Detecting toxic substances in water by Chlorophyll Fluorescence

CAMEO·A··

May, 2018

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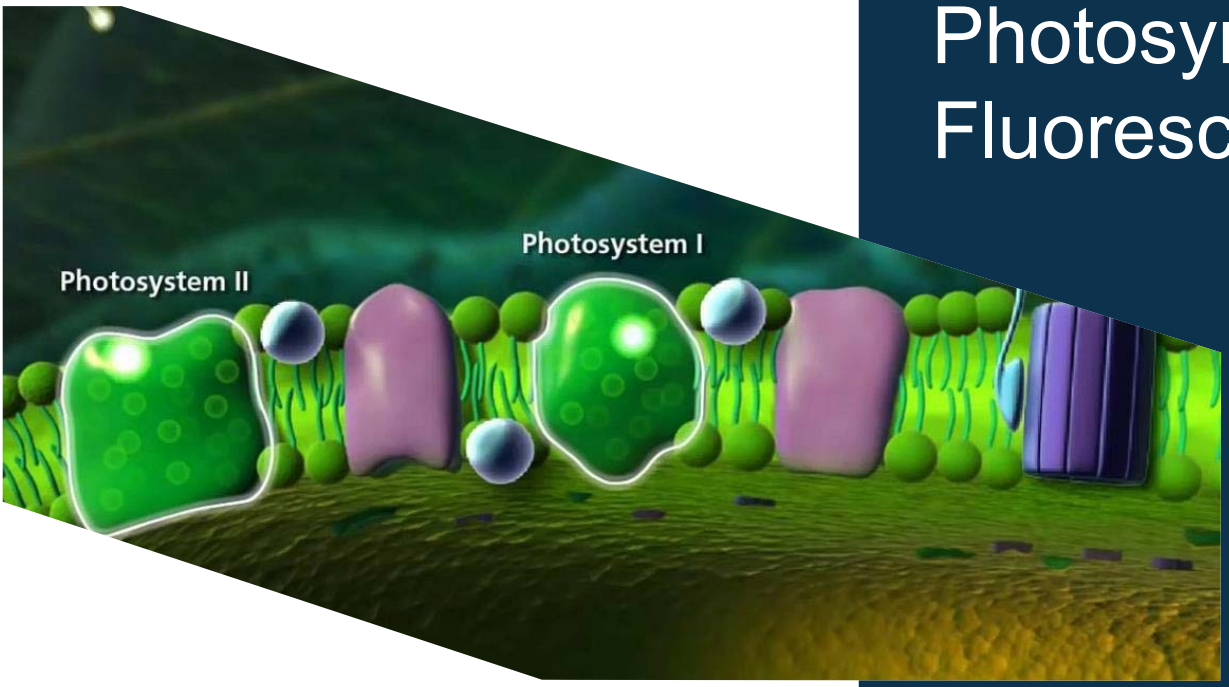
Photosynthesis and Fluorescence



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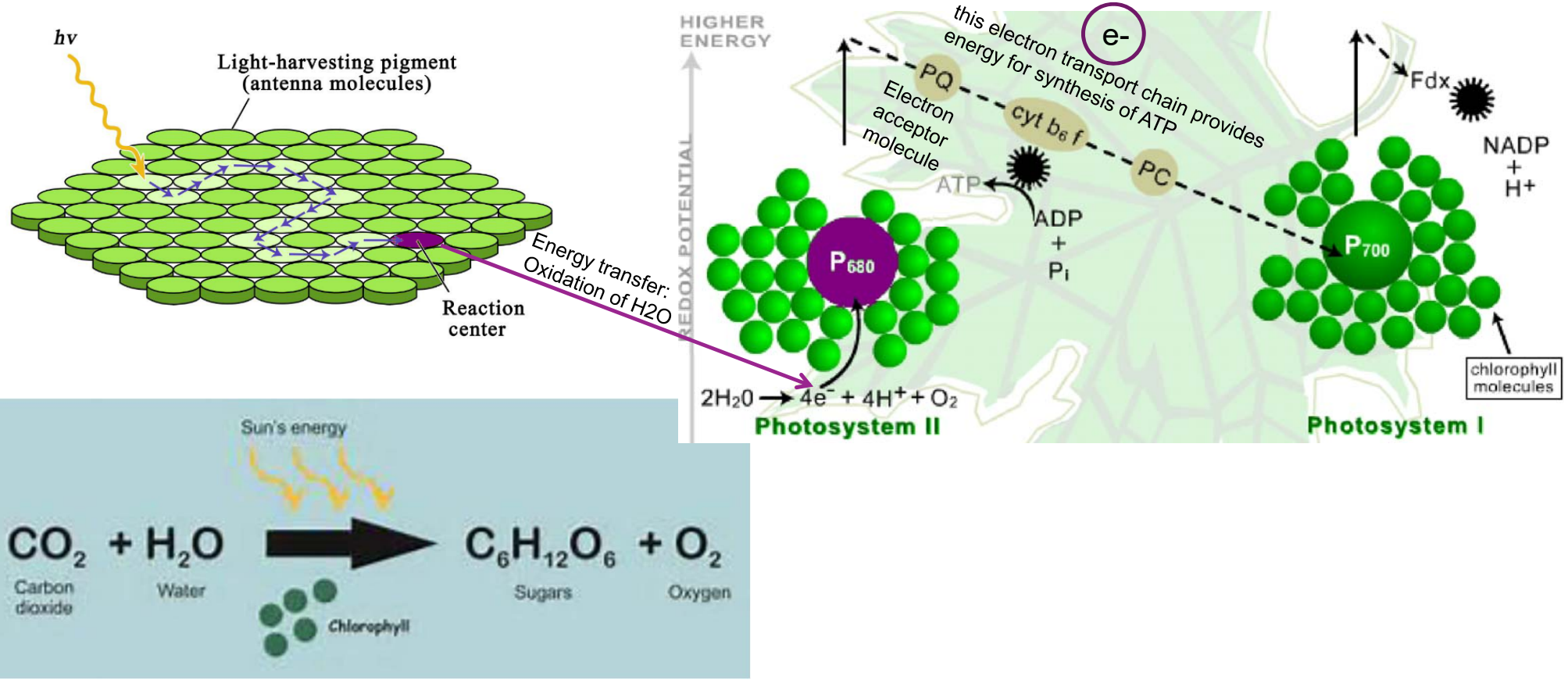
Photosynthesis – the principle



