OaSys iCT™

Advanced dosage control for
chemical disinfection applications

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USP technologies™
Solutions for a clean environment

Disinfection Process Control – Can we get better?

- WRRFs typically overdose disinfectant by a factor of two
- If chemical disinfection is used, several issues arise:
  1. Excessive disinfectant cost and supply disruption
  2. Excessive quenching cost and supply disruption
  3. Risk of DBPs formation (especially with excess chlorination)
  4. Inconsistent performance
  5. Inadequate public health protection (during CSOs, plant upsets, etc.)
- Improving disinfection + saving money: Is this possible?

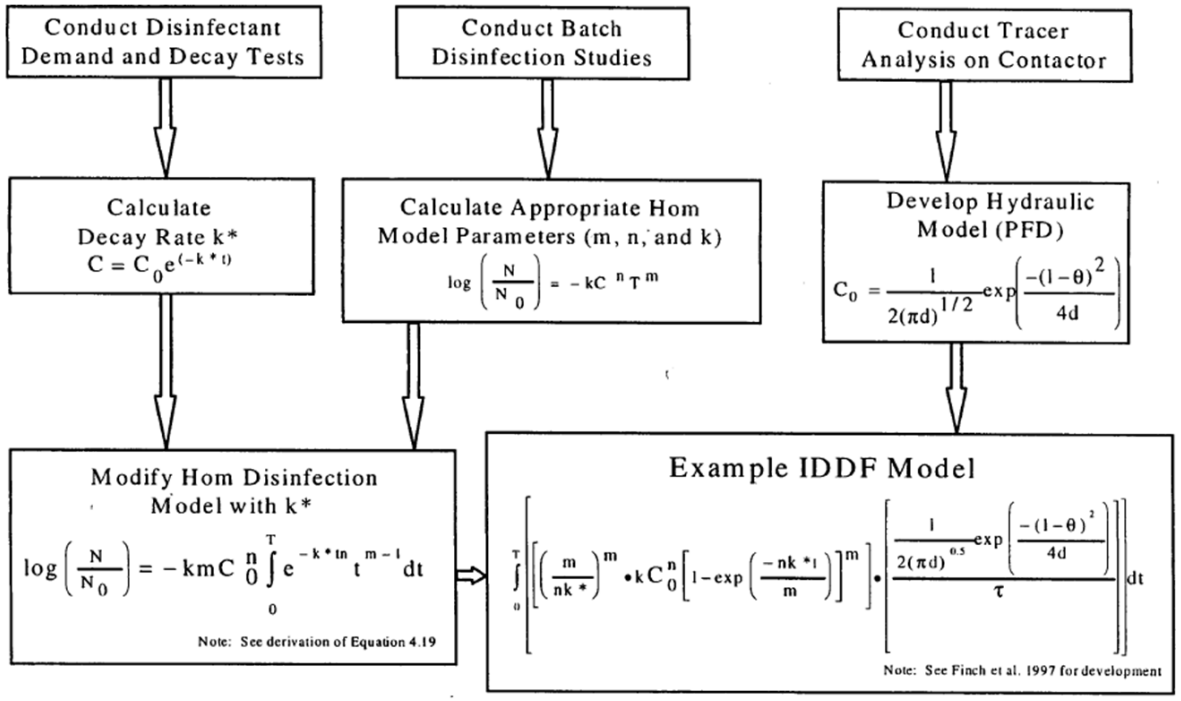
What is OaSys iCT™Role?

iCT™ is a novel control approach that optimizes disinfection performance by calculating the optimal chemical dosage that accounts for sources of treatment variability in real time.

Recommended for WWTP with:

- Highly variable flow or water quality
- High disinfection and/or quenching costs
- Limited contact basin sizing
- Tightening disinfection permit limits

Integrated Disinfection Design Framework



Bellamy, Finch, Haas (1998)

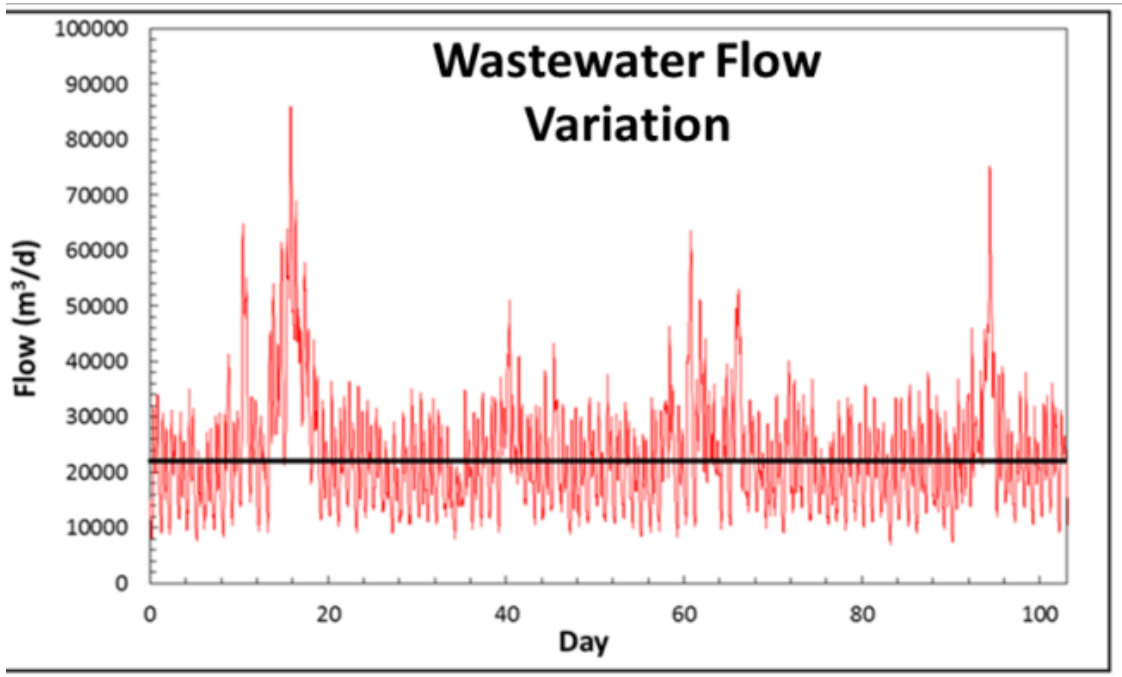
The IDDF model is useful for… studying at universities

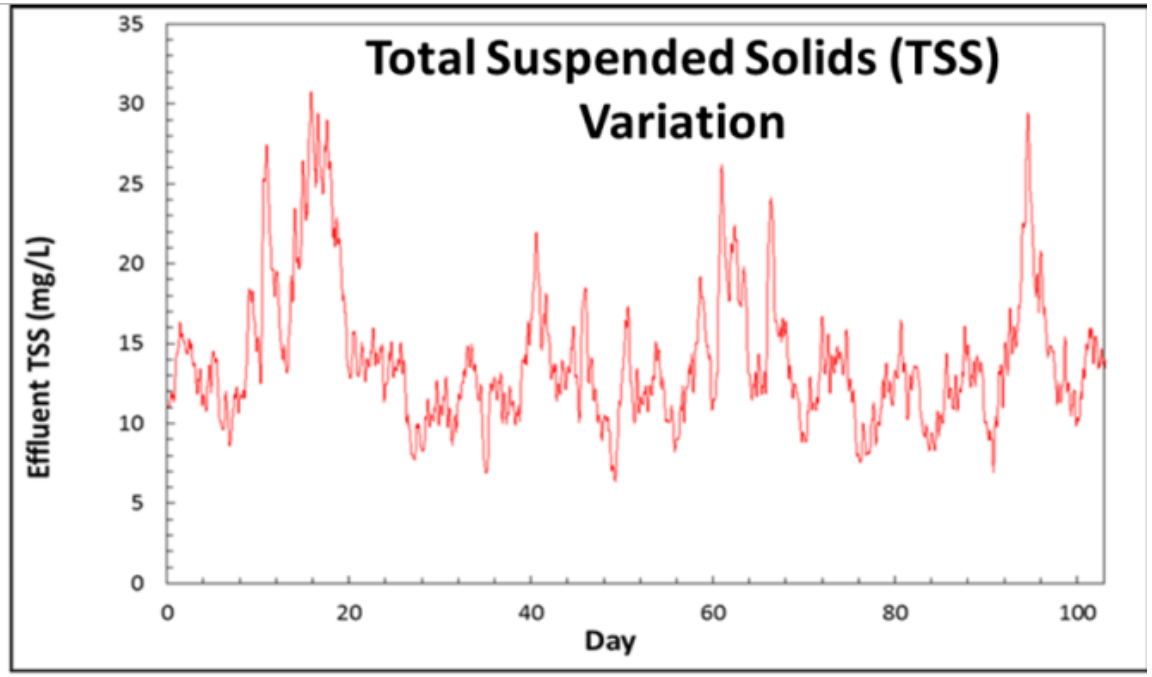
But is it possible to apply this practically, in real time?

