



Ceramic MF: pre-treatment & membrane operational performance

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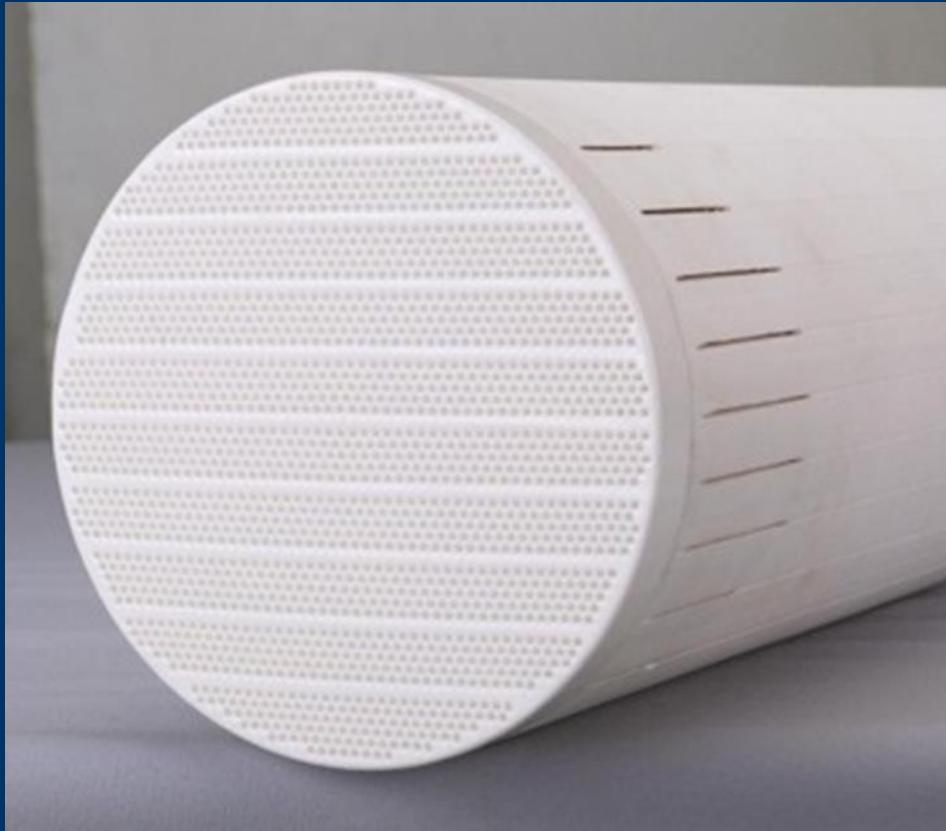
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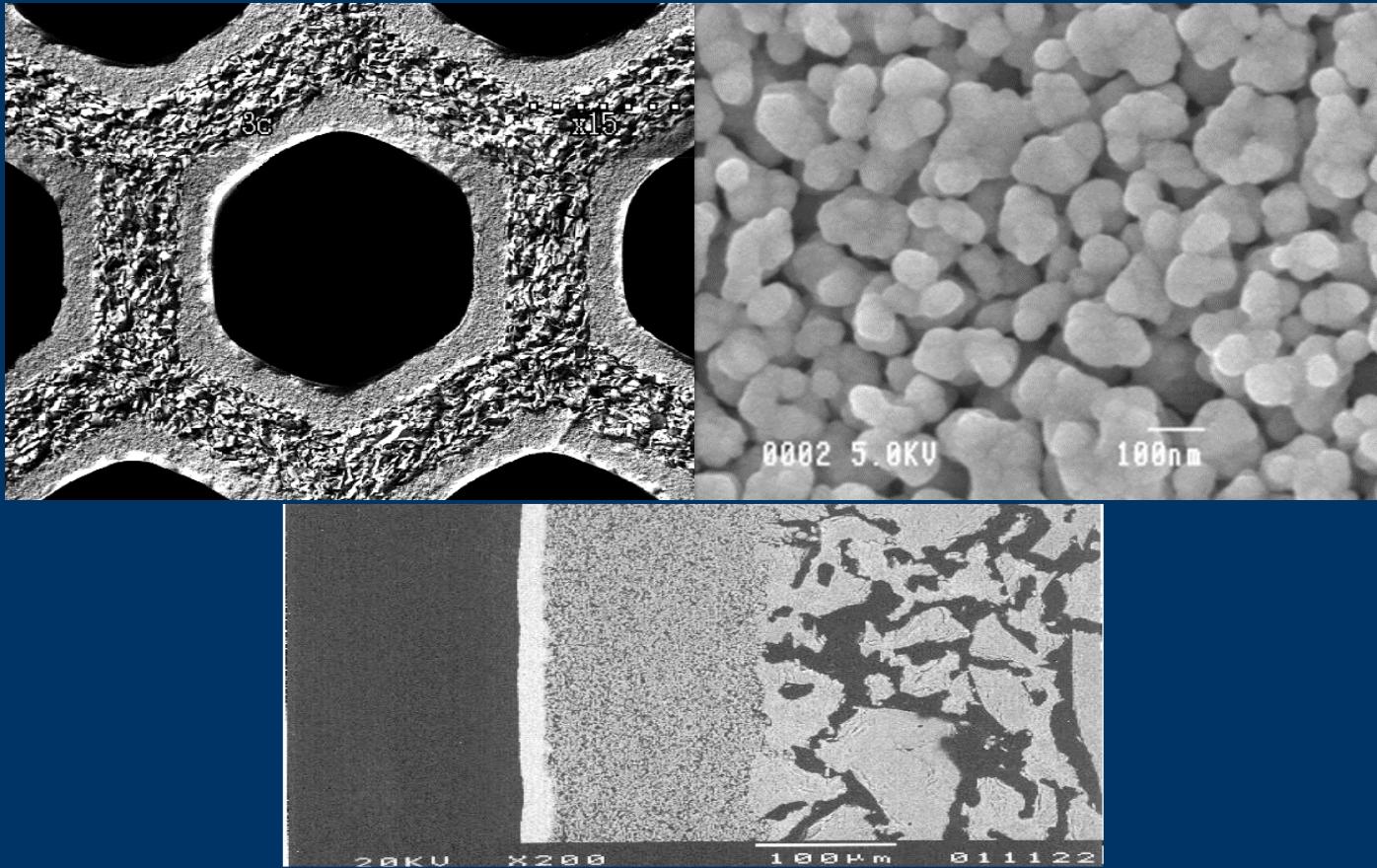
content

- the Metewater ceramic MF membrane
- LC-OCD and raw wate NOM characteristics
- two case studies
 - ✓ Crownhill CeraMac pilot, UK
 - ✓ Andijk CeraMac pilot, NL
- final remarks

