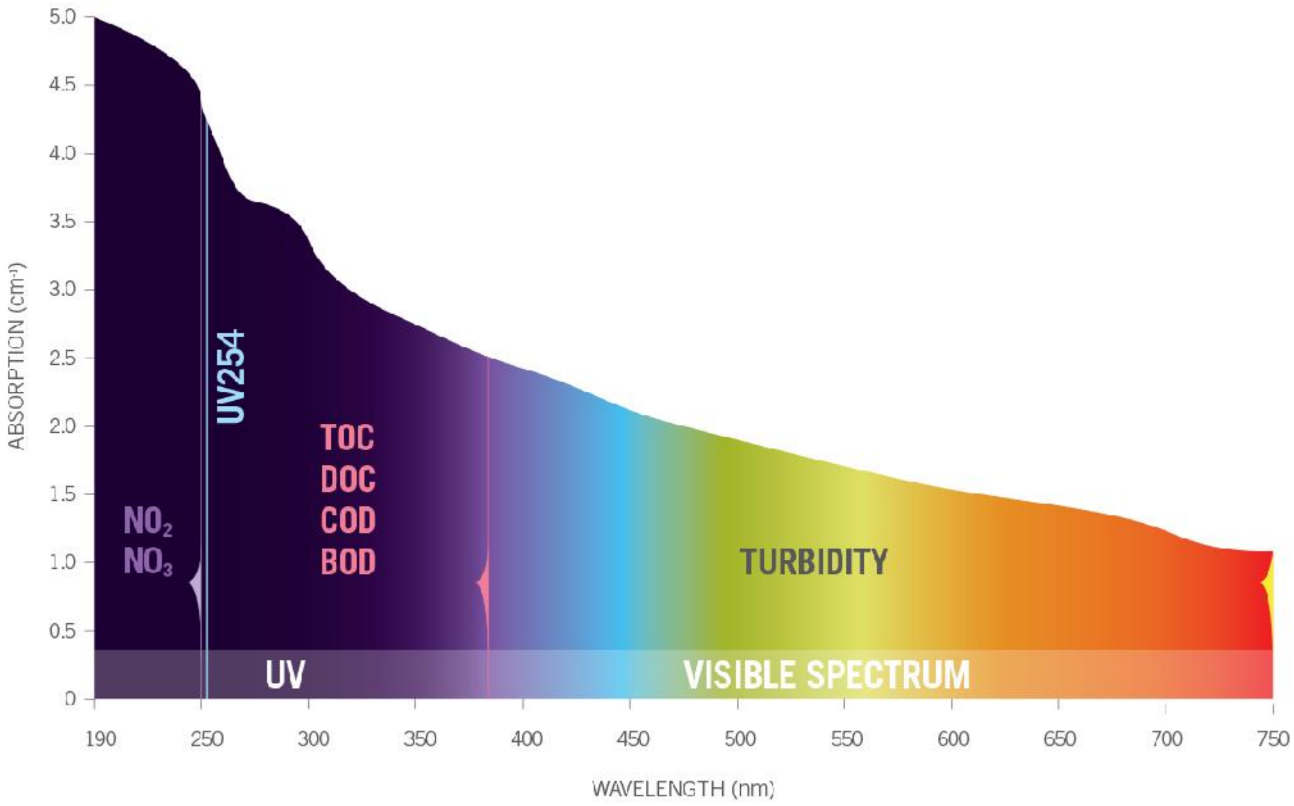
TOC/Colour/UVA Organics

Organics

- Natural Organic Matter (NOM) generally determines coagulant dosage because it has 10 to 100 times more charge density than inorganic particles.
- NOM combines with chorine to form DBPs. The amount of DBP precursors will vary from source to source and from season to season.
- A big driver for automatic coagulation control is to improve removal of the Organics to prevent DBPs
- This understanding has led an increasing number of WTP’s to look at TOC and surrogate measurements as a way to optimize coagulant dosing.

Colour

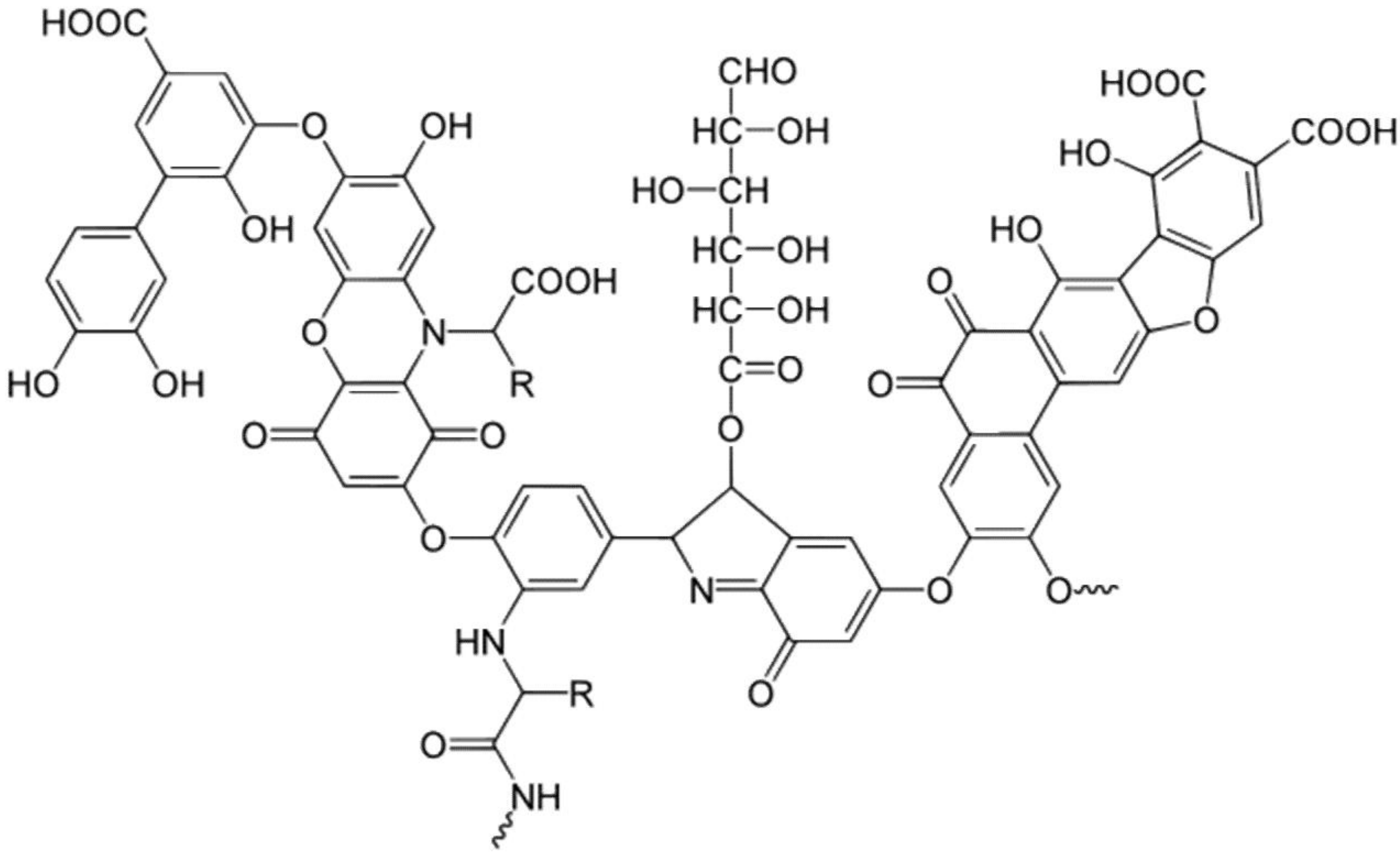
- Colour is a good measure of the water aesthetics, but not a reliable surrogate for TOC.
- But UVA/UVT is a better surrogate for the specific faction of TOC that is particularly troublesome in terms of DBP formation.