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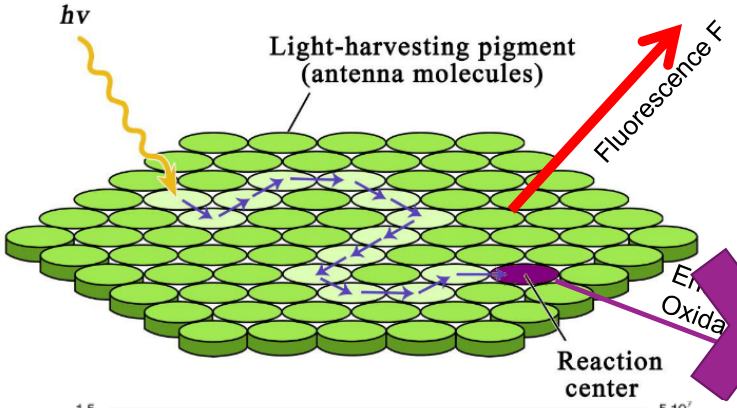
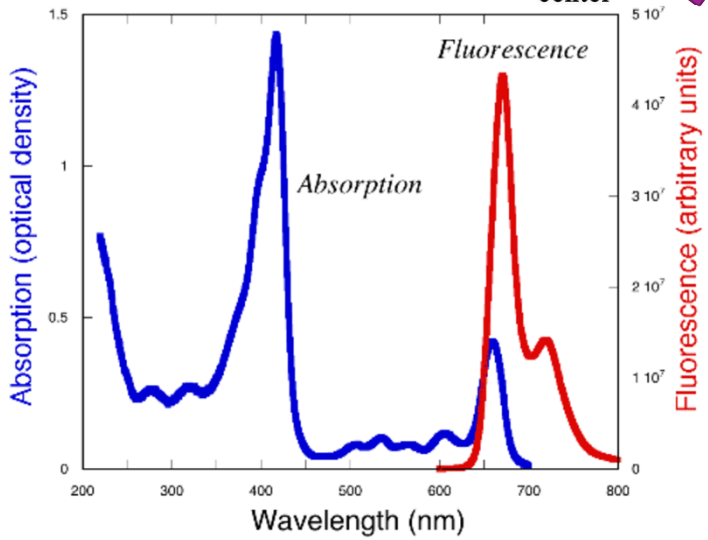
Fluorescence – the principle





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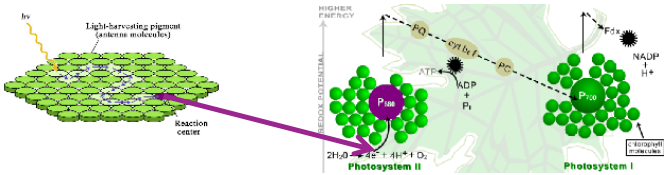
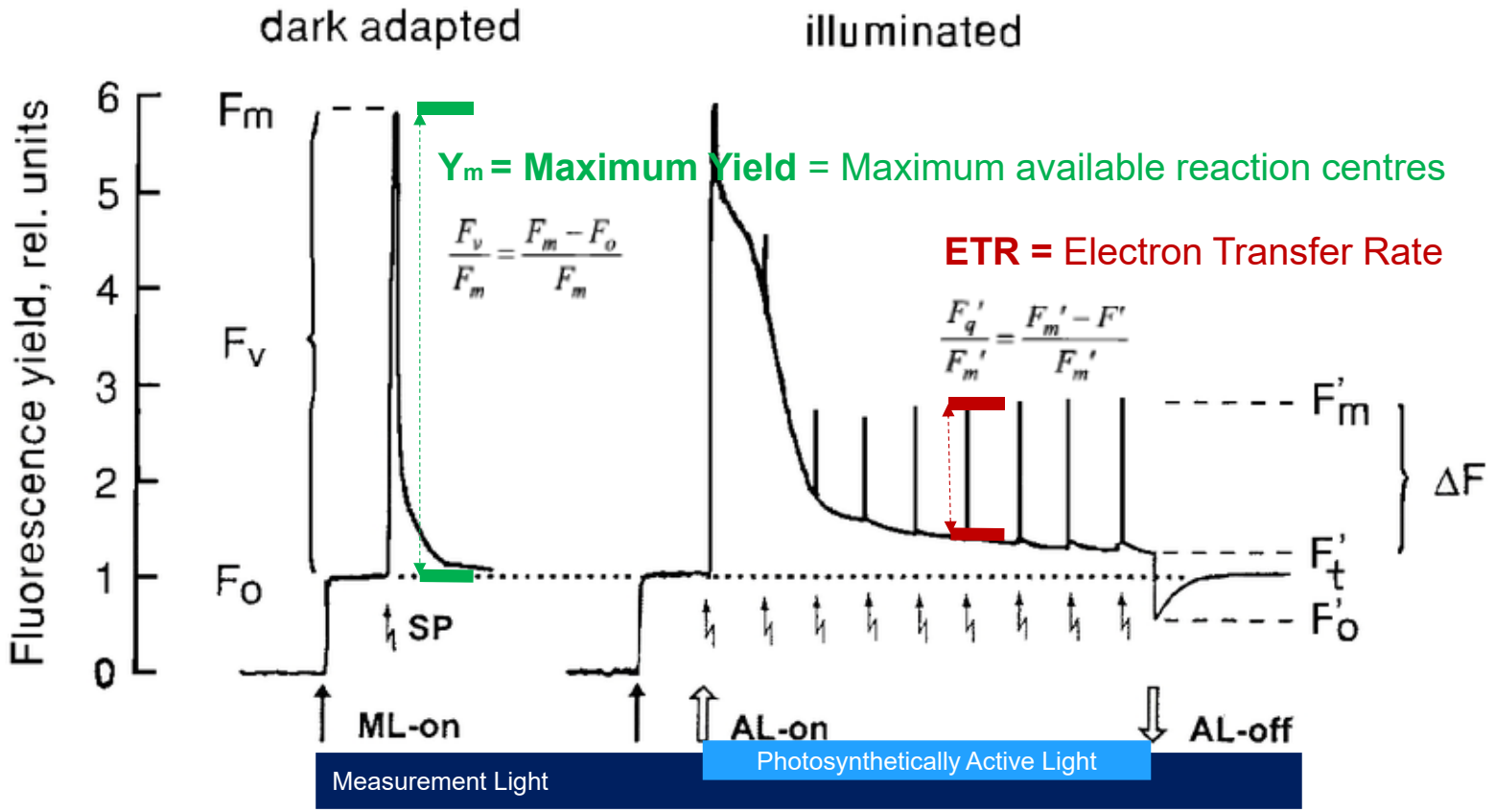
Fluorescence measurement – the principle