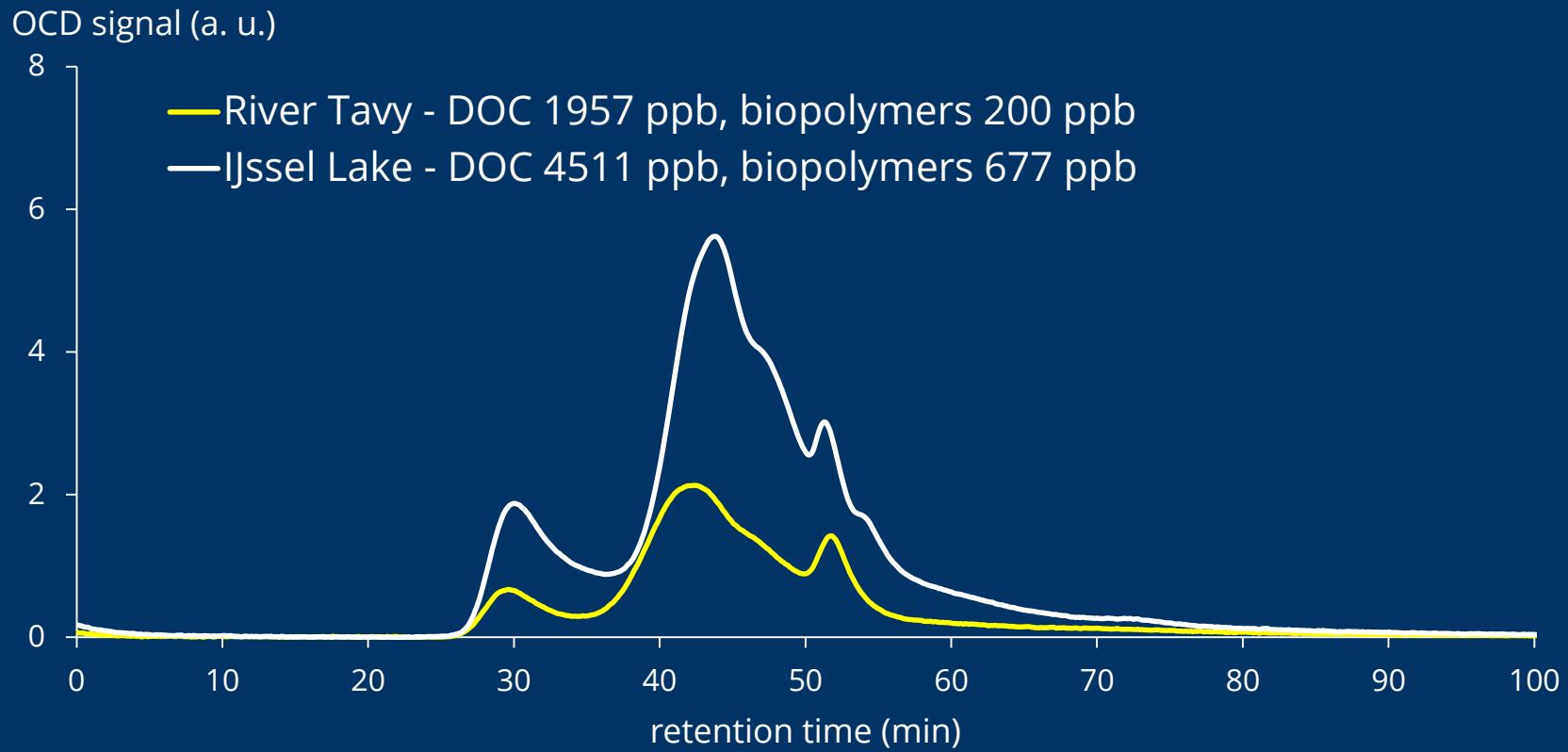
the Metawater membrane



the Metawater membrane

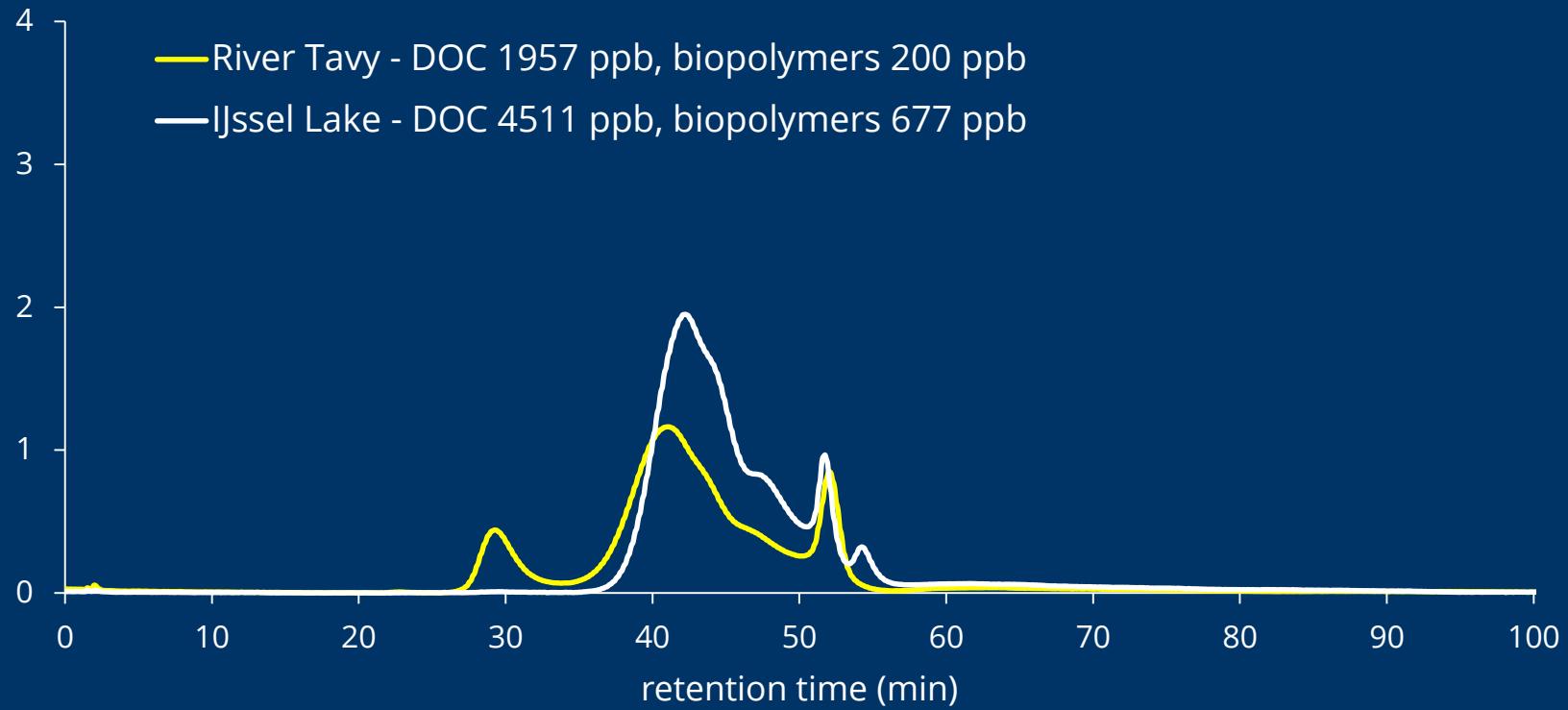


raw water NOM characteristics

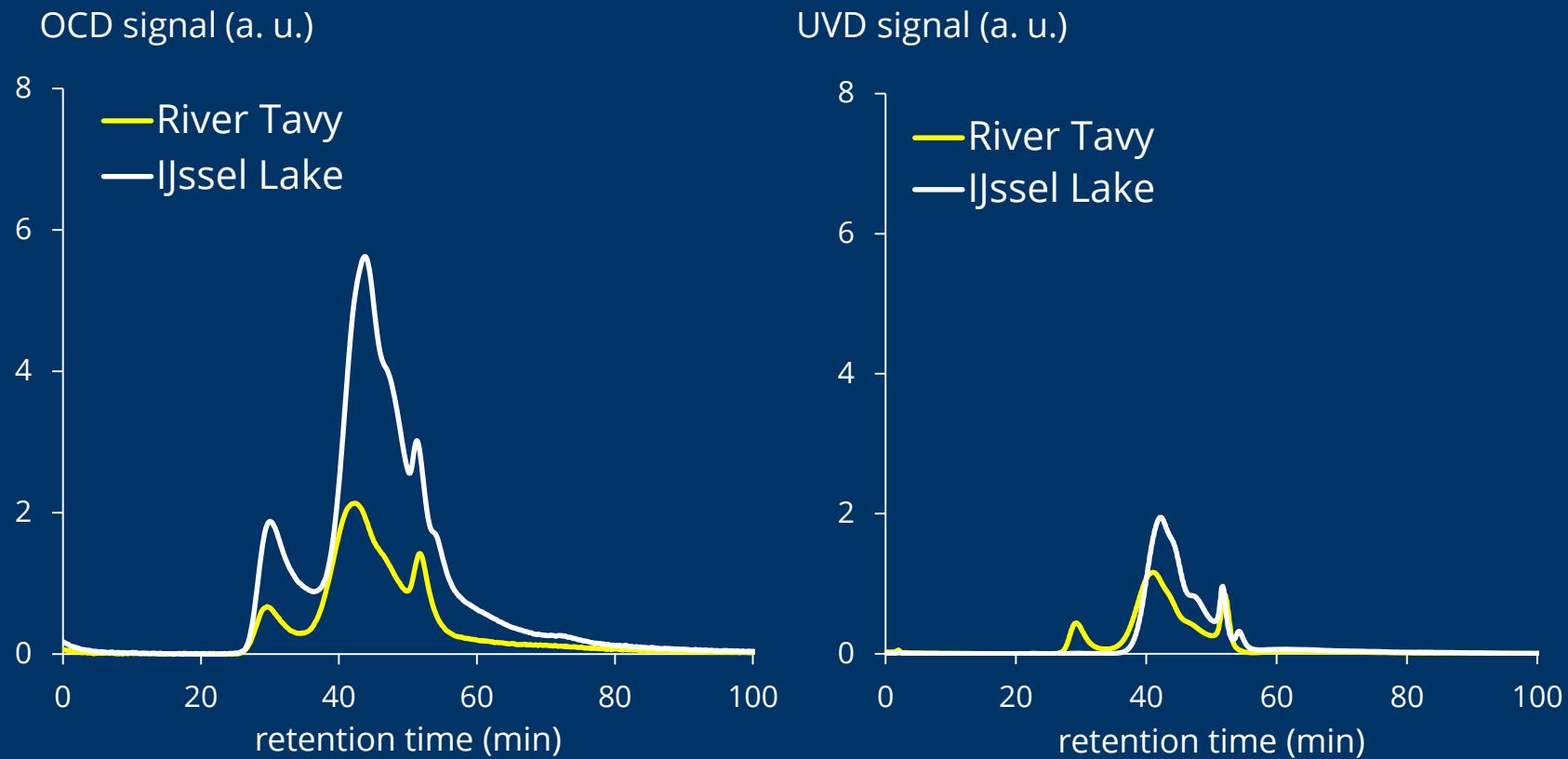


raw water NOM characteristics

UVD signal (a. u.)



raw water NOM characteristics



