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DEPARTMENT OF ENVIRONMENTAL SCIENCE

MERMISS I+II
MILJØEFFEKTIV RENSNING AF HØJPOTENTE LÆGEMIDDELSTOFFER I HOSPITALSSPILDEVAND

– ET SAMARBEJDE MELLEM UNIVERSITETER, VIDENINSTITUTIONER OG PRIVATE VIRKSOMHEDER

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Background

- Hospitals use a lot of pharmaceuticals
- Pharmaceuticals are excreeted
- High loads of Pharmaceuticals are in the wastewater
- Super hospitals increase this problem

- No established removal technologies
- Cost efficiency needed

The team

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DANISH TECHNOLOGICAL INSTITUTE

DTU

ANOXKALDNES

KRÜGER

Aarhus Universitetshospital
Teknisk Afdeling

The challenge

- Some pharmaceuticals are recalcitrant
- Some pharmaceuticals are Antibiotics

Original concept

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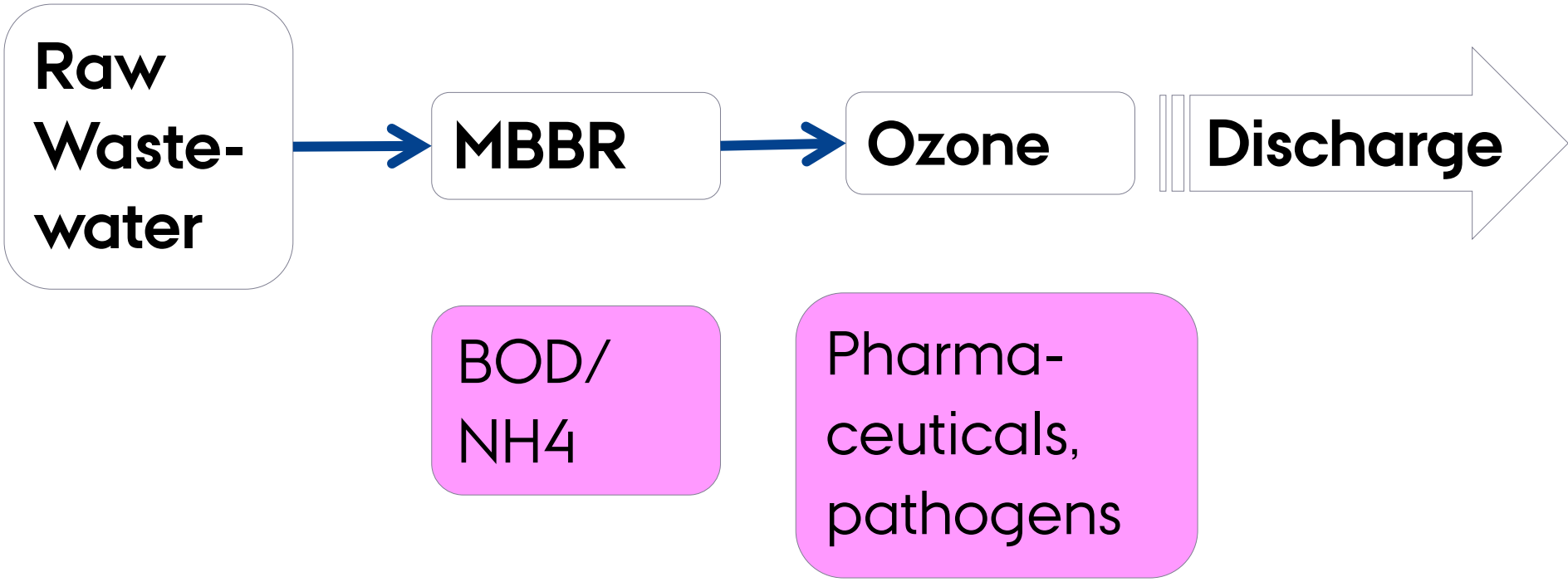

