Practical Implications of Coagulation Control

Mike Riding
Process Instruments (UK) Ltd.

Introduction

- Installation experience in Ireland.
- Do they work?
- Before and after cost/risk/benefit analyses.
  - **Plant B**
  - **Plant M**
  - **Plant D**
- What have we learned?
  - **Some things that CCS won't fix.**
  - **Commissioning vs Optimisation.**
  - **Optimisation SCM vs Optimisation UVA/Turbidity**
  - **Who does what?**
  - **Maintenance and re-optimisation.**
- Working with the operator
- Conclusions
- Remote Access…who is it for?

Installation Experience in Ireland

But do they work?

- 26 purchased
- First one went in in 2011
- The first 18 were StreamerSense (Streaming Current only)
- The last 8 are CoagSense (UVA, pH, etc.)
- As far as we can tell 4 are not 'working'
  - **2 due to poor coagulant mixing**
  - **2 due to the chemistry (pH above 7.5)**
- All 4 (from the 18 StreamerSenses) were purchased without the manufacturers involvement
  - **No application worksheet**
  - **No site visit**
  - **No discussion**
- They do work!

Why Automatic Coagulation Control?

- Optimise water treatment
  - **Reduce DBPs (enhanced coagulation- Barrier 6).**
  - **Improve Pathogen Removal (Barrier 4).**
  - **Reduce Aluminium carryover (Barrier 10).**
- Save money (5 years payback).
  - **Reduced coagulant usage.**
  - **Reduced sludge disposal costs.**
  - **Reduced operator call out costs.**

Plant B – Plant Information

- 27 m^3hr^{-1}
- 2 sources
- Crypto detected
- Regularly pumping treated water to waste
- Very variable NOM in low alkalinity low turbidity water
- High Aluminium residuals
- PAC coagulant
- Supplemented by borehole water
- On/off several times a day
- Installed spring 2016
- Optimised and put in control Autumn 2016

Installation Issues: Plant B Layout (before)

Installation Issues: Plant B Layout (after)

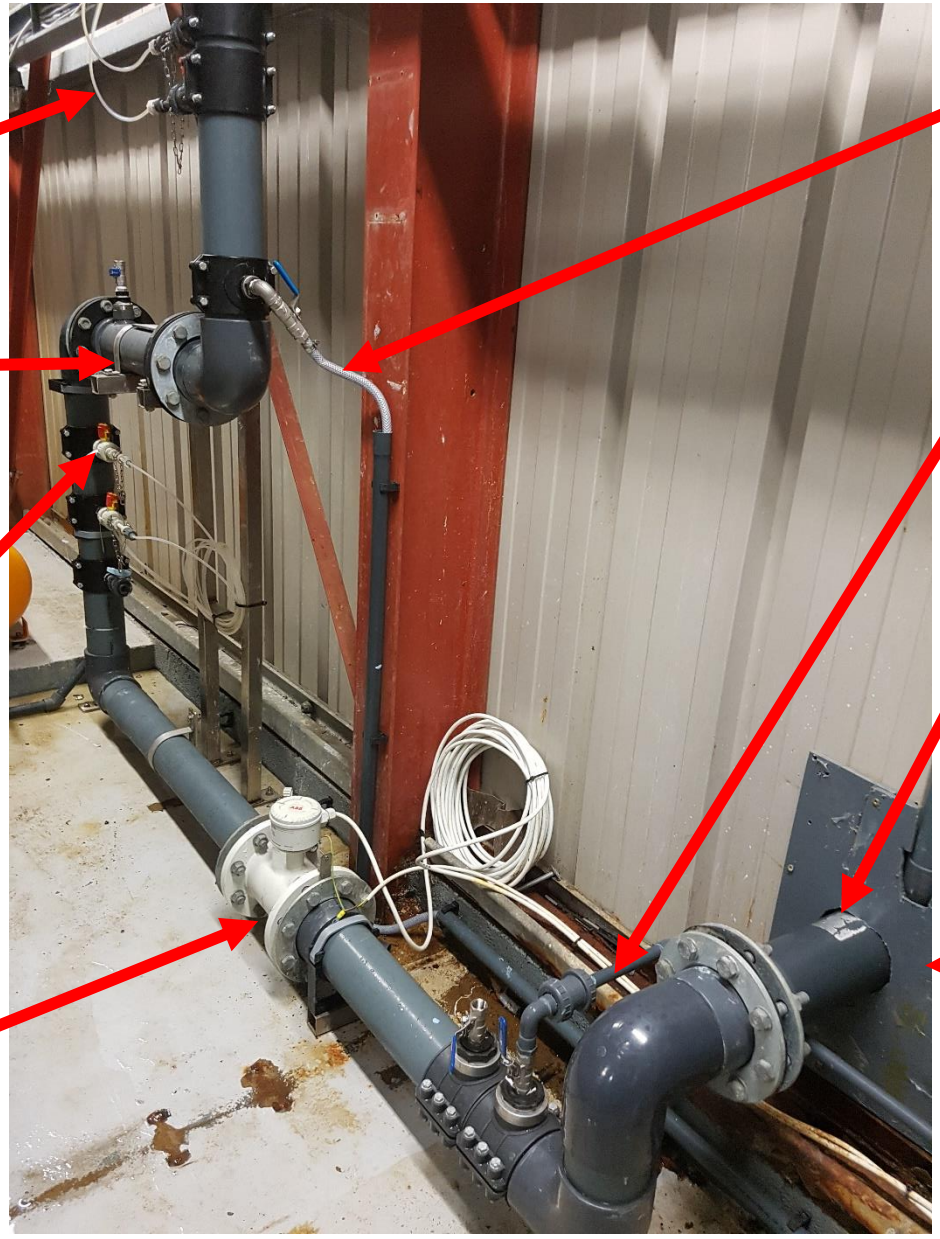
TRIDENT HERE

Flocculant addition

2nd static mixer

Coagulant dose (PACl)