Crownhill pilot

overall information

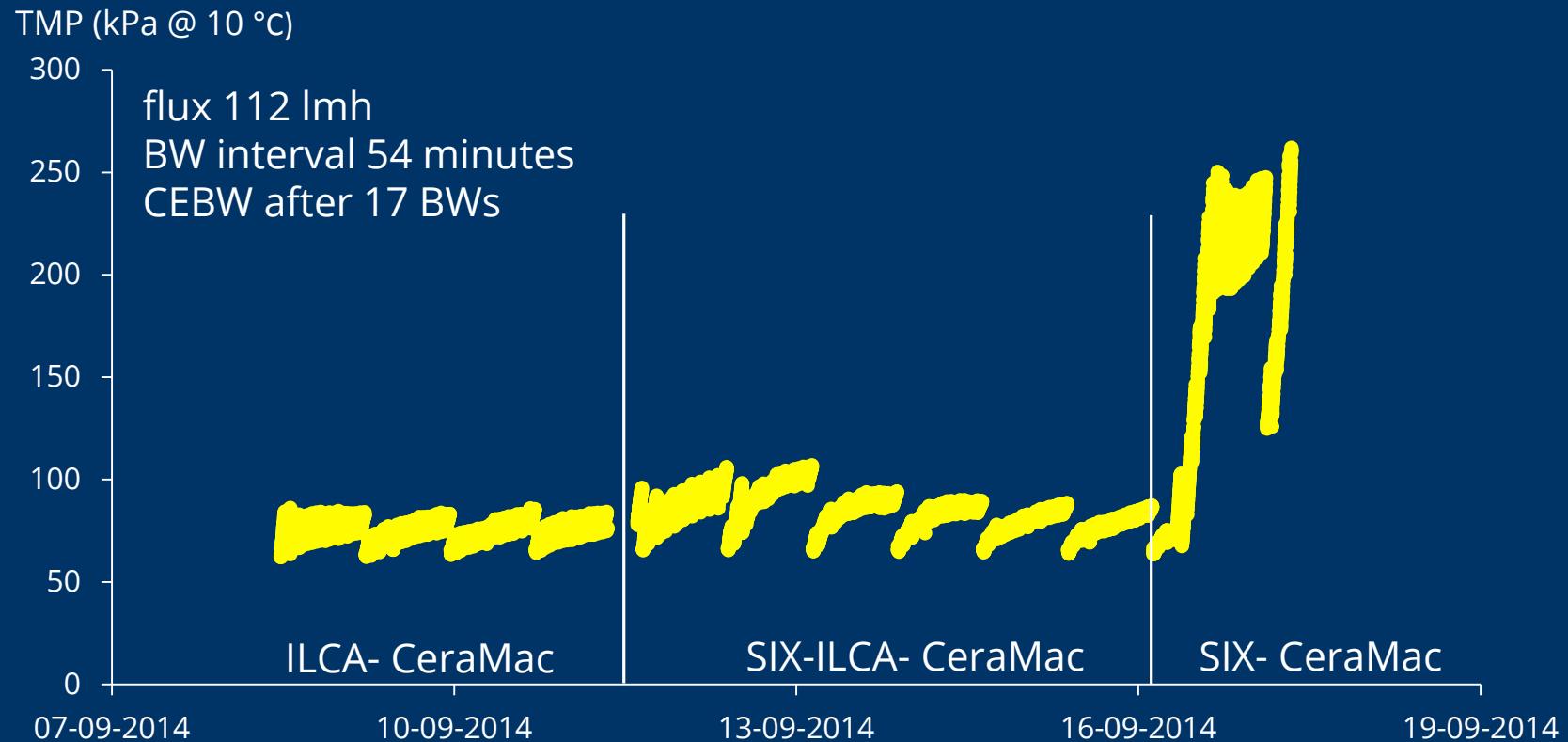
- raw water from Burrator reservoir, River Tamar, River Tavy
- reservoir water DOC down to 1 ppm
- river water DOC up to 10 ppm
- SIX-ILCA-CeraMac process train
- Jan 2014 to May 2015