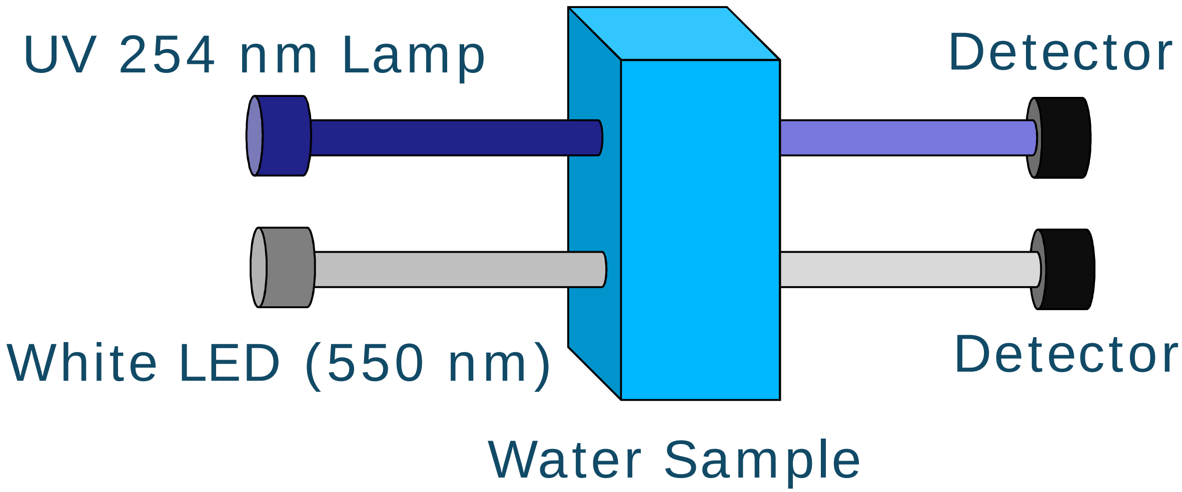
TOC Analysers

- TOC has a good track record for correlating to coagulant dosage.
- However, TOC analysers are expensive to purchase (>€30K), and also expensive and difficult to maintain.
- Simpler, and more affordable options are UV254 transmission (UVT) or absorbance (UVA) or colour measurement.

Aromatic Organics



UV254 (UVA/UVT)



Organics Free Water = 100% UVT / 0.000 UVA

Aromatic Organics ↑ UVT ↓ UVA ↑

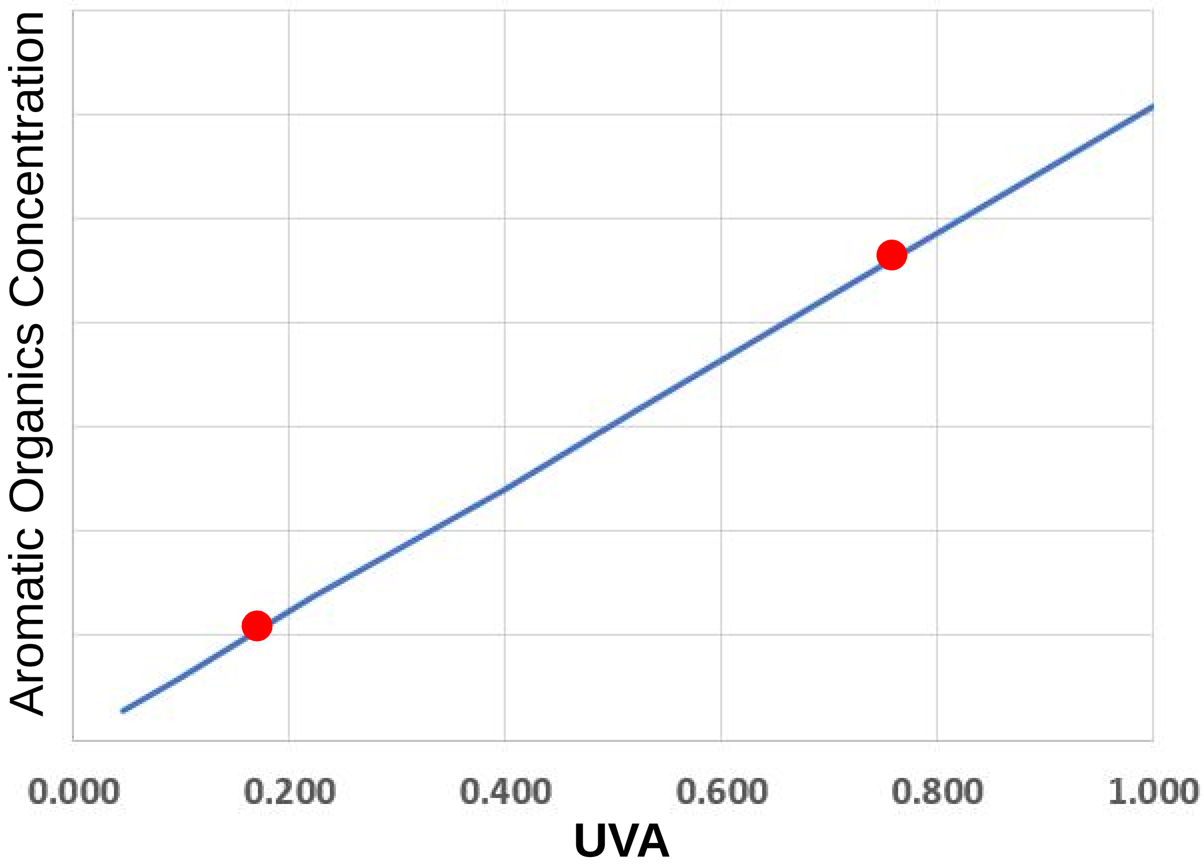
Or

Turbidity

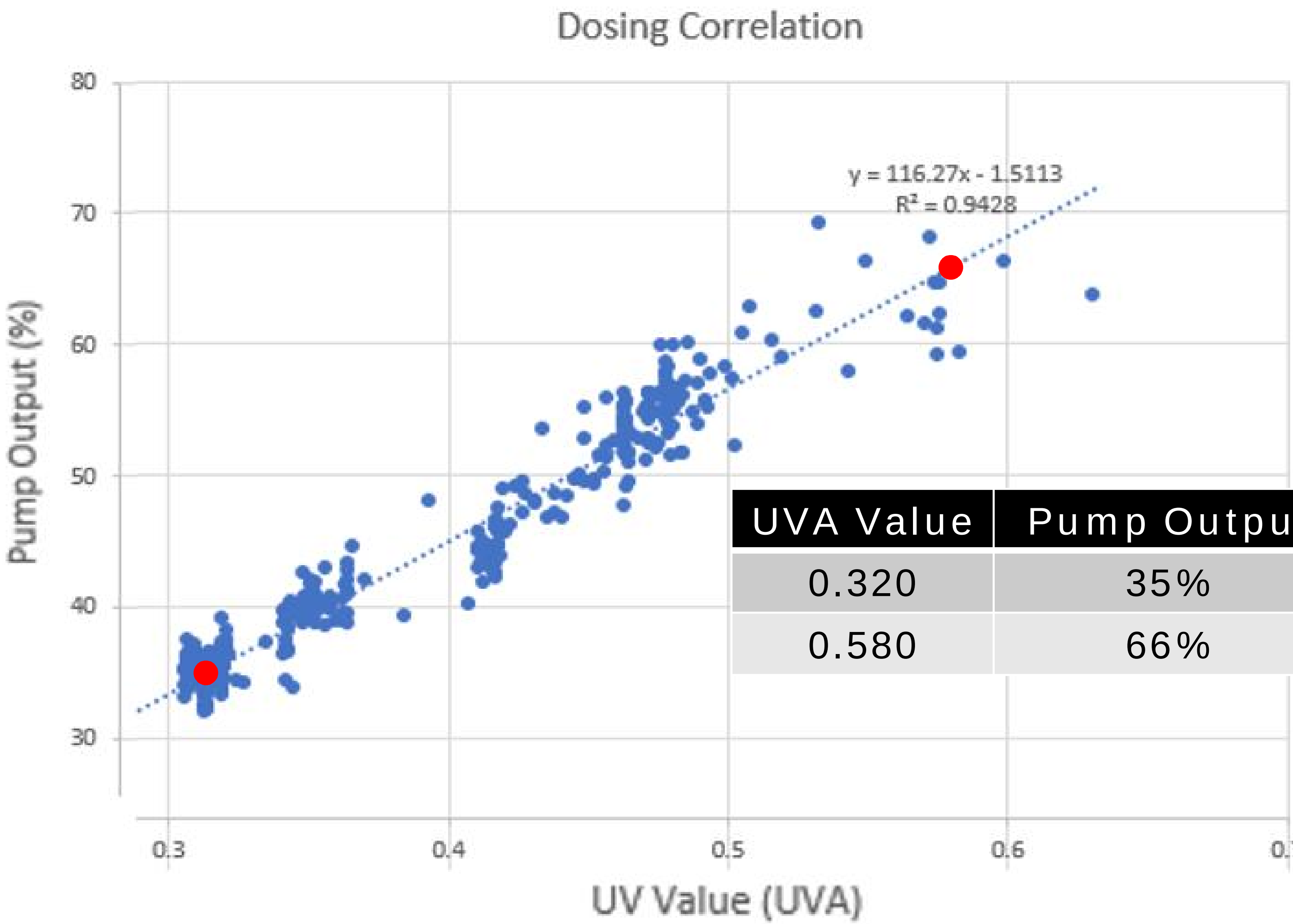
70% UVT 0.155 UVA

UV Absorbance

$$UVA = 2 - \log_{10} UVT$$



Plant B Dosing Correlation



UVA Value	Pump Output
0.320	35%
0.580	66%

UV254 Analysers (the good)

