South West Water

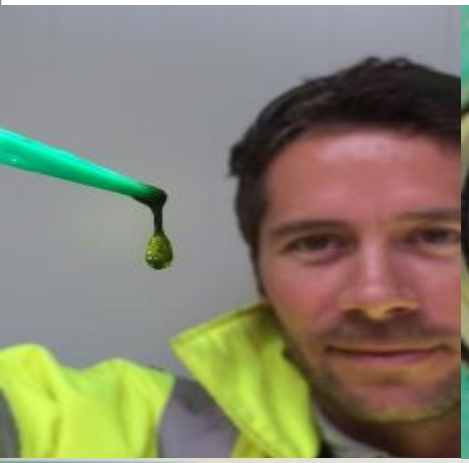
‘...you couldn’t make it up’

Chris Rockey

DOC2C’s Workshop 3, Plymouth, 2018

Acknowledgement

South West Water






DOC2C's collaboration

South West Water

Interreg
2 Seas Mers Zeeën
DOC2C's
European Regional Development Fund

PWNT
WATER TECHNOLOGY

South West Water

Provincie Noord-Holland

De Watergroep

Université de Lille

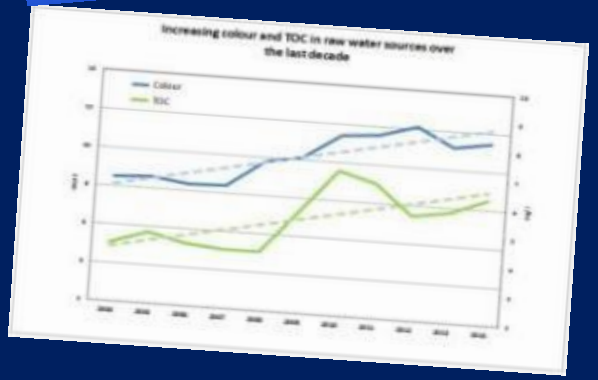
TU Delft

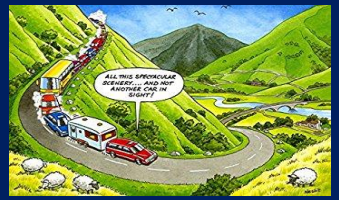
Contents

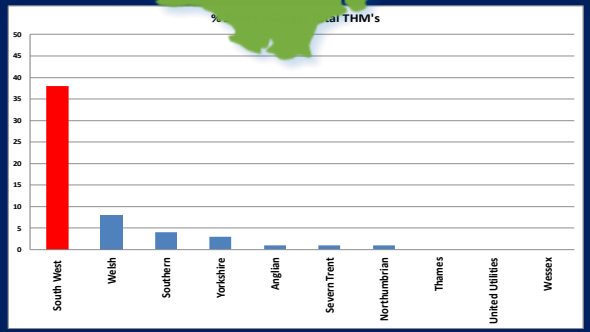
- South West Water
- ‘Amazing, you couldn’t make it up’
- Application of SIX, ILCA, CeraMac and...
- ...their impact on DOC, membrane fouling and DBPs
- Full scale application

Drinking water supply in South West England

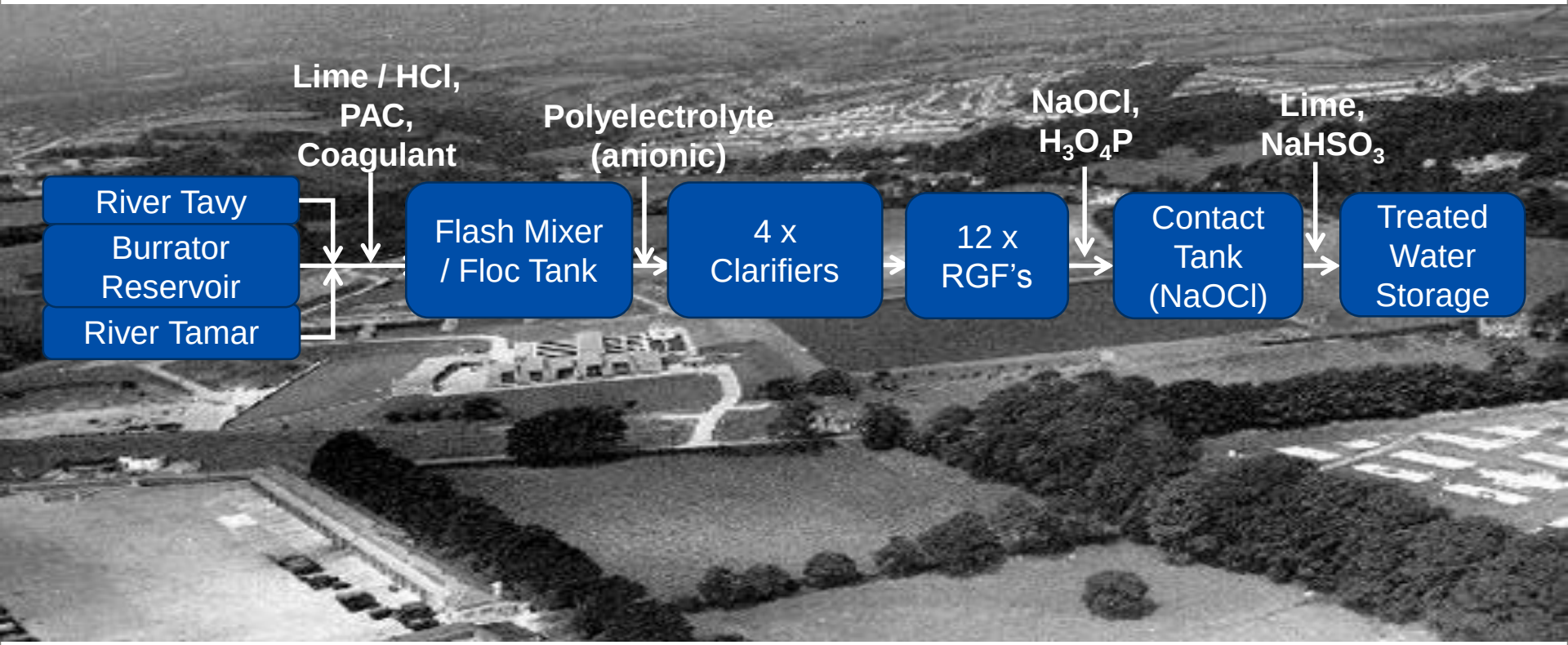
South West Water







Desire to retire Crownhill WTW, began working in the late 1950's



Goals for the next generation of WTWs...