Crownhill pilot

special trials in September 2014

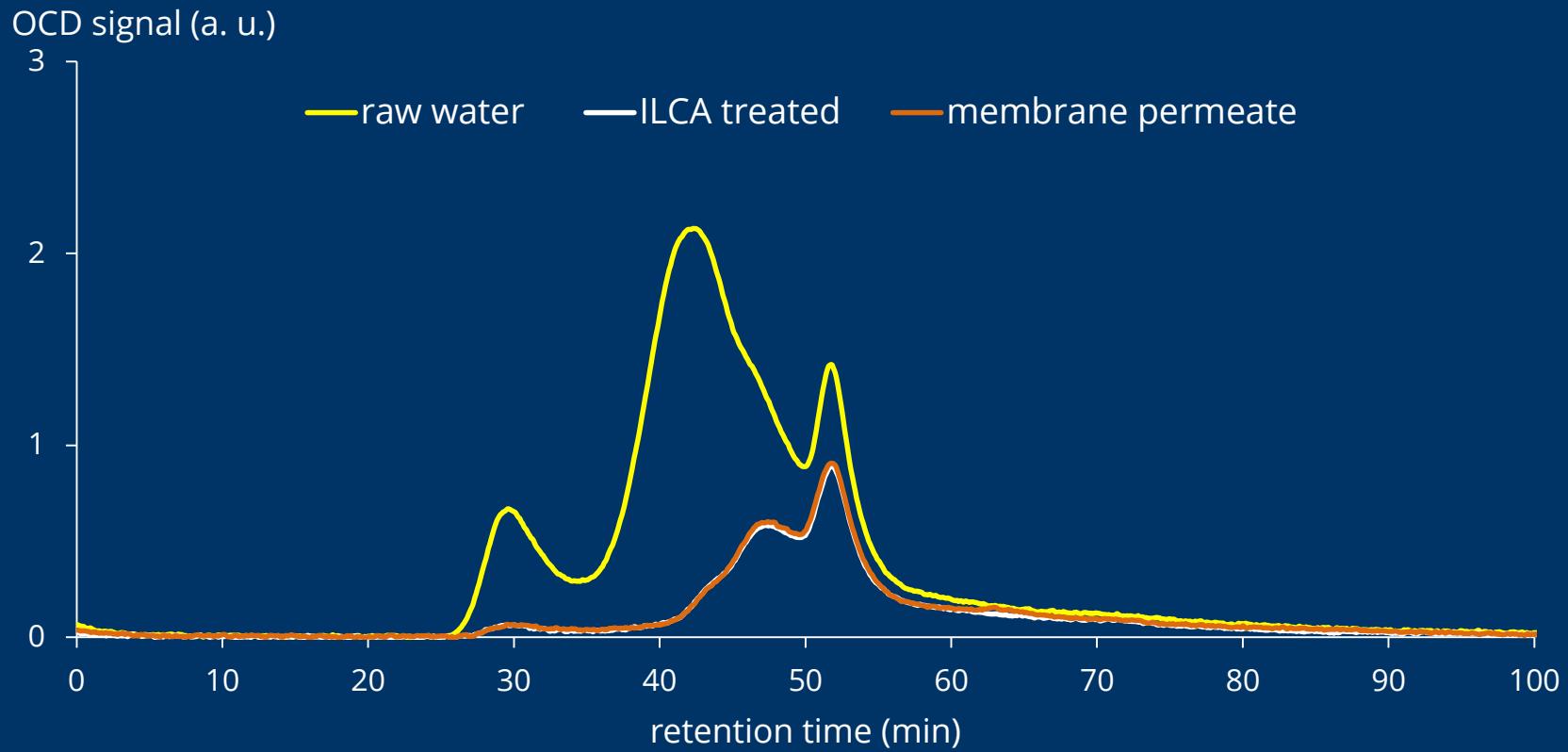
- raw water from River Tavy
- three trials
 - ✓ 08 to 11 Sep, ILCA-CeraMac, raw water DOC 2.0 ppm
 - ✓ 11 to 16 Sep, SIX-ILCA-CeraMac, raw water DOC 1.6 ppm
 - ✓ 16 to 17 Sep, SIX-CeraMac, raw water DOC 1.6 ppm

