2016 Membrane Technology CONFERENCE & EXPOSITION

Pilot Evaluation of Ion Exchange, Coagulation and Ceramic MF for Treating Surface water at South West Water, UK

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America's Authority in Membrane Treatment

AMTA American Membrane Technology Association

Improving America's Waters Through Membrane Treatment and Desalting

American Water Works Association

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acknowledgements

- Metawater, Japan
- RWB, the Netherlands
- Het Waterlaboratorium, the Netherlands
- Harry Scheerman, PWNT, the Netherlands
- Milo Mackin, SWW, UK

background

- South West Water, UK
  - a water utility in south-west England
  - owning and operating 29 WTWs
- future new WTP – 90 Mld (24 Mgd)
  - one reservoir and two rivers as sources
  - pre-treatment, ceramic MF, UV, GAC
- goals
  - improved water quality
  - sustainable operation

pilot plant

- located at Crownhill WTW, Plymouth
- up to 8 m^3/hr (2113 gallon/h)
- April 2013 to May 2015
  - phase 1, ion exchange feed*
  - phase 2, clarified feed, w/o ion exchange*
  - phase 3, ion exchange and coagulated feed

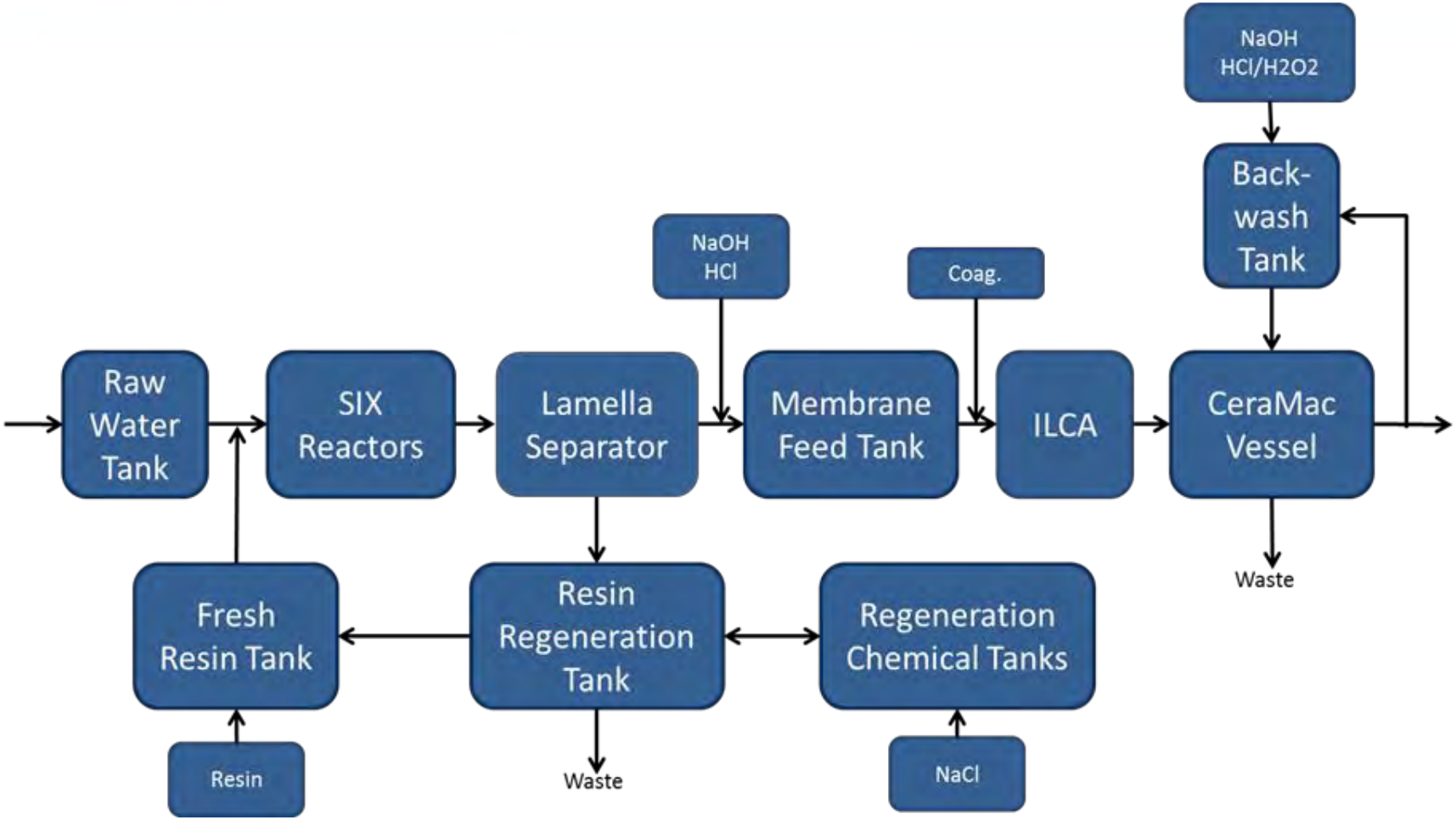
* Shorney-Darby et al. (2014), Ceramic membrane filtration of a surface water treated with ion exchange, AMTA conference 2014, Las Vegas.