Flow meter



Post coagulant sample

Soda dosed pH sample

1st static mixer (soda dosed just before)

Raw water sump 2 metres outside the wall

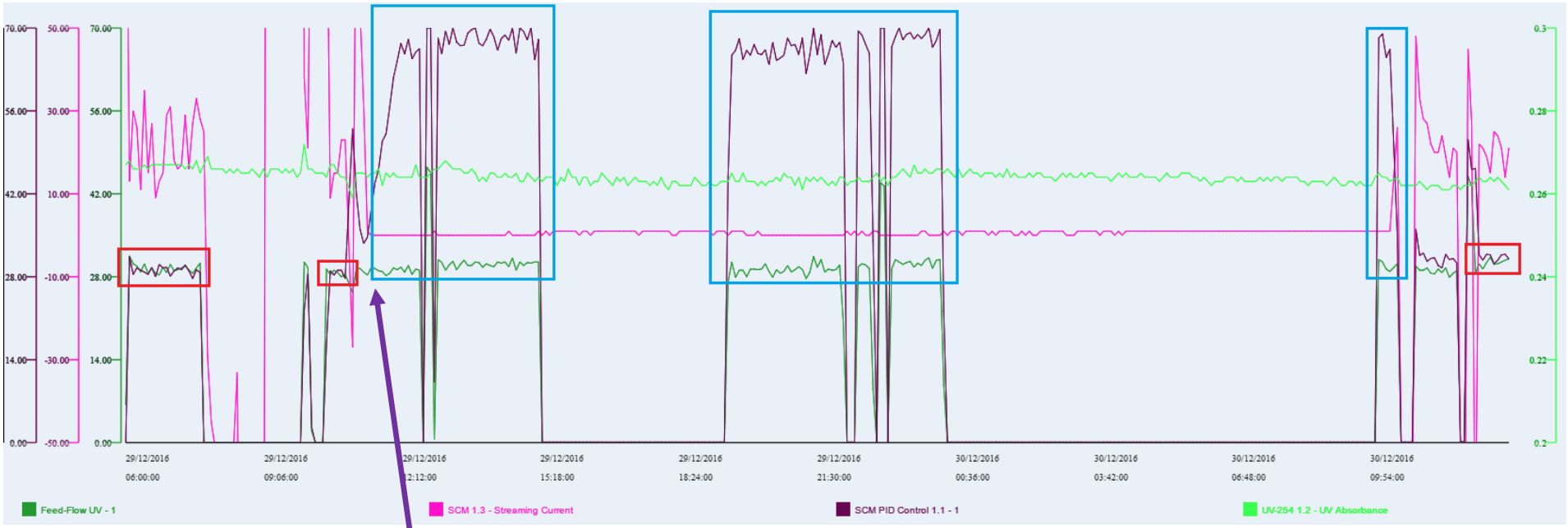
Total transit time <45 seconds.

Installation Issues: Plant B Layout

Results and Cost Benefit – Plant B

	Before Controller Installed	After Controller Installed
Final Water Turb	0.25 to 0.8 NTU	0.05 to 0.1 NTU
Aluminium Residual	0.1 to 0.2 mg/l	0.01 to 0.03 mg/l
PAC usage	-	25% reduction
Colour event	70-80 PtCo upper limit	110 PtCo no problem
	80+ PtCo pump to waste	No longer pumping any treated water to waste