Y_m = Maximum Yield = Maximum available reaction centres

$$\frac{F_v}{F_m} = \frac{F_m - F_o}{F_m}$$

ETR = Electron Transfer Rate

$$\frac{F_q'}{F_m'} = \frac{F_m' - F'}{F_m'}$$

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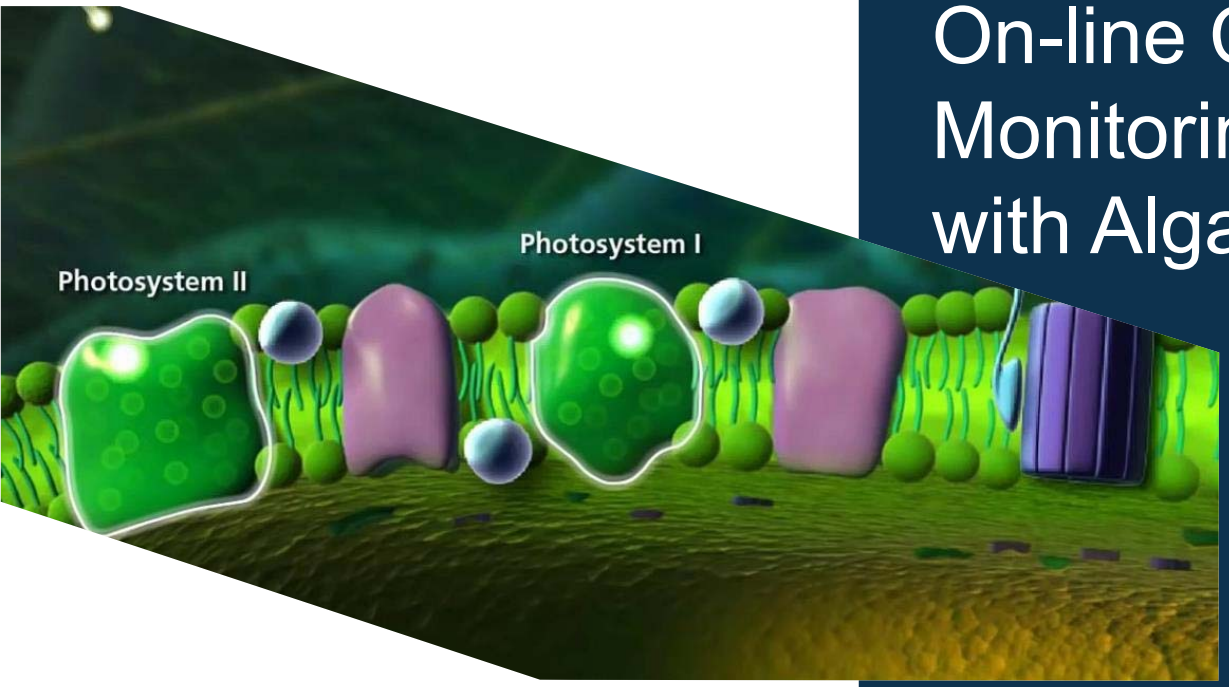
On-line Chronic and Acute Monitoring for Ecotoxicology with Algae



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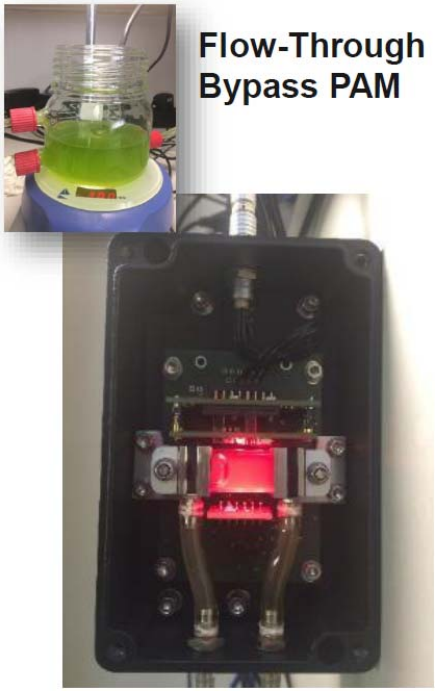
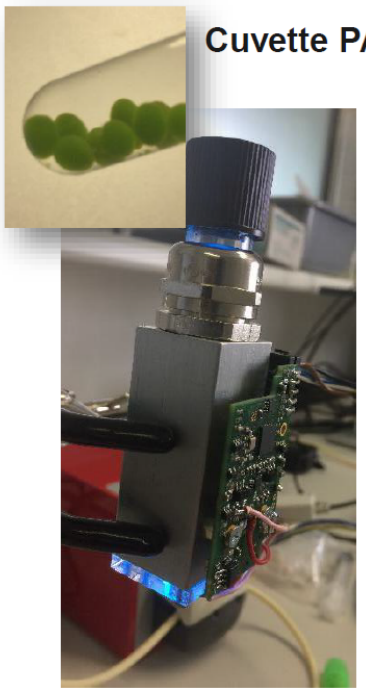
Different configurations were validated for accuracy and maintainability





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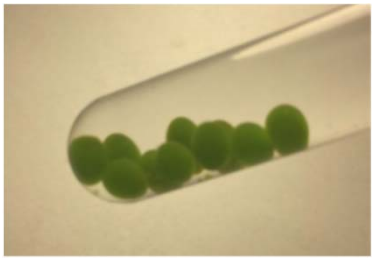
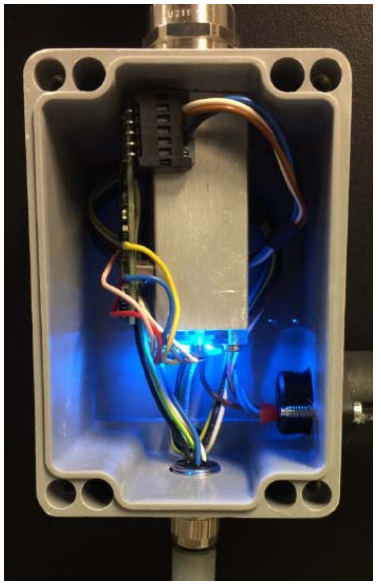
CAMEO-A® – the sensor gives two clear values, no scientific background necessary