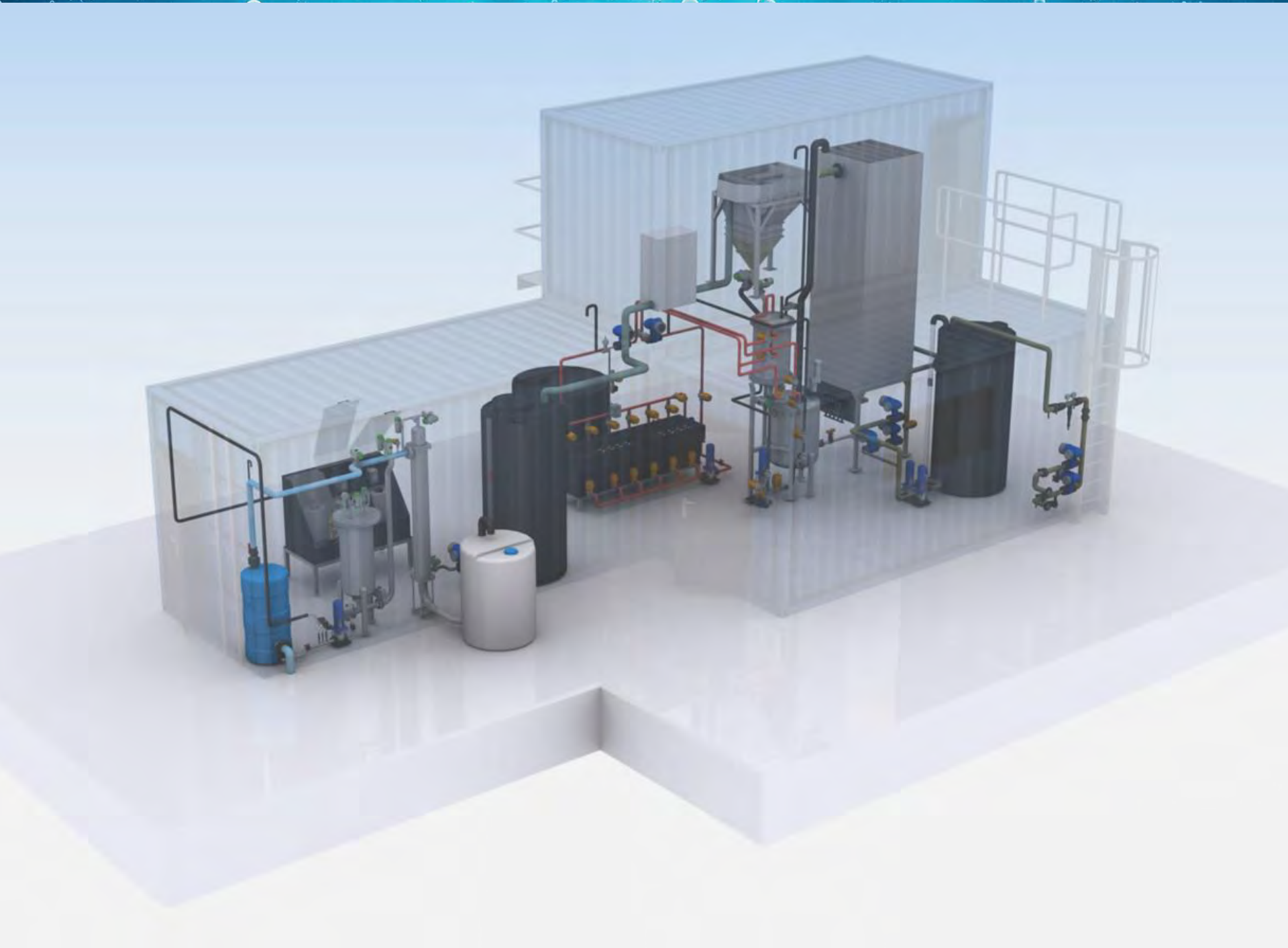
a containerized pilot

water sources

- Burrator reservoir
- River Tamar
- River Tavy

flow diagram





SIX(®)

- “single pass” process
- Lewatit S 5218 resin (Lanxess, Germany)
  - strongly basic anion exchange resin
- resin concentration 18 ml/L
- contact time 30 minutes
- 30 g/L NaCl for regeneration

ILCA(®)

- 2.4 to 4 min contact time
- PACl coagulant (Brenntag WAC, UK)
- 0.5 to 4 ppm as Al^{3+} (10 to 80 ppm as product)
- pH 6.4
- pH/coagulant dosing control automated May 2015

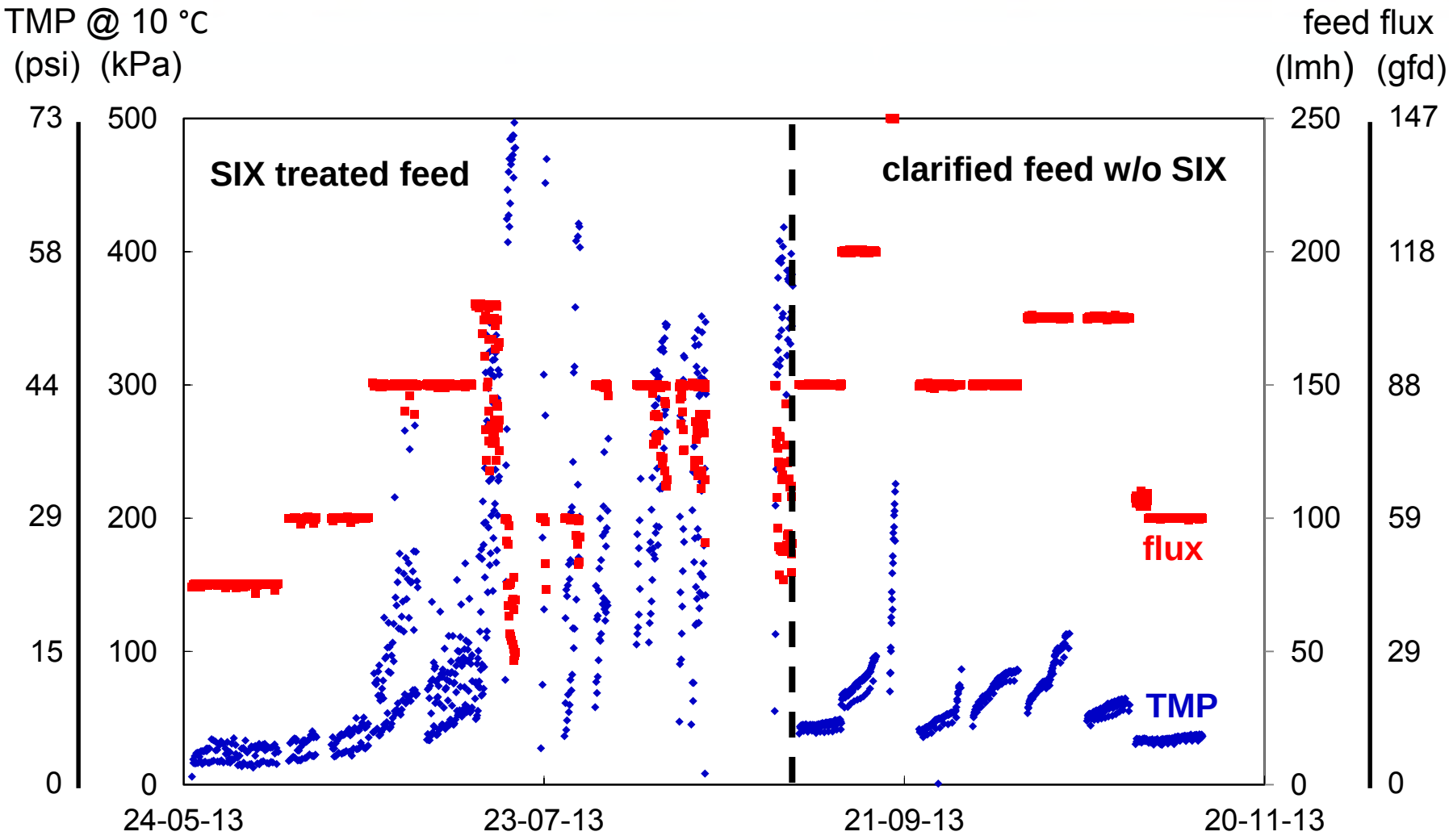
ceramic MF

- 25 m^2 (269 ft^2) Metawater element
- nominal pore size 0.1 micron
- a virgin membrane in May 2013
- another virgin membrane in March 2015