All three parts are necessary:

- Disinfectant demand/decay
- Microbial kill
- Contact basin hydraulics

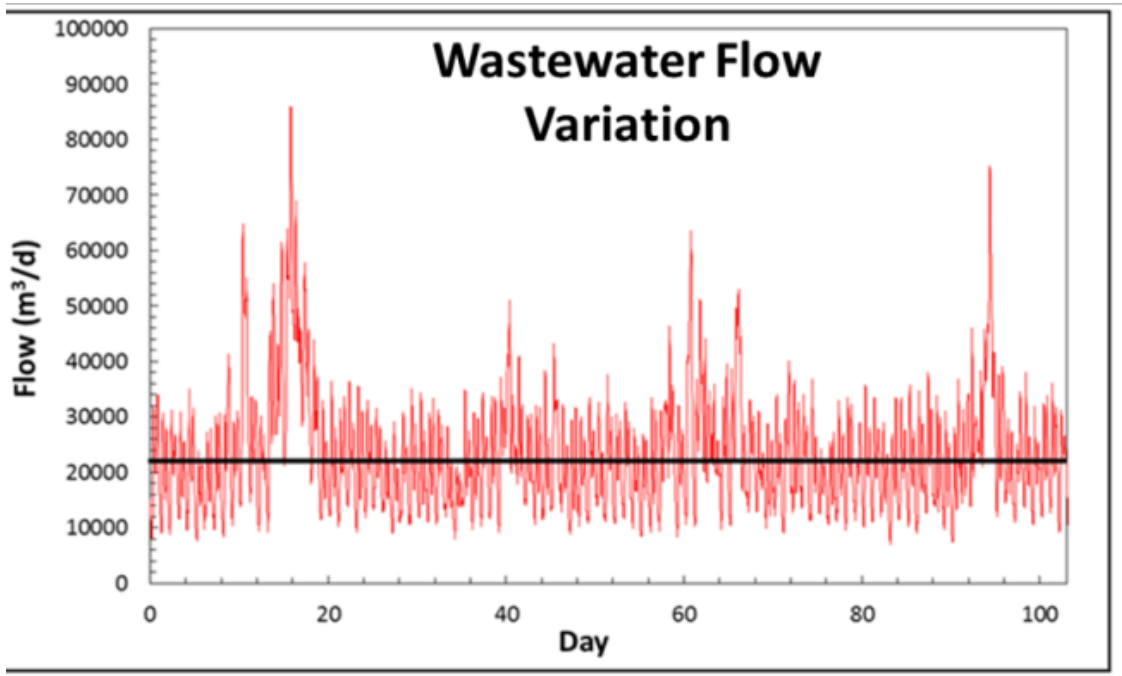
Considerations for Chemical Disinfection

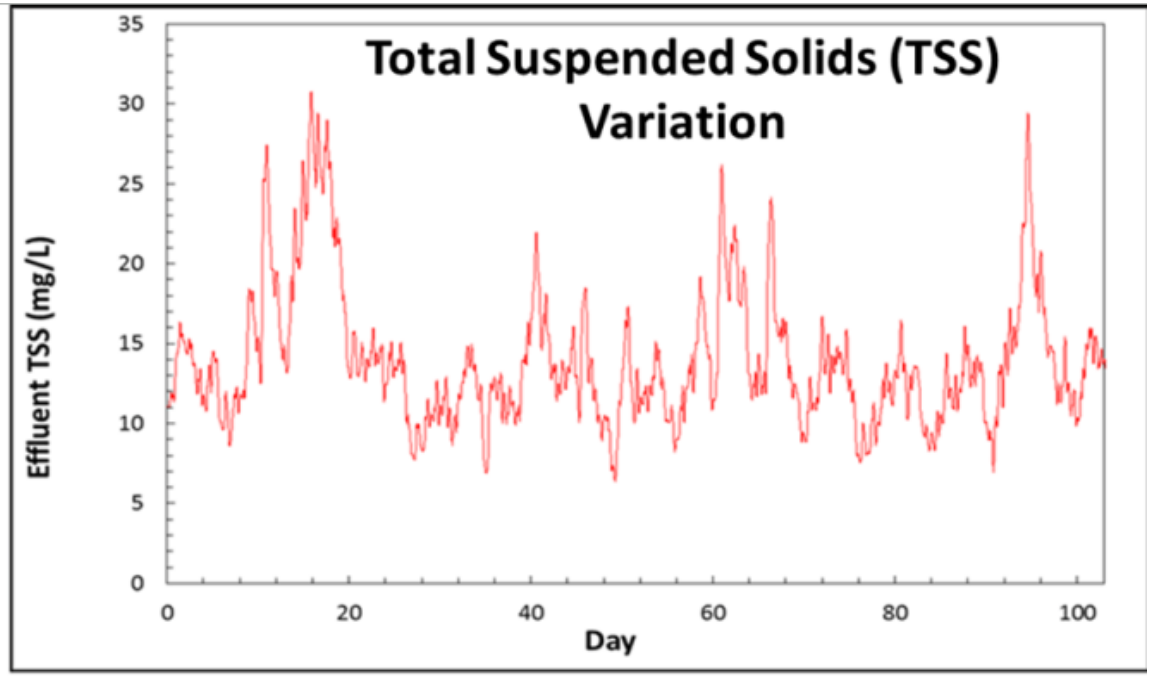




- The primary challenge for chemical disinfection: VARIABILITY
- Flow variability: daily/diurnal hydraulics, rainfall events
- Water quality variability: TSS, BOD, nutrients (e.g. NH3), upsets, etc.

Considerations for Chemical Disinfection

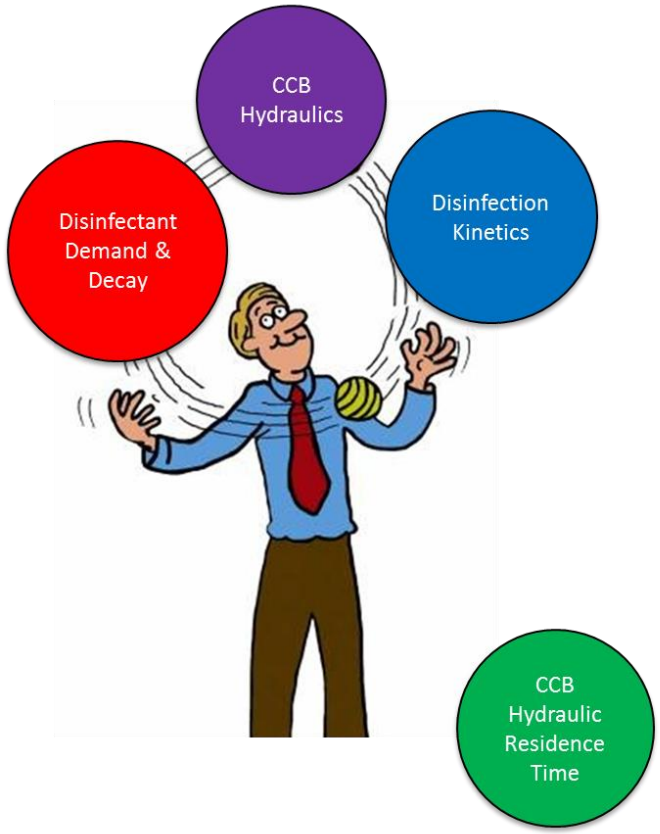




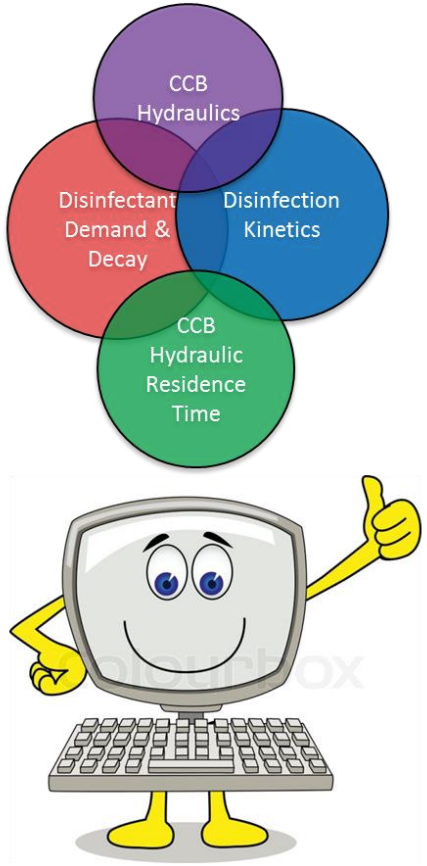
- Integrated Disinfection Design Framework (IDDF) required
  - But not practical for ***real time*** process control
- Process variability necessitates dynamic control
- Model-based control such as iCT is ultimately necessary

Opportunities and Challenges

We can manually select a concentration set point and flow pace to achieve a desired CT, BUT…



FLOW PACING



ADVANCED DOSE CONTROL

What's being missed is the integration of the variables that impact the disinfectant chemical demand

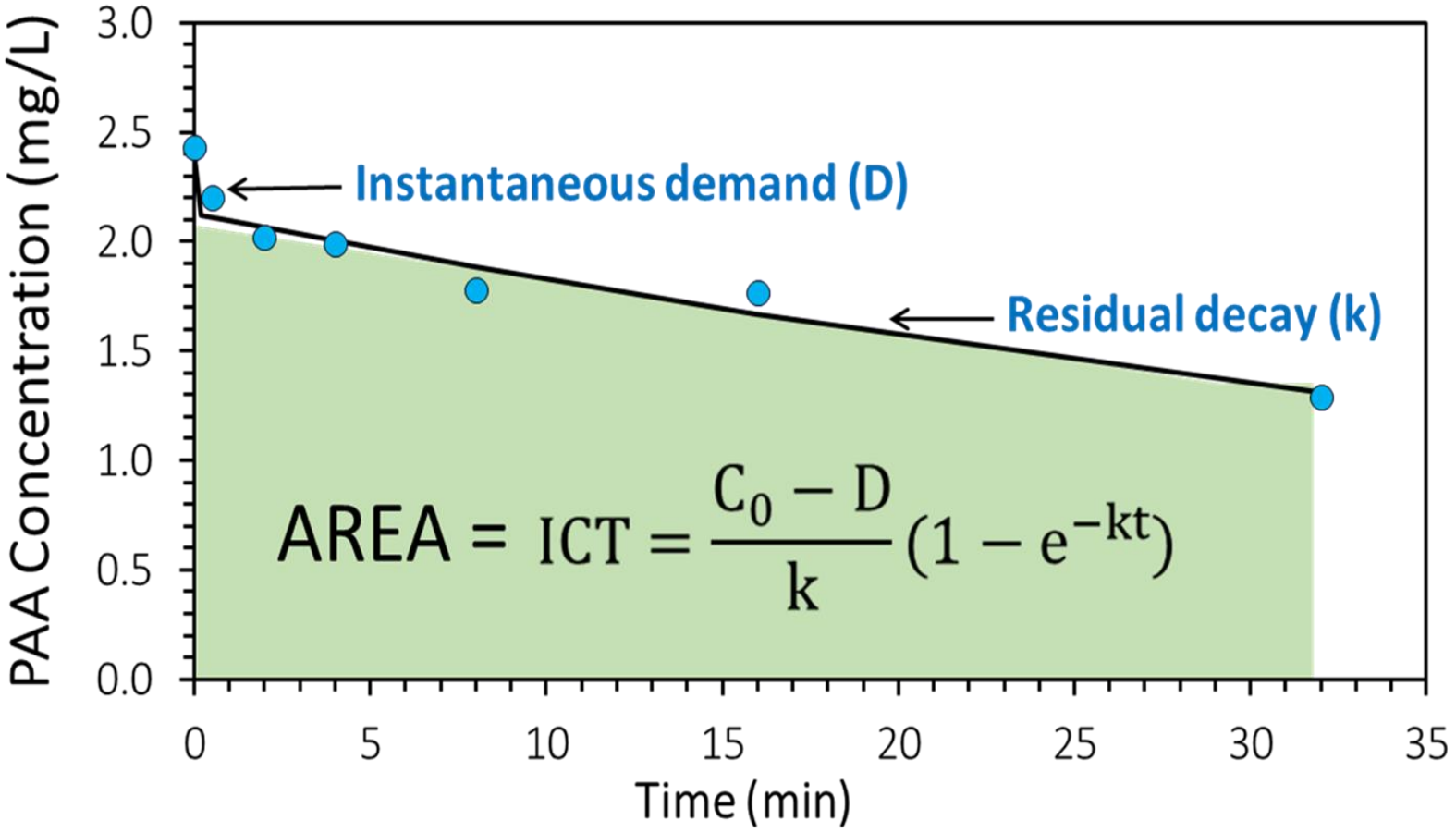
…and this is what OaSys iCT™ dosing control provides