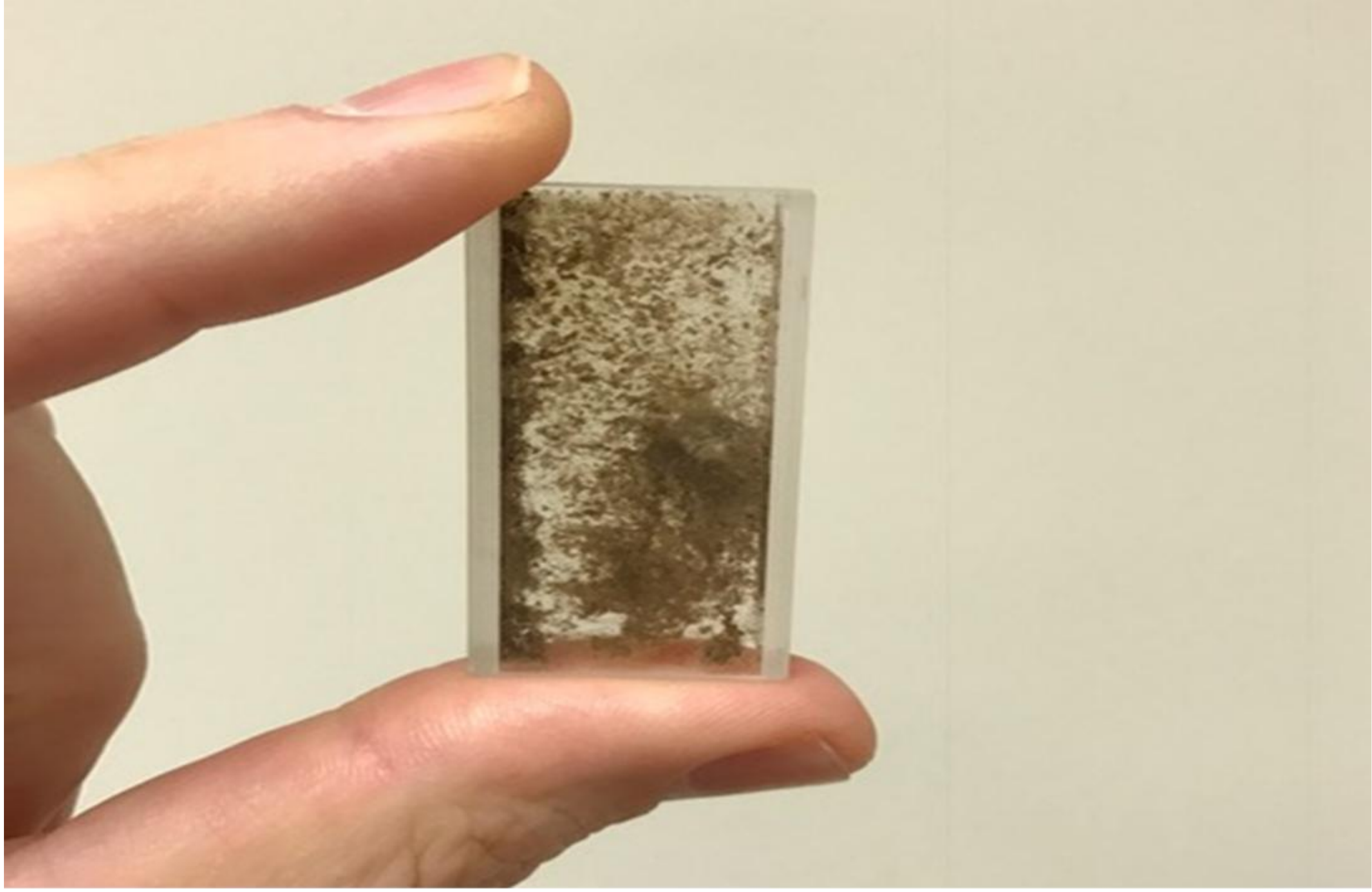
- Affordable (€7k) and easy to maintain (in comparison to TOC analysers).
- Correlations can be made using jar tests (but be careful!).
- Helps explain why SCM is making dosage adjustments when NTU is not changing.

UV254 Analysers (the not so good)

- Not good for higher NTU waters (>8 NTU).
- Feed forward (predictive) control, not a direct measurement of the coagulant performance.
- Not all source water contamination which creates demand for coagulant will absorb 254nm light.
- Seasonal variation, storm events, and switching raw water sources can change the makeup of the organics and therefore the correlation.

UV254 Analysers (the not so good)

- Optical Measurement – Bubbles, Condensation, Fouling

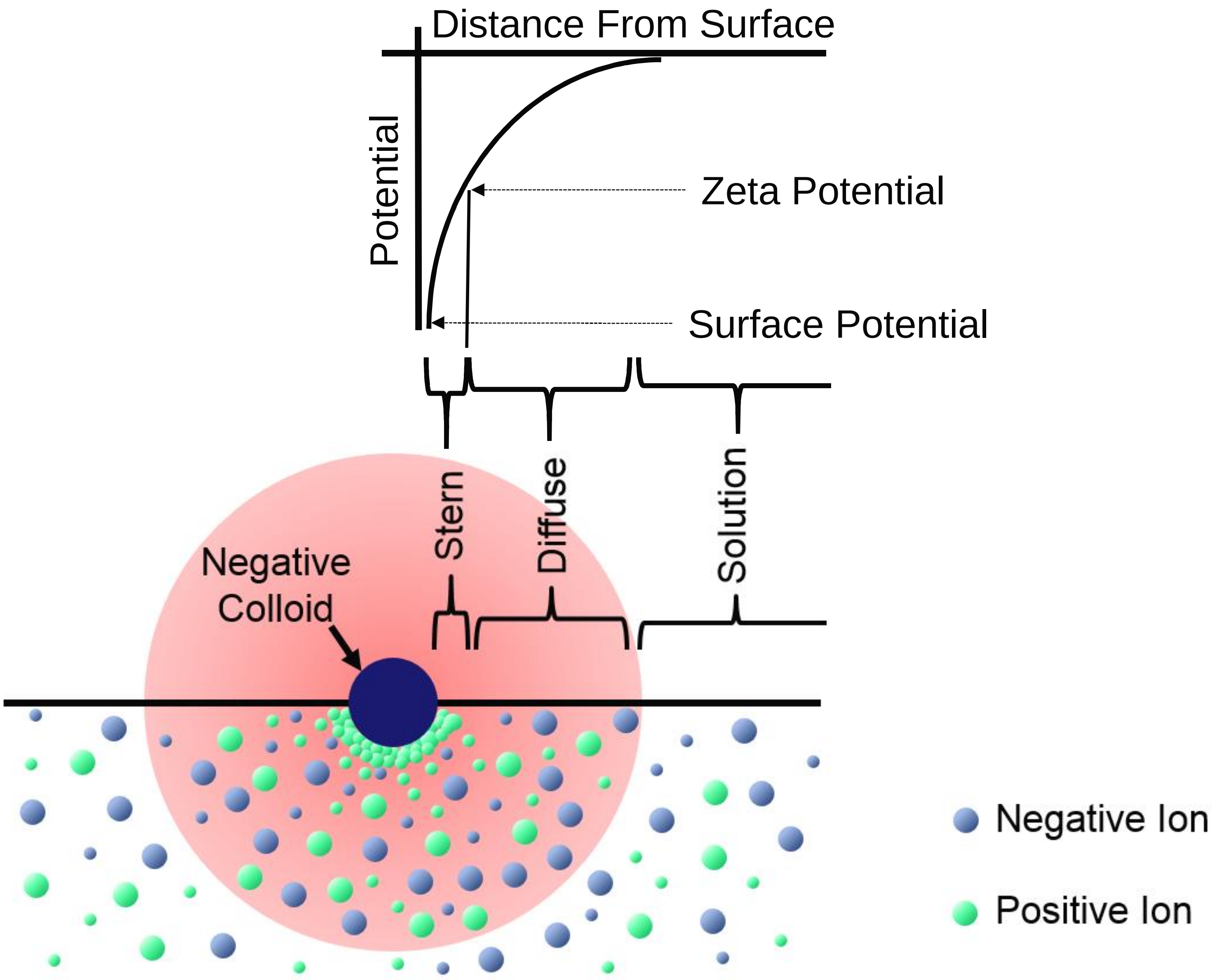


Option #4

Zeta Potential/Streaming Current

Measurement of Charge

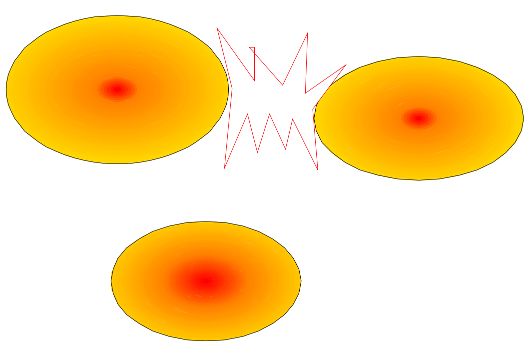
What is Zeta Potential?