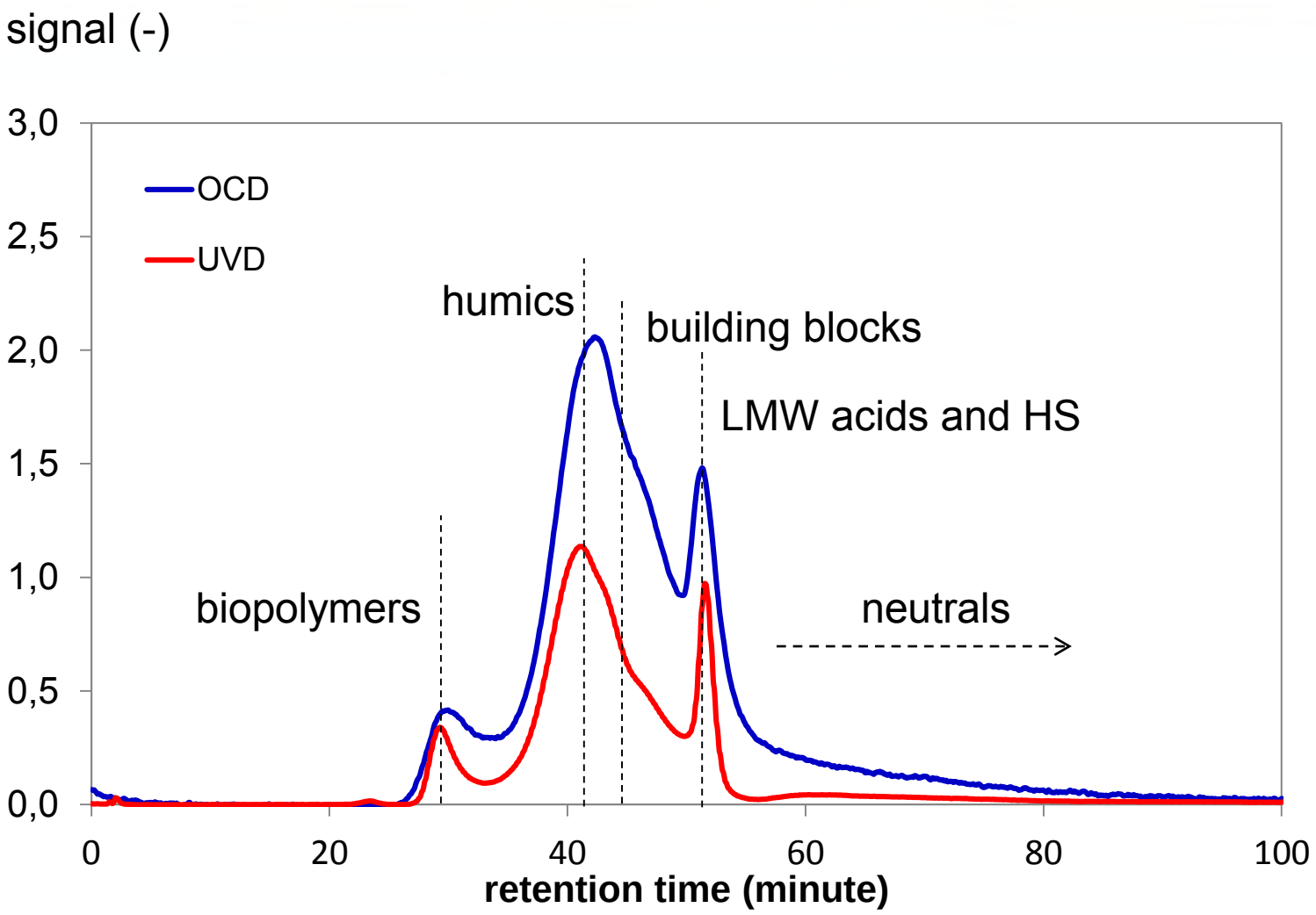
ceramic MF (continued)

- feed flux 64 or 109 gfd
- filtration load until BW 2.5, 3.7, 4.9 or 7.4 gal/ft^2
  - filtration time of 32 to 165 minutes at fluxes tested
- filtration load until EBW 44.2 gal/ft^2
  - after 17, 11, 8 or 5 BWs
- chemicals for EBW/CIP
  - EBW, NaOCl, and HCl/peroxide
  - EBW, NaOH, and HCl/peroxide
  - CIP, NaOH, NaOCl, HCl/peroxide