Validation at Plant B



From Crius - B9BC:A05E:02BF:D5EF <crius@processinstruments.co.uk>

Subject **Alarm Active**

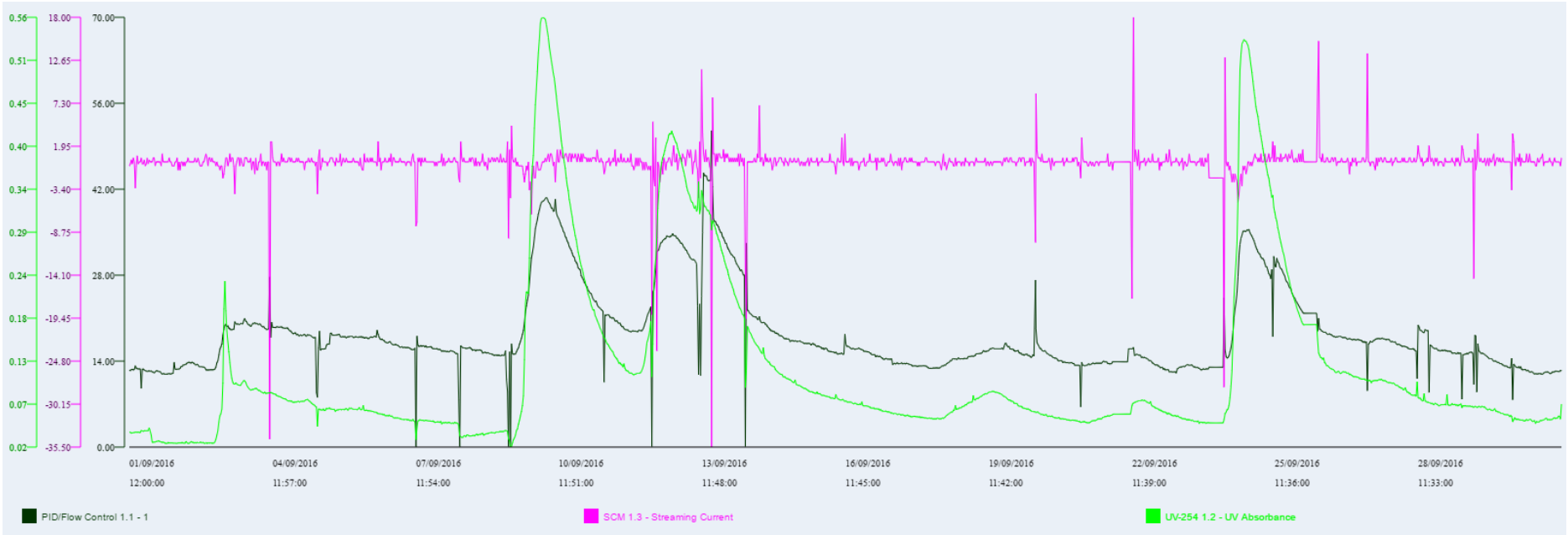
```
Alarm message update: 29/12/2016 11:04:53 GMT

Alarm details:
Coagulation Control 1.1
        Control input validation error
        Control in fail safe
```

Plant M – Plant Information

- 128 m^3hr^{-1}
- 1 source
- Very variable NOM in low alkalinity low turbidity water
- High Aluminium residuals
- No pH control
- PAC coagulant
- Continuous plant
- Installed spring 2016
- Optimised and put in control Summer 2016

What Does The Data Show Us?