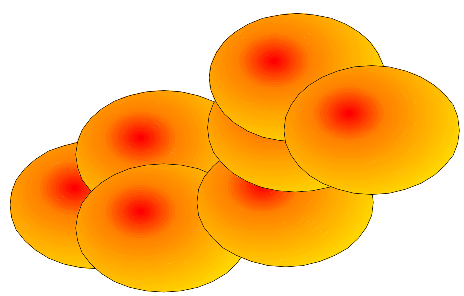
Particle Repulsion / Attraction

- Like-charged particles repel.
- Neutral Particles are free to collide and aggregate.

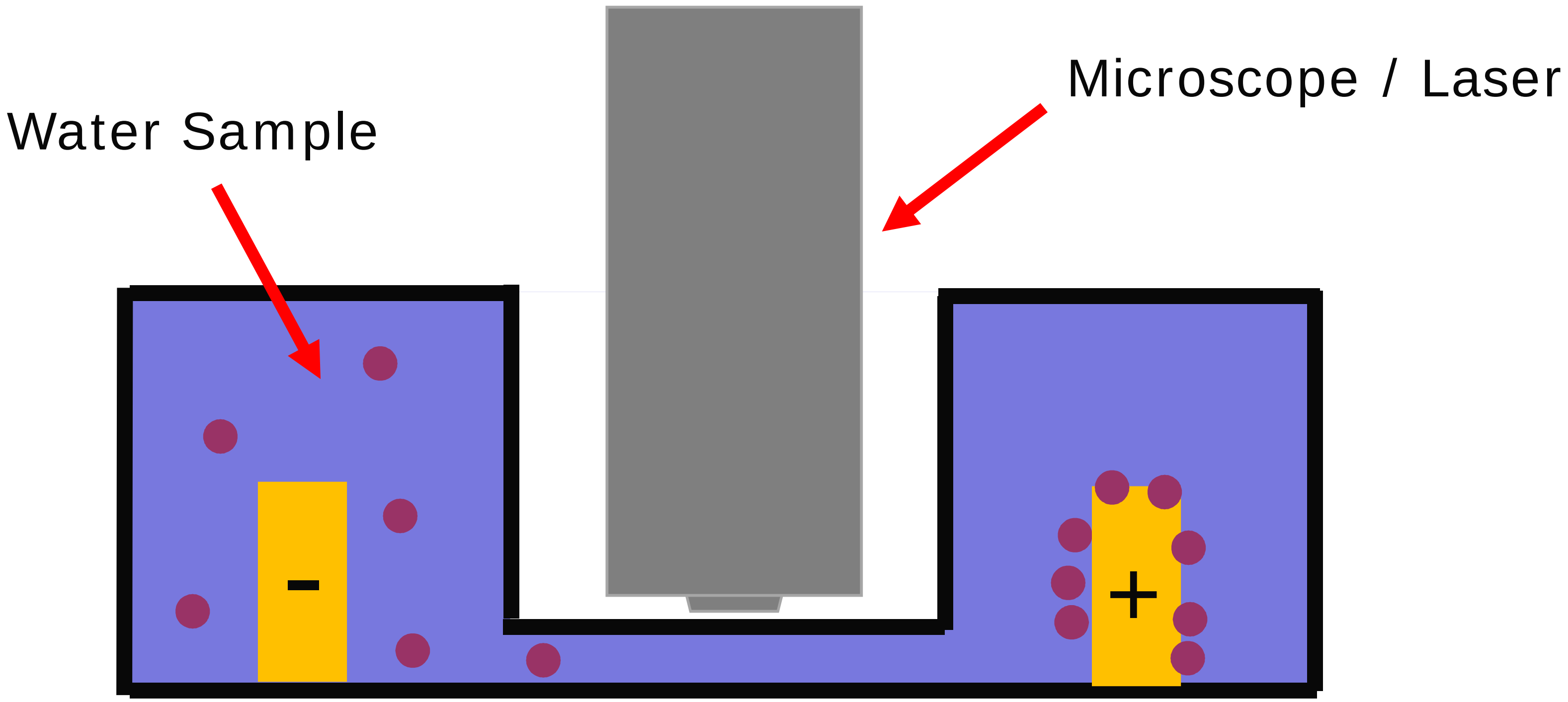
Anionic (Negative) Charge



Neutral / Destabilised Charge



Microelectrophoresis (Zeta Potential)



Electrophoretic Mobility (EPM) = VP / Ex

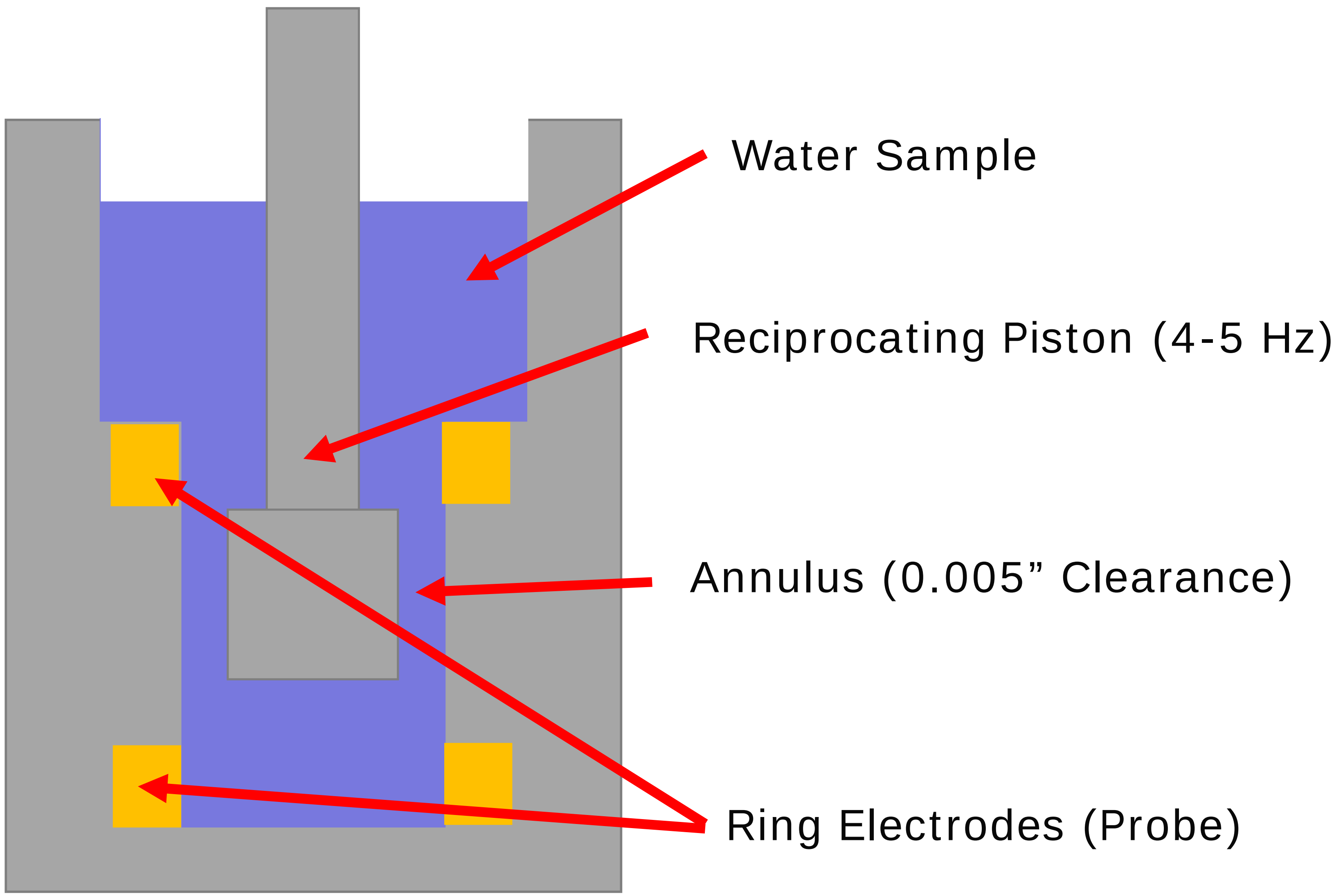
Vp = Particle Velocity (μm/s)

Ex = Applied Electric Field (volt/cm)