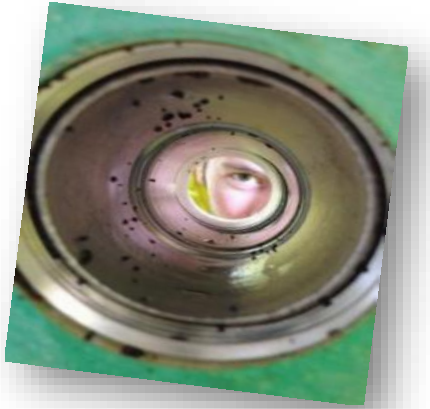
- Absolute barrier to Cryptosporidium
- DOC / disinfection by product reductions
- Very compact, forward looking design
- Highly automatable
- Robust and efficient process
- Environmental impact/sustainability
- Keep consumer bills down in long term

‘You couldn’t make it up...’, things that helped

- ‘Be lucky’, had a great internal team and external partners
- Had an interesting story for everyone (not just the geeks)
- Clear goals/strong need – research and a constant focus on the full scale reality
- Local knowledge from piloting and used pilot to engage
- Reduced the risk of operational/engineering myths
- Un-scientific demands, got involved
- Enjoy it and try and make it enjoyable for everyone else

Key moments in Plymouth's water supply...

South West Water



1589

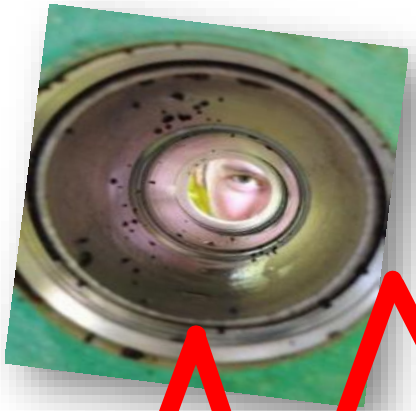
1958

2013

2018

Key moments in Plymouth's water supply...