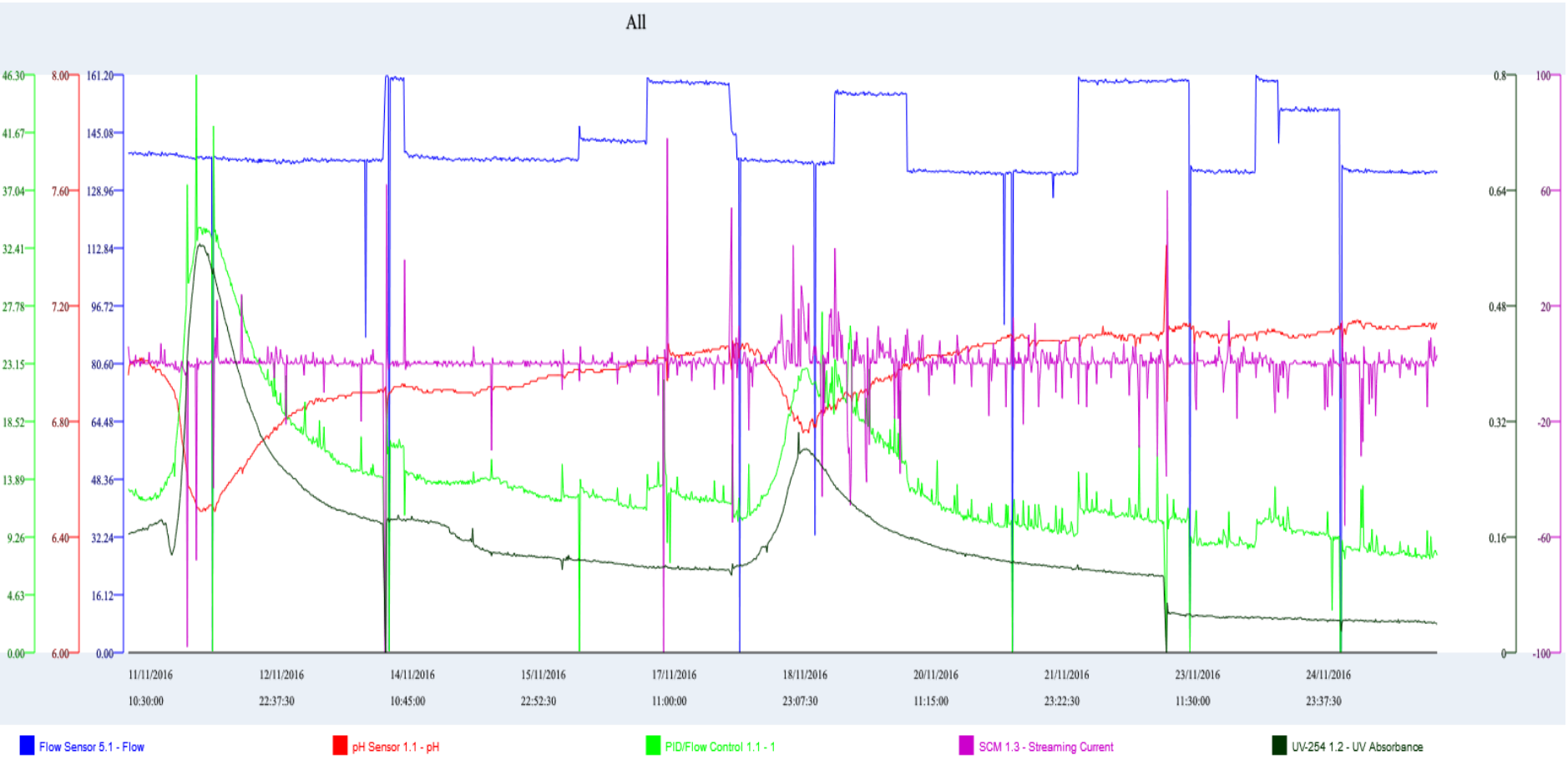


An Operators View

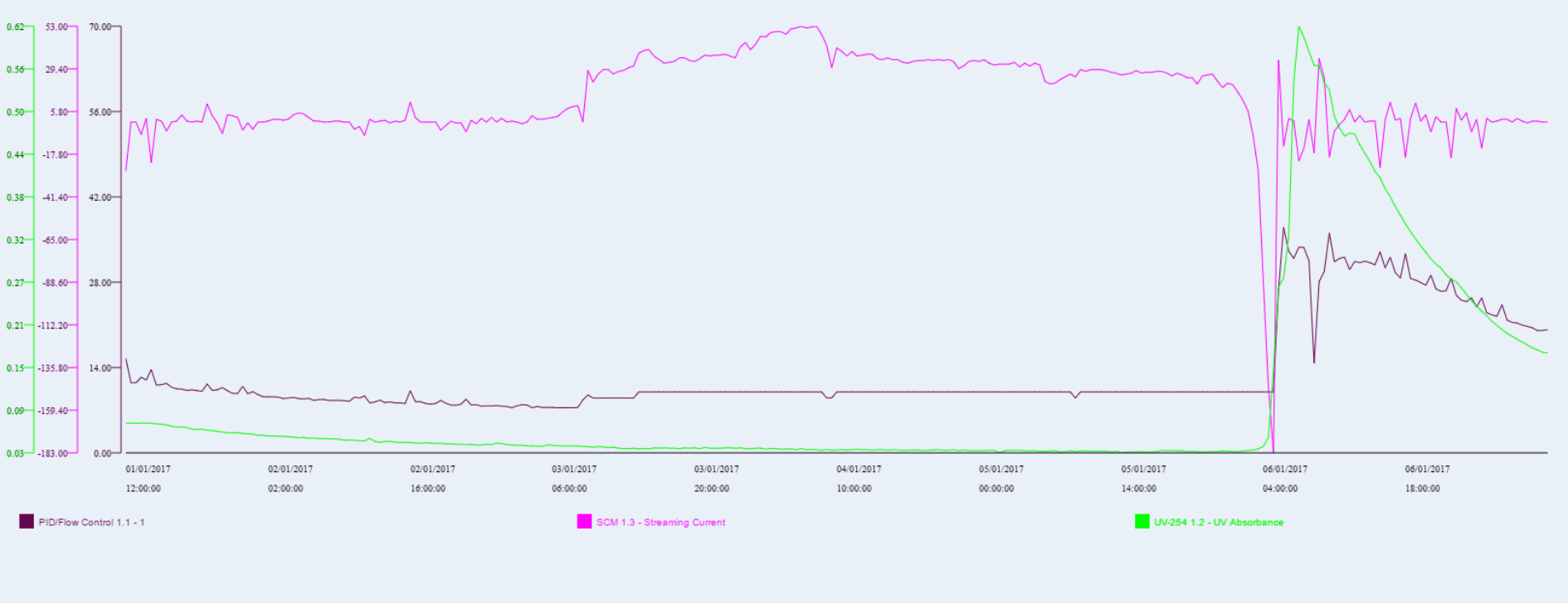
Results and Cost Benefit – Plant M

	Before Controller Installed (Jan/Feb 2016)	After Controller Installed (Jan/Feb 2017)
Settled Water Turb	0.43 NTU	0.34 NTU
Aluminium Residual	34.01 ug/l	18.40 ug/l
PAC usage	48.94ppm	36.58ppm Min 10% reduction (€1705)
Aluminium Residual	Several alum spikes 200ug/l	No barrier 10 breaks or

What Does The Data Show Us?



When do they turn it off?



Plant D – Plant Information

- 500 m^3hr^{-1}
- 1 source (Influenced by another)
- Very variable NOM in low alkalinity variable turbidity water.
- Soda control.
- Alum coagulant.
- Continuous plant.
- Installed spring 2016.
- Not yet in automatic control.
- Needed control when the operator isn’t present.

Results and Cost Benefit – Plant D

	Before Controller Installed	After Controller Installed
Final Water Turbidity	? to NTU	? to NTU
Aluminium Residual	? to mg/l	? to mg/l
Alum and Soda Savings	-	€14,000 PA (2.5 year payback)

What have we learned? Some things that a CCS won't fix

- Fundamentals of a Plant
  - **Multiple sources and feed forward control.**
  - **Physical layout.**
  - **Poor mixing.**
  - **High energy floc environments.**
- Poor Practise
  - **Sample point inappropriate.**
  - **Dosing point inappropriate.**
  - **Non-dilution of Alum.**
  - **Dilution of PAC.**
  - **Poorly sized dosing pump.**
  - **Poor instrumentation/maintenance (pH)**
- If a plant can't run in manual automating it WON'T fix it!
- It also needs looking after! (maintenance)