Crownhill pilot - TMP profile



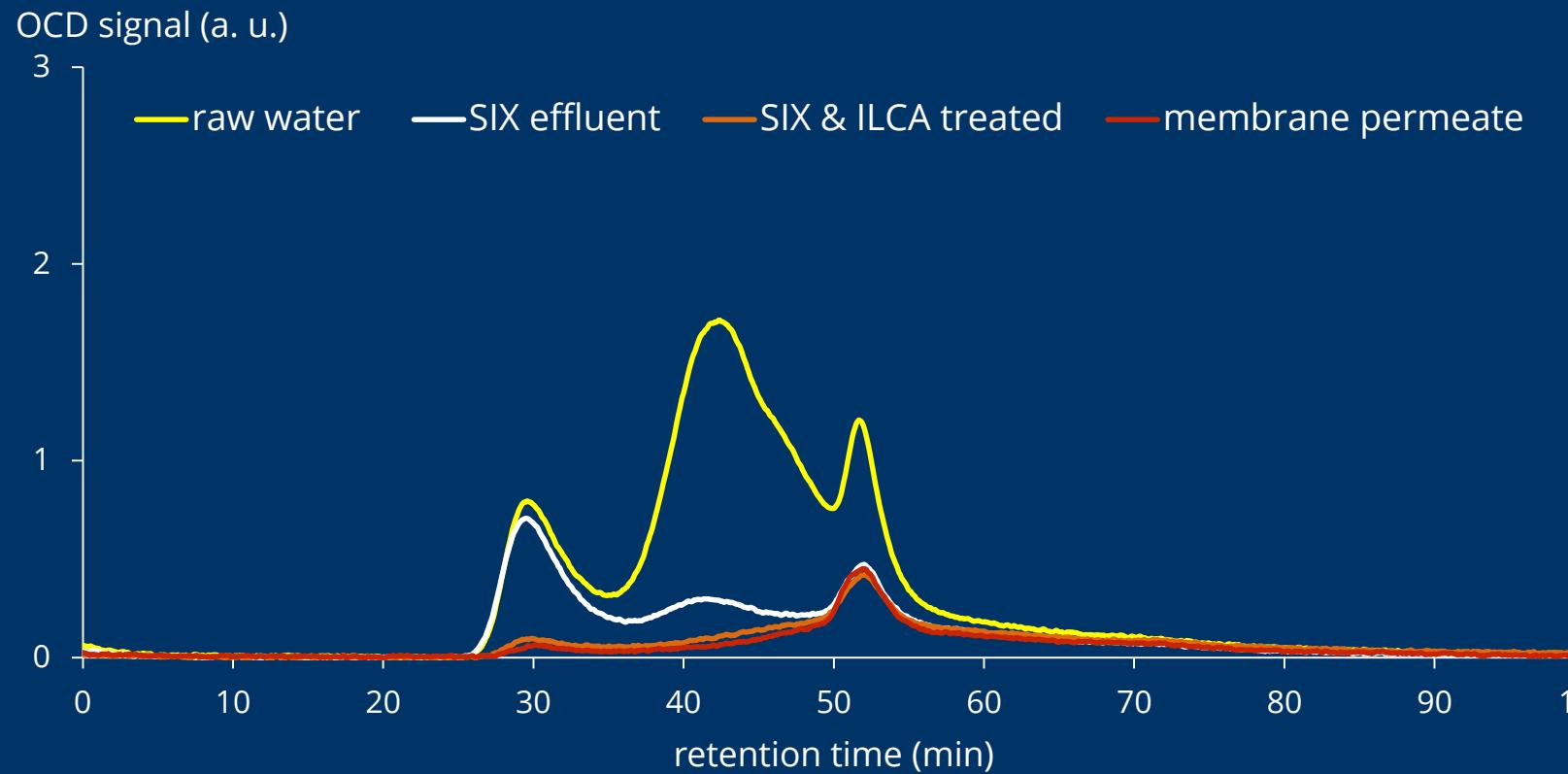
Crownhill pilot - NOM removal

ILCA-CeraMac process



Crownhill pilot - NOM removal

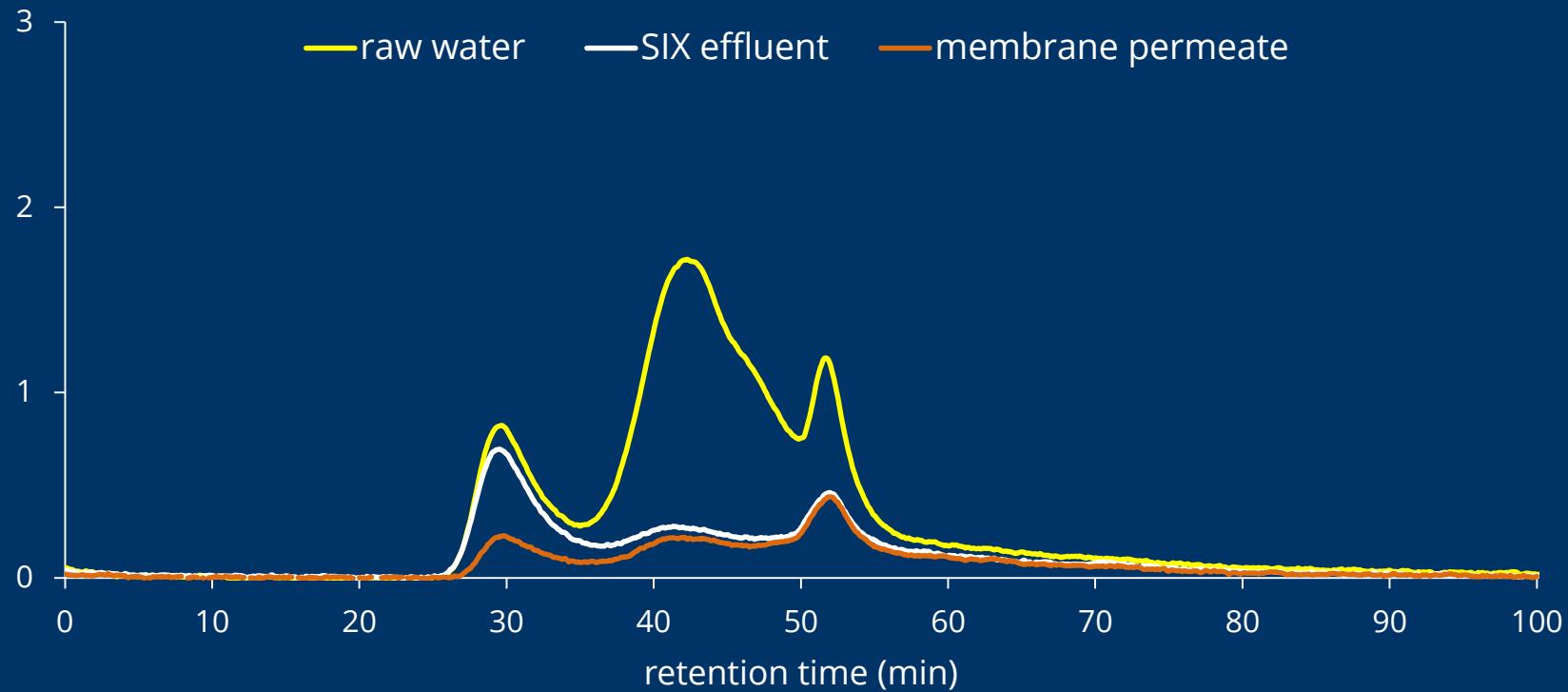
SIX-ILCA-CeraMac process



Crownhill pilot - NOM removal

SIX-CeraMac process

OCD signal (a. u.)



Crownhill pilot - summary

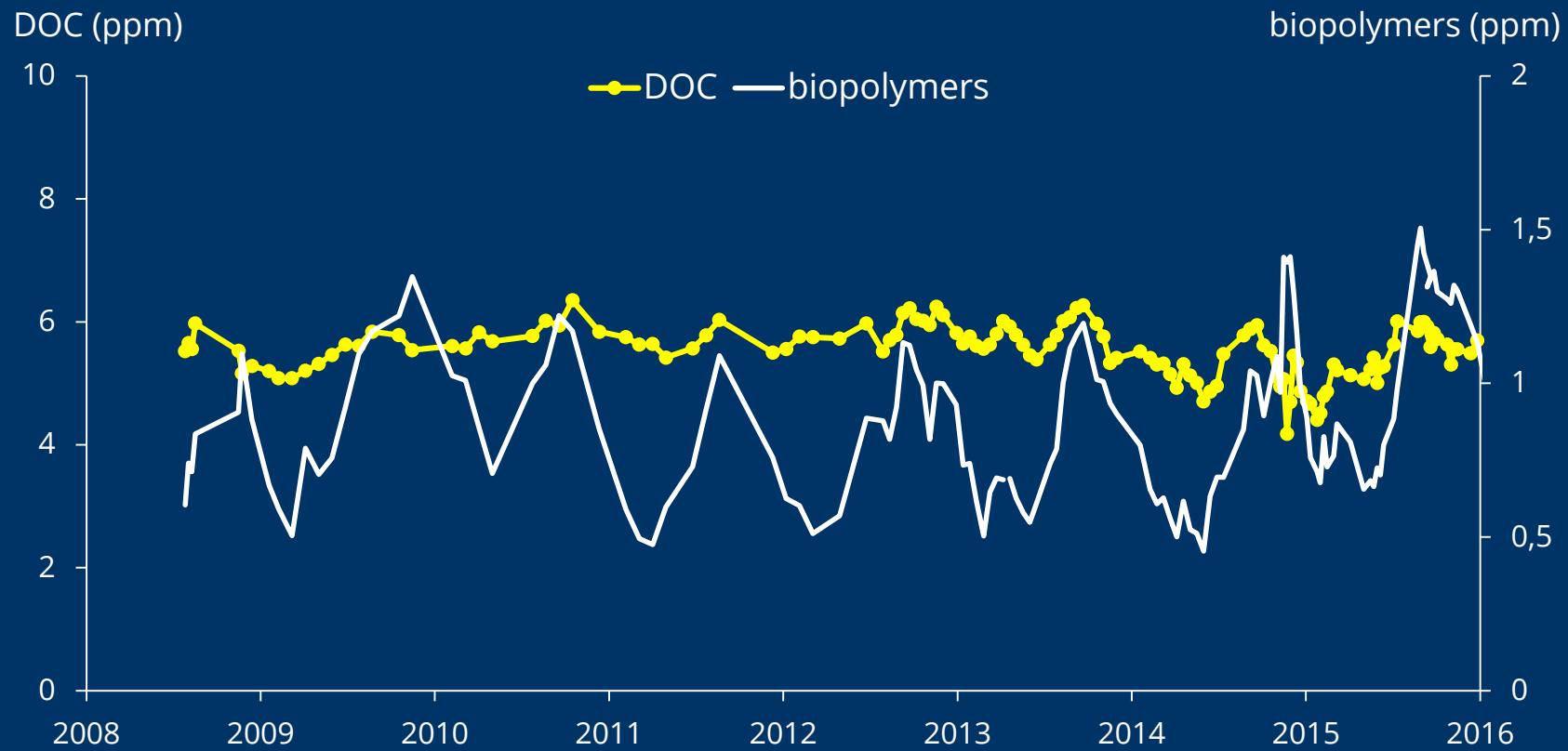
- the biopolymers cause membrane fouling
- coagulation removes biopolymers and therefore controls the membrane fouling