South West Water



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1958

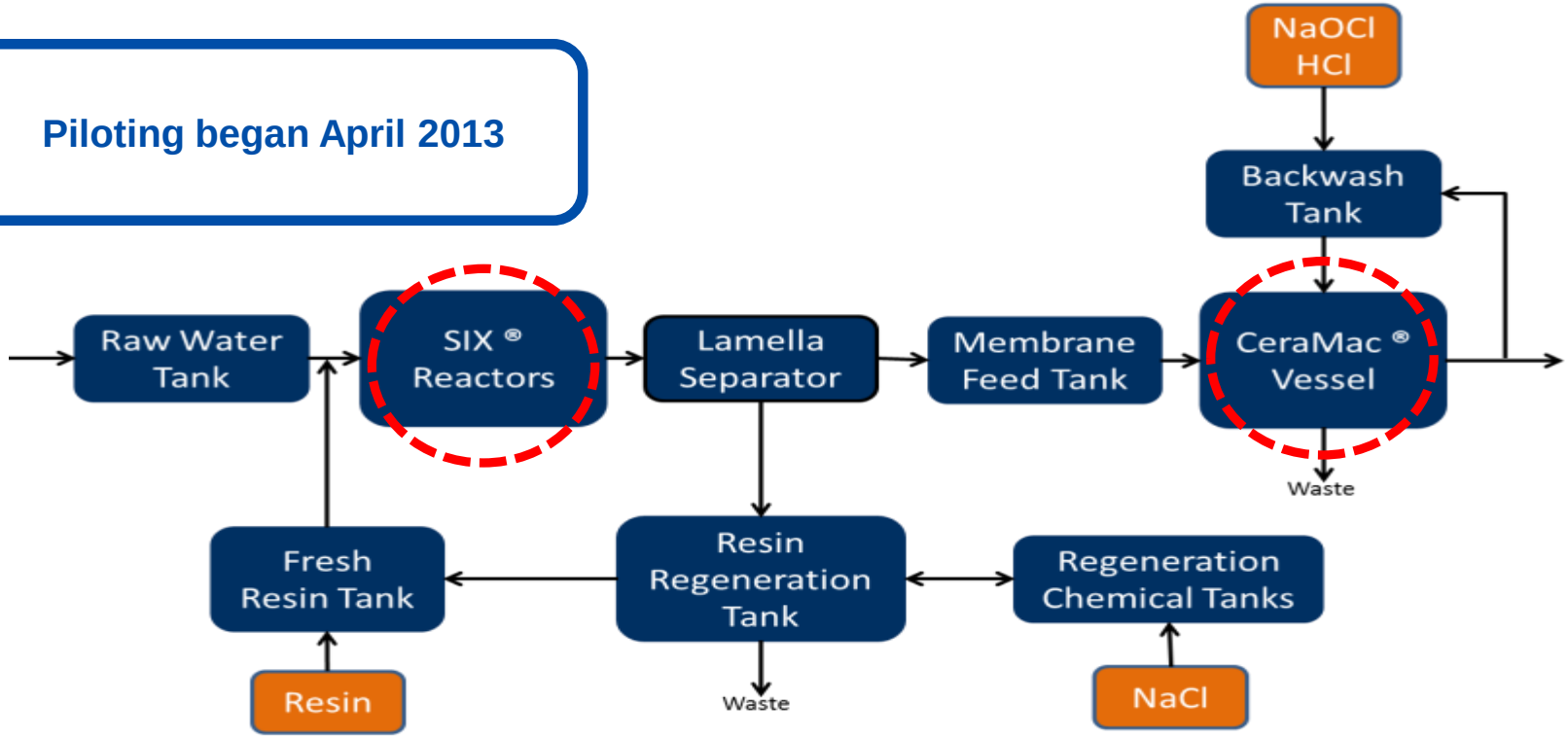
2013

2018

Initial pilot testing

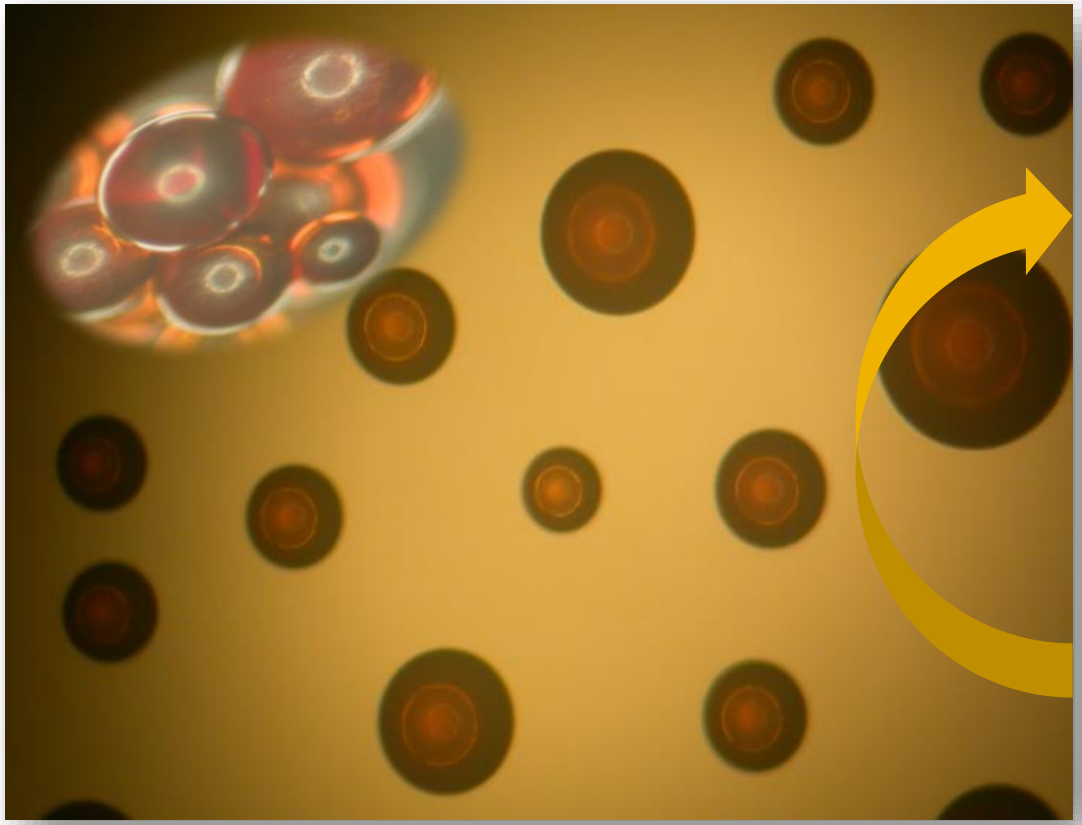
South West Water

Piloting began April 2013



Process Flow Diagram for the SWW Pilot Study of SIX ® and CeraMac®

Suspended ion exchange (SIX PWNT, The Netherlands) – DOC removal



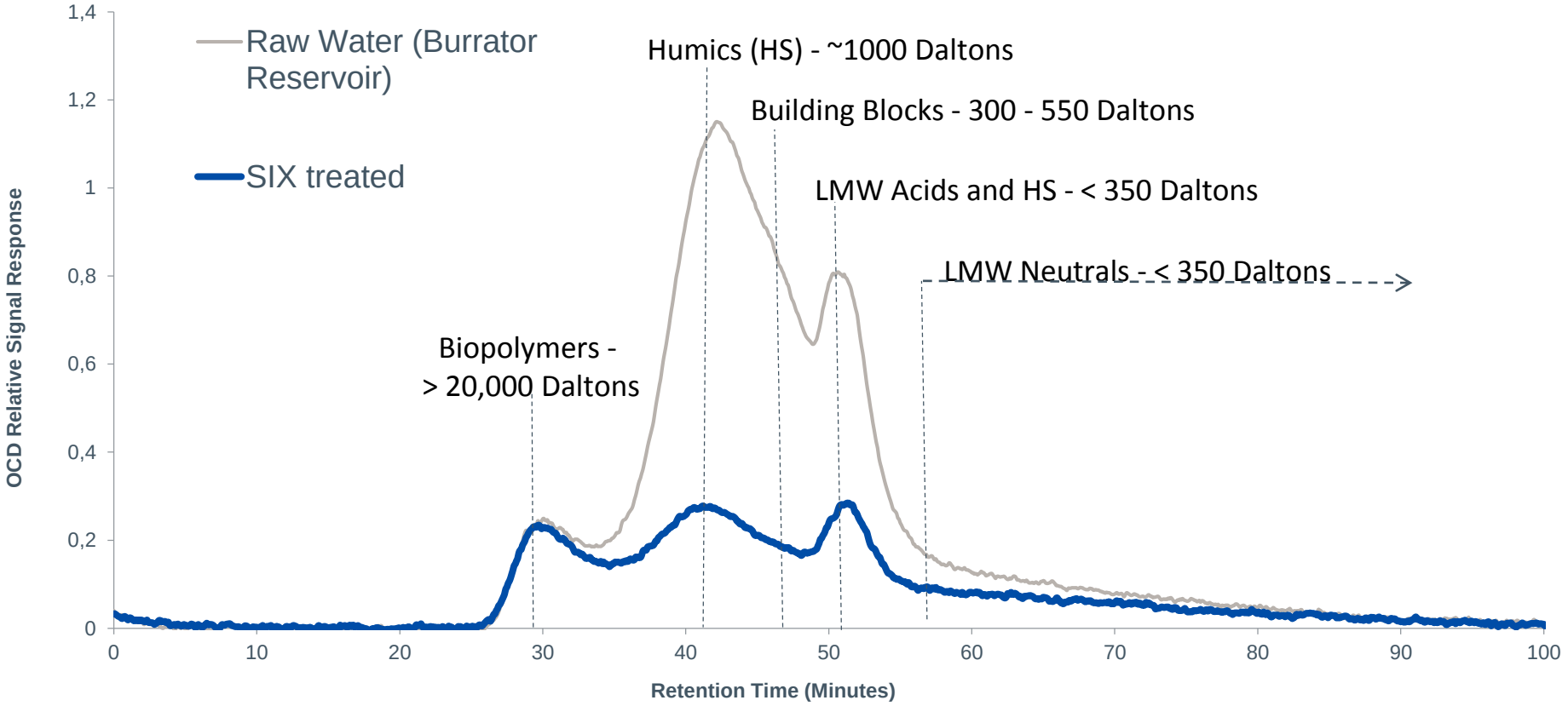
- Raw water flowing through 5 tanks in series
- Small dose of resin added to the raw water
- Good mixing (with air) and high turbulence
- Single pass (minimise risk of resin blinding)
- Resin separation (lamella), regeneration with multiple salt solutions

CeraMac/Ceramic membranes (PWNT Netherlands, Metawater, Japan) – turbidity and crypto

South West Water

- Filtration area 25m^2/0.1um pores
- Close to 100 plants, no integrity failures
- **Treat direct river abstractions with no upstream clarification???**
- High pressure backwash and range of chemical cleaning options?
- Perceived cost and recovery issues

Optimised DOC removal by SIX (LC-OCD)