A Deeper Look: The Integral of CT

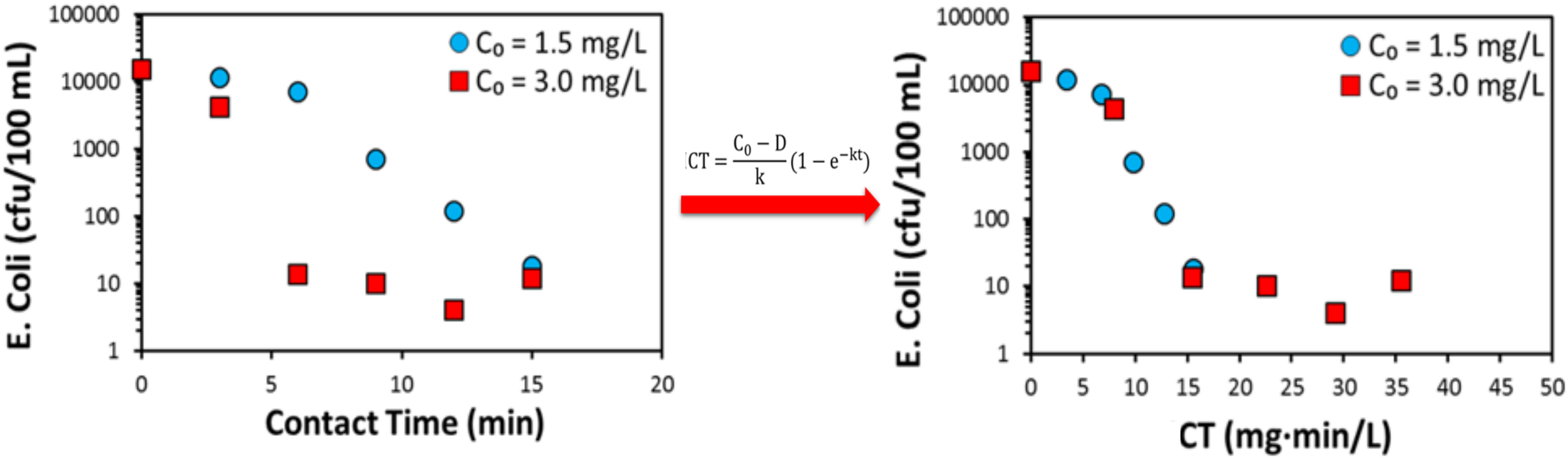
Core principle of CT integral: relationship between concentration and time

It's a measure of the exposure of microorganisms to the disinfectant

Oxidizing disinfectants have an initial instantaneous demand (D), followed by a slow residual decay (k)