Andijk pilot

overall information

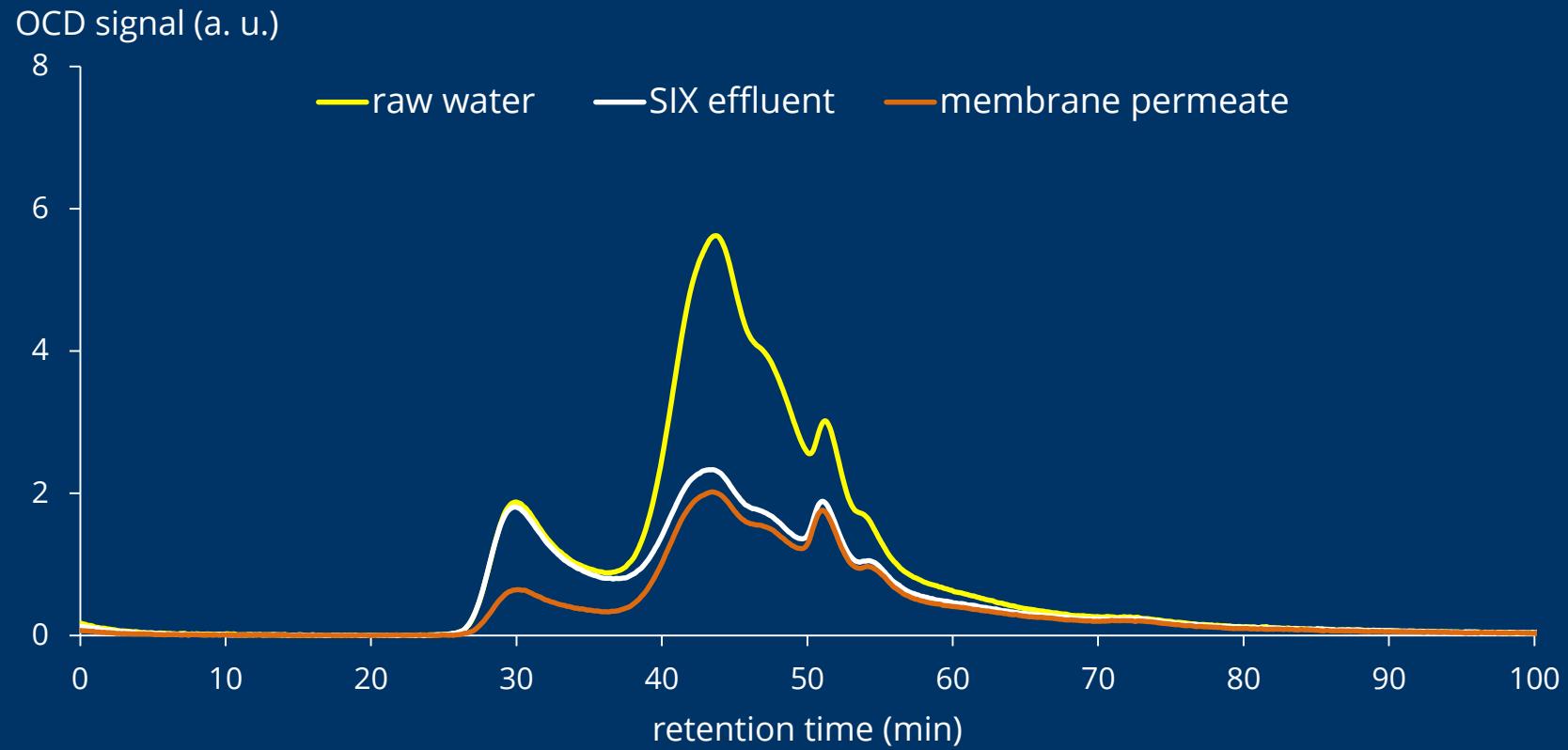
- raw water from IJssel Lake, a branch of River Rhine
- stable DOC 5.5 ± 1 ppm over the years
- significant seasonal variation of NOM fractions
- SIX-CeraMac process since 2006
- SIX-ILCA-CeraMac process since 2016
 - ✓ ferric chloride coagulant April to June 2016
 - ✓ PACl coagulant July to August 2016