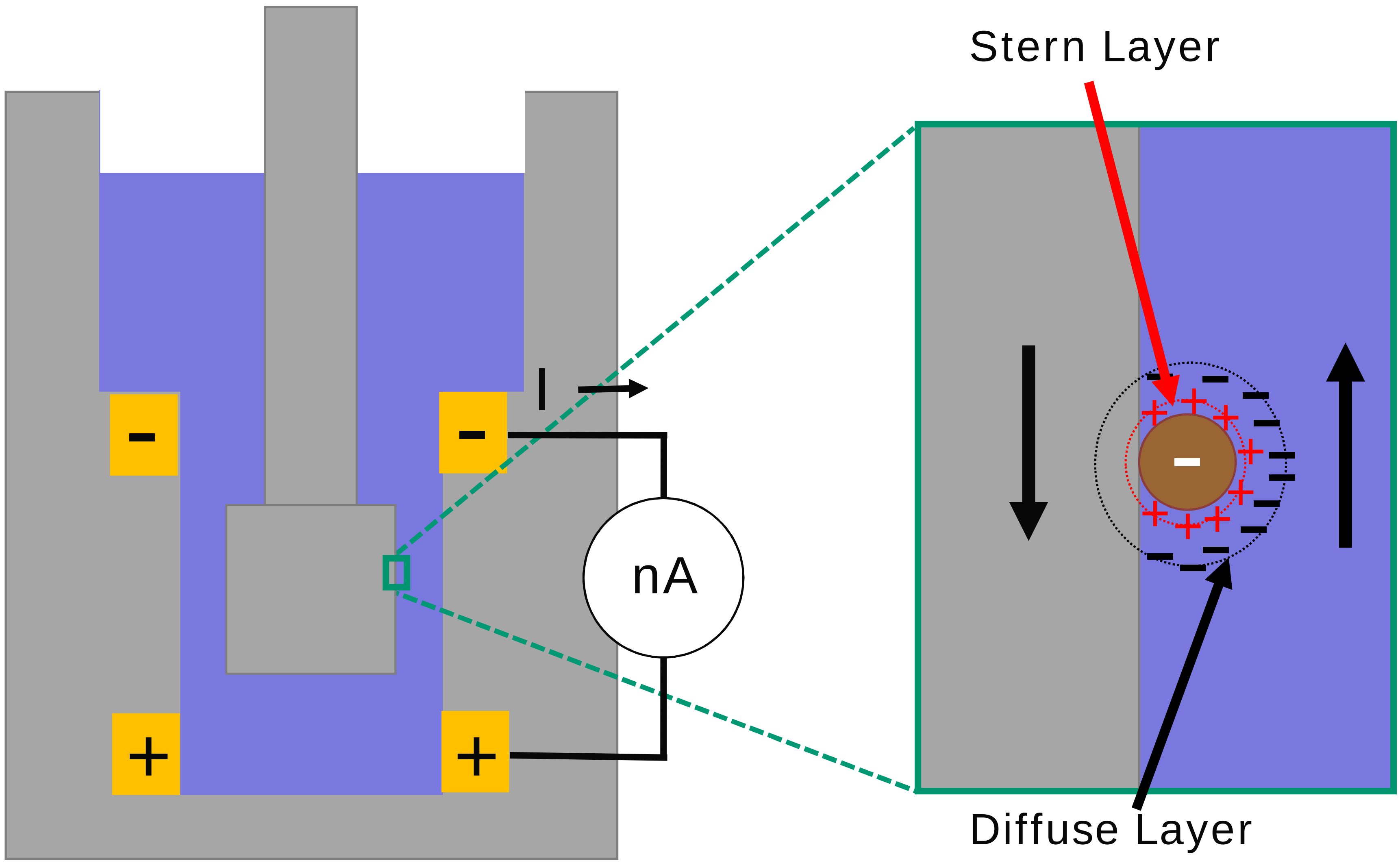
Zeta Potential (ZP)

- Benchmark measurement of charge that has been in use in water treatment for longer than SCM.
- Historically a laboratory measurement, but an online version was recently introduced with cost 4 to 6 times higher than SCM technology (€50k).
- Unrealized by most, ZP “Setpoint” for optimum coagulation is determined by pH and therefor presents same challenges as online SCM.