SIX-Membrane testing and fouling

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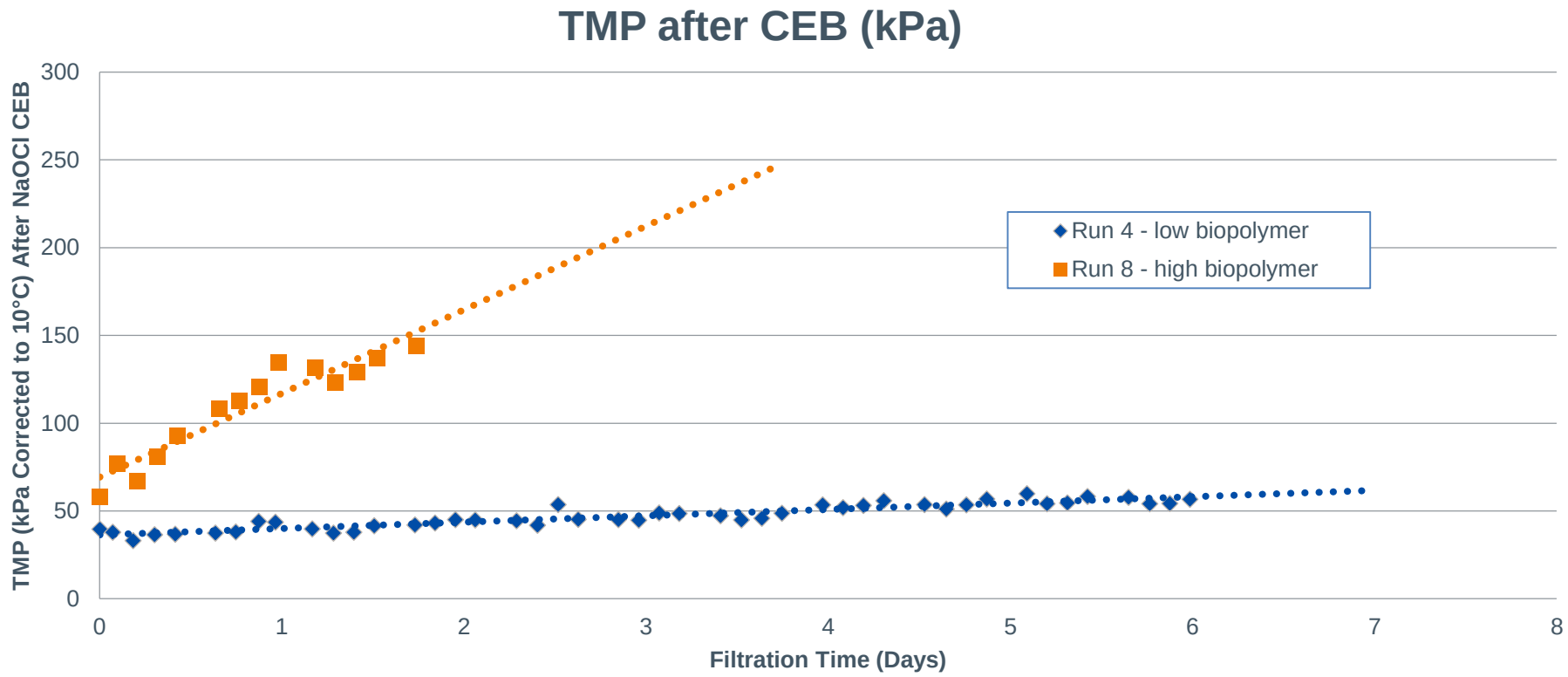
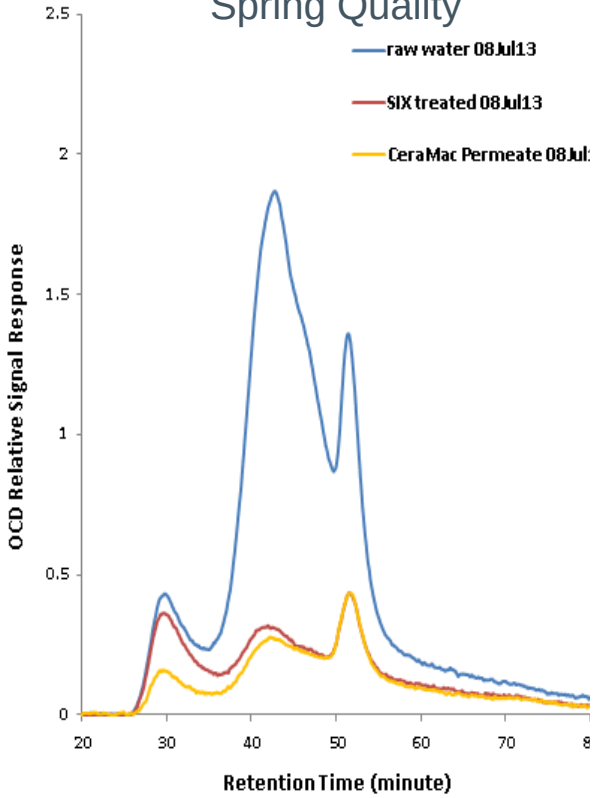
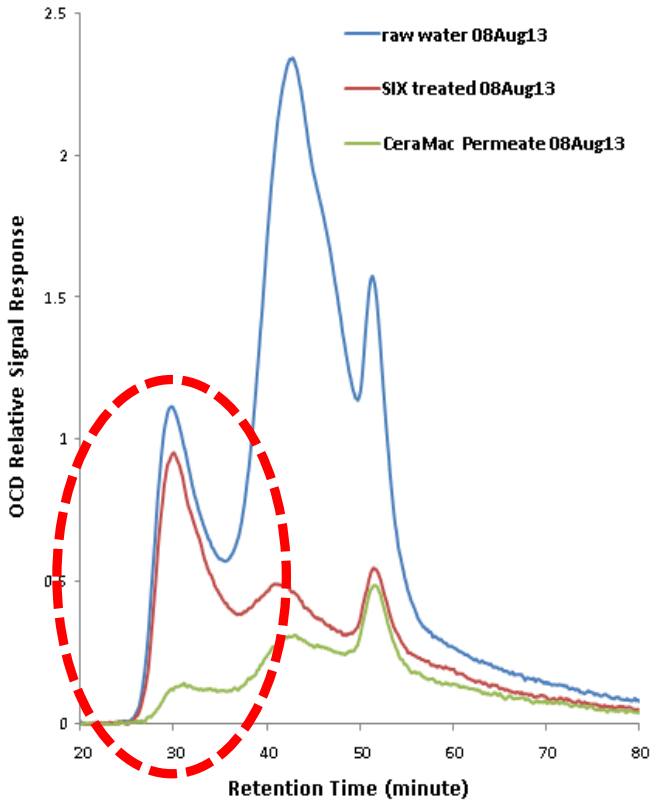