DOC/biopolymer variation



Andijk pilot - NOM removal

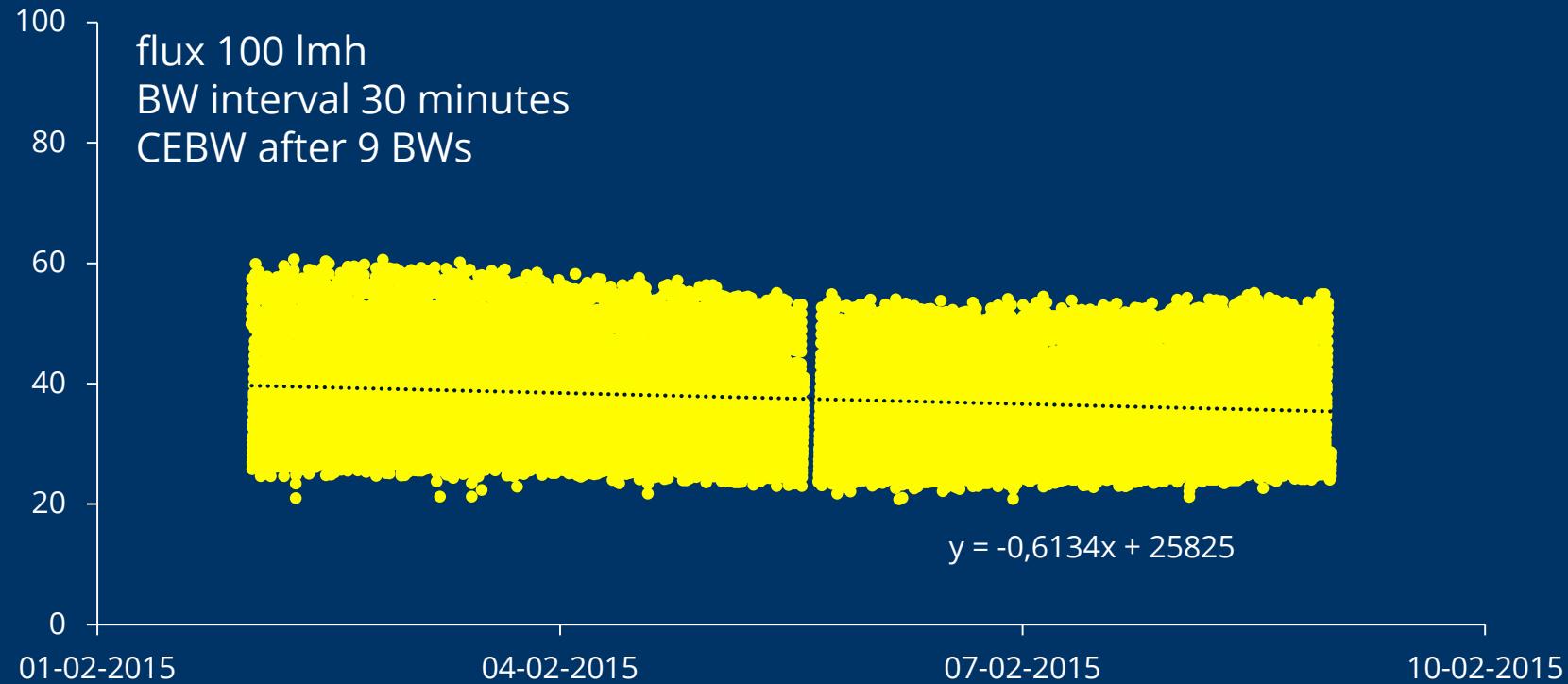
SIX-CeraMac process



Andijk pilot - TMP profile

SIX-CeraMac process

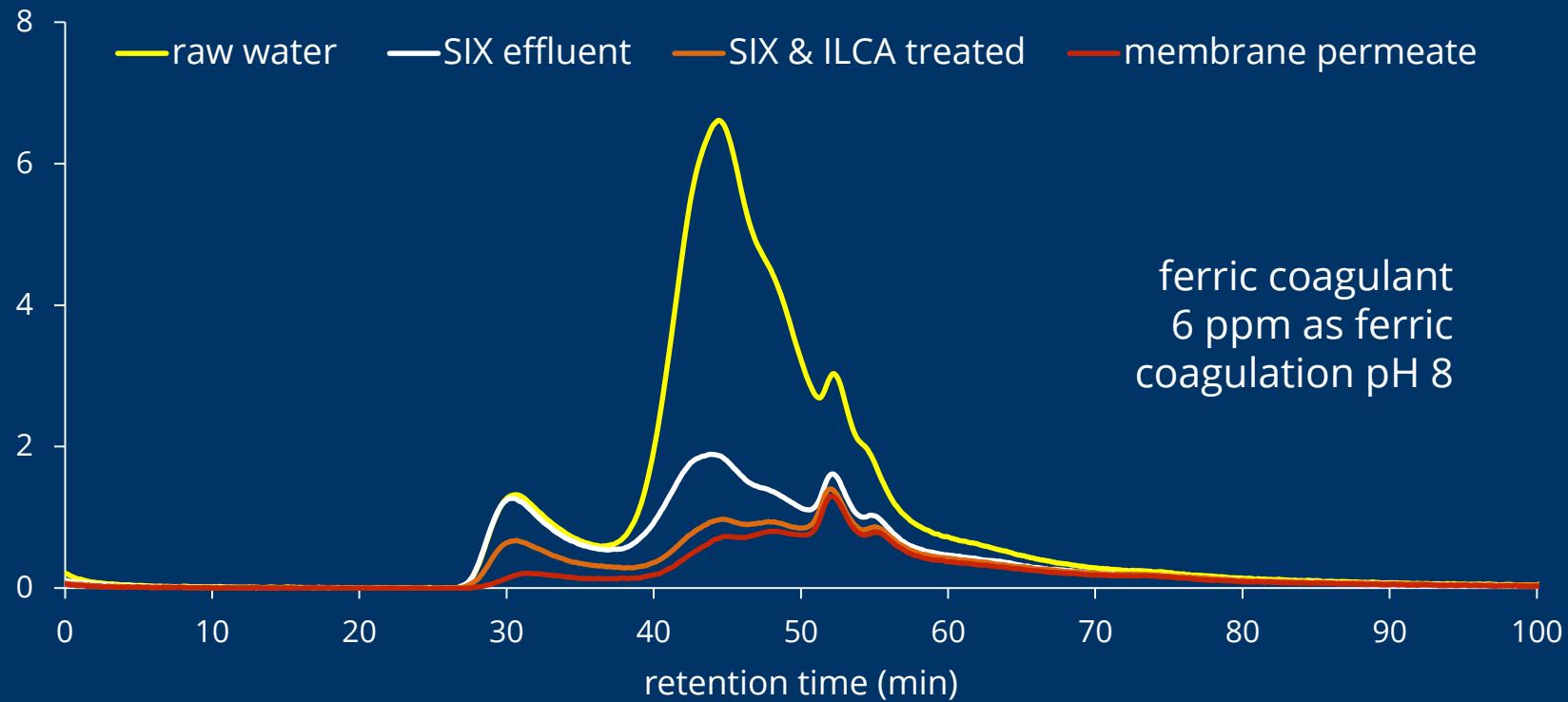
TMP (kPa @ 10 °C)



Andijk pilot - NOM removal

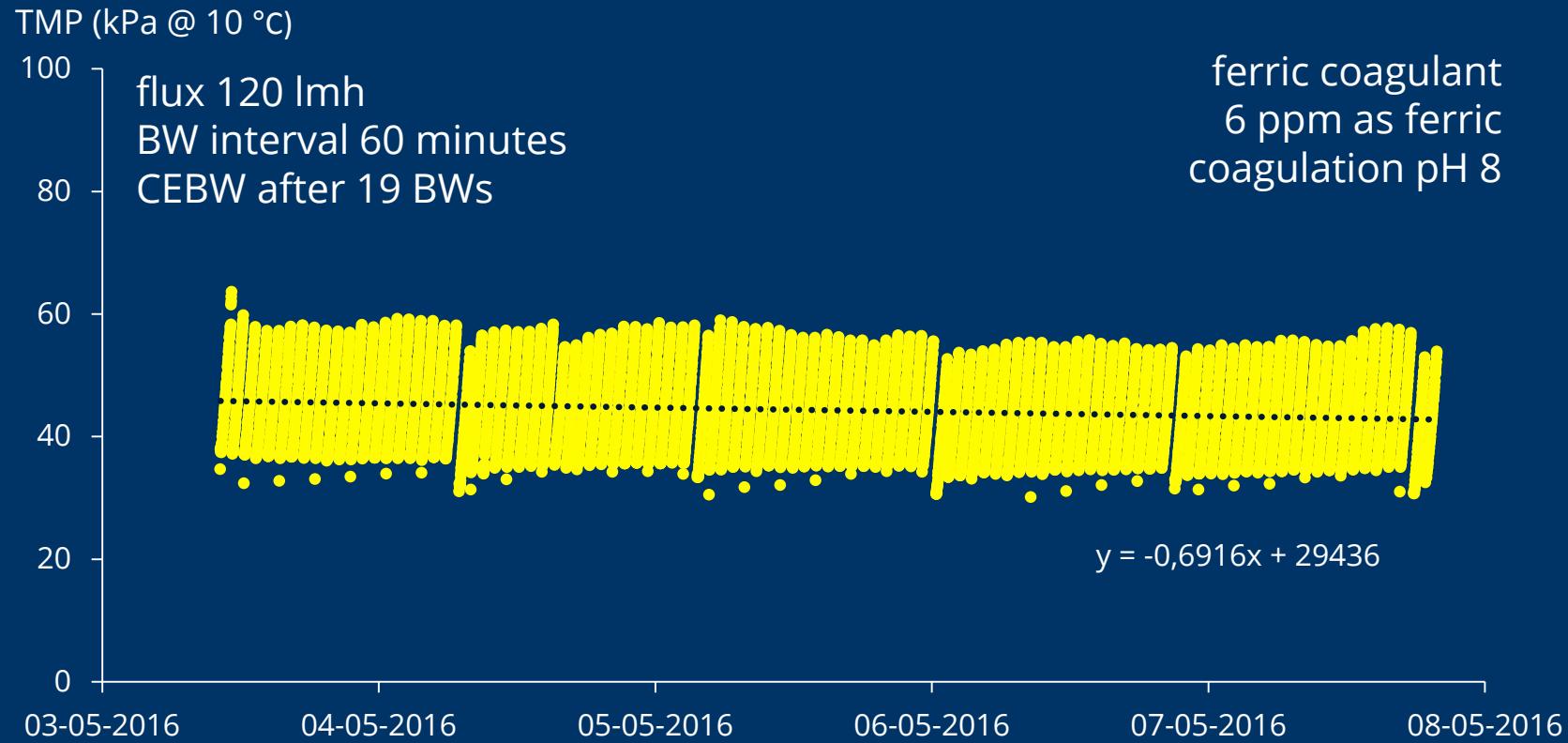
SIX-ILCA-CeraMac, ferric coagulant

OCD signal (a. u.)