Modified concept

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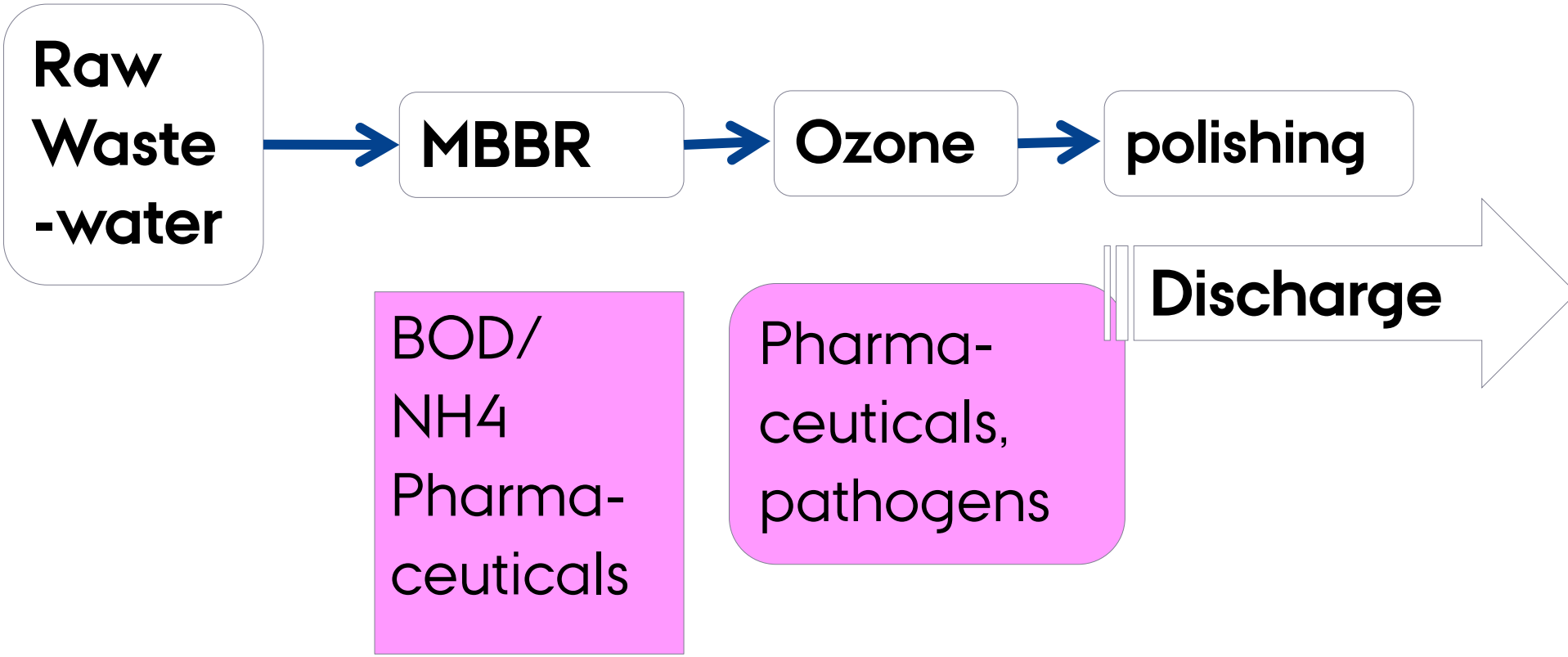
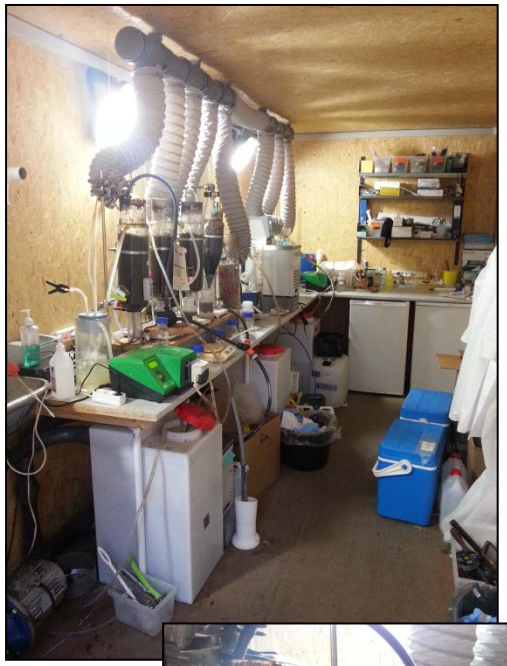
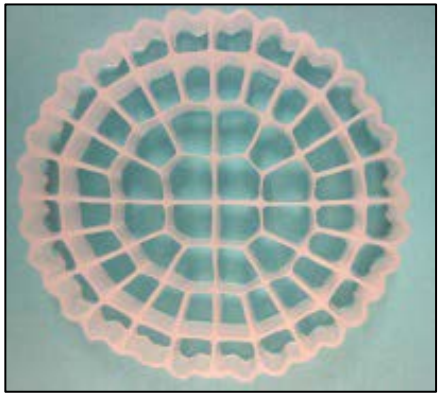