- Our analyser is based on a cuvette PAM
  - Yield
  - ETR

  → health of the sample

  → determination of toxicity





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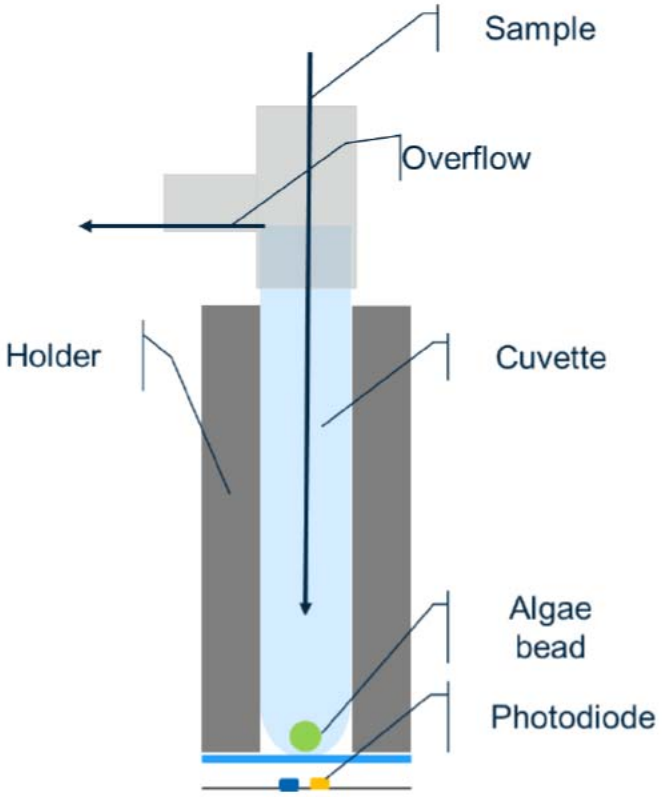
CAMEO-A – the sensor is easy to use

- No algae culture maintenance necessary
- Continuous monitoring → quick detection
- Algae bead remains separate from the sample or reference liquid
- No interference with suspended solids
- No pre-treatment nor filtering necessary → representative samples
- No interference with the sample colour
- High tolerance for salts (up to 15 mS/cm)



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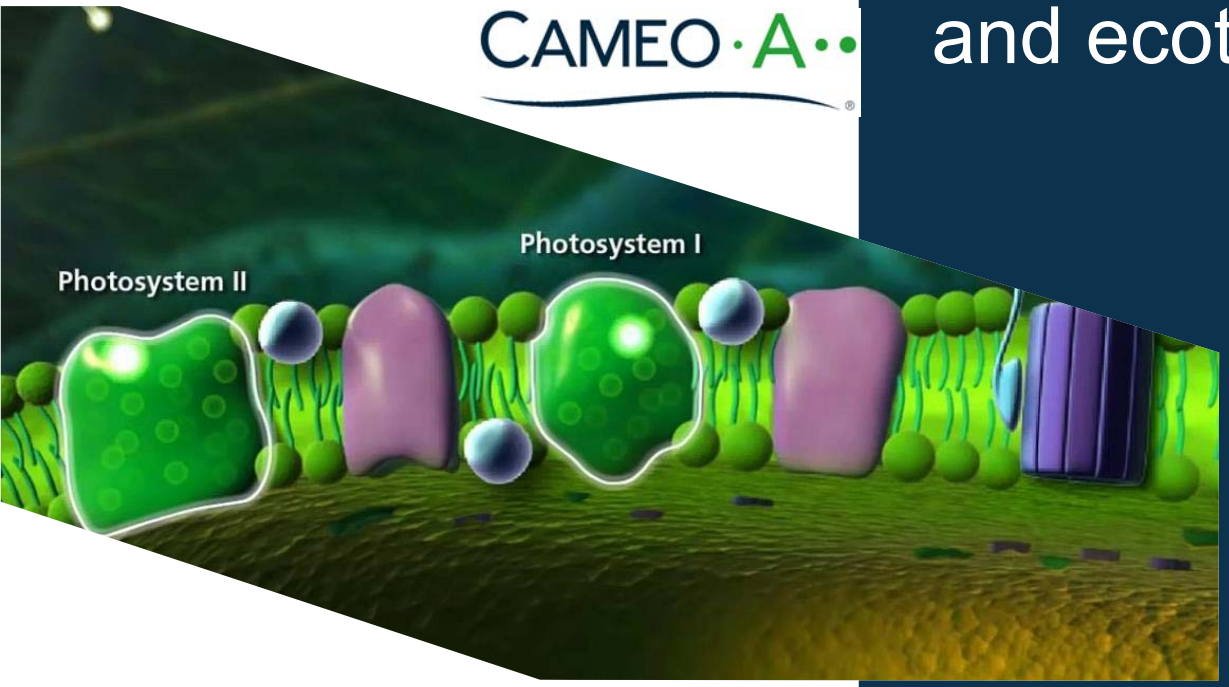
and ecotoxicity



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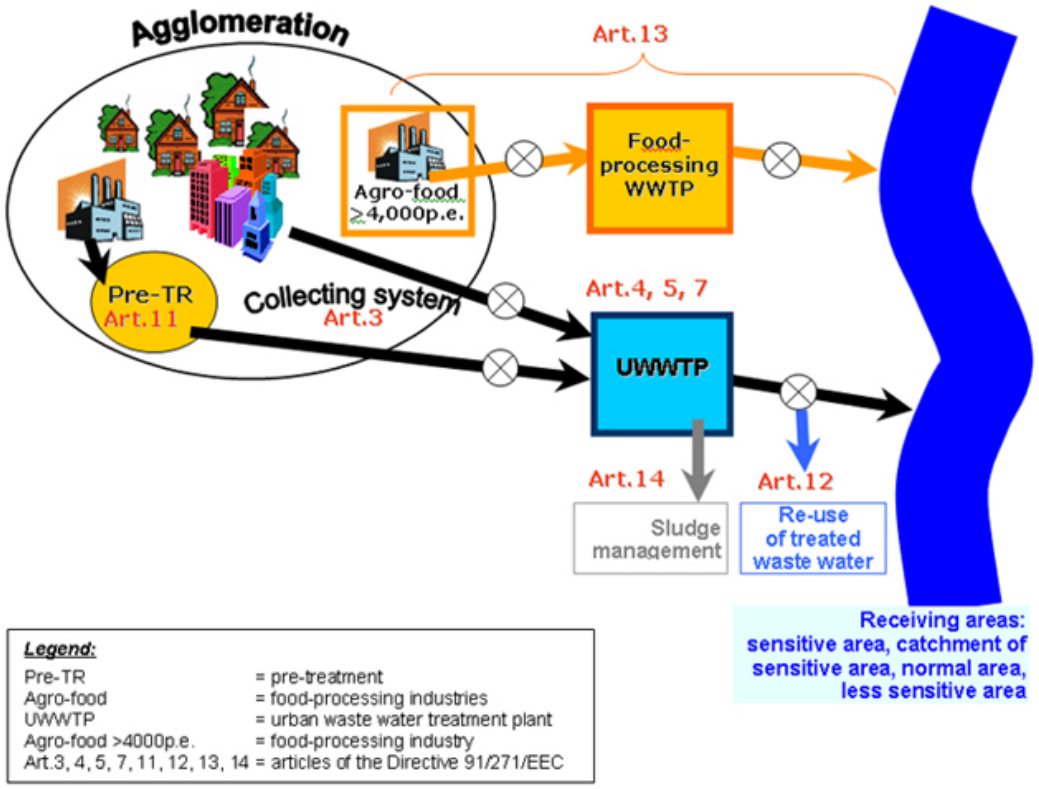
Water is not a commercial product but rather a heritage which must be protected, defended and treated as such !