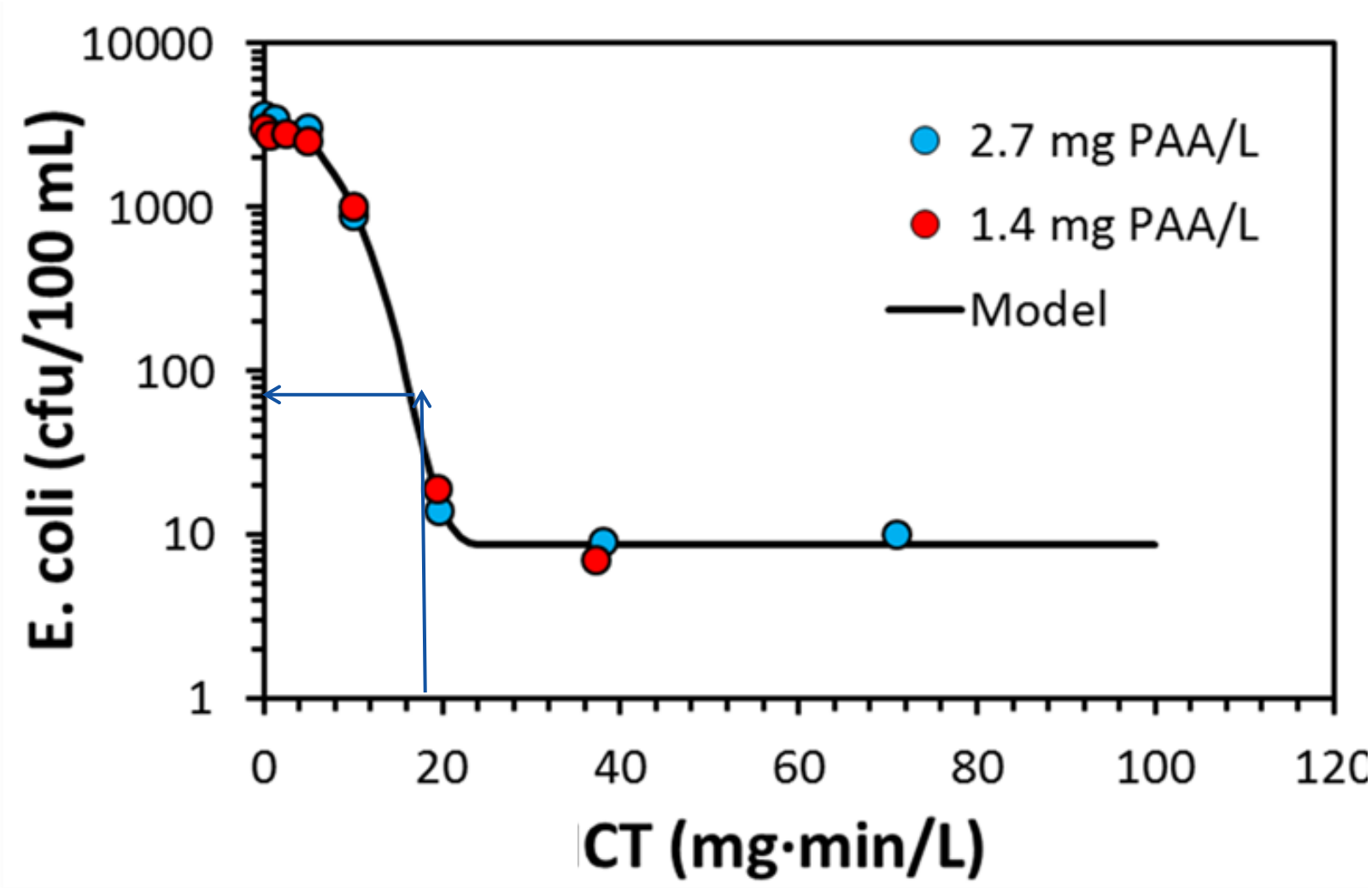


A Deeper Look: The Integral of CT

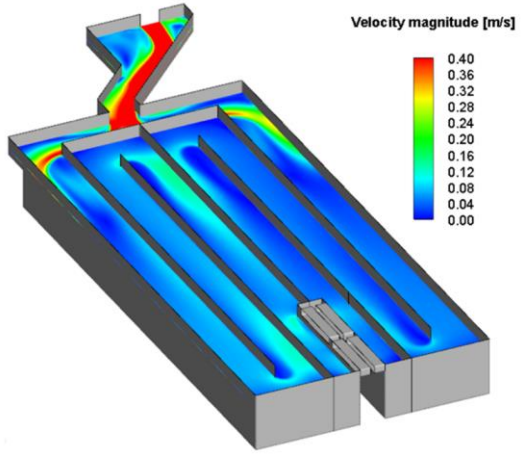


Microbial Kinetics – OaSys iCT™ allows you to control CT dose

A Deeper Look: The Integral of CT

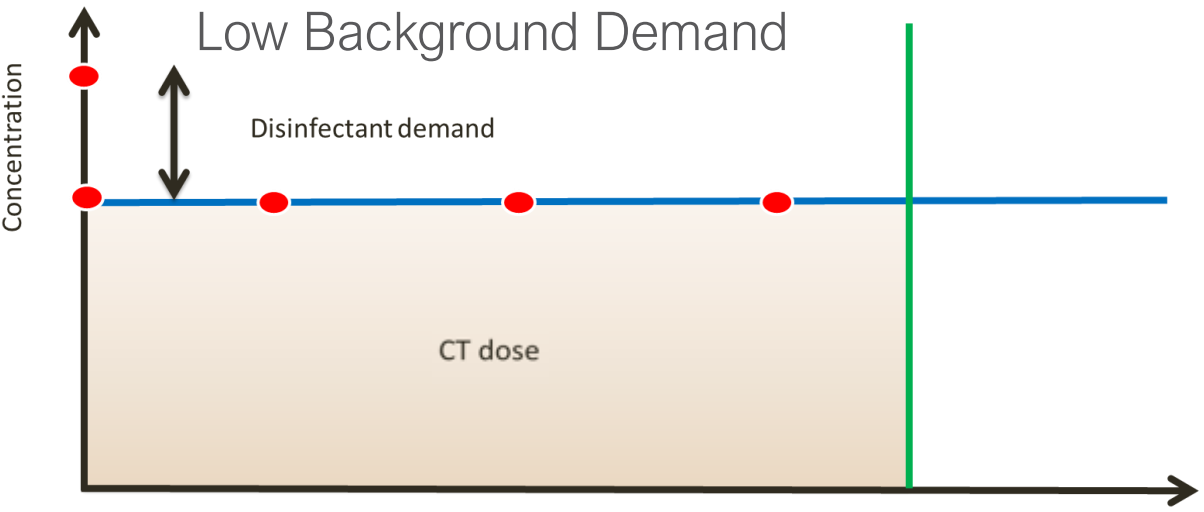


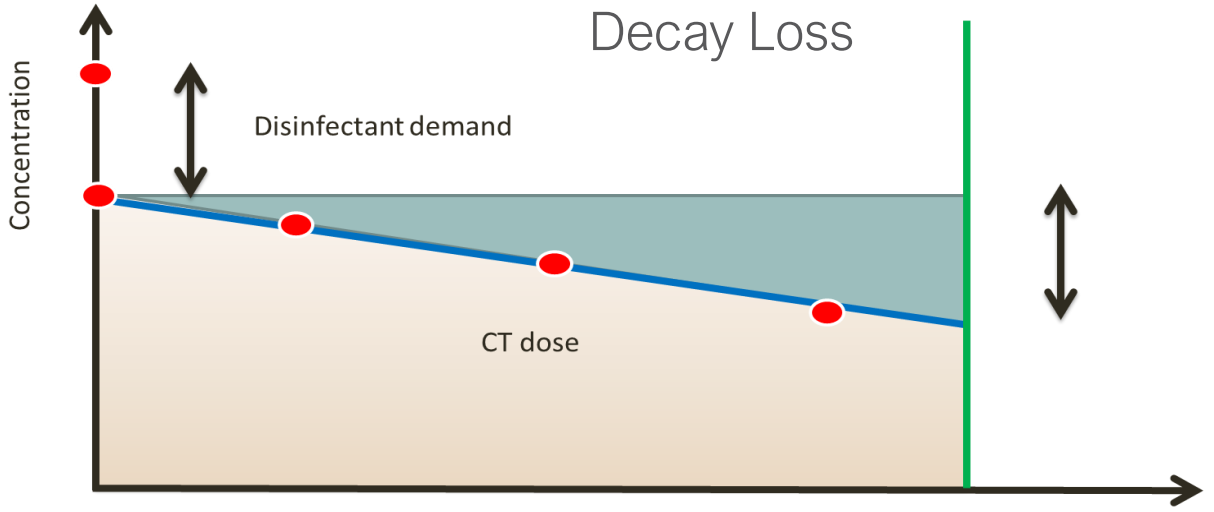
iCT™ incorporates reactor hydraulics and chemical demand and decay into the disinfection model

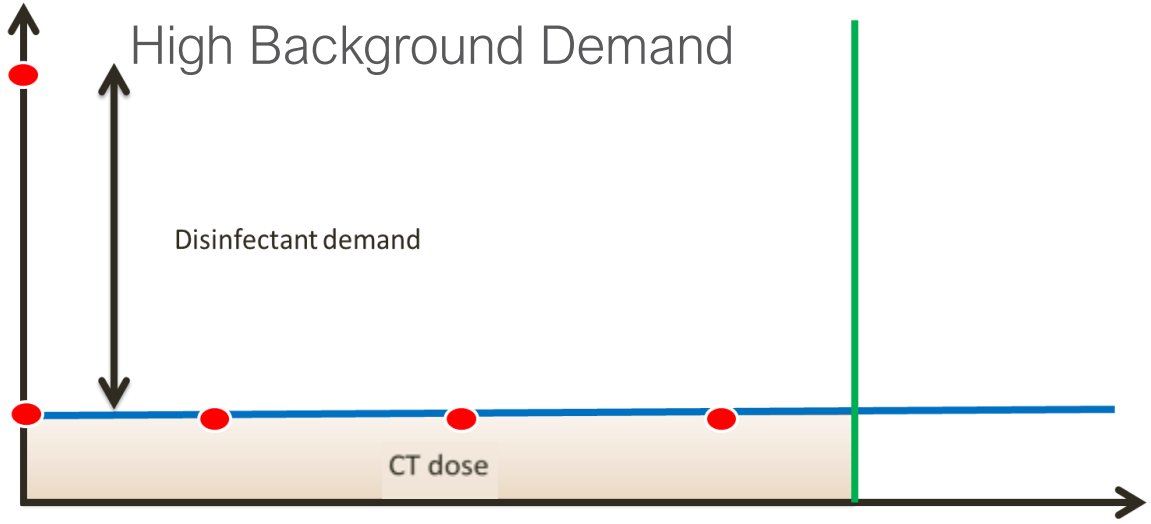


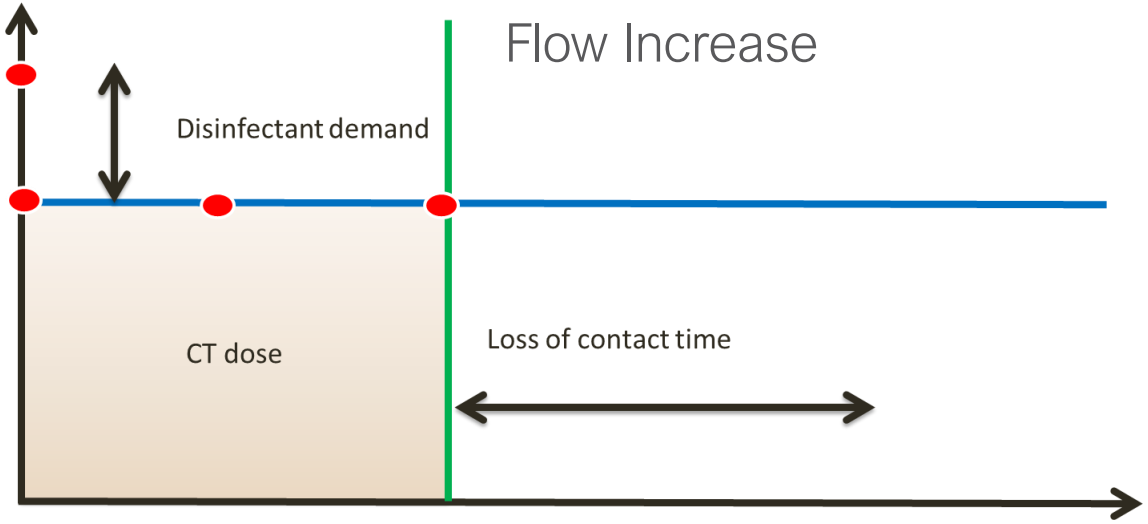
…and we can use this curve to select our iCT™ setpoint