4.2.1 Hospital-Wastewater Treatment

- Biological/biofilm degradation of organic compounds

- 30 relevant compounds
- 11 antibiotics
- 2 analgesic drugs
- 6 cardiovascular system drugs
- 5 central nervous system drugs
- 5 contrast media
- 1 disinfectant





MBBR-technology

Experimental set-up

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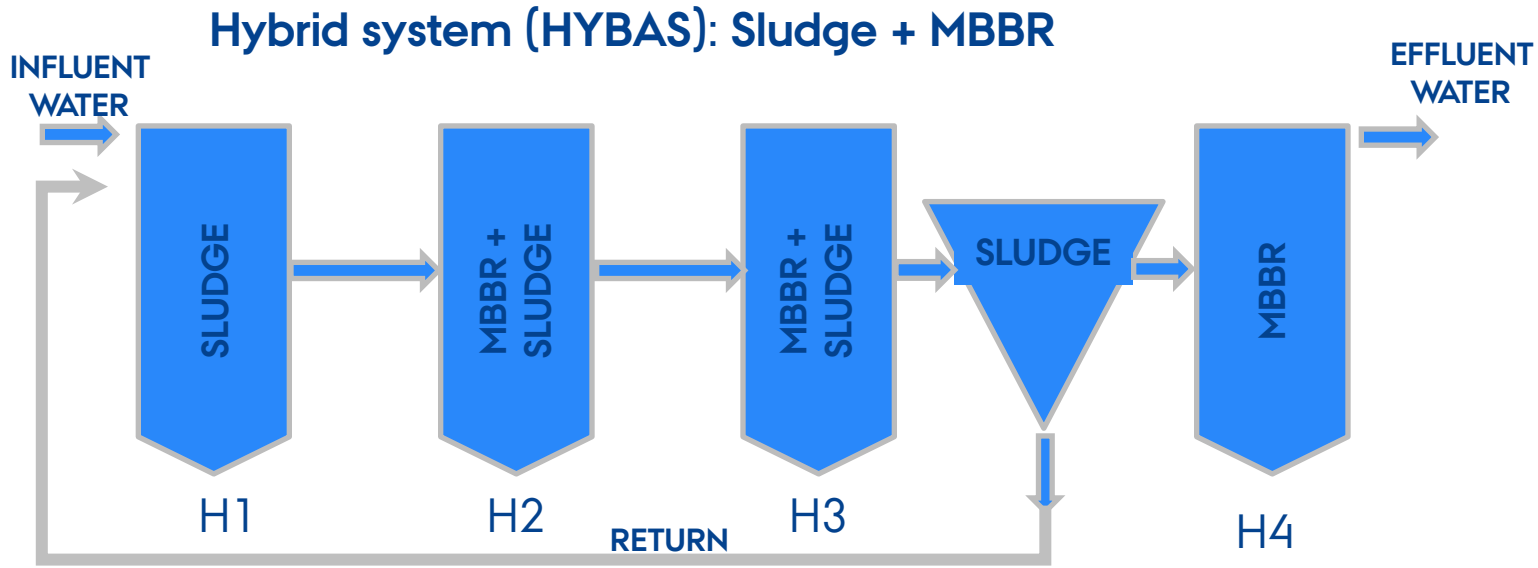