- Companies are bound to European Legislation 91/27/EEC EC directive concerning urban waste water treatment
  - Planning
  - Regulation
  - **Monitoring**
  - Information and Reporting
- Monitoring of toxic substances by
  - Group parameters → no information on ecotoxicity
  - Specific analyses → never complete
  - Ecotoxicity testing → Whole Effluent Toxicity



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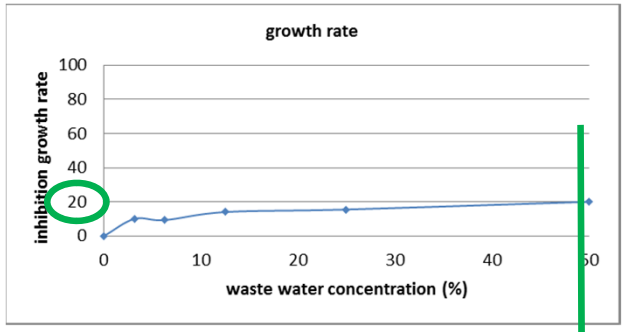
We focus on monitoring of the algae trophic level

- Pseudokirchneriella subcapitata (freshwater algae)
  - Reference is made to OECD guideline 201
  - Based on inhibition of growth rate
  - Lab tests / Sampling / 3 days test: snapshot analysis
  - Interpretation of results

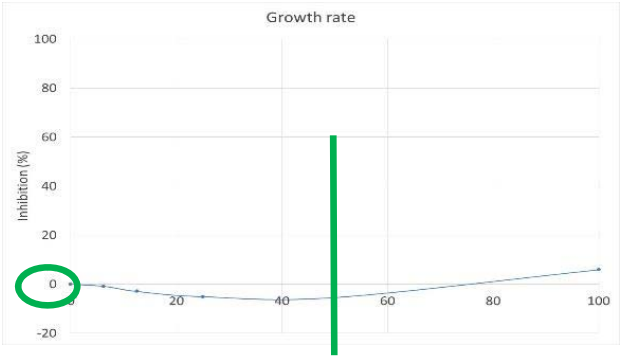
Sample May 2016

Inhibition growth rate (Lab 1)



50%

Inhibition growth rate (Lab 2)



50%

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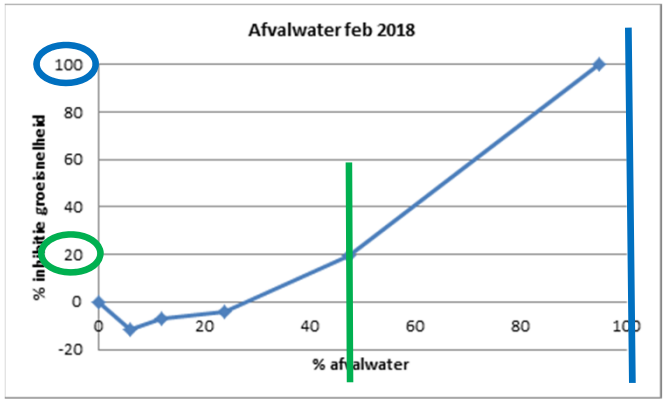
CAMEO-A – detailed in-depth data compared with analyses by accredited labs