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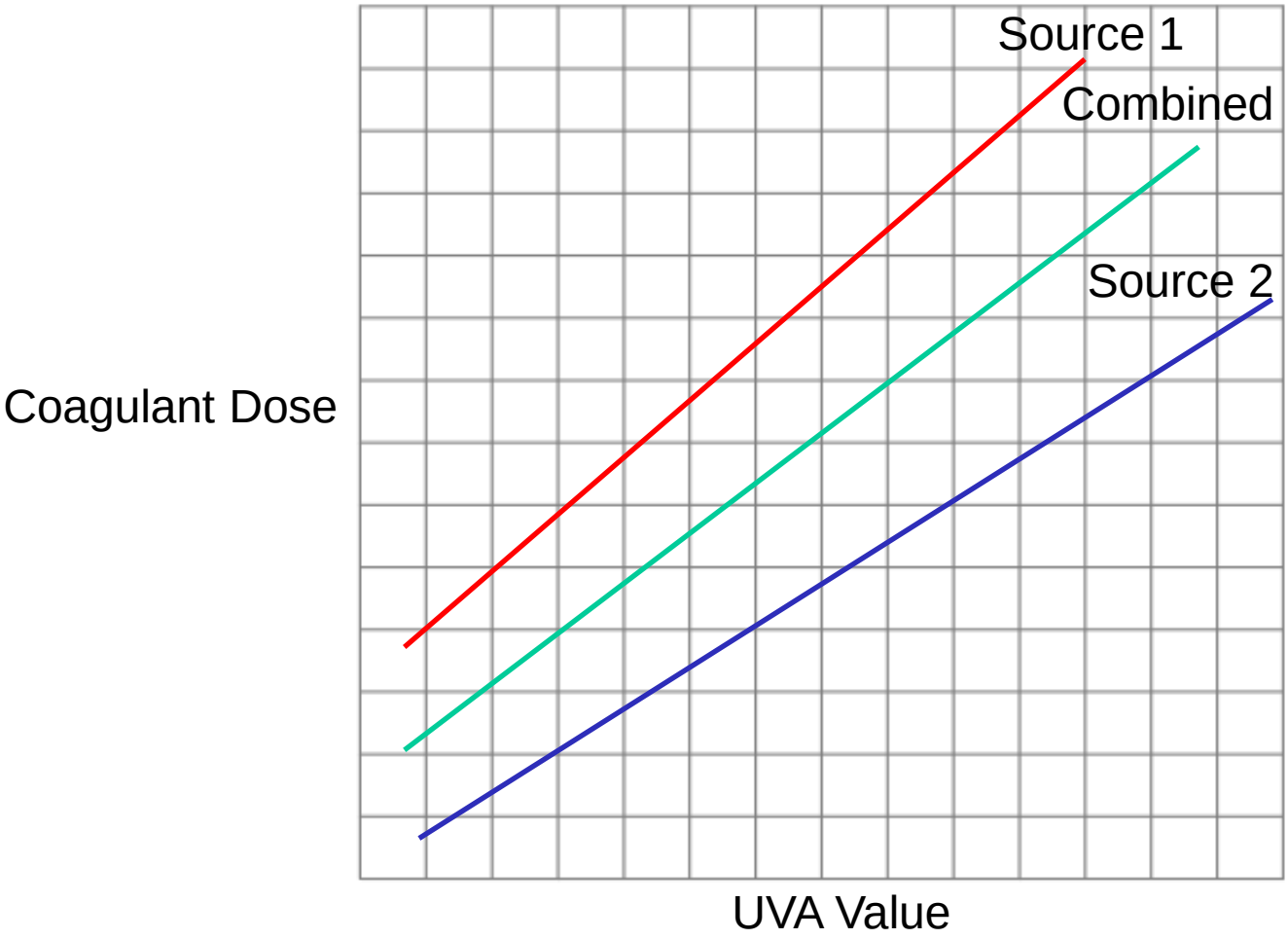

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What have we learned?: Pumps and Mixing - Plant R