previous findings

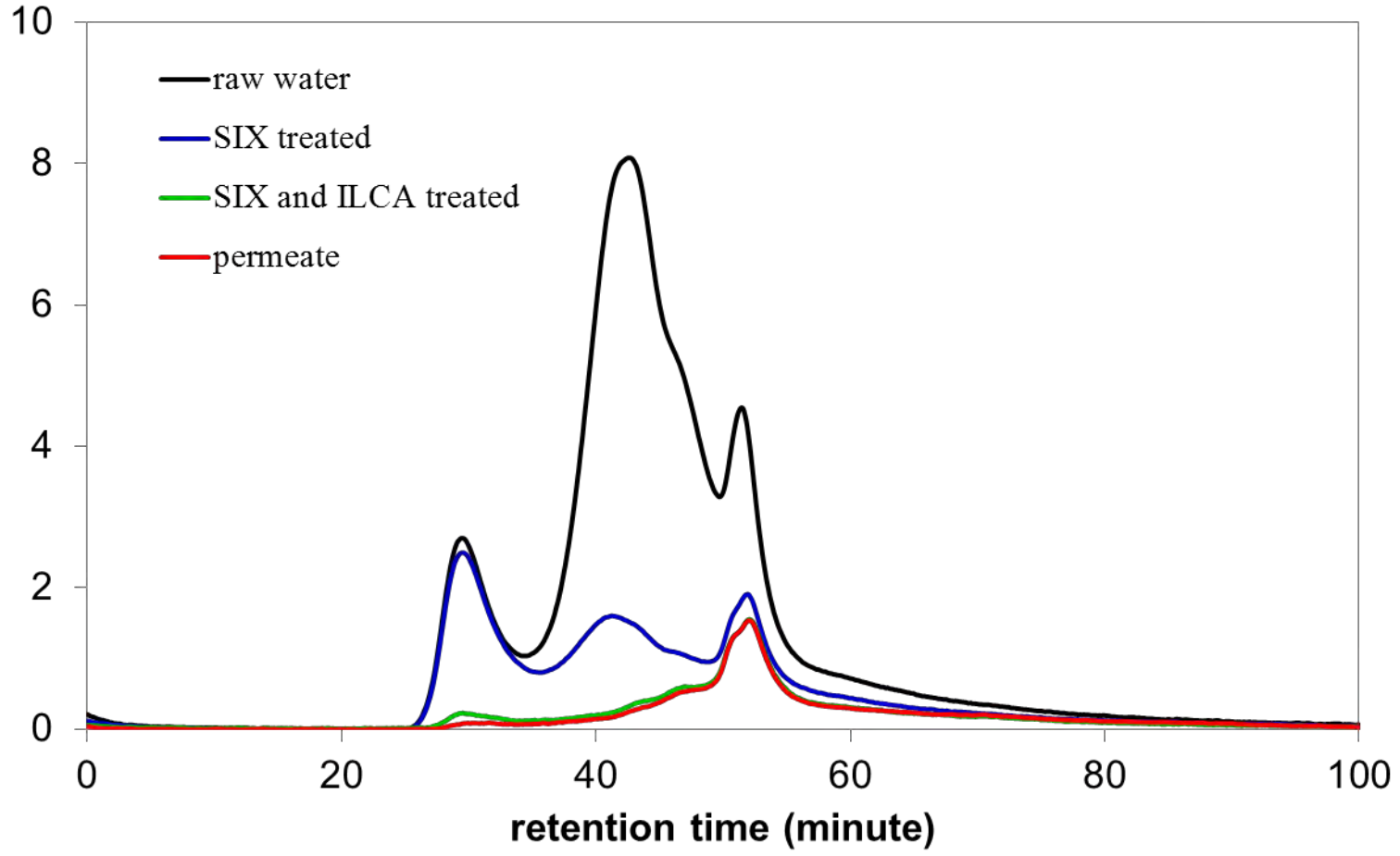


rather unique DOC

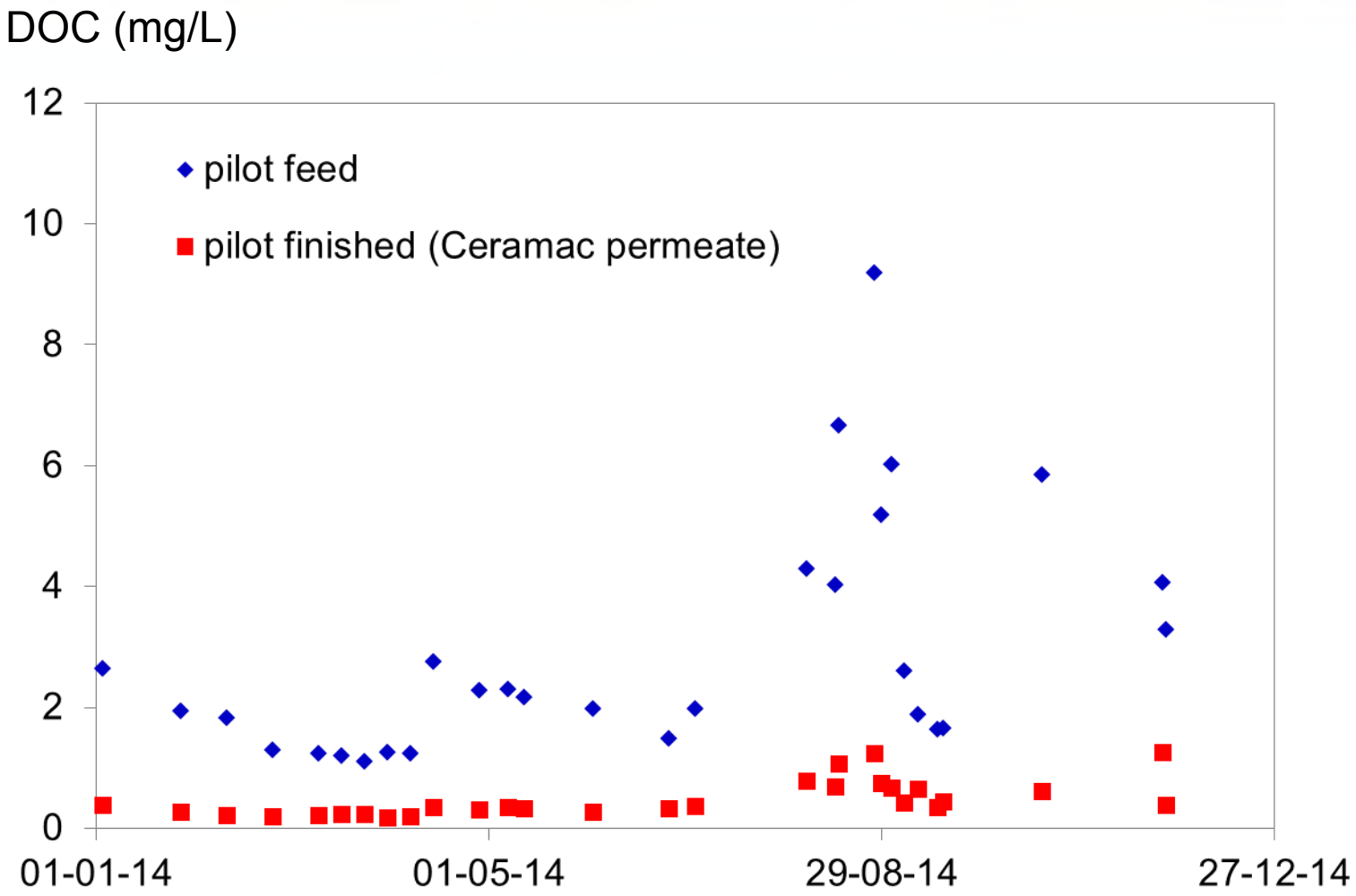


NOM removal upon the process

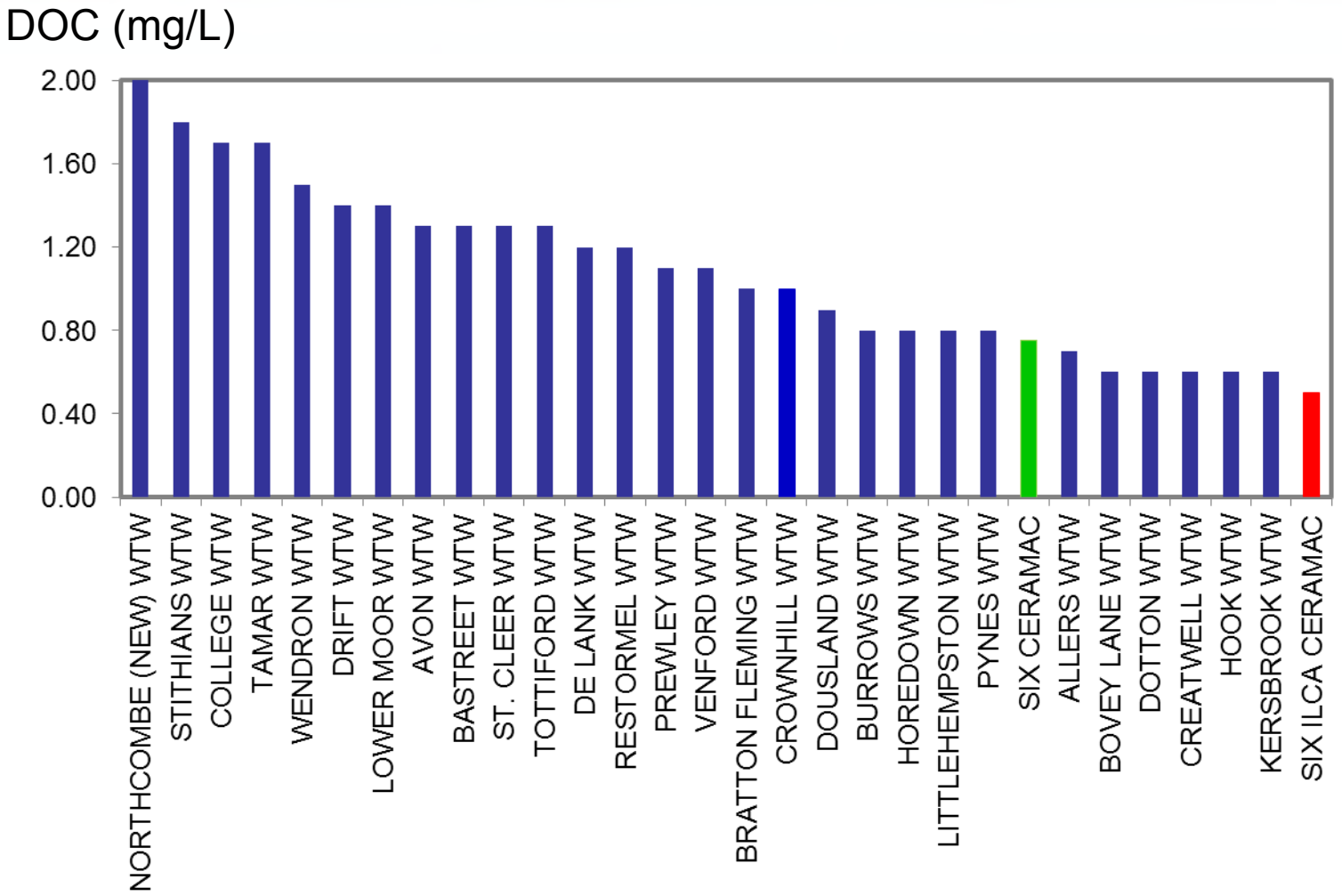
OCD signal (-)