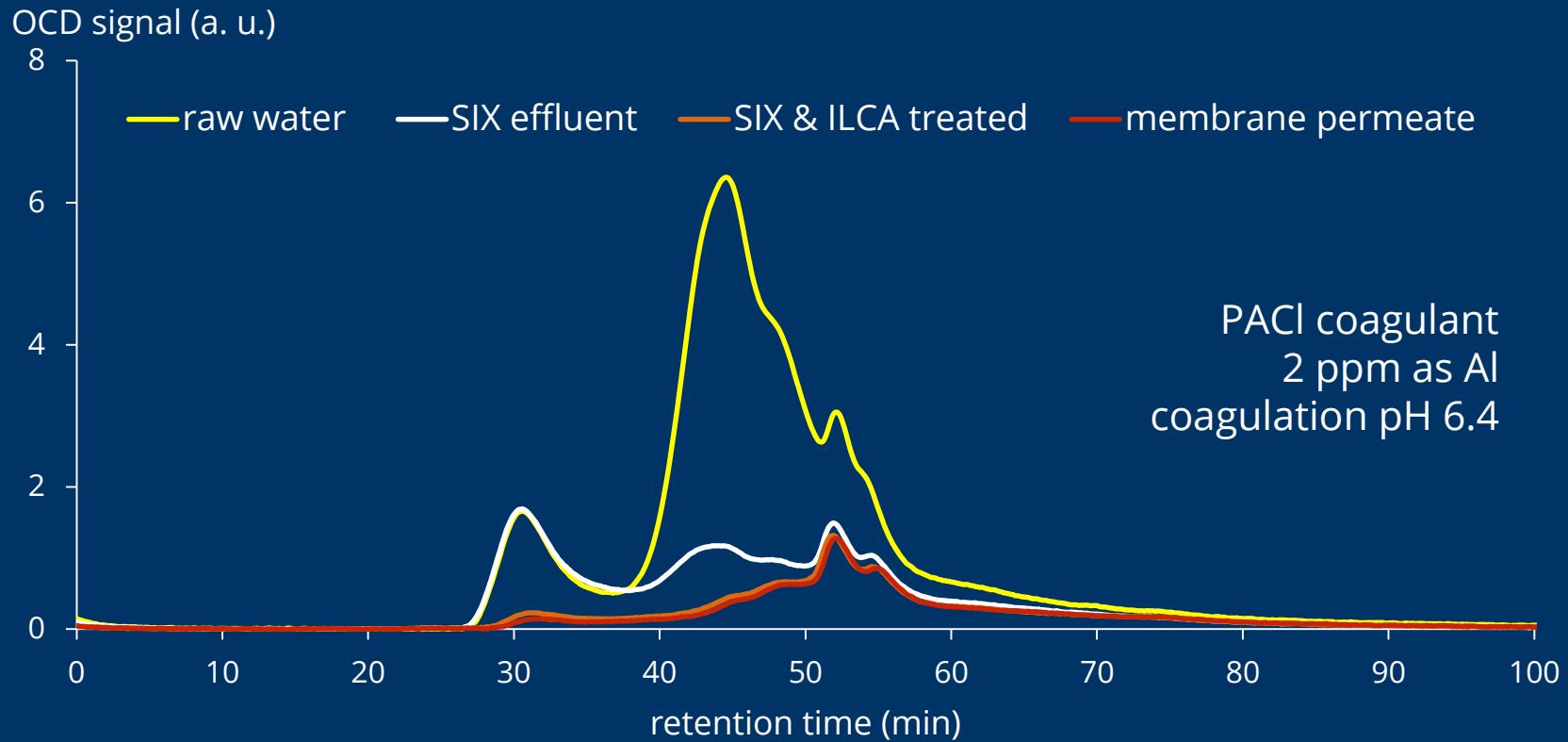
Andijk pilot - TMP profile

SIX-ILCA-CeraMac process, ferric coagulant



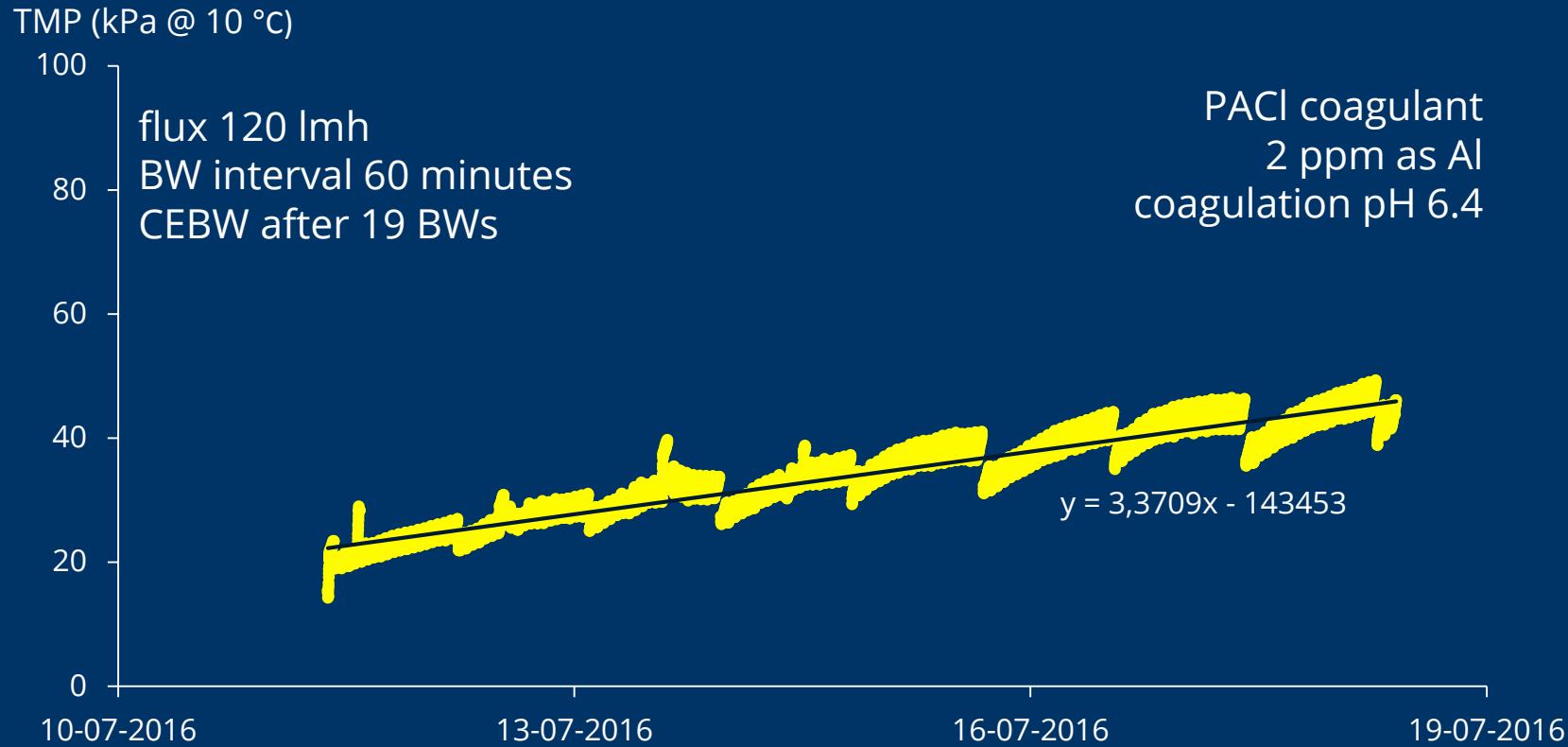
Andijk pilot – NOM removal

SIX-ILCA-CeraMac process, PACl coagulant



Andijk pilot - TMP profile

SIX-ILCA-CeraMac process, PACI



Andijk pilot - summary

- biopolymers don't contribute to the membrane fouling
- coagulation with 6 ppm ferric at pH 8 removes relatively less NOM but it improves the membrane performance
- coagulation with 2 ppm PACl at pH 6.4 removes relatively more NOM but it negatively impacts the membrane performance

final remarks

- the membrane operational performance depends on pre-treatment
- pre-treatment must be carefully selected because every water is unique