Installation Issues: Mixing

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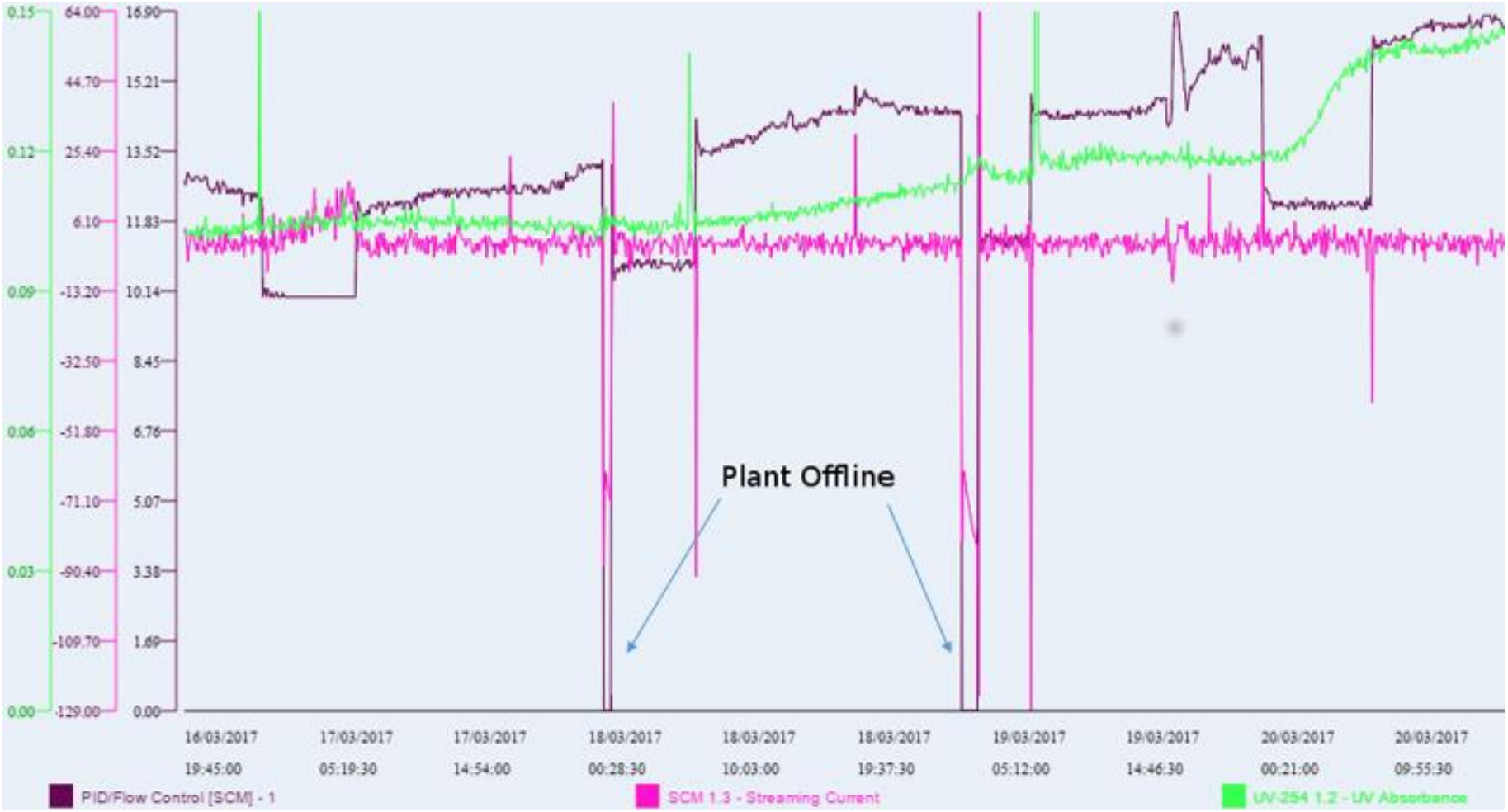
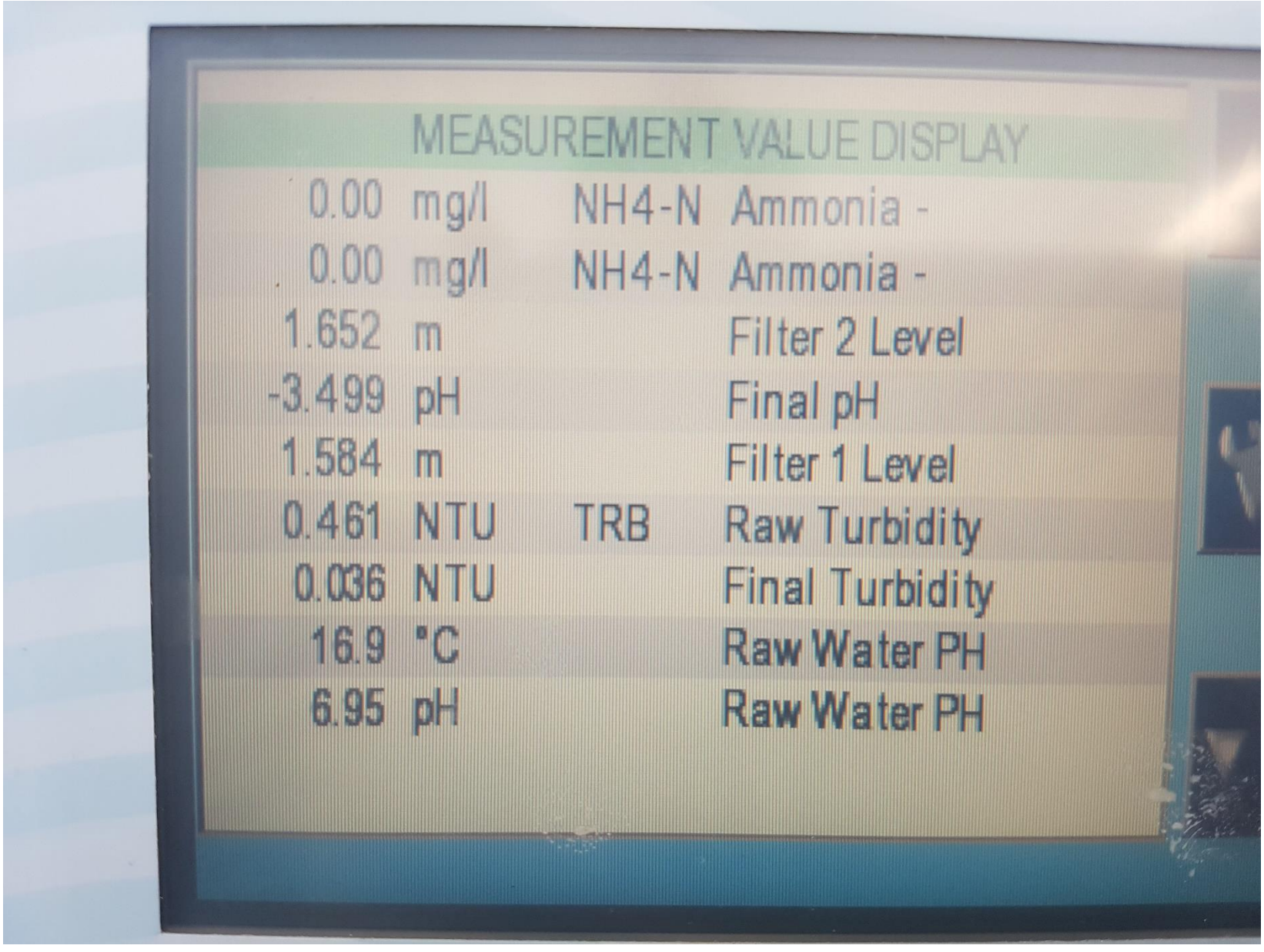
Installation Issues: Mixing