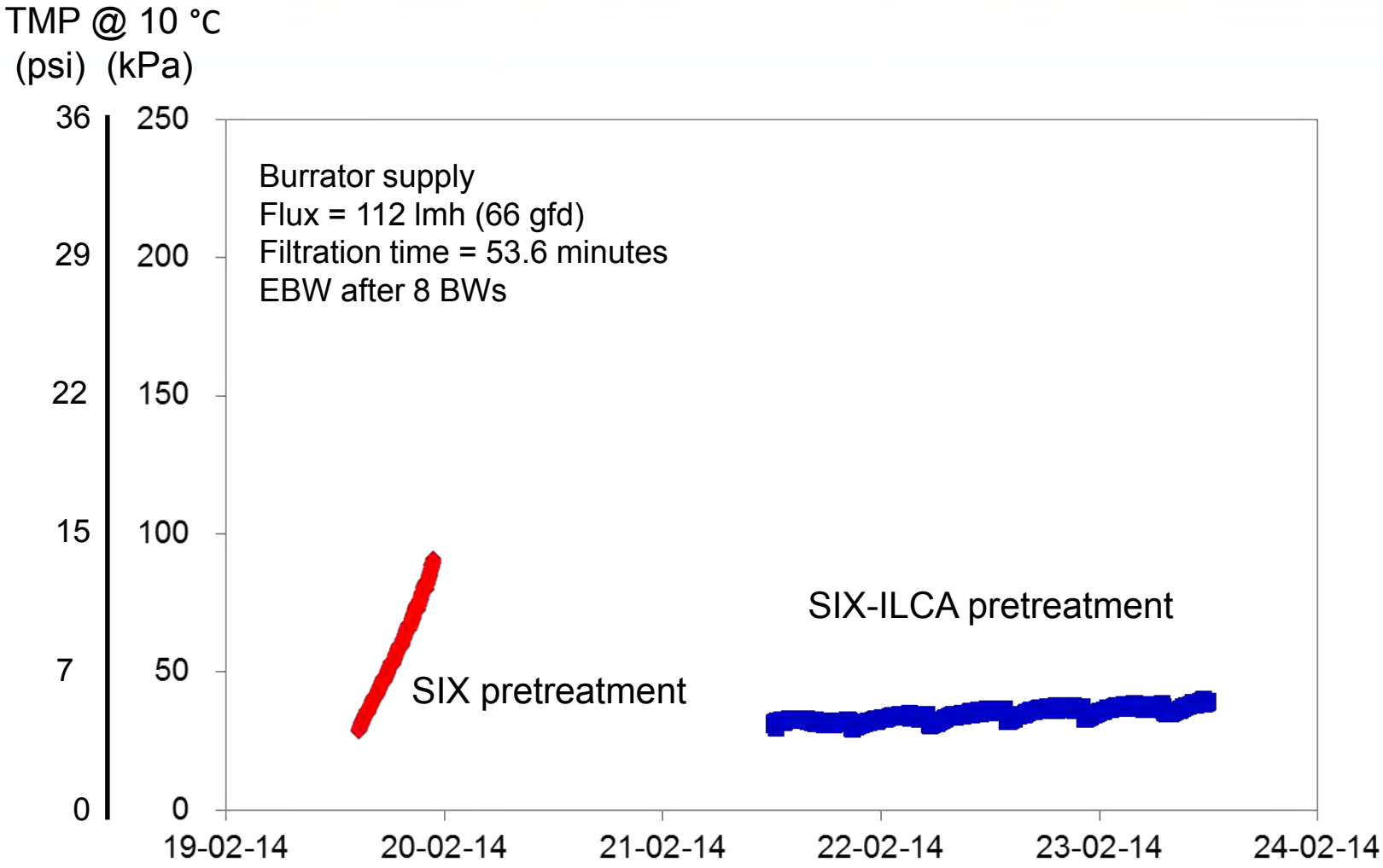
DOC removal upon the process



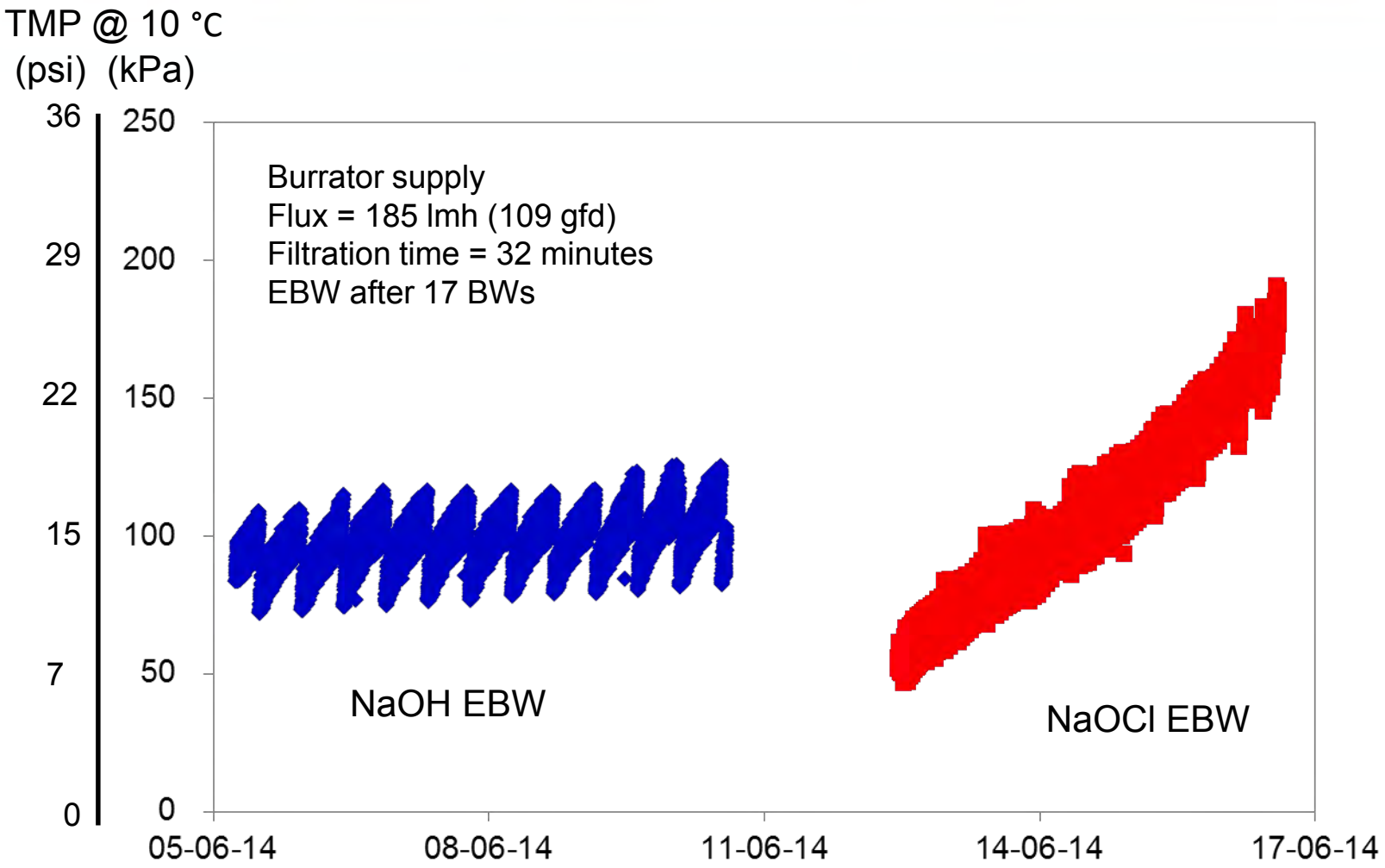
comparing pilot and existing WTWs



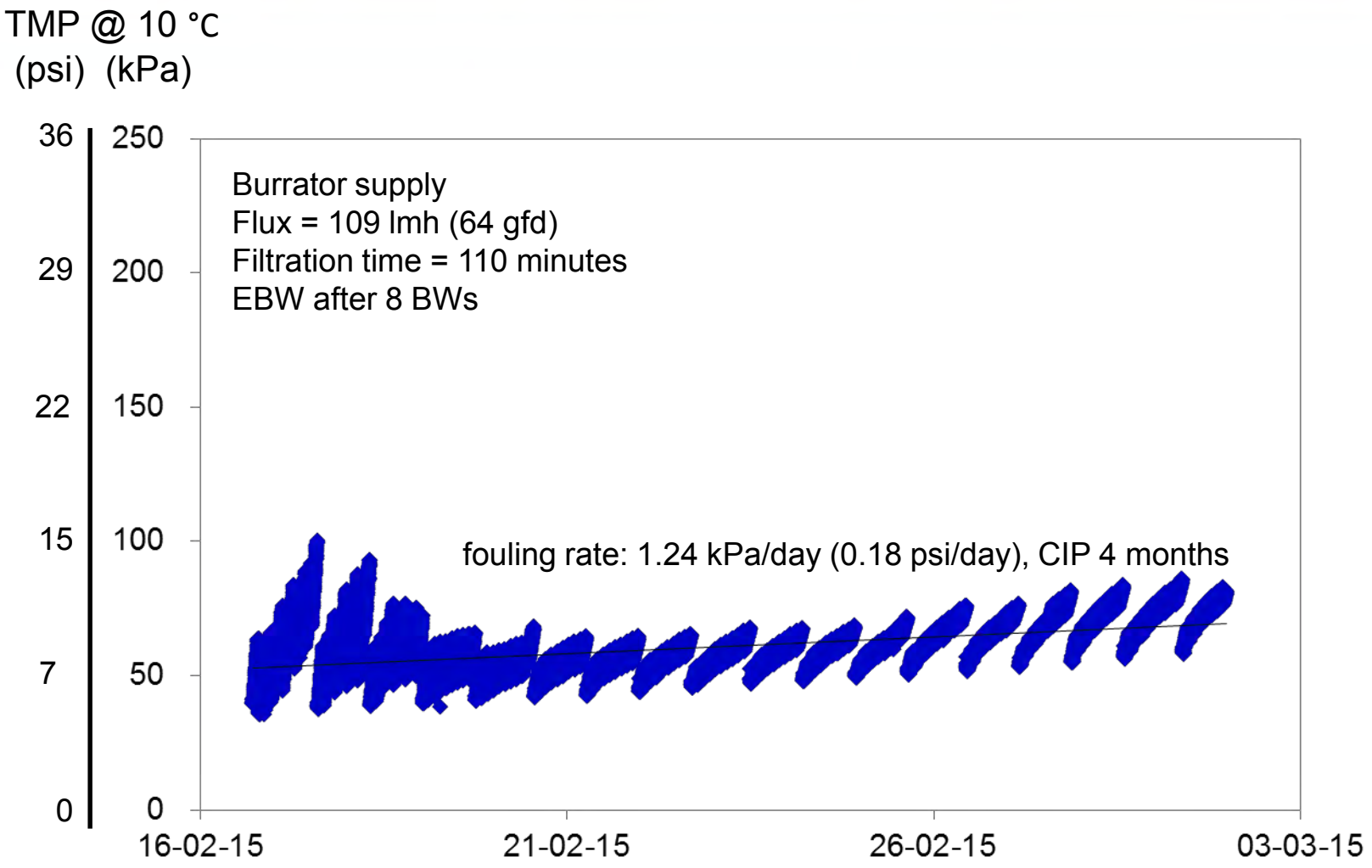
comparing different pretreatment



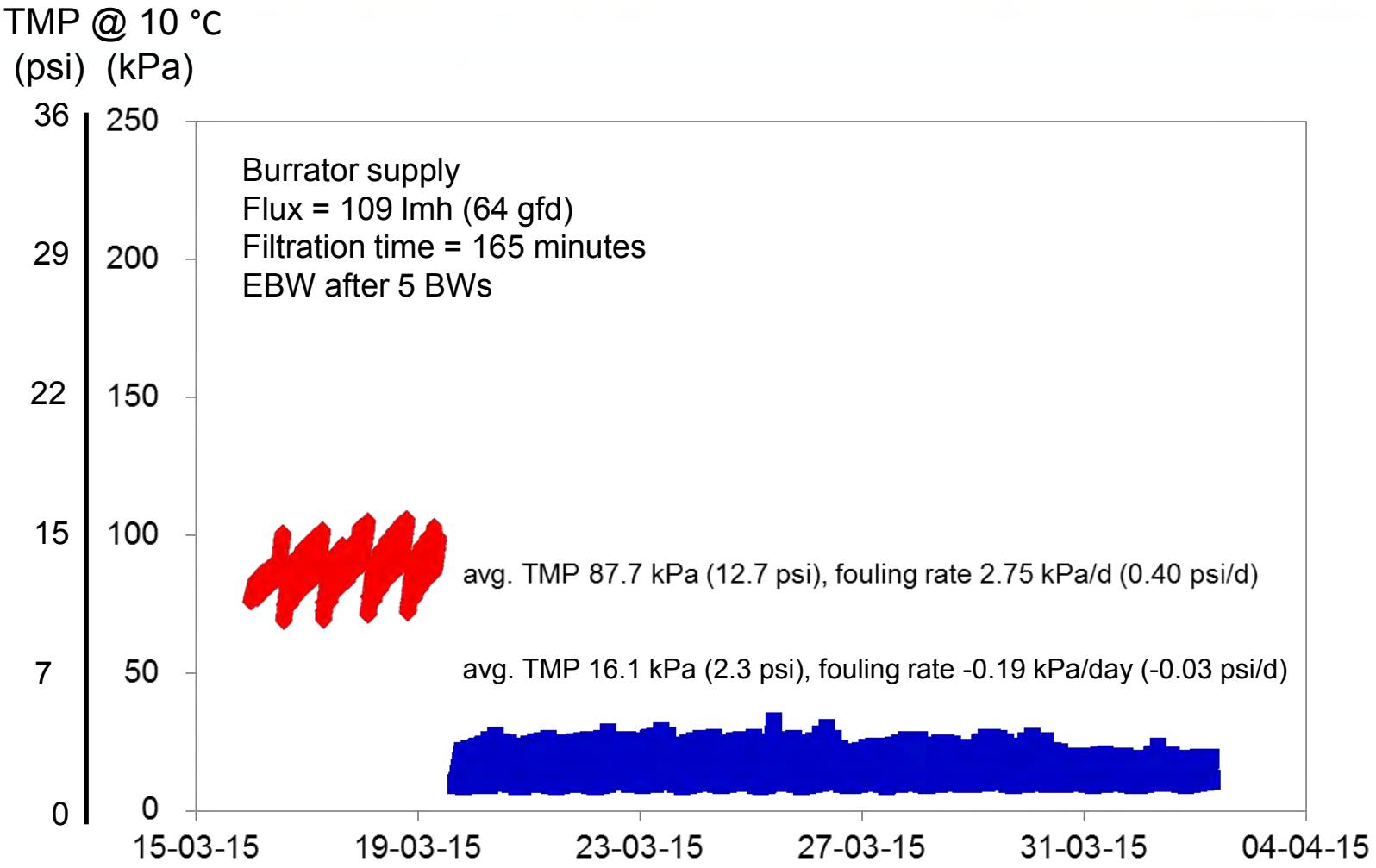
comparing different EBW method



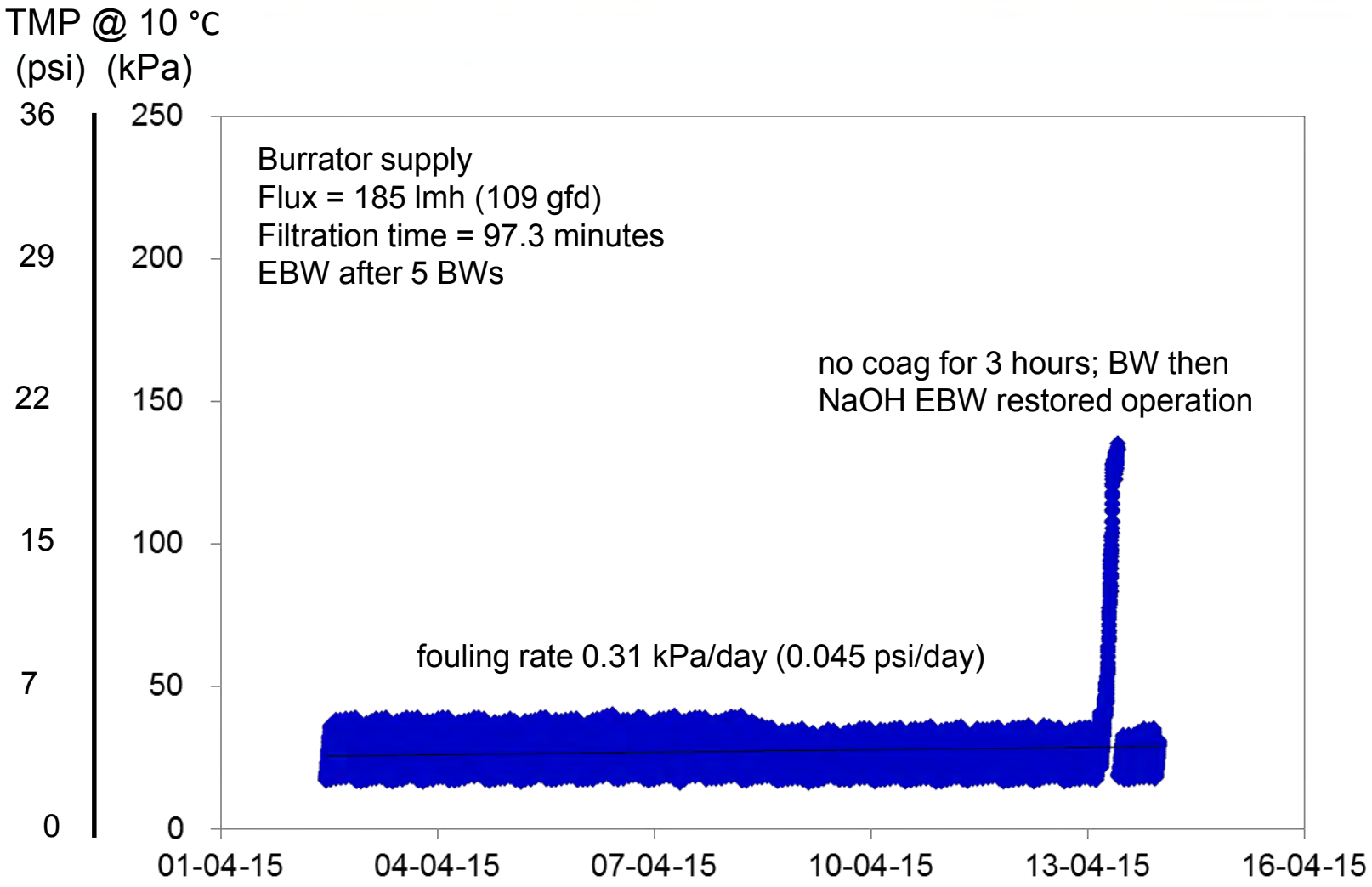
performance at “optimized” conditions



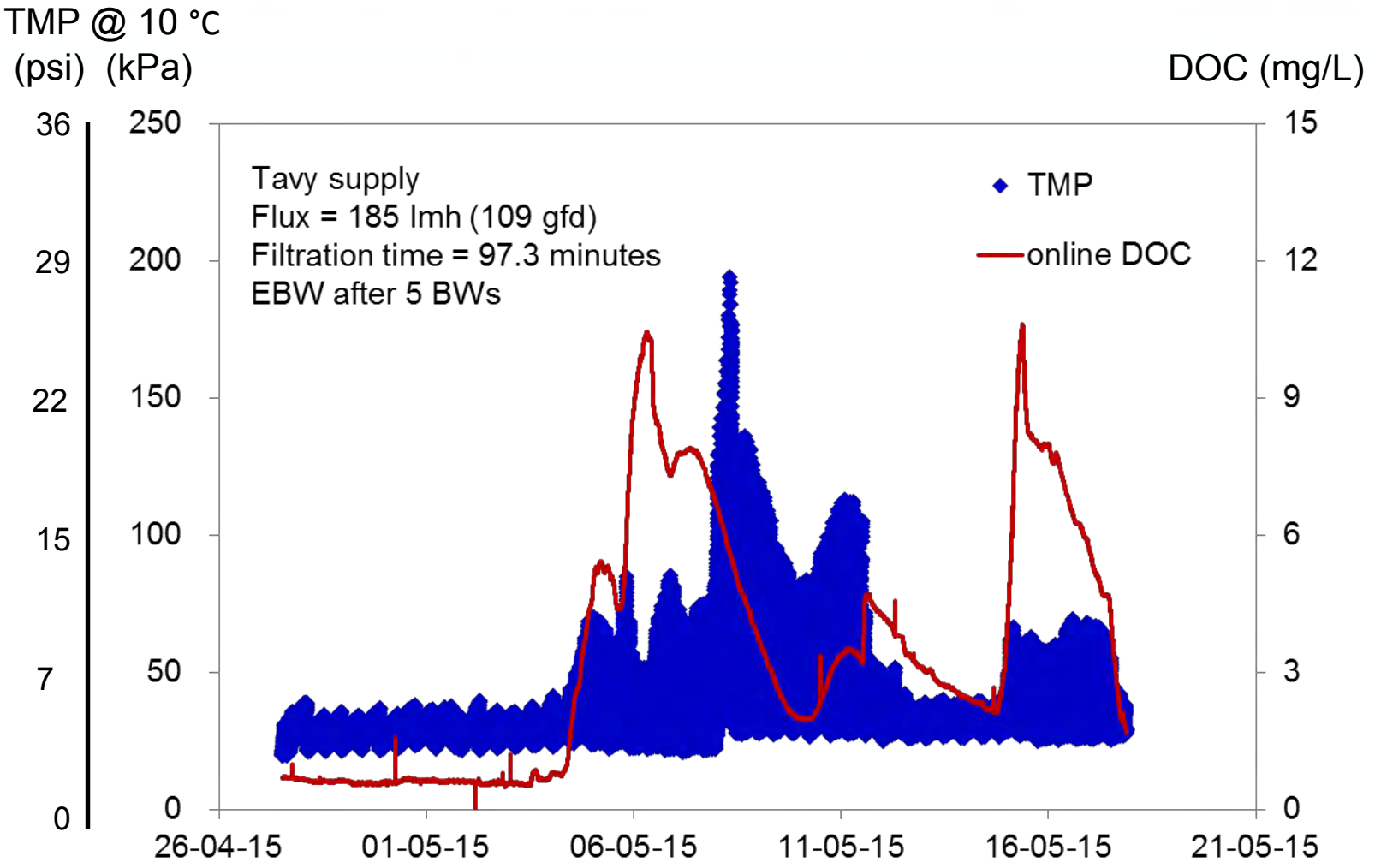
“old” and “new” membranes



performance at 185 lmh



performance at 185 lmh