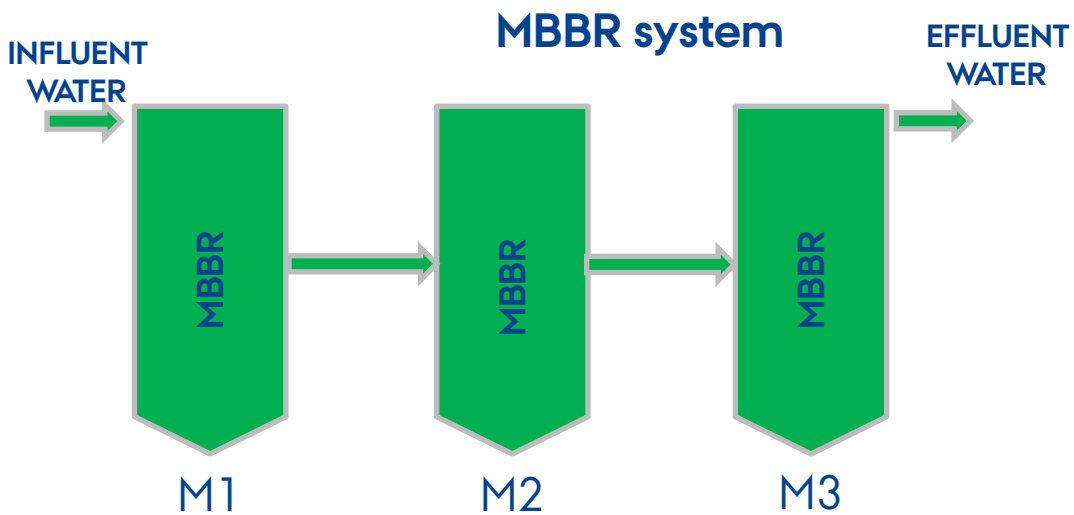

On both systems:

- Baseline control
- Degradation kinetics
  - ✓ Stop flow and spike
  - ✓ Continuous flow

Escola et al., 2015 in preparation

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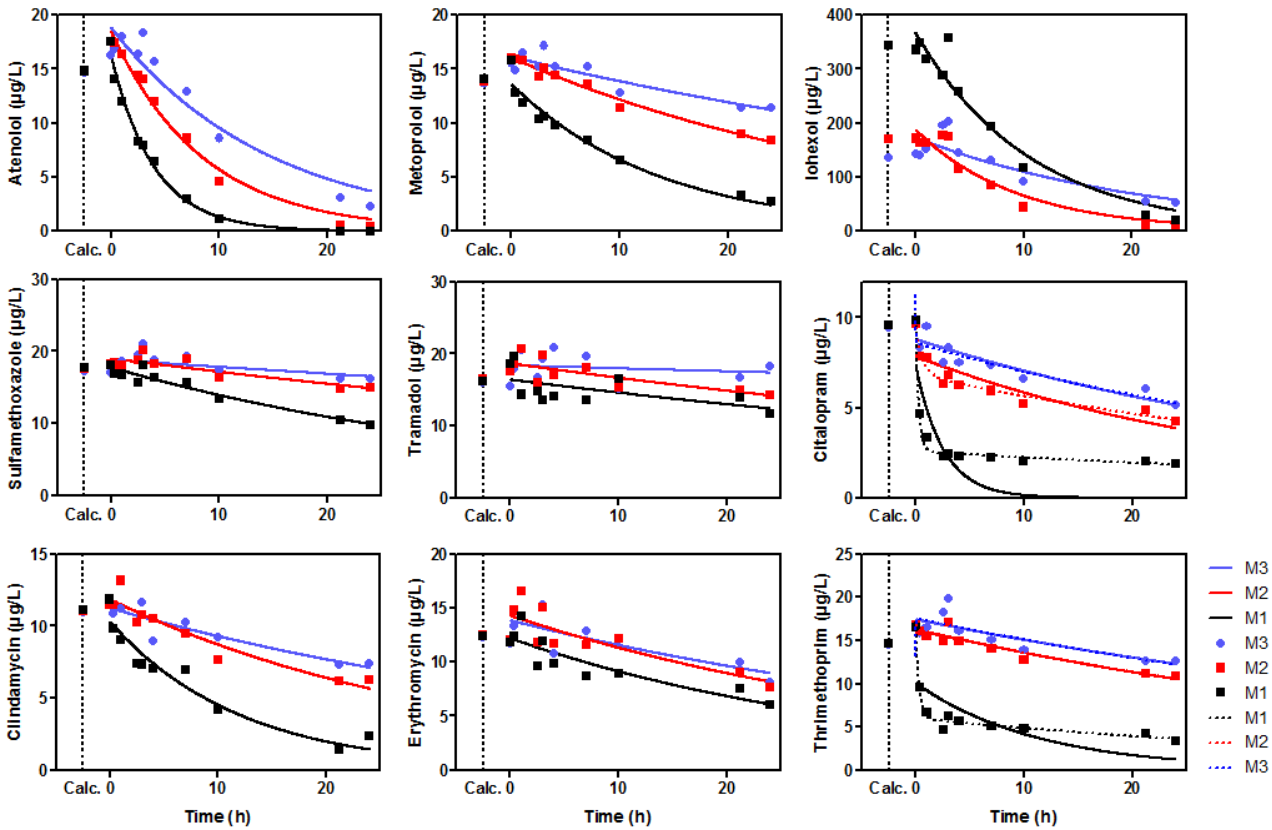
Moving-Bed Biofilm Reactors: MBBR

Batch experiment



- 21/26 compounds degraded >20%
- First order kinetics for most compounds.
- Two phase kinetics for four compounds.