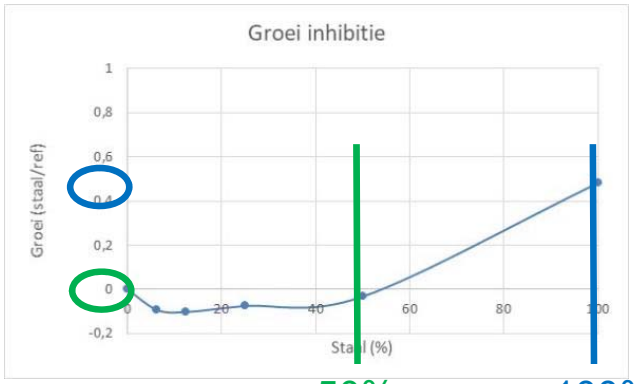
Sample February 2018

Lab 1



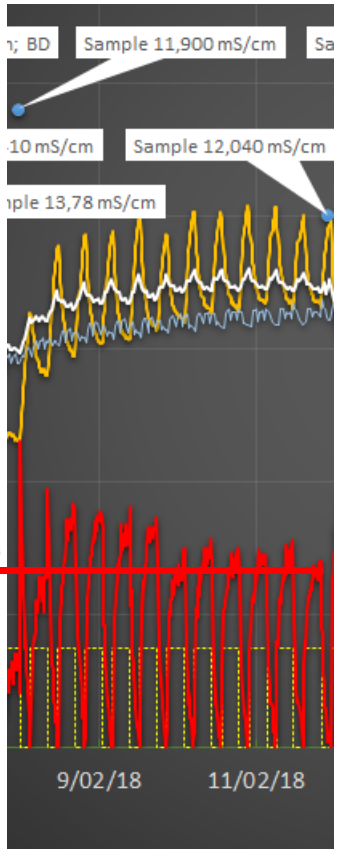
50% 100%

Lab 2



50% 100%

CAMEO-A



I_{ETR}= 20%

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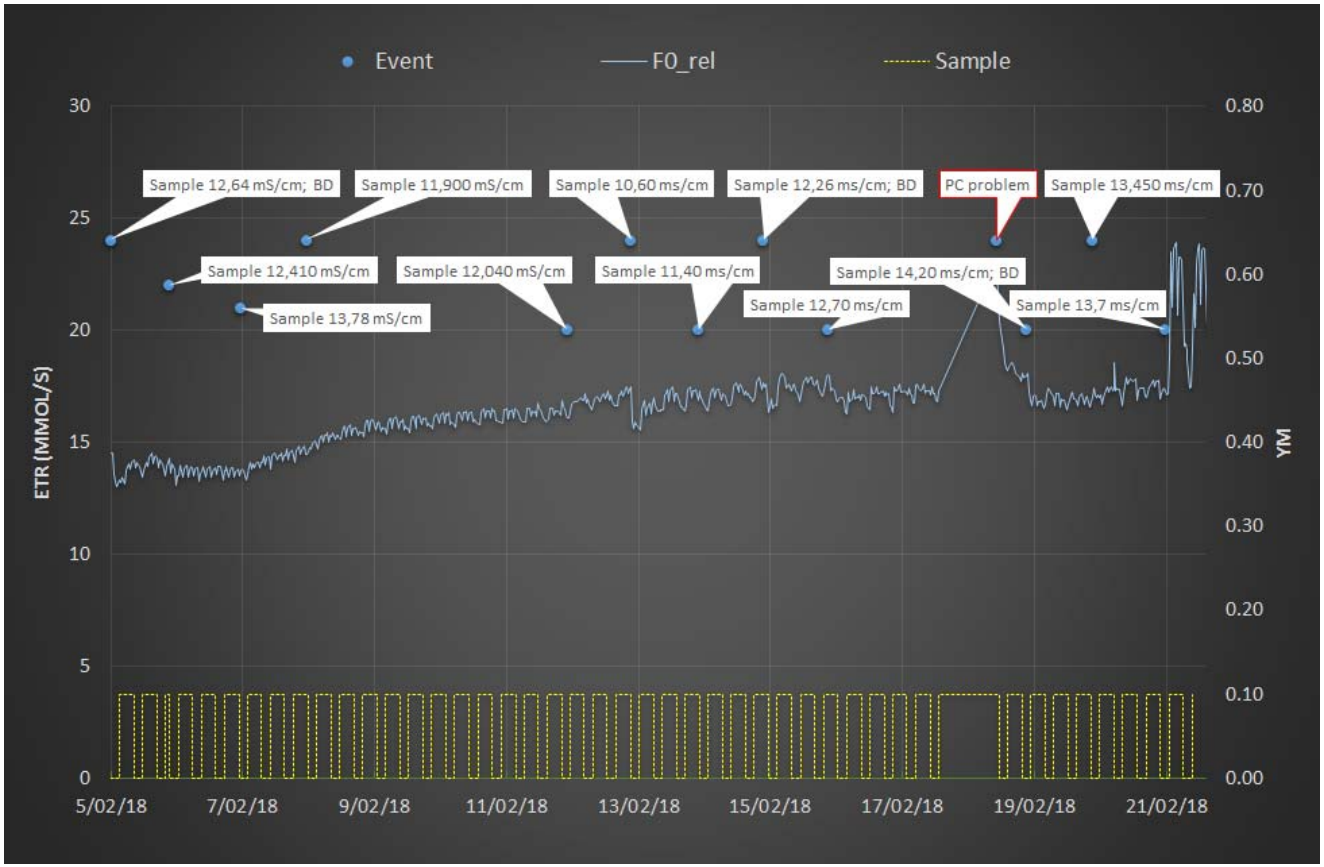
CAMEO-A – detailed in-depth data step-by-step

- Events are shown
- F0 (relative)
- Sample (high) vs Reference medium (low)



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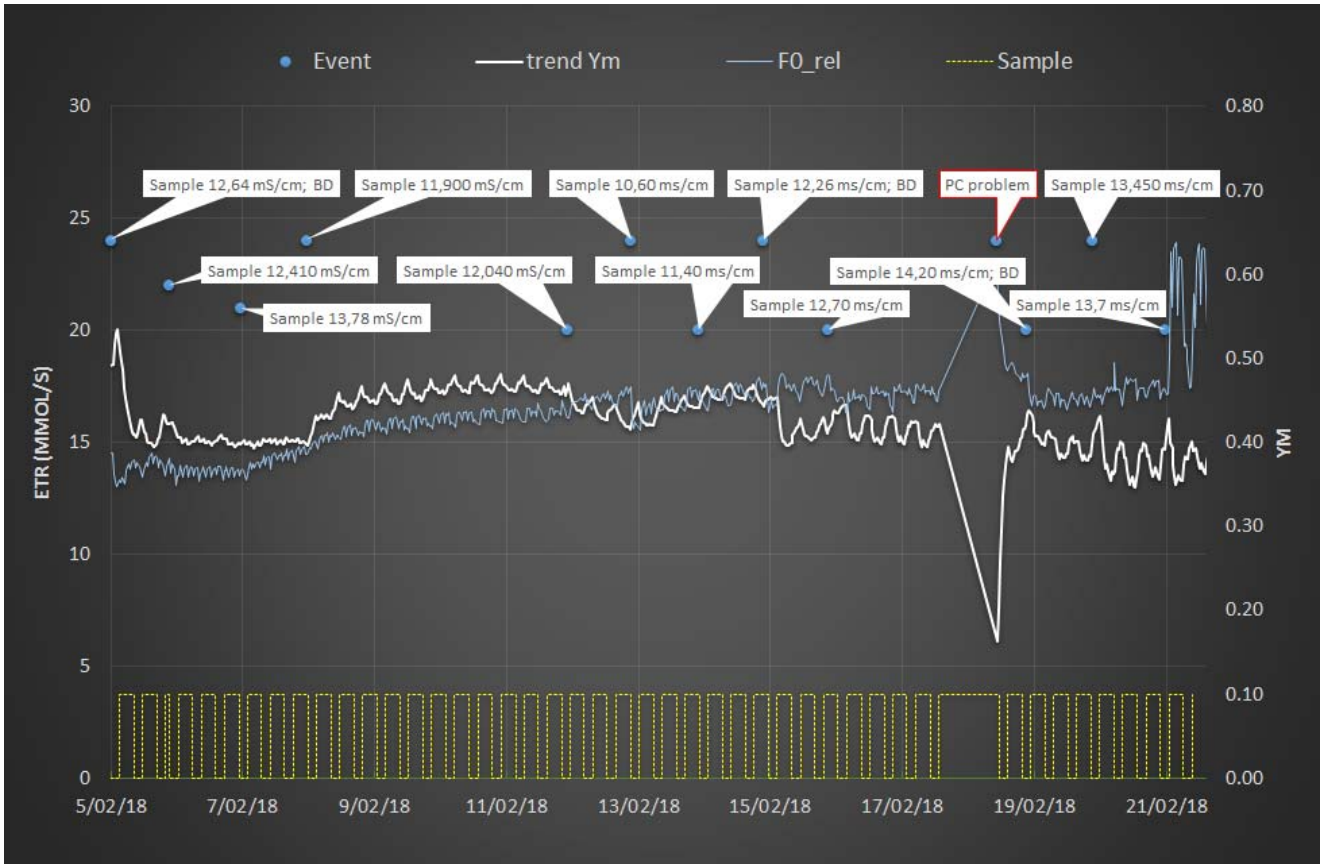
CAMEO-A – detailed in-depth data step-by-step