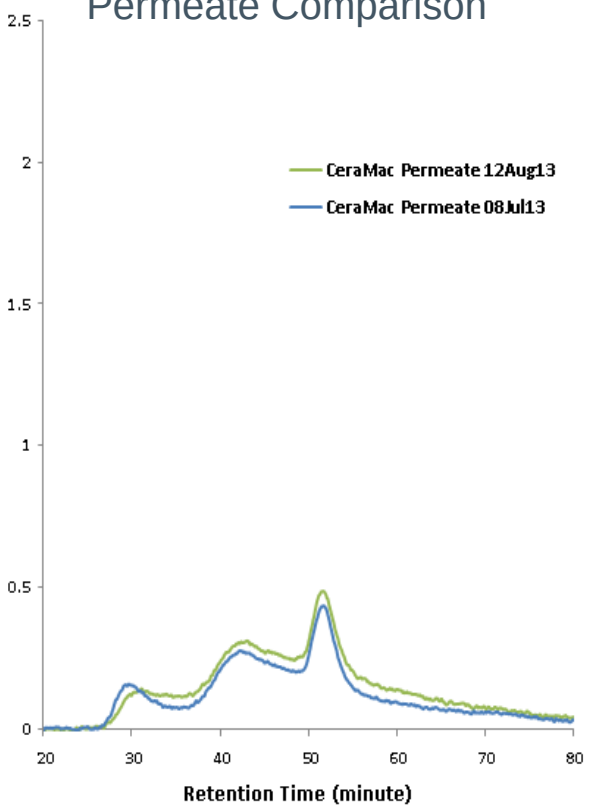
Reservoir water quality change

Spring Quality

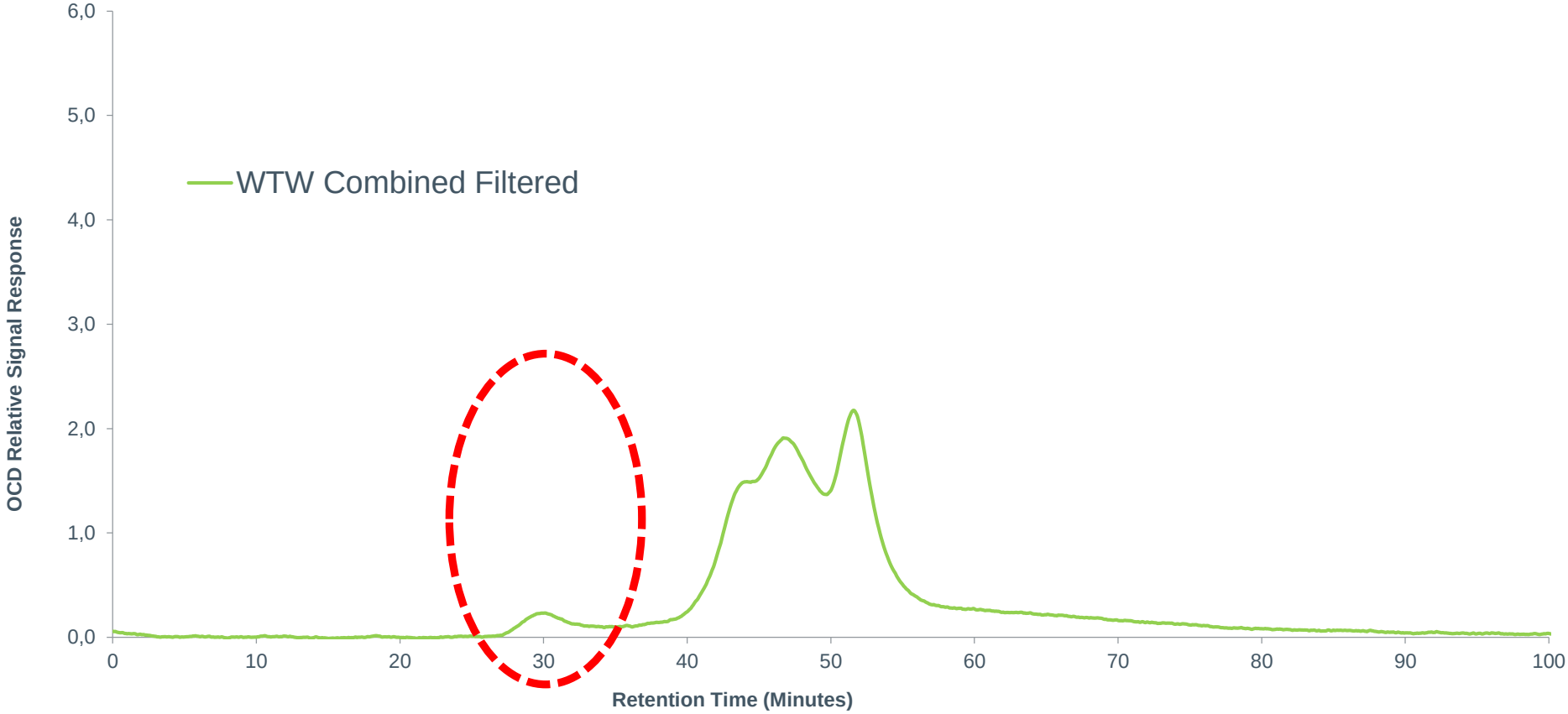




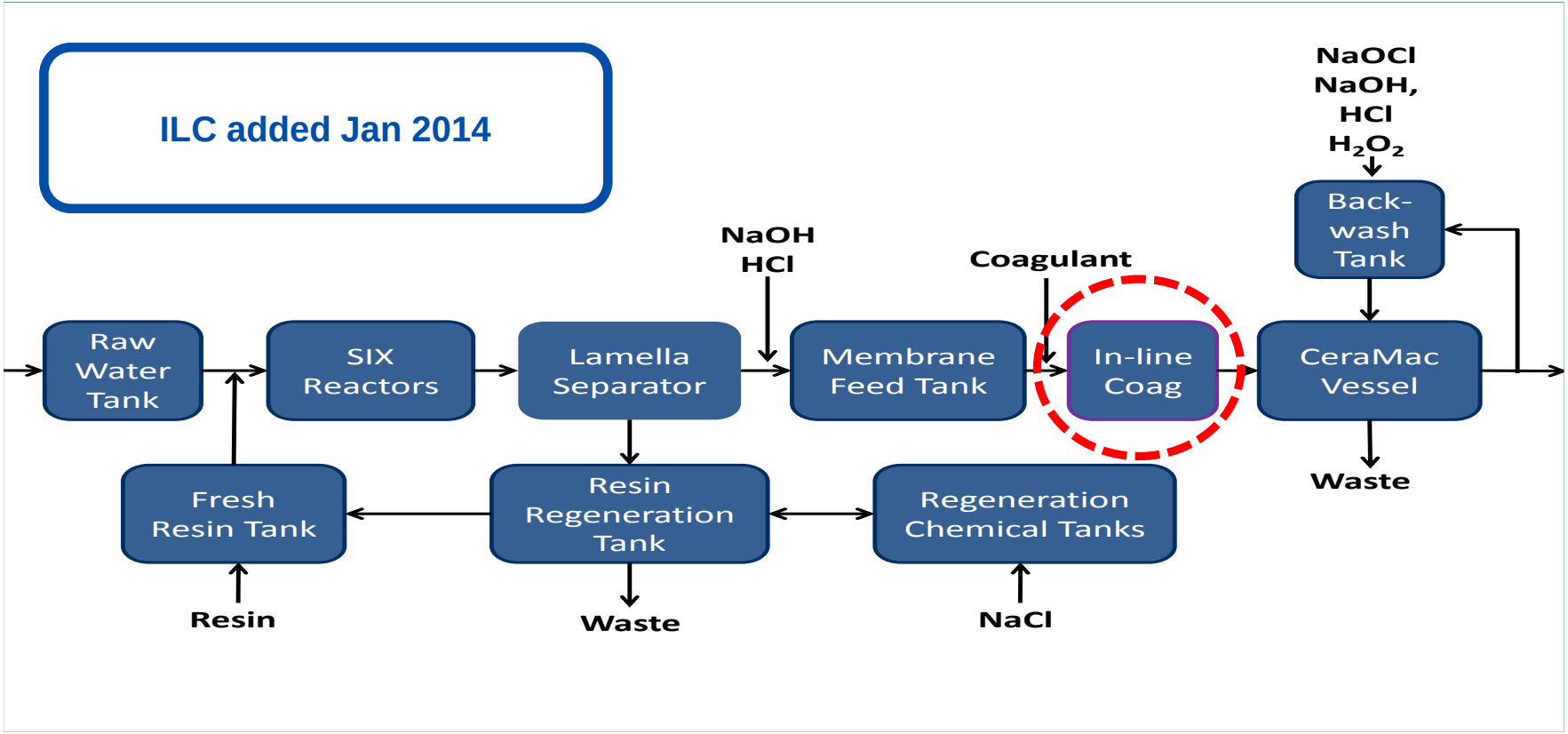
Permeate Comparison



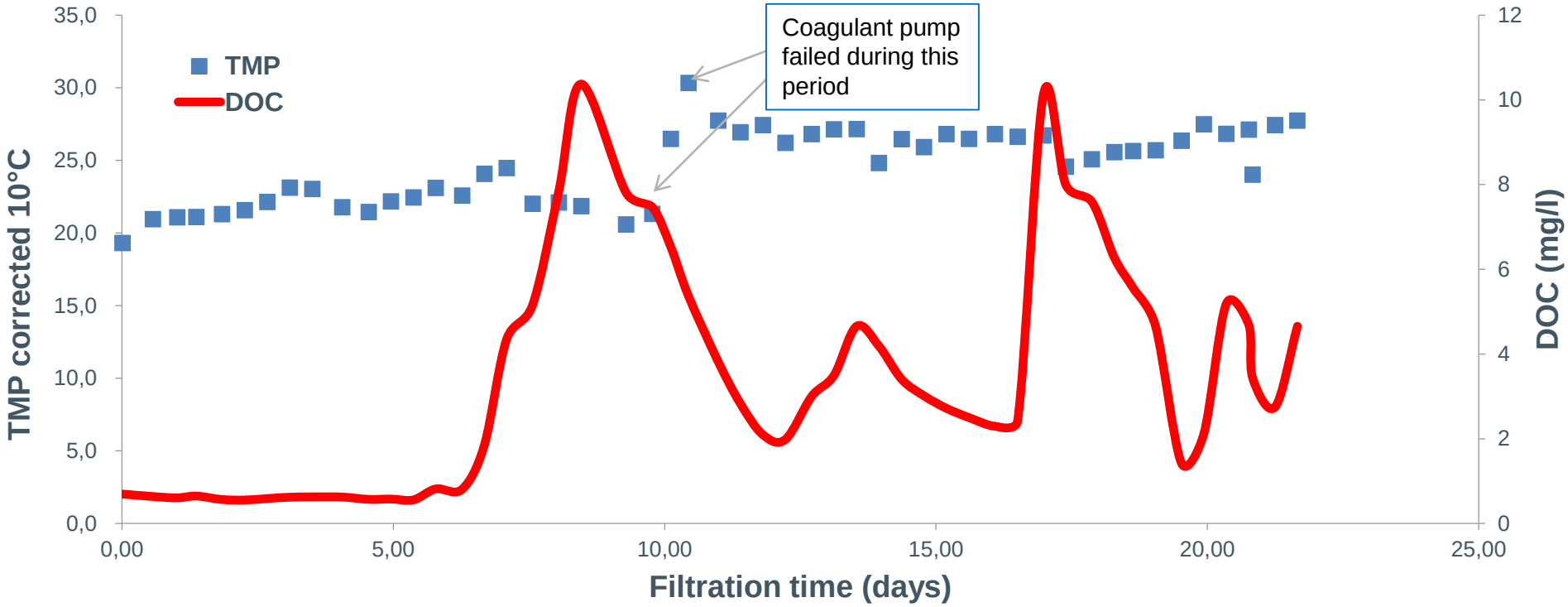
Coagulation



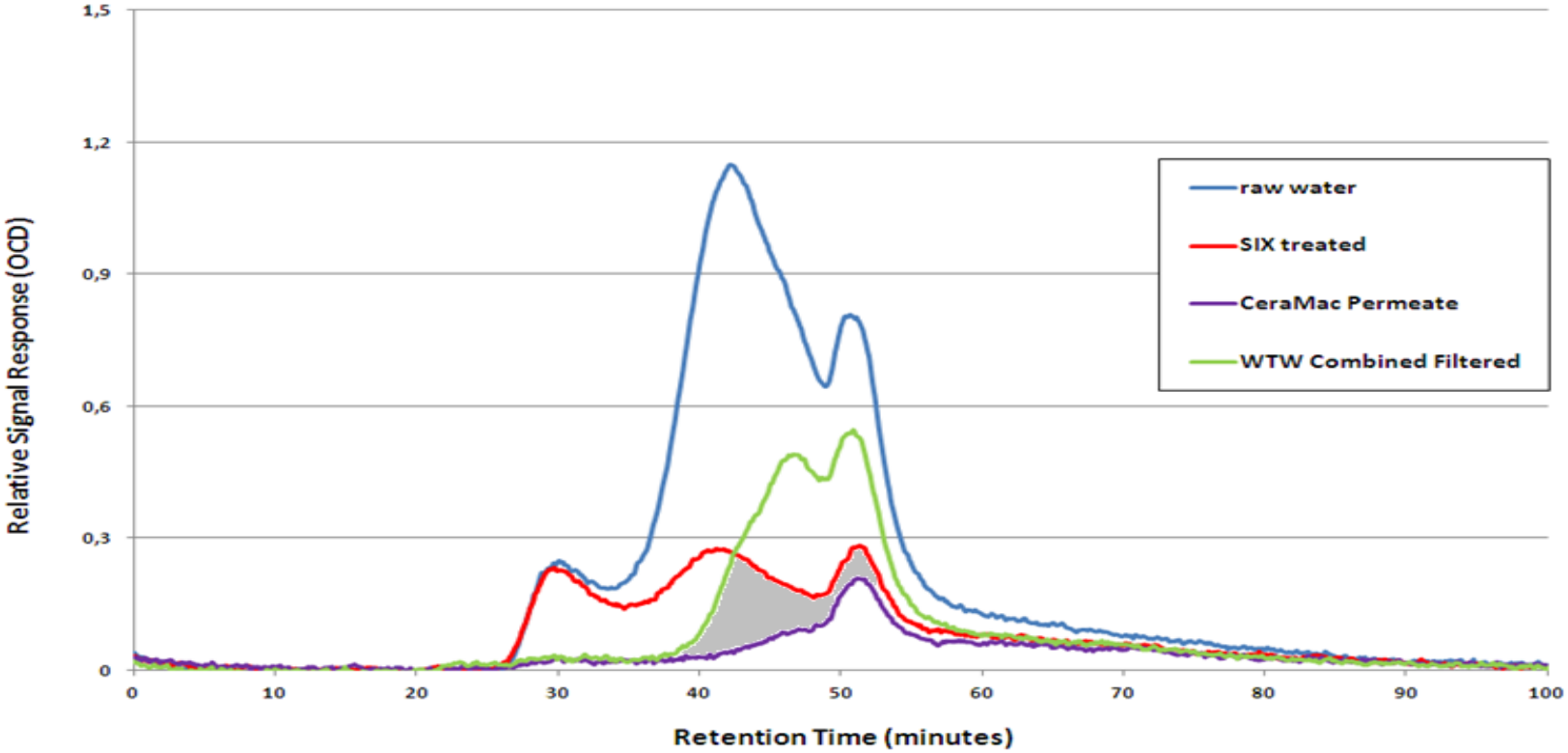
Revised pilot process train



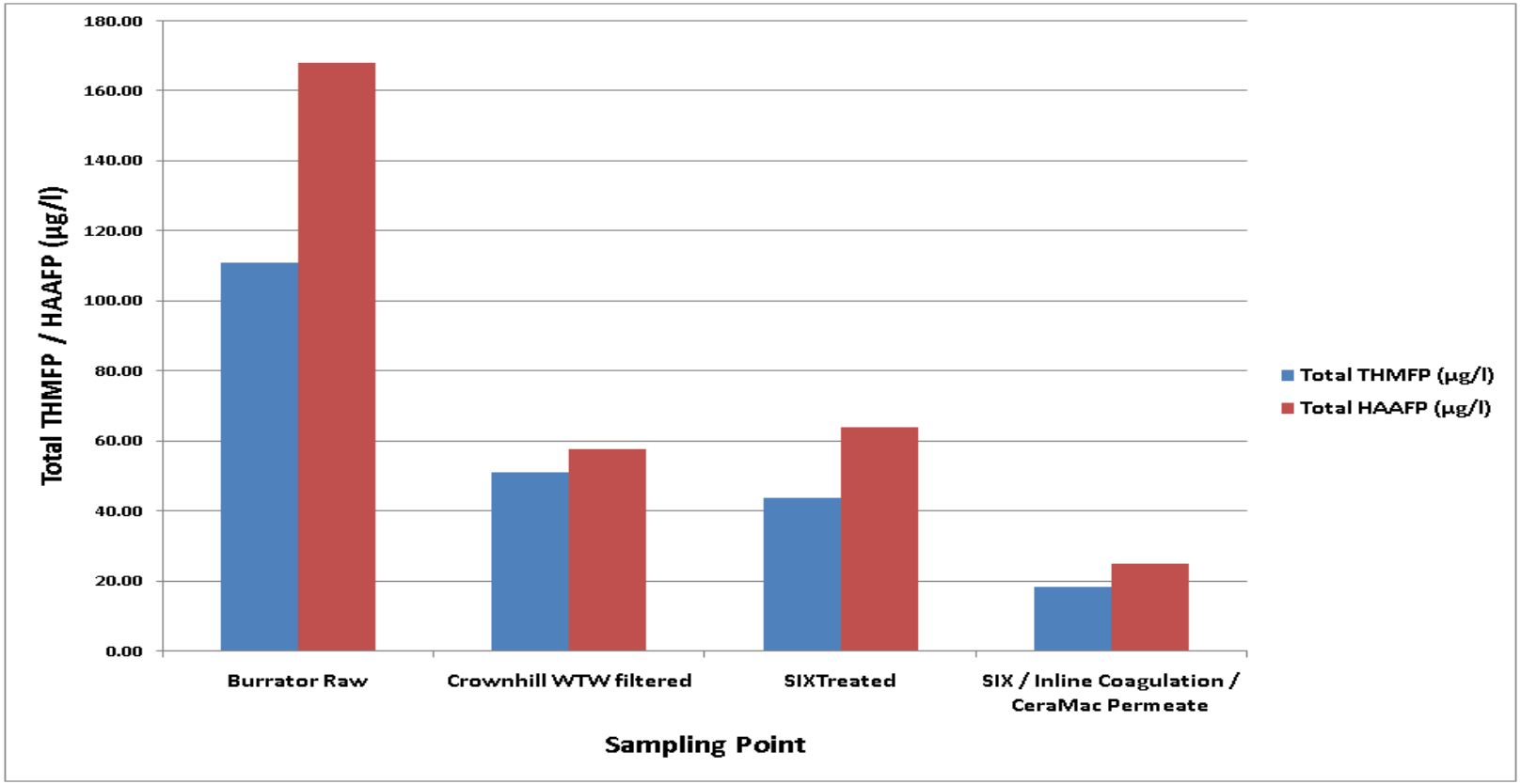
Long term stable operation/economically viable flux c180lmh...



Organics removal/disinfection by products



By products



Publications

CRANFIELD UNIVERSITY

David Christopher Metcalfe

Application of Suspended Ion Exchange, In-line Coagulation and Ceramic Membranes for Surface Water Treatment

School of Applied Science
MSc by Research

Master of Science
Academic Year: 2014 - 2016

Contents lists available at ScienceDirect