Mixing – Plant R



What we have learned: Operation and Maintenance



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Control vs Commissioning vs Optimisation

Automatic Control

"The ability to automatically maintain a setpoint in varying conditions".

Commissioning

"Turning a system on and ensuring that all constituent parts are functional".

Optimisation

"Choosing the best setpoint".

Optimising SCM

SCM Value	Plant outcomes
+100	Slightly high alum residual Good turbidity
+50	Slightly high alum residual Good turbidity
+30	Good alum residual Good turbidity
+10	Good alum residual Good turbidity
-10	Good alum residual Good turbidity
-20	Good alum residual Increase in turbidity
+20	Compromise

Optimising UVA

If we have SCM control

- Plot data dosing data against UVA
- Add more points over time

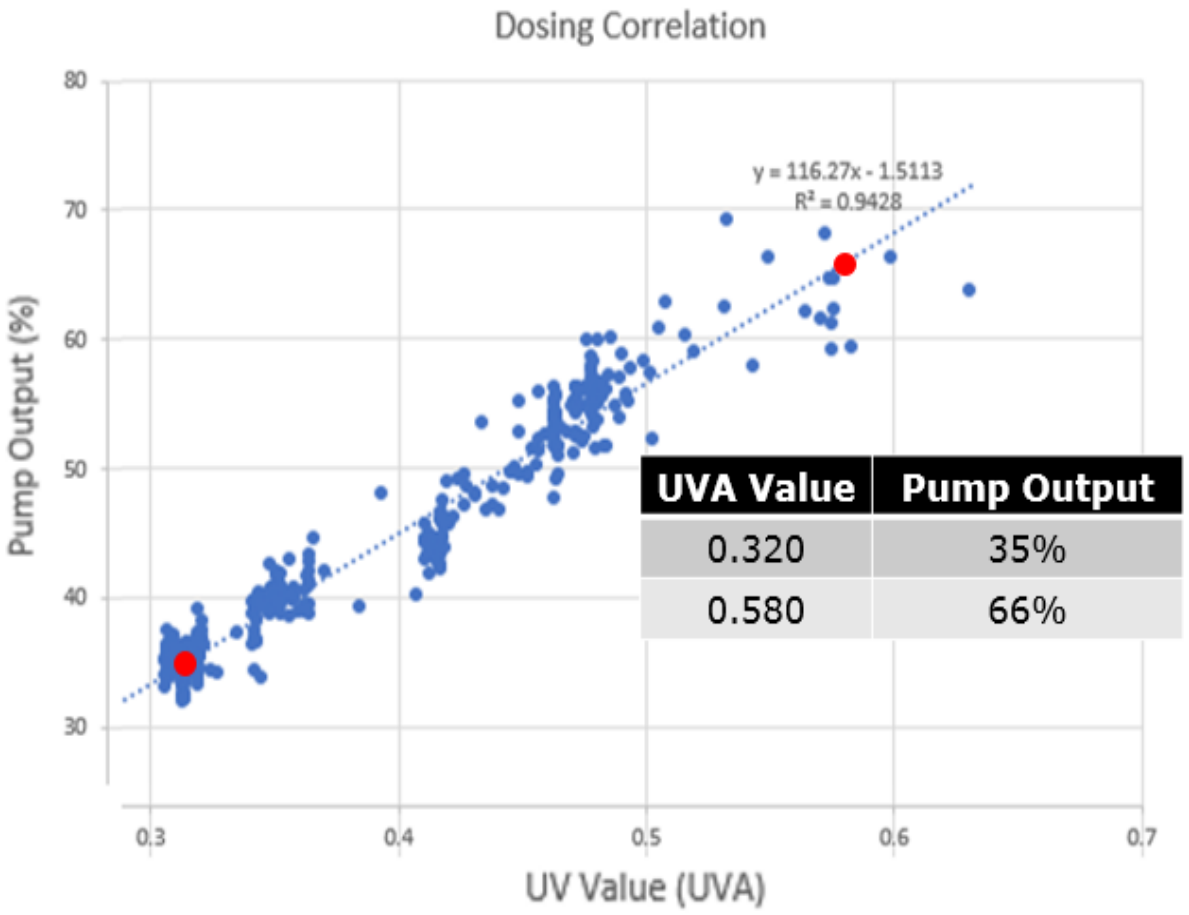
- Repeated ‘tweaking’

If we have don’t have SCM

- Jar testing
- Multiple times
- Multiple organics levels
- Different seasons

- Repeated ‘tweaking’