- Events are shown
- F0
- Sample vs Reference medium
- Yield (max. available reaction centres)



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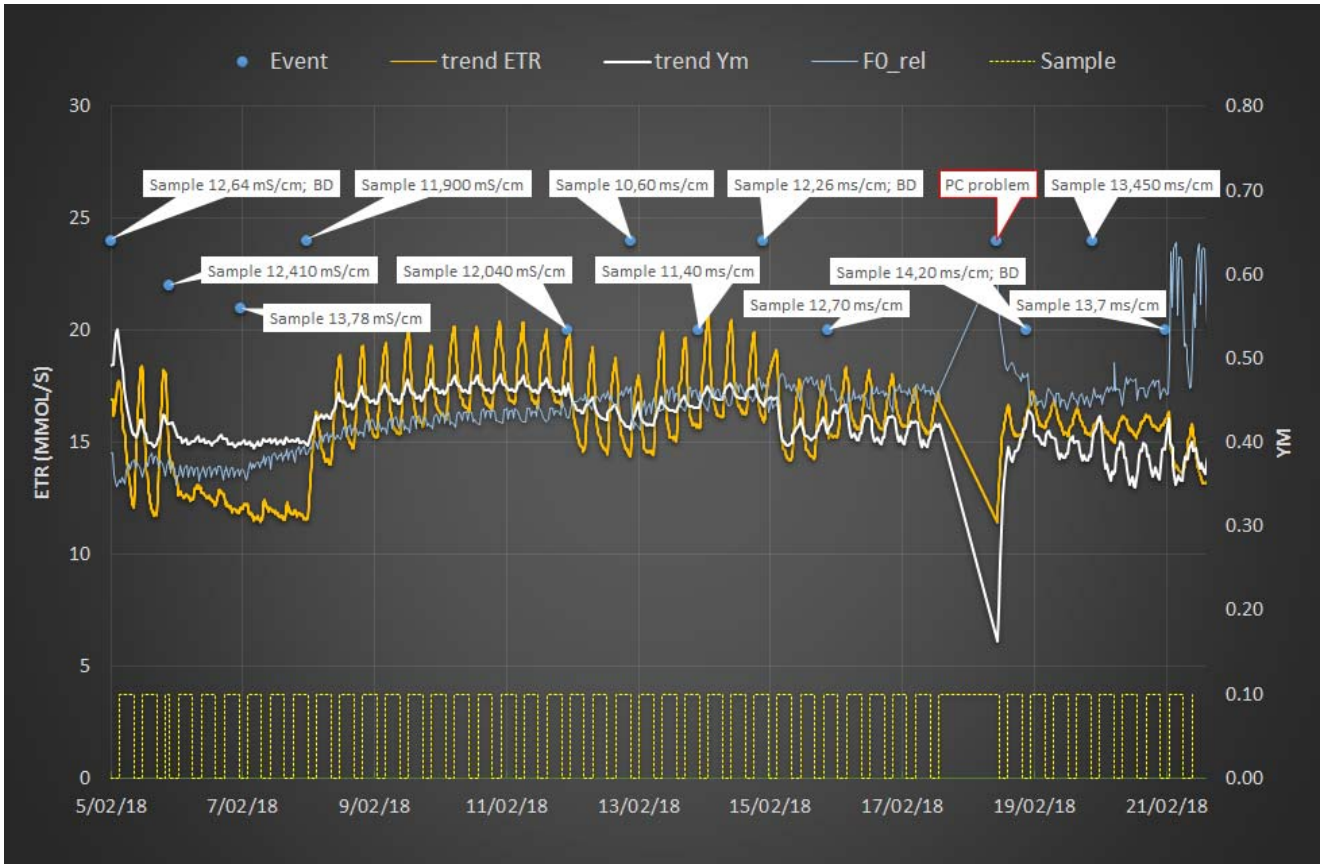
CAMEO-A – detailed in-depth data step-by-step

- Events are shown
- F0
- Sample vs Reference medium
- Yield (max. available reaction centres)
- ETR