The CT Dose is Dynamic

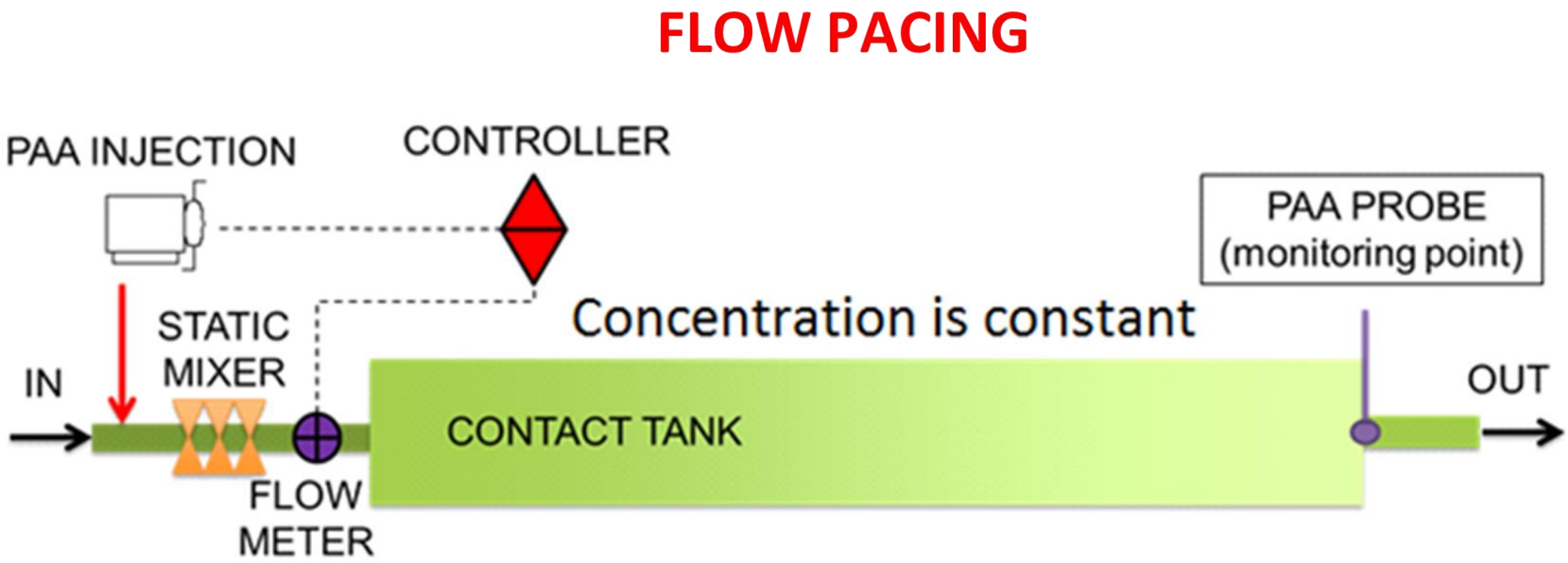




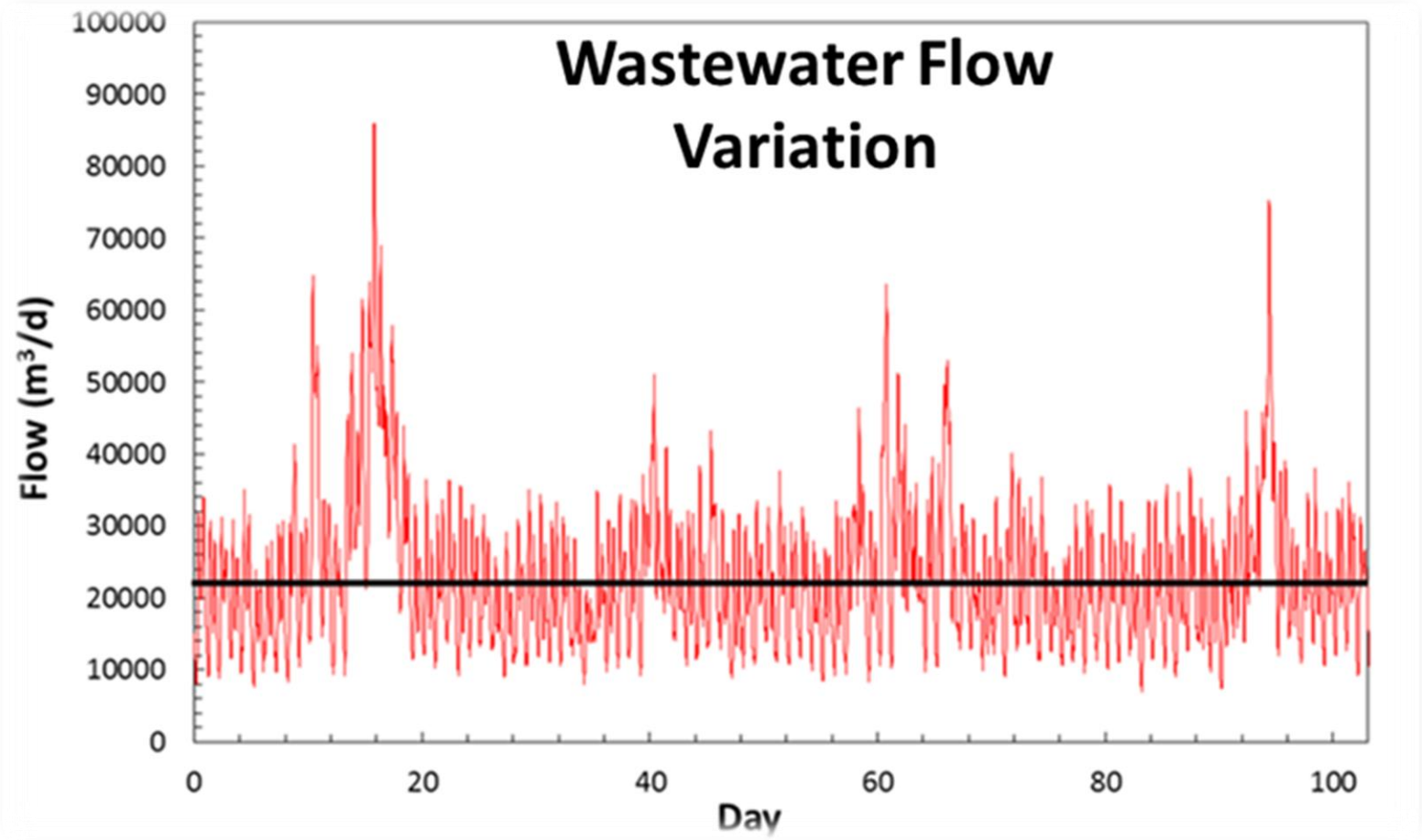




Flow Pacing Control



Flow Pacing: The Variability Problem

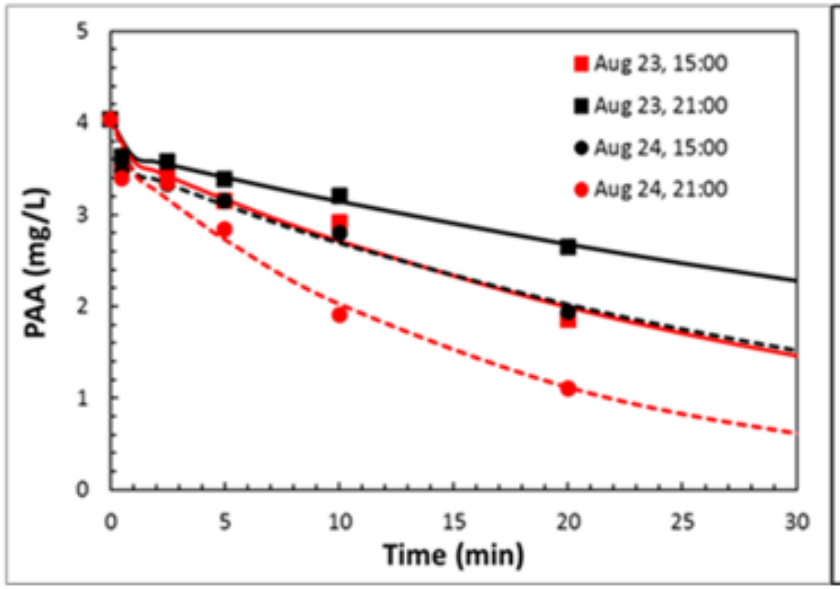


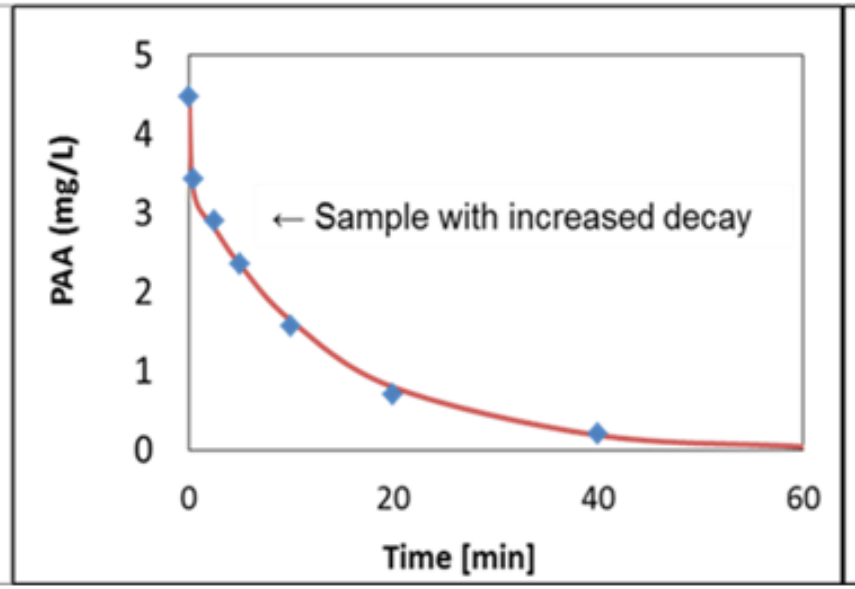
Flow variability = HRT variability

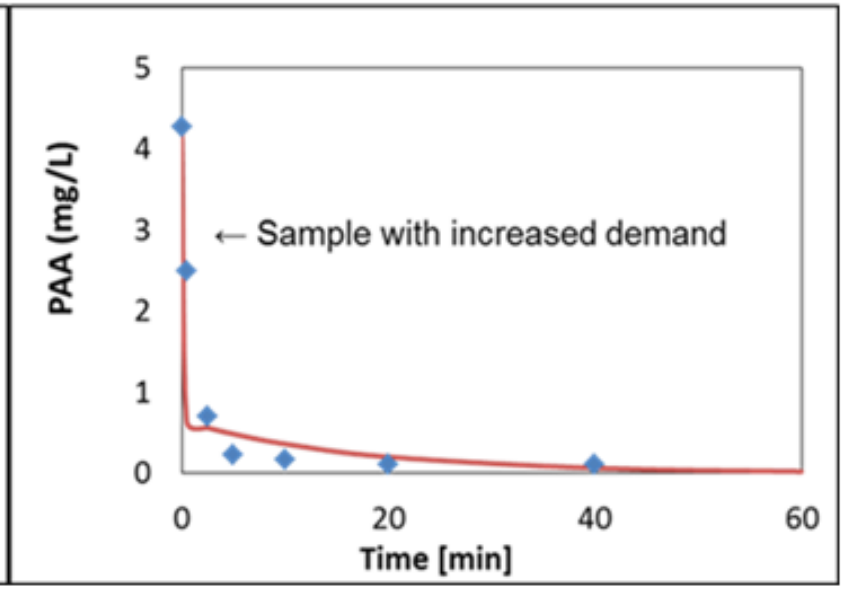
flow-pacing only keeps the concentration fixed

The result is intentional over-dosing

Flow Pacing: Demand/Decay Problems







$$C = (C_0 - D)e^{-kt}$$

where,
C is the concentration of PAA at time t; mg/L
C_0 is initial concentration of PAA; mg/L
D is the instantaneous demand of PAA; mg/L
k is the decay rate constant of PAA; min^{-1}
t is the contact time; min^{-1}

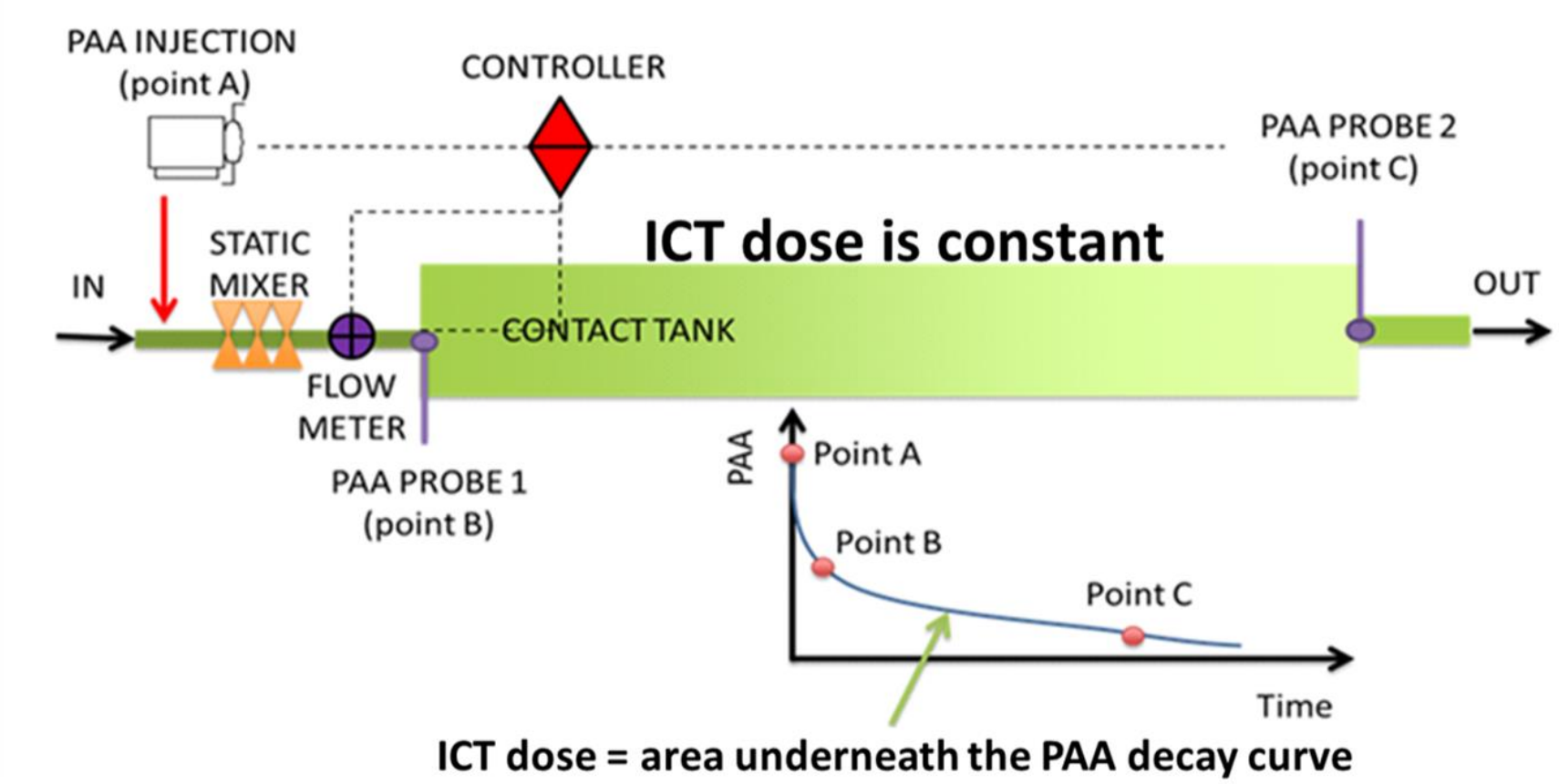
Wastewater quality changes…

Disinfectant decomposition is affected by:

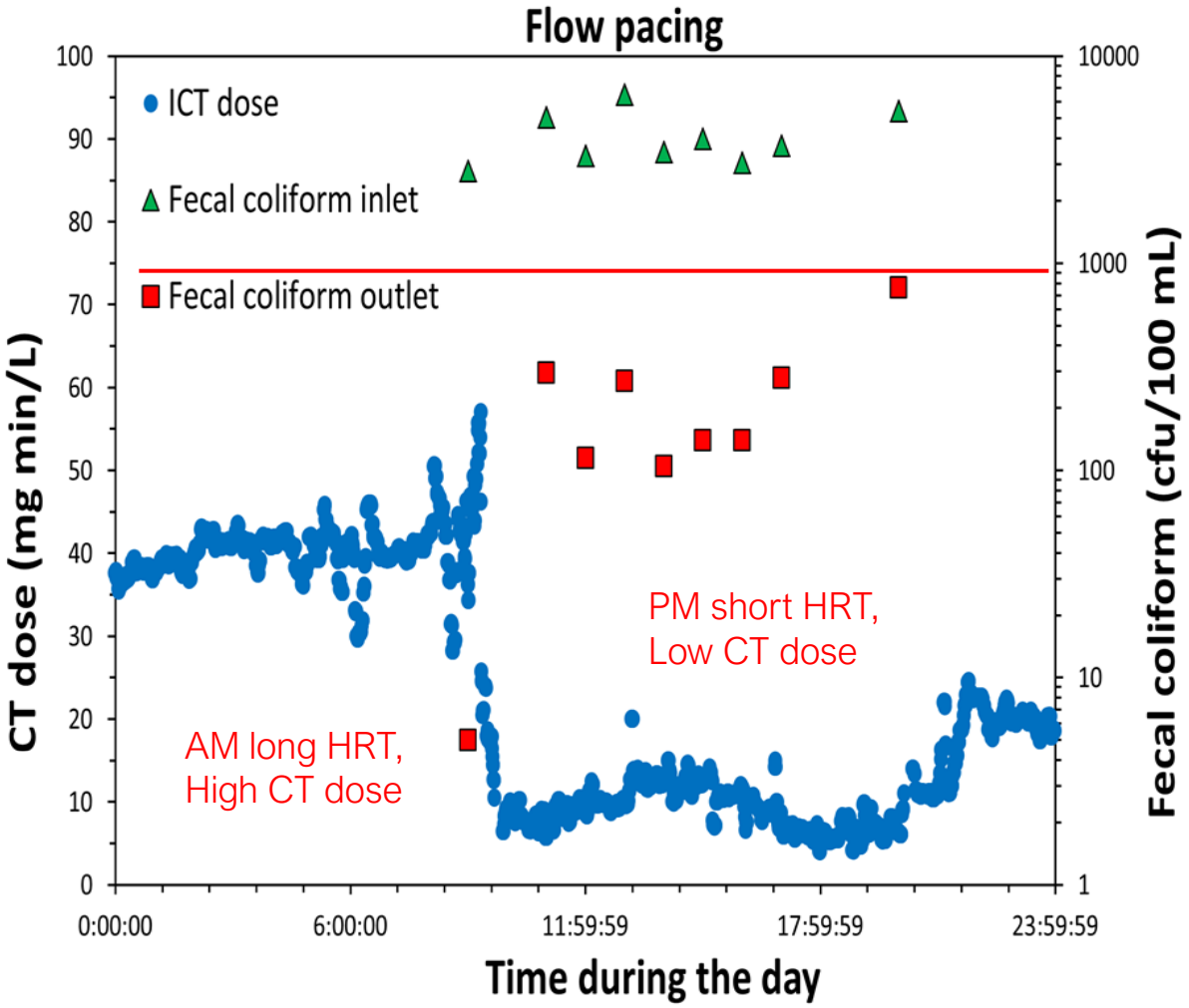
- Organics
- Trace Metals
- Temperature
- pH