Water Research

journal homepage: www.elsevier.com/locate/watres

Removal of disinfection by-product precursors by coagulation and an innovative suspended ion exchange process

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Keywords:
Ceramic membrane filtration
Disinfection by-products
Ion exchange
Natural organic matter

ABSTRACT

This investigation aimed to compare the disinfection by-product formation potentials (DBPFPs) of three UK surface waters (1 upland reservoir and 2 lowland rivers) with differing characteristics treated by (a) a full scale conventional process and (b) pilot scale processes using a novel suspended ion exchange (SIX) process and inline coagulation (ILCA) followed by ceramic membrane filtration (CMF). Liquid chromatography-organic carbon detection analysis highlighted clear differences between the organic fractions removed by coagulation and suspended ion exchange. Pretreatments which combined SIX and coagulation resulted in significant reductions in dissolved organic carbon (DOC), UV absorbance (UVA), trihaloemethane and haloacetic acid formation potential (THMFP, HAAFP), in comparison with the SIX or coagulation process alone. Further experiments showed that in addition to greater overall DOC removal, the processes also reduced the concentration of brominated DBPs and selectively removed organic compounds with high DBPFP. The SIX/ILCA/CMF process resulted in additional removals of DOC, UVA, THMFP, HAAFP and brominated DBPs of 50, 62, 62, 62% and 47% respectively compared with conventional treatment.