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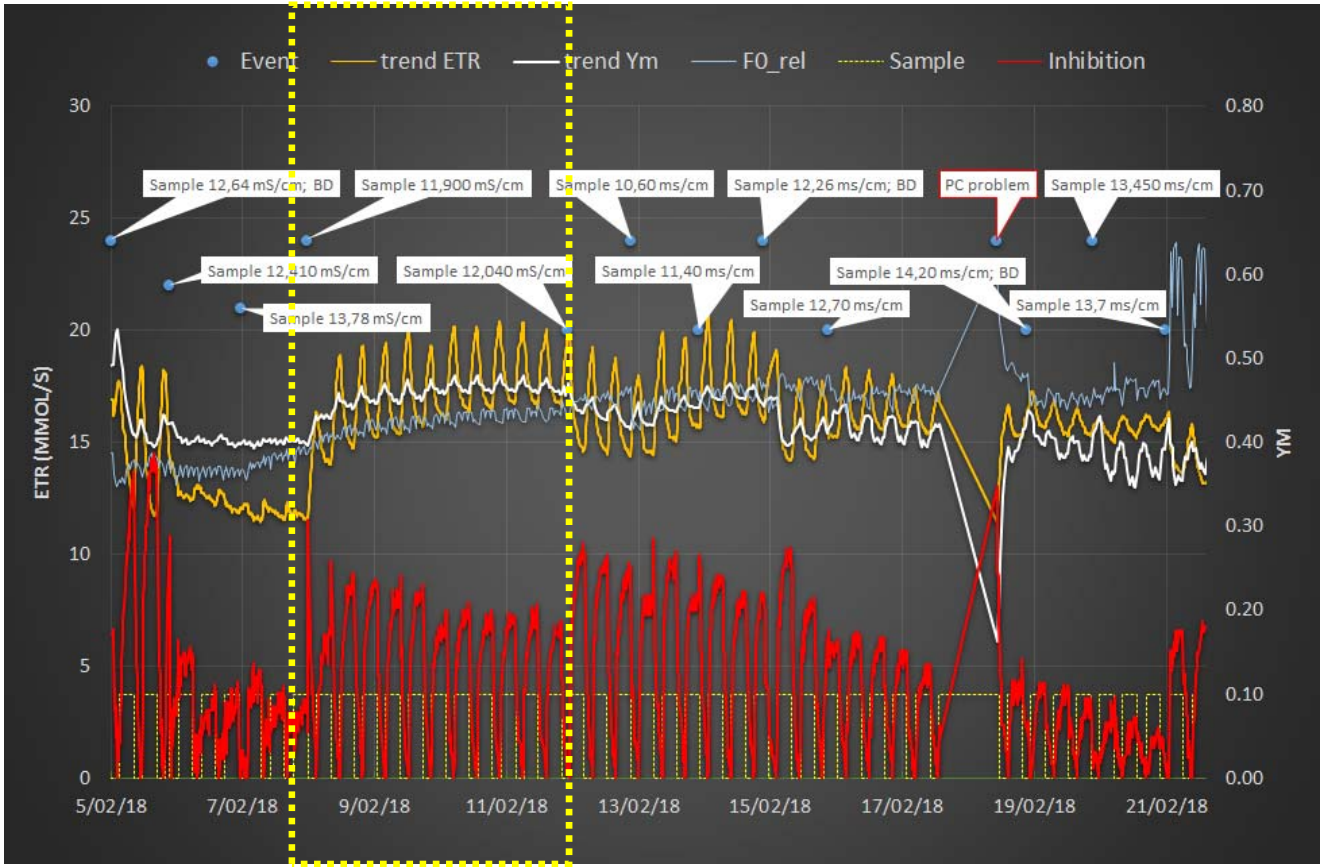
CAMEO-A – detailed in-depth data step-by-step

- Events are shown
- F0
- Sample vs Reference medium
- Yield (max. available reaction centres)
- ETR
- Inhibition ETR (right axis - up to 40%)



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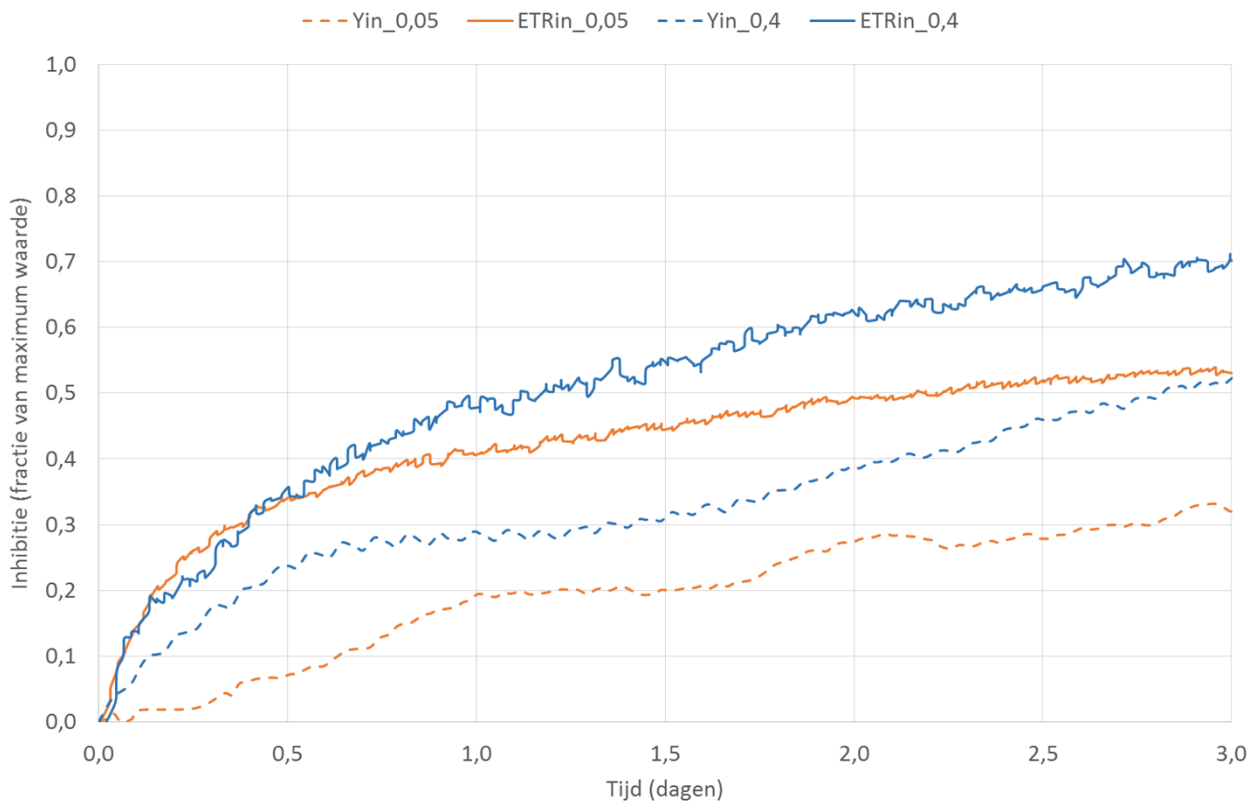
CAMEO-A – Benchmarking test with Zn^{2+} (50 µg/l and 400 µg/l)



ETR inhibition 400 µg/l

ETR inhibition 50 µg/l

Yield inhibition 400 µg/l

Yield inhibition 50 µg/l

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Conclusions

- CAMEO-A can be used in an industrial water treatment for process optimisation and early warnings.
- CAMEO-A is operational friendly.
- CAMEO-A provides an on-line measurement but doesn't replace the standard methods. Toxicity can be predicted.

- More benchmarking is still planned.

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Thank you


Laundry
Business
Solutions
Vlakwa
vito
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TECHNOLOGIES
& RESEARCH

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