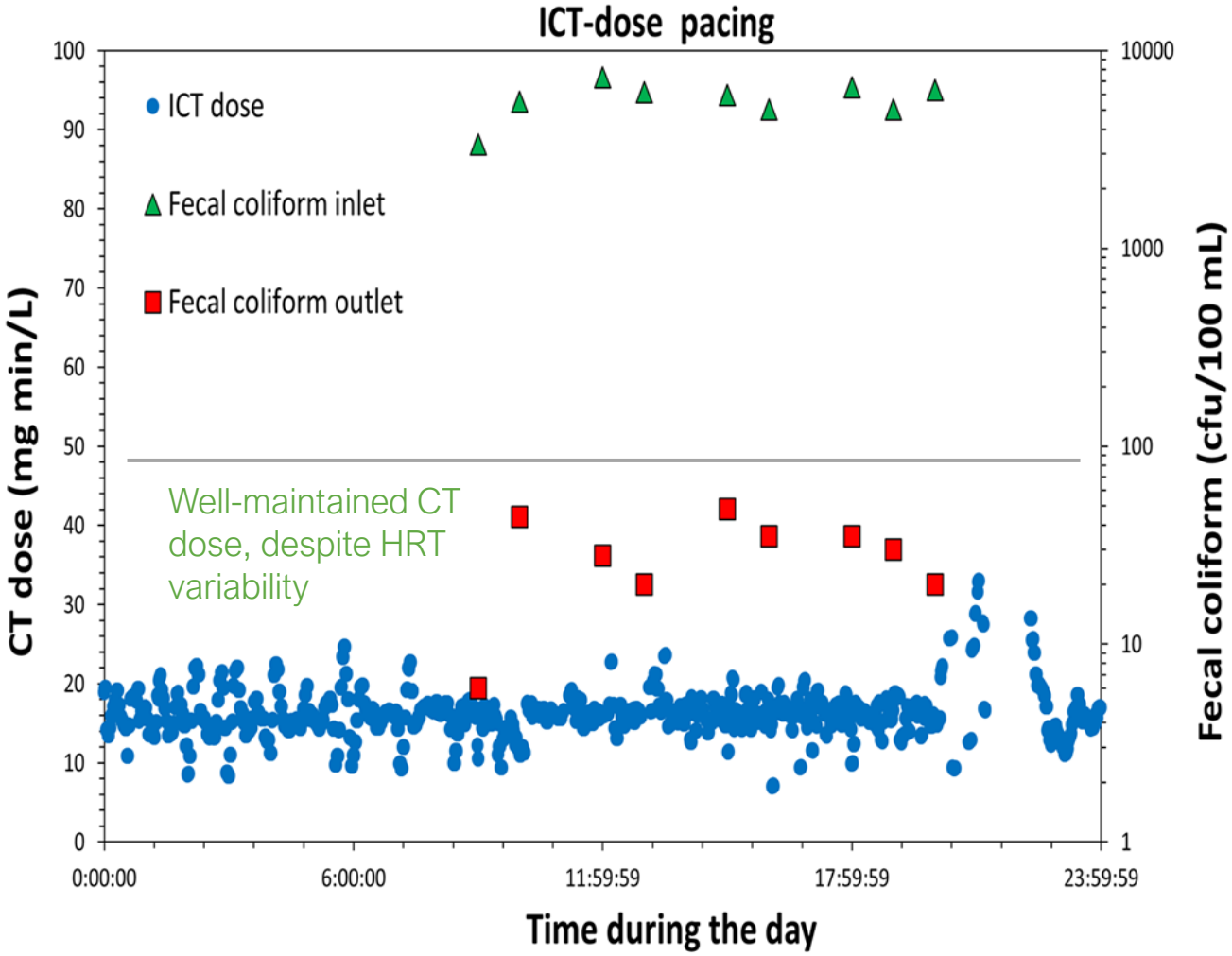
The OaSys iCT™ Approach

OaSys iCT™ Dose Pacing



Flow Pacing vs OaSys iCT™

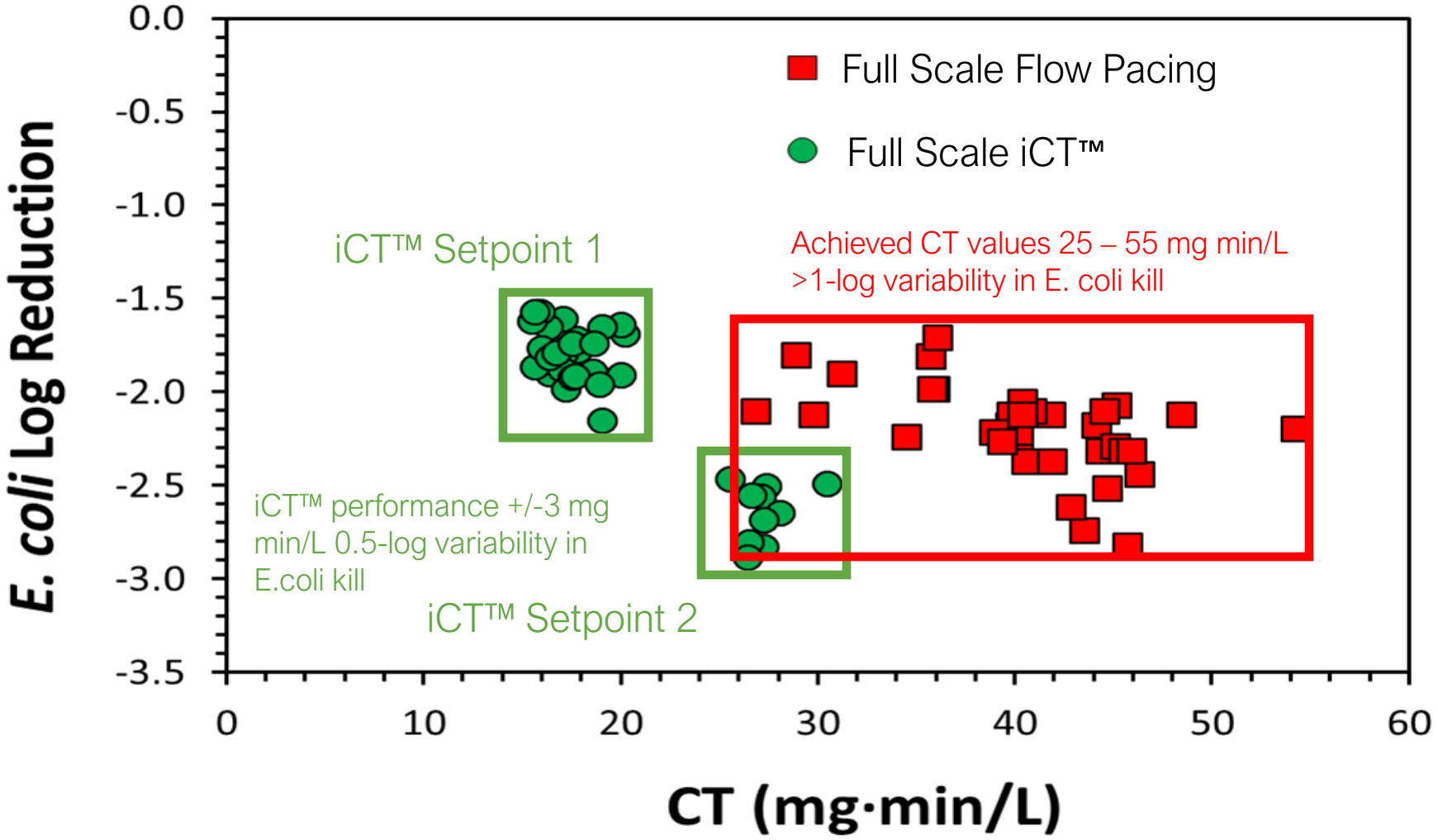




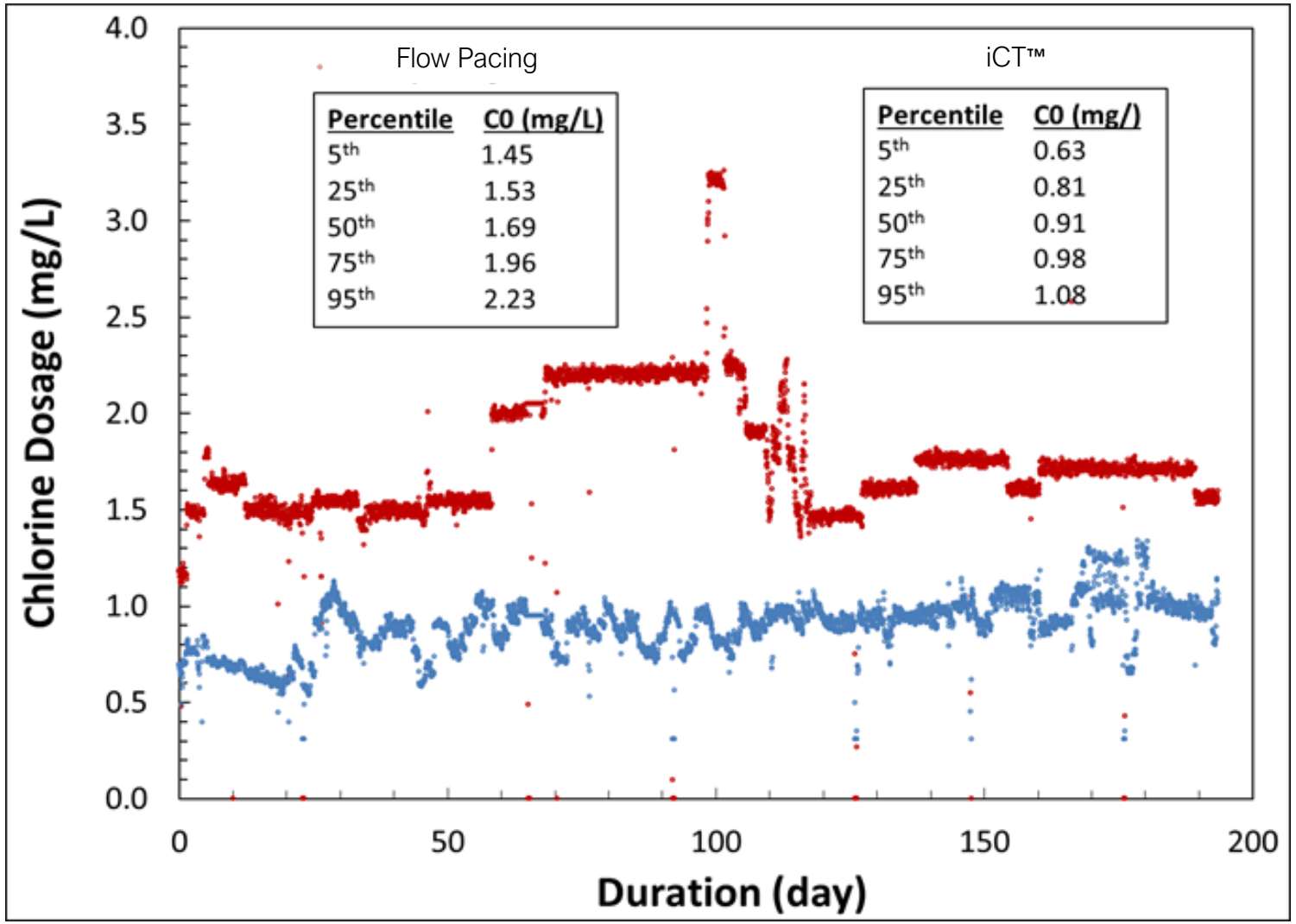
2-log variability in coliform at outfall is not optimal
Maintains coliform below 1000 cfu/100 mL

<0.5-log variability in outfall coliform
Maintains coliform below 100 cfu/100 mL

Performance Variability



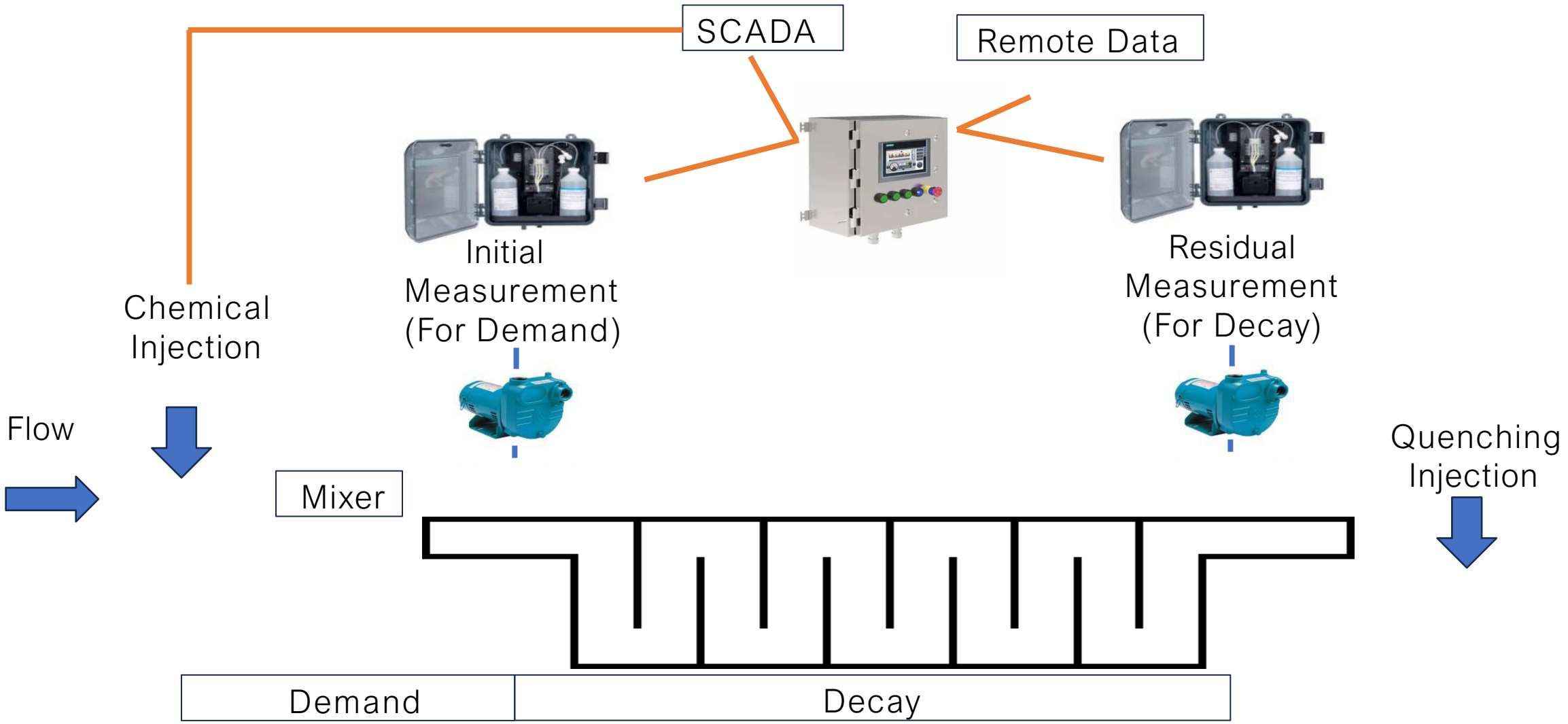
Demonstrated Savings



AND…

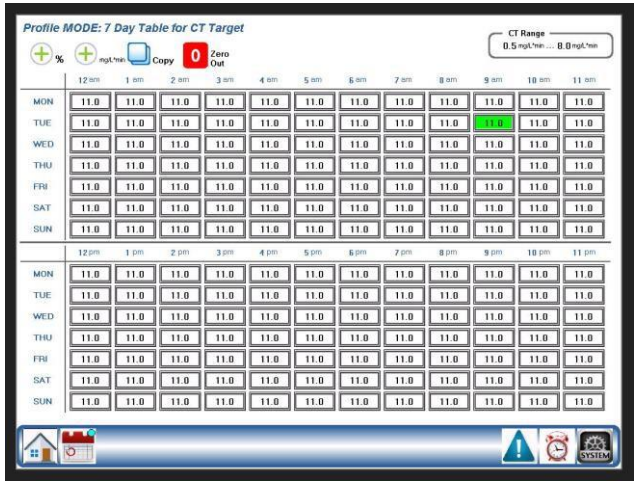
- iCT™ dose required 50% less hypochlorite
- Lower and more stable residual chlorine in effluent
- Expected reduction in demand for quenching chemical