Contents lists available at ScienceDirect

Separation and Purification Technology

journal homepage: www.elsevier.com/locate/seppur

Pre-treatment of surface waters for ceramic microfiltration

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[c] Qatar University, Doha, Qatar

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Keywords:
Ceramic membrane
Pretreatment
Ion exchange
Coagulation
Organic fouling

ABSTRACT

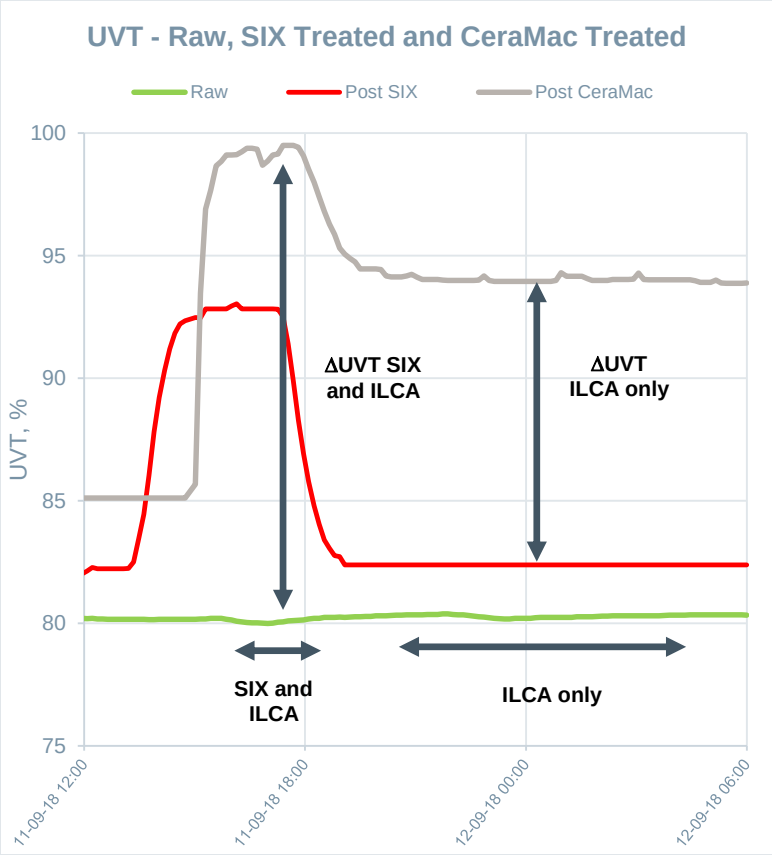
The influence of pre-treatment on the suppression of irreversible (IR) fouling of ceramic membranes challenged with three UK surface waters has been studied at pilot scale. An initial scoping study compared the efficacy of suspended ion exchange (SIX) and clarification (coagulation followed by sludge blanket clarification) individually and in combination. Direct membrane filtration following in-line coagulation (ILCA) was also investigated with and without SIX. The impact on the various organic fractions, specifically high molecular weight (HMW) biopolymers (BPs) and humic substances (HSs), and lower molecular weight (LMW) building blocks (BBs) and neutrals, was studied using liquid chromatography-organic carbon detection (LC-OCD).

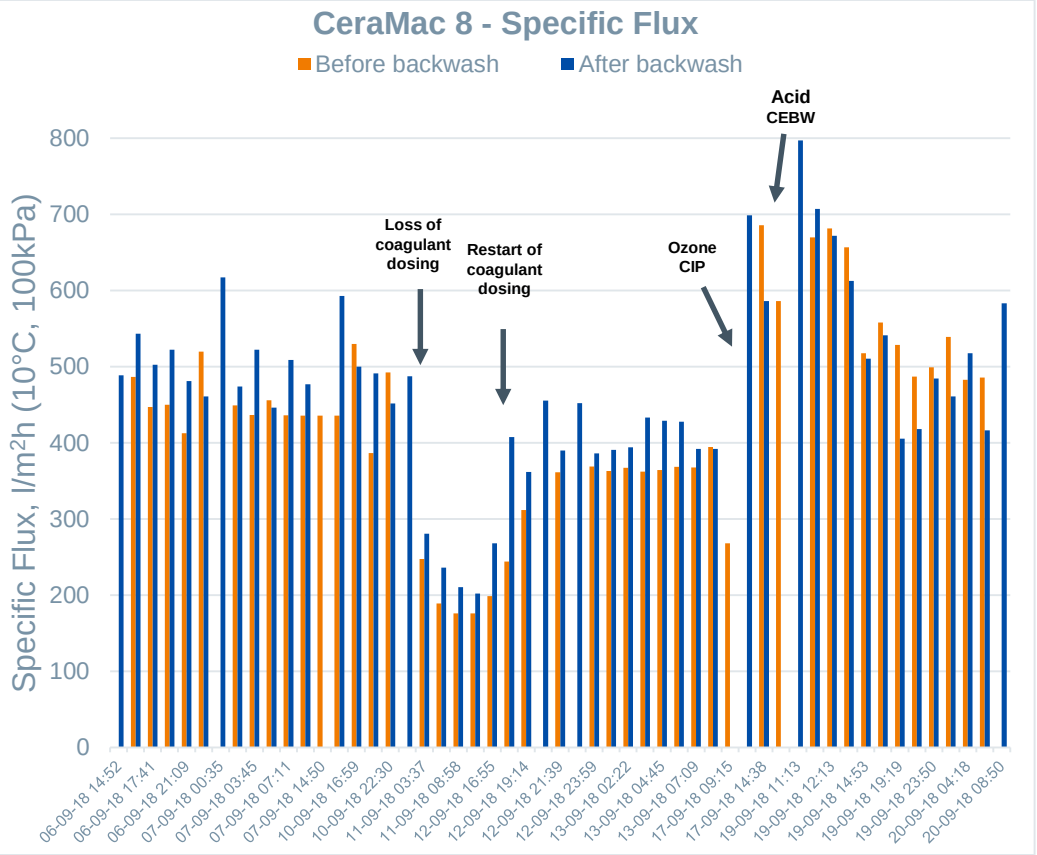
Results revealed SIX and coagulation to preferentially remove the LMW and HMW organic fractions respectively. Residual HMW organic matter (primarily BPs) following SIX pre-treatment were retained by the membrane which led to rapid irreversible fouling. Coagulation pre-treatment provided stable membrane operation and the residual LMW organics were not significantly retained by the membrane. Combining clarification and SIX resulted in significantly increased removal of organics and lower mem-

Research into delivery

SIX and CeraMac

Very early full scale data





Summary

- Very lucky
- Knowledge – small investment for long term
- New drinking water supply for people of Plymouth
- High quality water at a fair cost
- Special project for the South West of England

Thank you

‘Dubbel genaaid houdt beter!’

Peer Kamp

‘Water guarantees welfare. It banishes ailments. It gives happiness; therefore acknowledge the primacy of water...’

Akhandadhi Das, R4