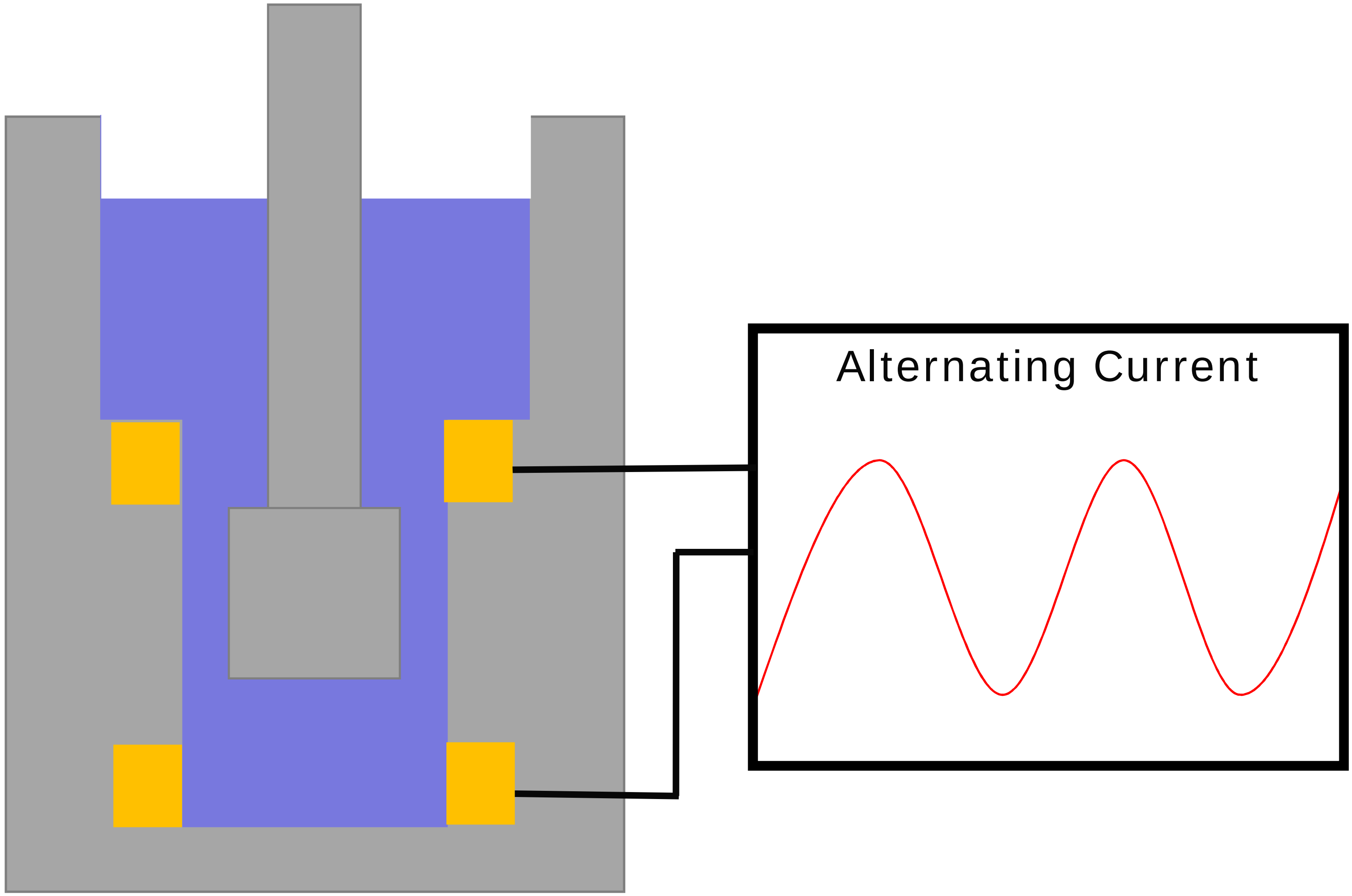
Streaming Current



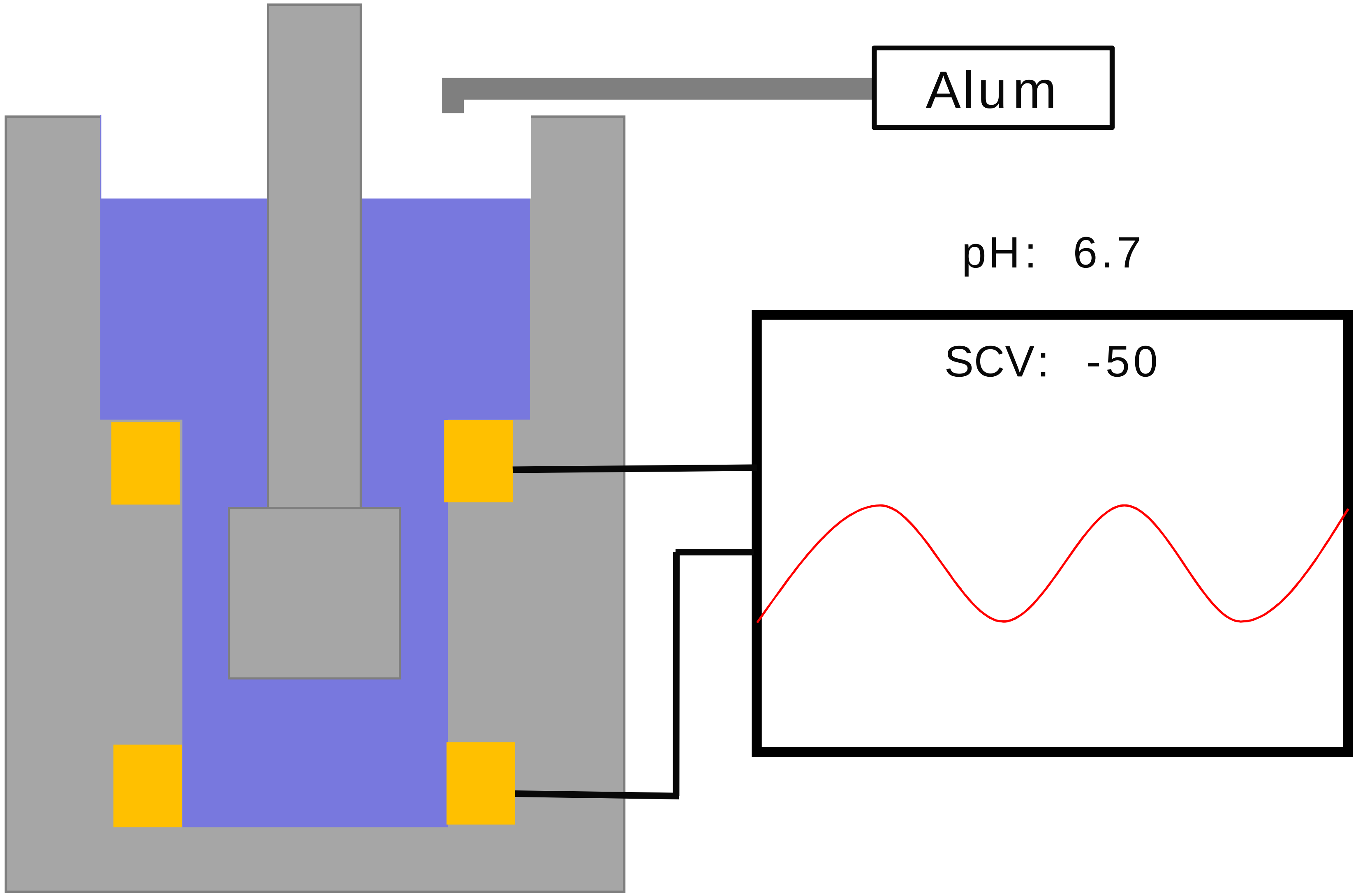
Streaming Current



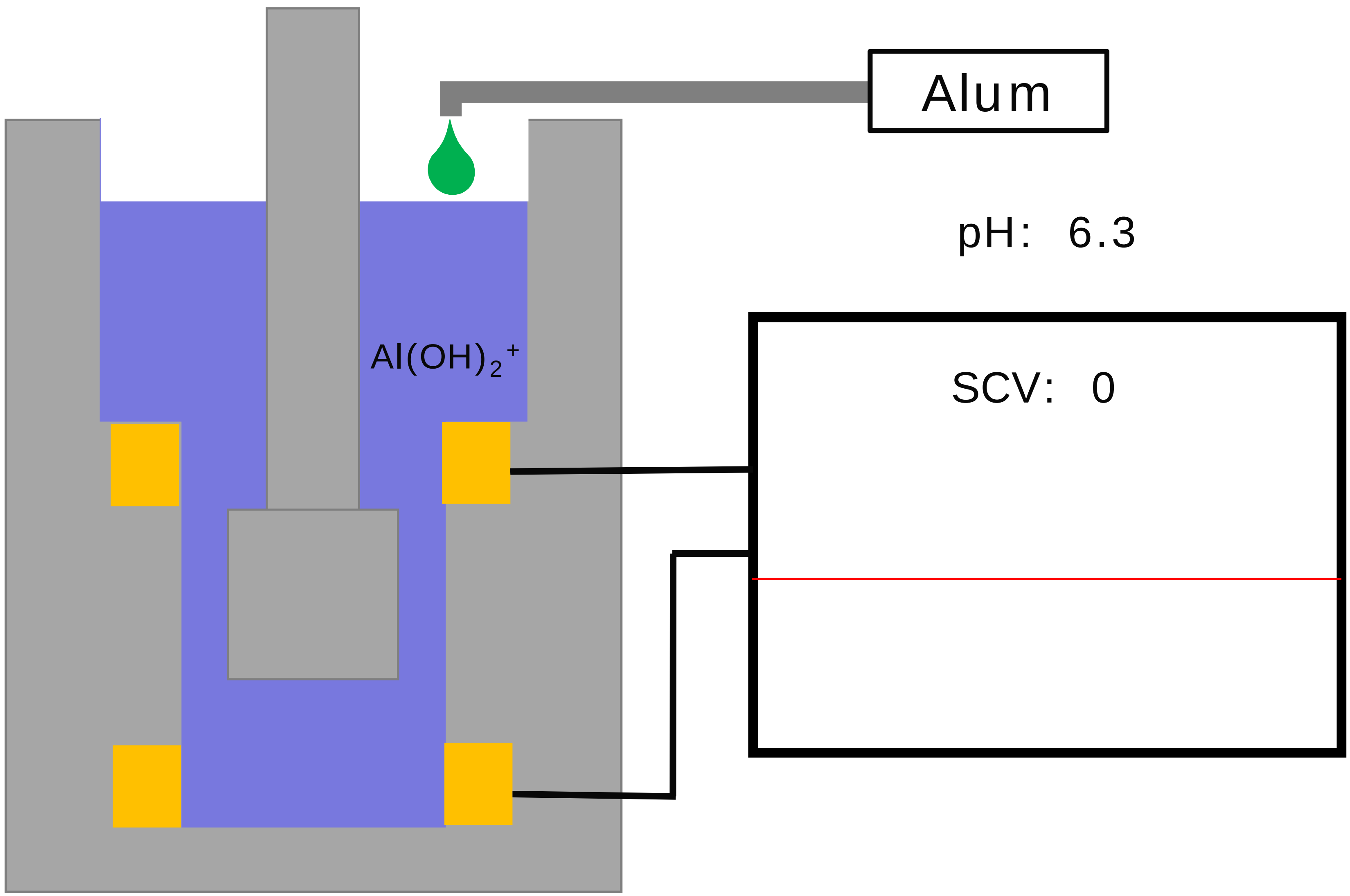
Streaming Current



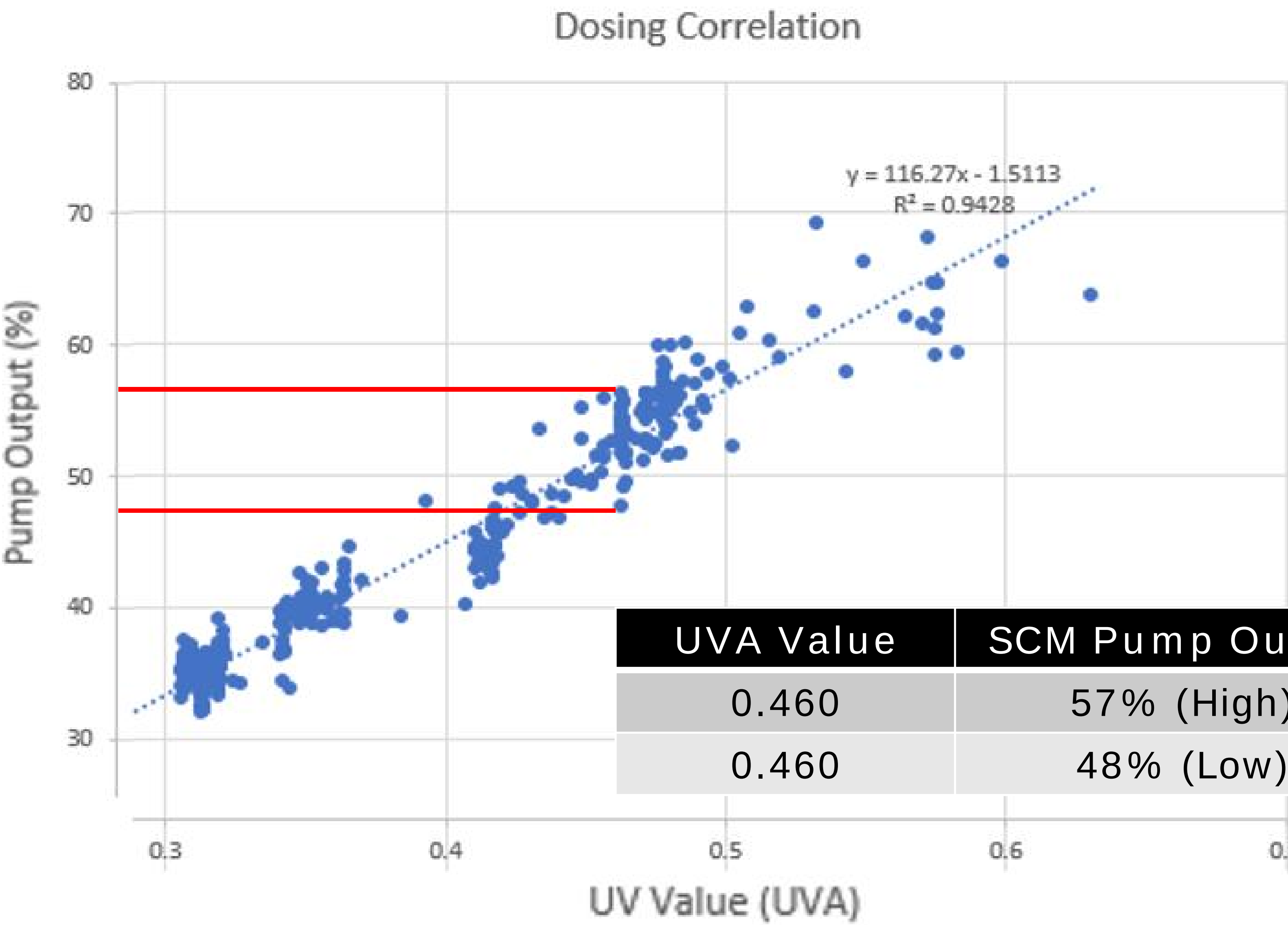
Streaming Current



Streaming Current



Plant B SCM Control vs UVA



UVA Value	SCM Pump Output
0.460	57% (High)
0.460	48% (Low)

Streaming Current (the good)

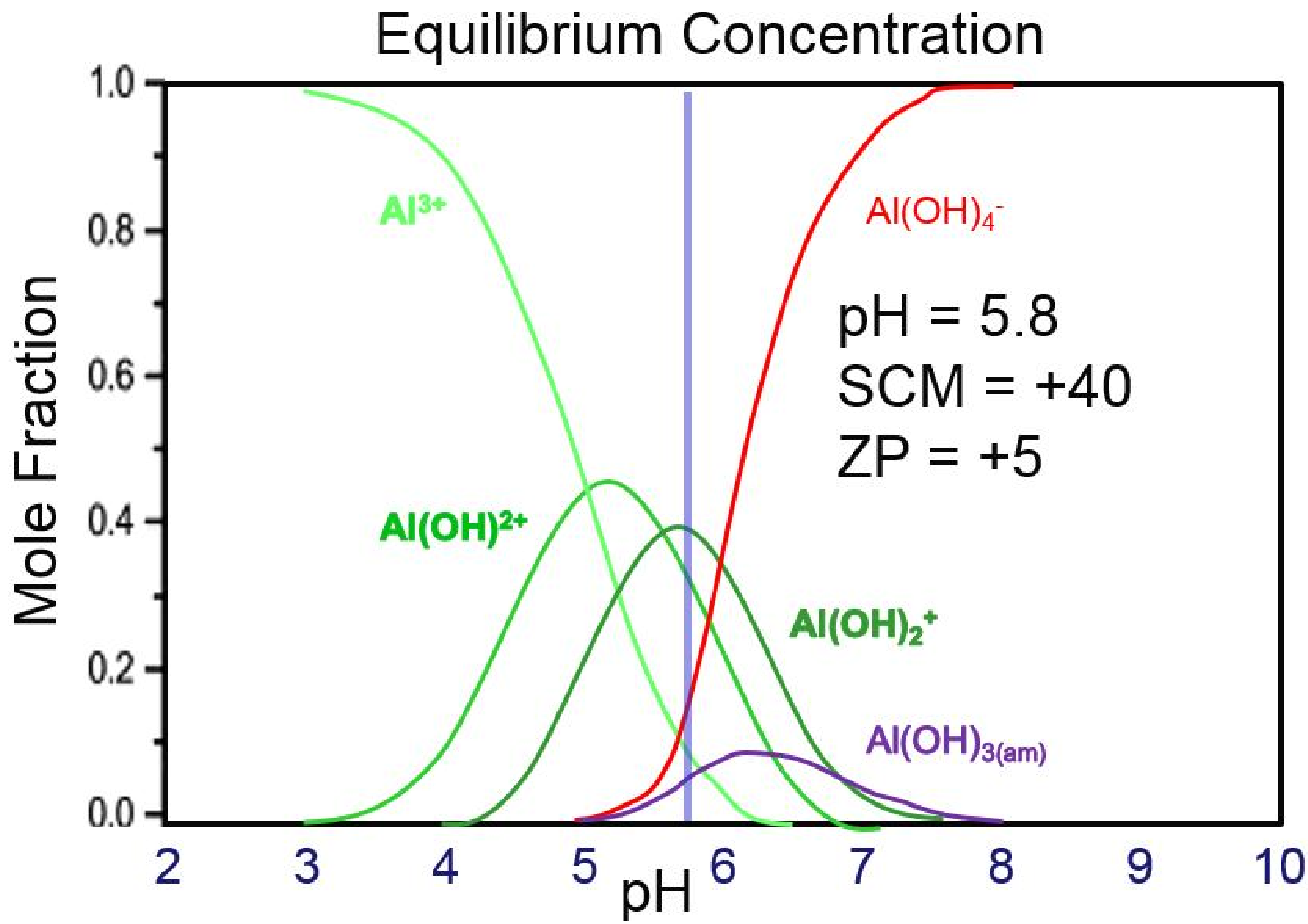
- Affordable (€13k) measurement of charge neutralisation.
- Responds to multiple variables that impact coagulation including those not detected by turbidity and UV254.