Optimised UVA Control



UVA Value	Pump Output
0.320	35%
0.580	66%

Who does what – From the beginning

- Get the CCS manufacturer involved.
- Risk/cost benefit analysis.
- Jar testing.
  - **Coagulant selection.**
  - **pH adjustment?**
- Get the CCS manufacturer involved.
- Best practice advice on suitability and compliance with IW requirements.
  - **Pre-installation checklist.**
  - **Site visit.**
  - **Design layout advice.**
- Installation Supervision – 1 Day
- Commissioning – 2 Days
- Optimisation – Multiple Days
- Ongoing Operator Support

Pre-Installation Checklist

Technical Note 22

CoagSense Application Questionnaire

Pi are committed to ensuring that you get the best experience from your CoagSense. To ensure that the CoagSense is suitable to meet your coagulation control objectives we need the following information to get every installation right first time, every time. When you have completed the form please email it to your local sales organisation or direct to the factory.

Contact Info

Name.....

E-mail.....

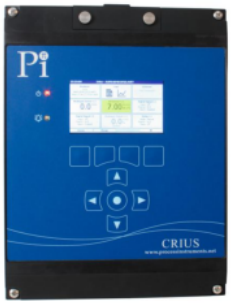
Mobile No.....

Plant Name.....

Town.....

Country.....

Date.....



Application

1. Application type: Water Plant, In-plant Process, DAF, Laundry, Other (explain):

2. Batch Process:_____, Occasional Shutdowns:_____, or Continuous Online Process:_____.

3. Quality Water Data (please indicate units):

Flow Rate	Max: _____	Min: _____	Normal: _____
TOC (Raw Water)	Max: _____	Min: _____	Normal: _____
UVA (Raw Water)	Max: _____	Min: _____	Normal: _____
UVA (Final Water)	Max: _____	Min: _____	Normal: _____
Turbidity (Raw Water)	Max: _____	Min: _____	Normal: _____
Turbidity (Settled Water)	Max: _____	Min: _____	Normal: _____
TDS (Raw Water)	Max: _____	Min: _____	Normal: _____

Pre-Installation Checklist

7. Estimated (calculated) lag time from chemical feed point to sample take off point:
   Under Max. flow:_____ seconds, Under Min. flow: _____ seconds

8. Does raw water flow change widely (+/-30%), and/or frequently in a relatively short time (e.g. once per hour).
   Yes _____ No _____ If Yes, how often or quickly: _____

9. Is an open, atmospheric drain available at sensor location? Yes ____ No ____

10. Is coagulant currently paced on raw water flow? Yes _____ No _____

11. Which of the following instruments are already on site and able to provide an output for the CoagSense to use?

Raw Water	Settled Water	Final Water
Turbidity: ☐	Turbidity: ☐	Turbidity: ☐
pH: ☐	pH: ☐	UVA/UVT: ☐
UVA/UVT: ☐		

Tell us more

If plans include using the CoagSense for Auto-Control, then please answer the following questions:

1. Is it planned to pace chemical on both a raw water flow and CoagSense signal, or just the CoagSense signal alone?

   _____

2. Will the chemical feed control be performed by SCADA/PLC with a signal from the CoagSense or direct from the CoagSense?

   _____

3. Does chemical feed pump accept: _____ 4-20mA signal _____ pulse?

Drawing

Please draw below (or attach) a line diagram showing raw water flow, all chemical feed points, mixer, possible sample points, settling basins, filters, etc. Something like this:

Who does what?

Manufacturer Best Practice

- Pre-installation suitability.
- Equipment spec advice.
- Installation supervision.
- Commissioning.
- Remote data monitoring.
- Correlation implementation.
- UVA/SCM correlation.
- SCM plant optimisation.
- Specialist maintenance.

Customer Best Practice

- Jar testing.
- Coagulant selection.
- Plant mods/Installation
- Pipework mods.
- Equipment installation.
- Routine cleaning.
- UVA/coagulant correlation.
- Offline data recording.
- SCADA Integration.

Working with the Operator

Option 1

- Install, commission, optimise the system.
- Hand the operator a 100 page manual.
- Provide a formal training course delivered with several operators, in front of the boss.
- Require the Operator to sign to say (s)he's been trained

Option 2

- Involve the operator right from the beginning
- Explain 1 to 1 what is trying to be achieved
- Provide personal mobiles to phone for help
- Drop in regularly in the early days
- Provide training 1 to 1 with no one else around

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- Conclusions
- Remote Access…who is it for?

Conclusions

- CCSs do work and provide massive benefits …. not always monetary!
- Be clear on why you are installing coagulation control systems
- Be prepared to find (and fix) stuff you weren't aware of …. E.g. pumps, mixers, piping etc.
- Involve the manufacturer before, during and after commissioning (ongoing)
- Be clear on the difference between commissioning and optimisation and who does what
- Give the manufacturer and the operator time together
- Encourage the operator to do the routine maintenance and involve the manufacturer with non-routine maintenance.

Remote Access – Who Is It For?

Thank You

Any Questions?

Benefits of Automatic Control

- Improve Overall Plant Performance: Consistent, High Quality Finished Water (Barrier 4)
- Optimise Organics Removal (Barrier 6)
- Reduce Chemical Costs (5 year payback)
- Reduce Soluble Aluminum Carryover
- Increase Length of Filter Runs
- Less Sludge Generated
- Less Sludge Disposal Costs
- Operators Able To Focus More On Other Testing and Maintenance
- Fewer Call Outs
- Less Pumping to Waste