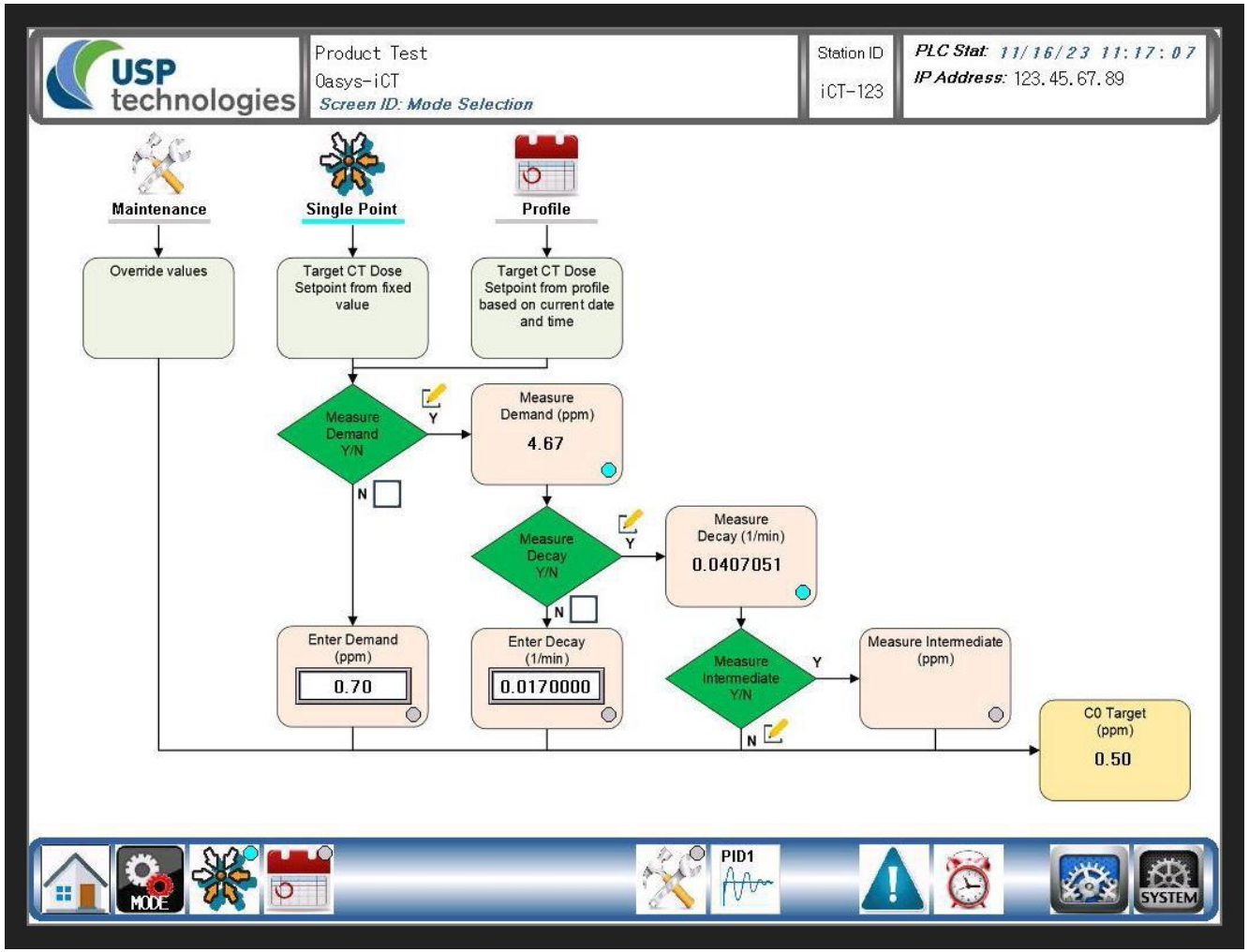
What is it?


SCADA
Remote Data
Initial
Measurement
(For Demand)
Residual
Measurement
(For Decay)
Chemical
Injection
Flow
Mixer
Quenching
Injection
Demand
Decay

Operating Modes

- Demand based on Initial concentration measurement vs. Injected concentration.
- Decay based on Residual concentration relative to Initial concentration vs. HRT.
  - iCT dynamically calculates the ideal Injected concentration to meet CT dose targets based on Demand and Decay.
- Demand and Decay can be measured or entered to provide flexibility and redundancy.
- System can be controlled based on a Single Point CT dose target or based on a configurable daily and hourly Profile.





Highly Configurable System

Inputs

- Can be configured to source signal from the HMI, SCADA, or a hardwired 4-20mA analog signal
- Highly configurable alarms with the ability to set system responses based on alarm conditions
- Valid signals stored to ensure that in the event of a signal fault, a previously valid value
  can be used until the fault is resolved
- Maintenance overrides of signals to ensure uninterrupted system

operation Outputs

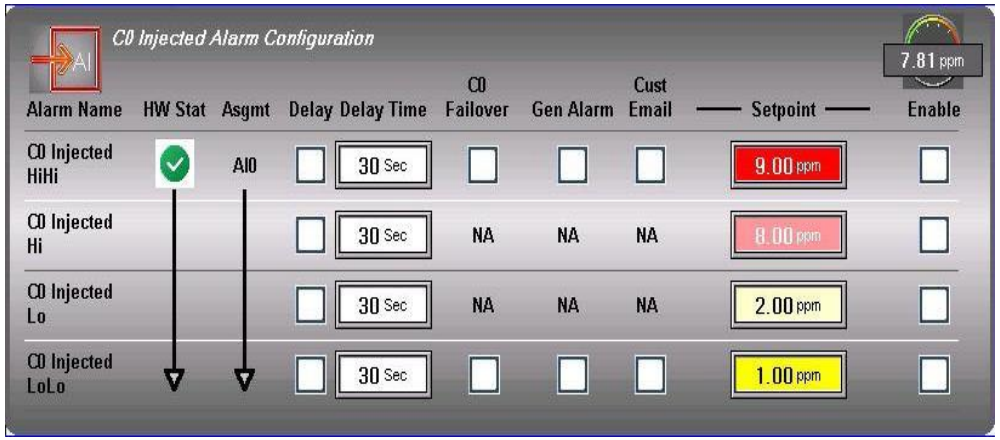
- Are available via SCADA or hardwired 4-20mA analog signals
- Maintenance overrides of signals to ensure uninterrupted system

operation Injected Target

- Limits can be configured to ensure the Injected Target only operates in a safe range
- Alarms can be configured to use an enterable Failover Injected Target in the event an alarm occurs

Configurable Alarm Outputs

- There are four configurable alarm discrete outputs
- These can be linked to specific alarms in the system to provide additional control actions if required



Accessible Information

Alarming

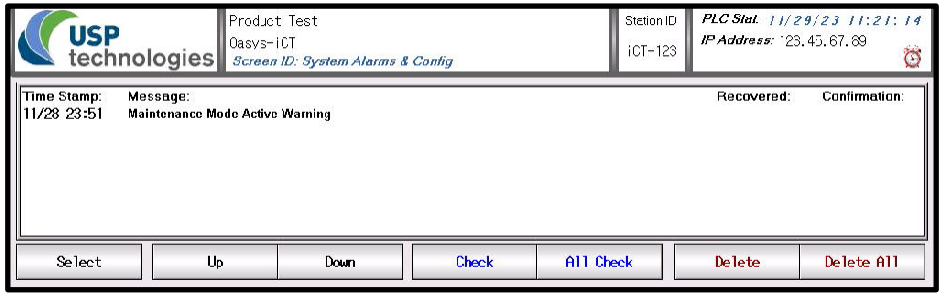
- Alarms are logged in the HMI
- Alarms can be configured to email specified addresses when they occur
- Alarm status is available over SCADA

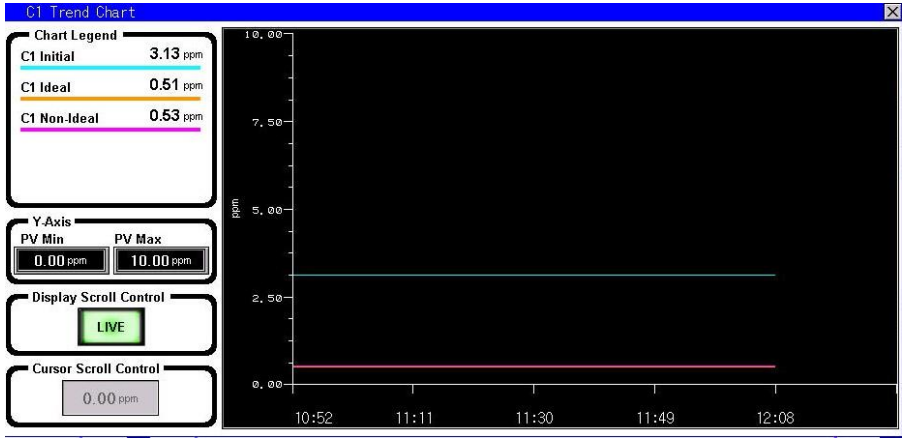
Trending

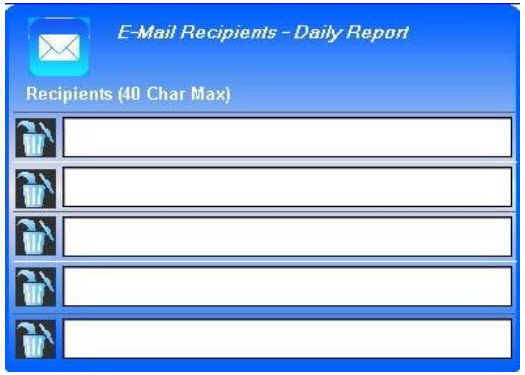
- Each signal has an associated trend
- Trends contain related signals
- Trends can be viewed historically

Data Logging

- Critical datapoints are logged in a remote data collection server
- Logging interval is configurable
- Data is available to be accessed remotely
- Data can be to emailed specified addresses daily on a set schedule







Thank You

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