- Works in high turbidity conditions, not as prone to fouling or plugging, and easy to maintain.
- A 30+ year track record, most widely used technology for automation.

Streaming Current (the not so good)

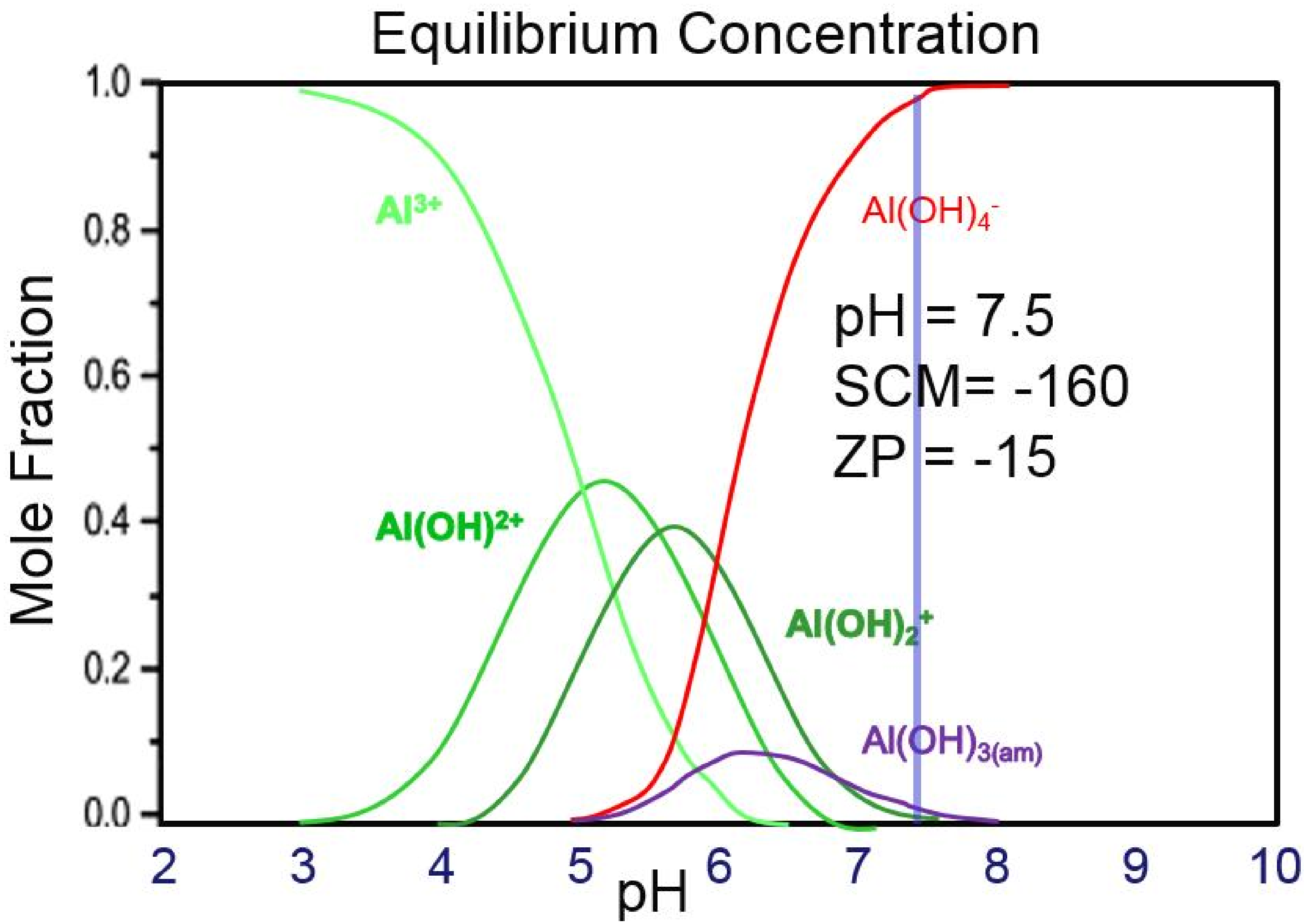
- Sensor must be installed in the right location, sometimes process changes are needed (mixing, sample lag time etc.).
- Good pH control is highly recommended.
- Sensor parts wear over time and need to be replaced to maintain optimum control performance.
- Large changes in water quality (seasonal) will require re-optimisation.
- Less likely to be of use in applications feeding Alum where post coagulation pH is >7.5.