Automated pH/coag 1 May; spate conditions, no SIX after 11 May, loss of coag on 8 May

mean % removal SIX/ILCA vs. conventional

Parameter	SIX/ILCA/CeraMac additional removal relative to conventional treatment (%)
DOC (% Reduction)	50
UVA (% Reduction)	62
THMFP (% Reduction)	62
HAAFP (% Reduction)	62
THMFP Reactivity (% Reduction)	22
HAAFP Reactivity (% Reduction)	18
Brominated DBPFP (% Reduction)	47

From: An Innovative Suspended Ion Exchange, In-Line Coagulation And Ceramic Microfiltration Process for Disinfection by-product Control,
by David Metcalfe, WQTC, 2015 Salt Lake City, Utah

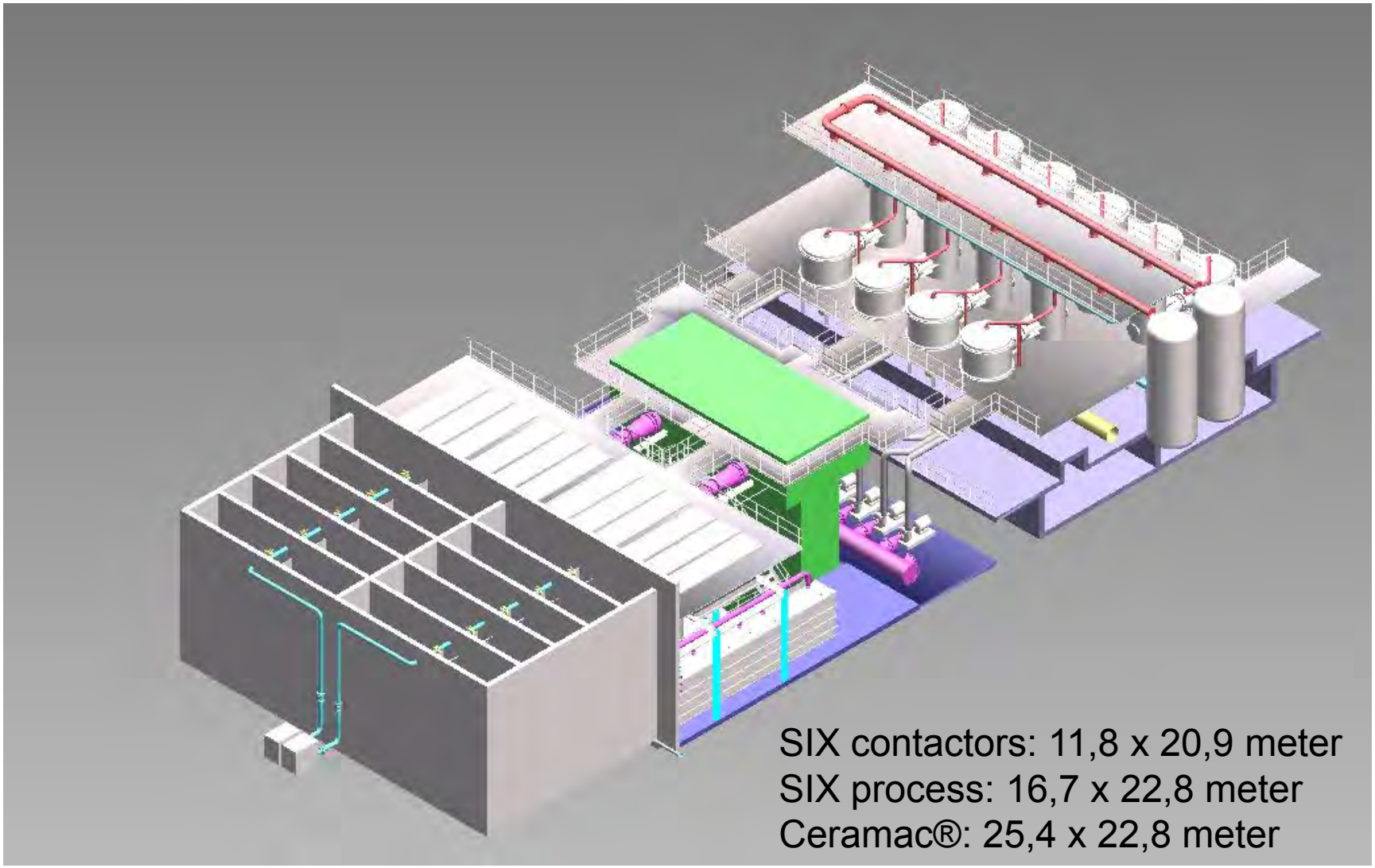
final remarks – water quality

- challenging raw water quality
  - abrupt quality changes
  - spate often occurred
  - special biopolymer properties
- excellent finished water quality
  - low DOC concentration
  - results comparable to ground water

final remarks – membrane operation

- sustainable operation at 109 lmh (66 gfd) when treating the reservoir water
- sustainable operation at 185 lmh (109 gfd) when treating the river water
- optimized coagulation as the key to control membrane fouling

the future North Plymouth WTW



Questions

ceramic MF (continued)

- feed flux 109 or 185 lmh
- filtration load until BW 100, 150, 200 or 300 L/m^2
  - filtration time of 55, 83, 110, 165 at 109 lmh
  - filtration time of 32, 49, 65, 97 at 185 lmh
- filtration load until EBW 1800 L/m^2
  - After 17, 11, 8 or 5 BWs when the filtration load until BW of 100, 150, 200 or 300 L/m^2, respectively
- chemicals for EBW/CIP
  - EBW, NaOCl, and HCl/peroxide, initially
  - EBW, NaOH, and HCl/peroxide, updated
  - CIP, NaOH, NaOCl, HCl, peroxide