pH Impact On Charge

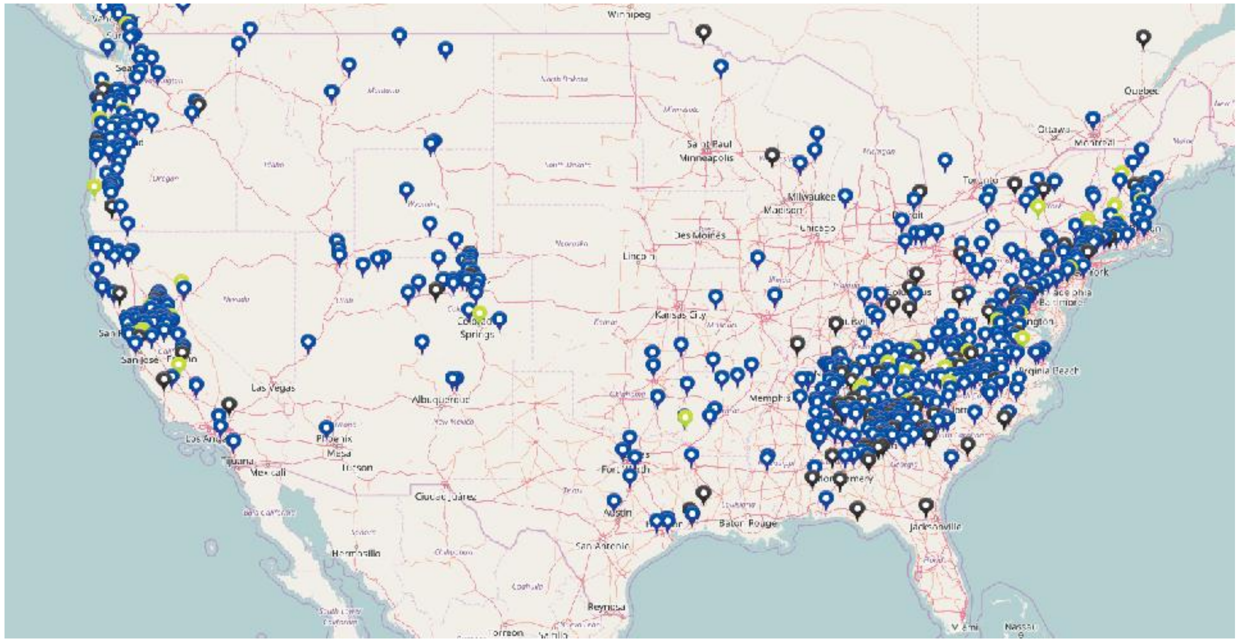
pH vs Charge (30 sec lag time)

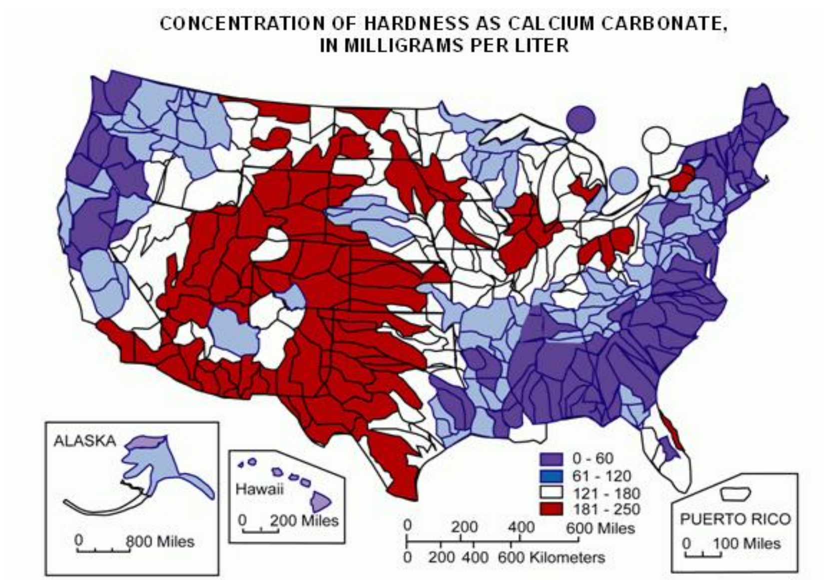


pH vs Charge (30 sec lag time)



USA Water Hardness vs SCM Sites

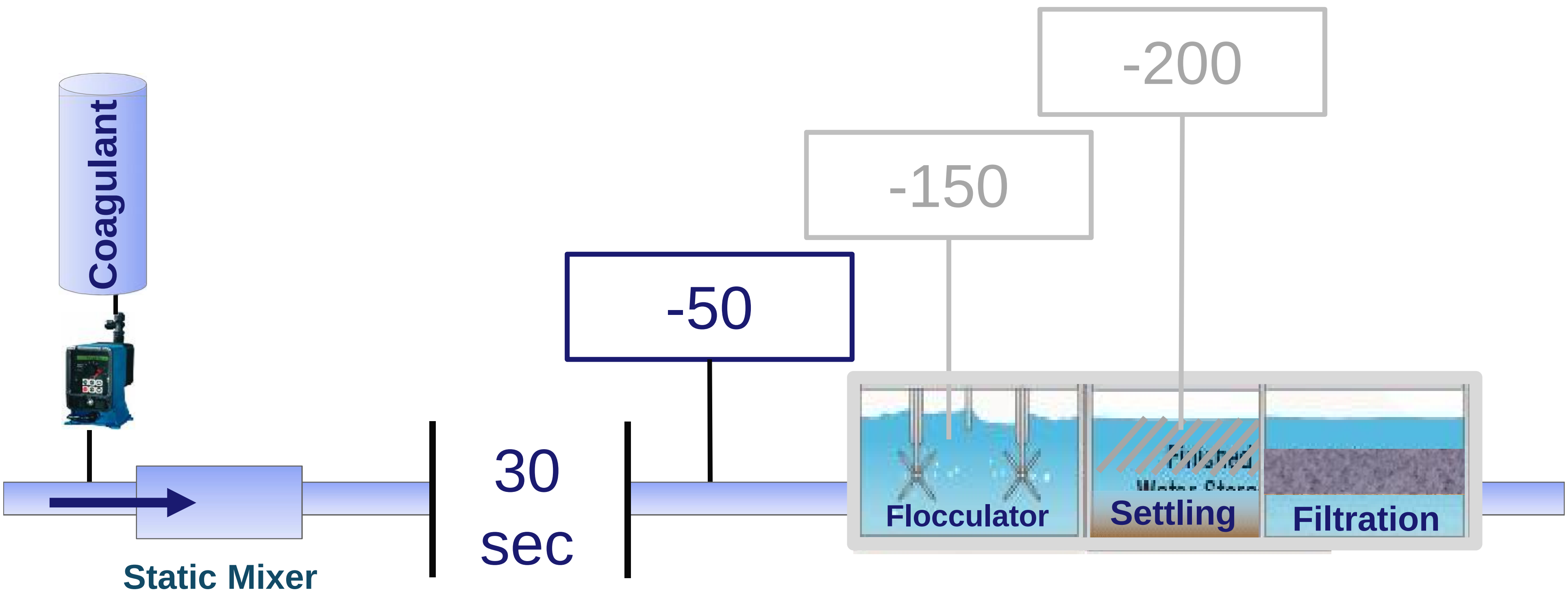




Proper Sample Point

SCM Sample Point

Ideal sample point is < 60 seconds downstream of coagulant addition, before treated water goes into any larger vessel with too much retention time.



Conclusion

- Many different single measurements have been used to control coagulation….. Including; pH, Turbidity, Colour, UVA, TOC, Zeta Potential, Streaming Current.
- All of these have issues and favour one sort of water or another.
- No single measurement can work on every plant and many waters vary so much that most of the above don't work all the time.
- Multi-parameter systems have tended to be too expensive and problematic (black box).

Thank You

Any Questions?