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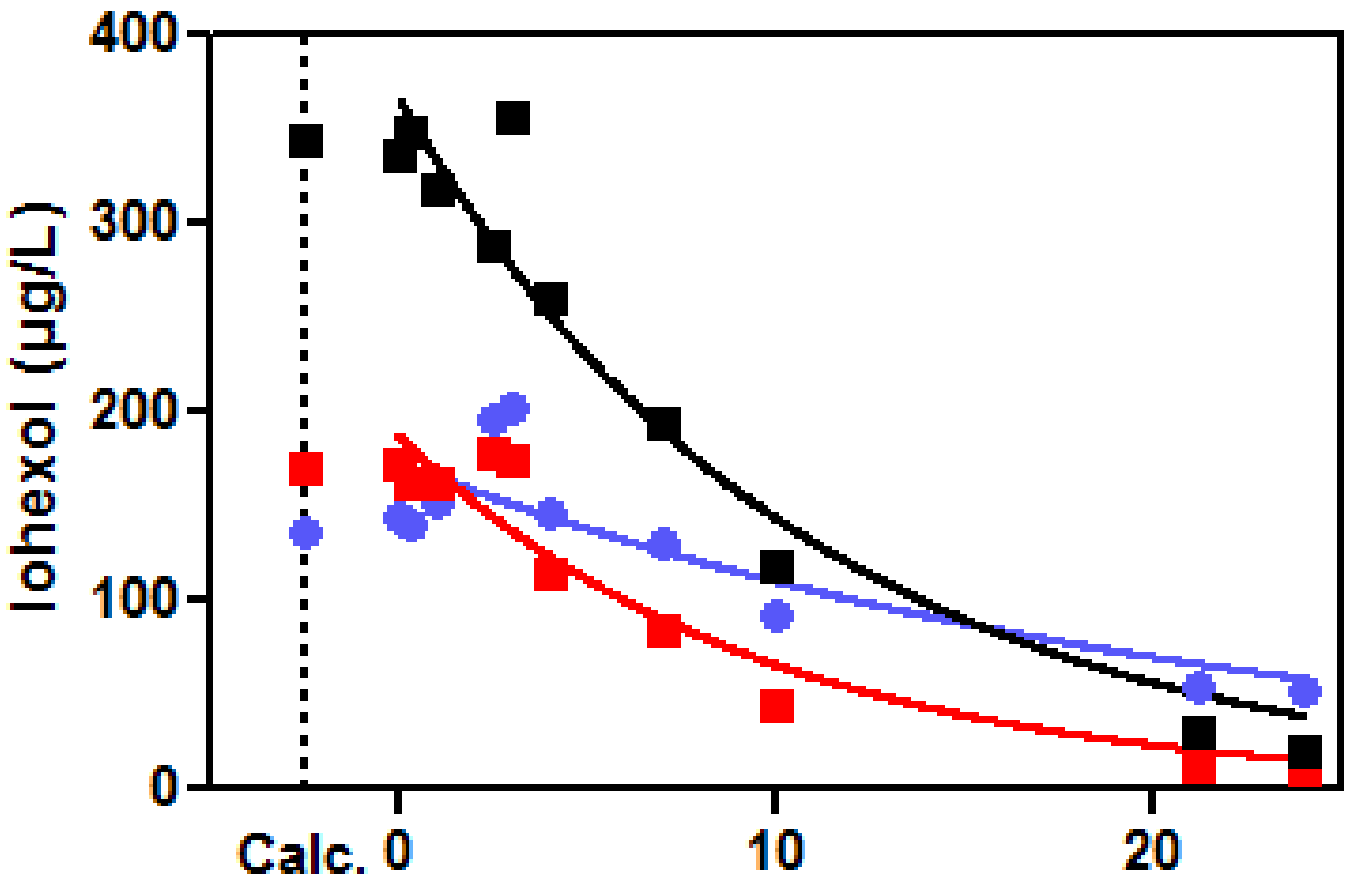
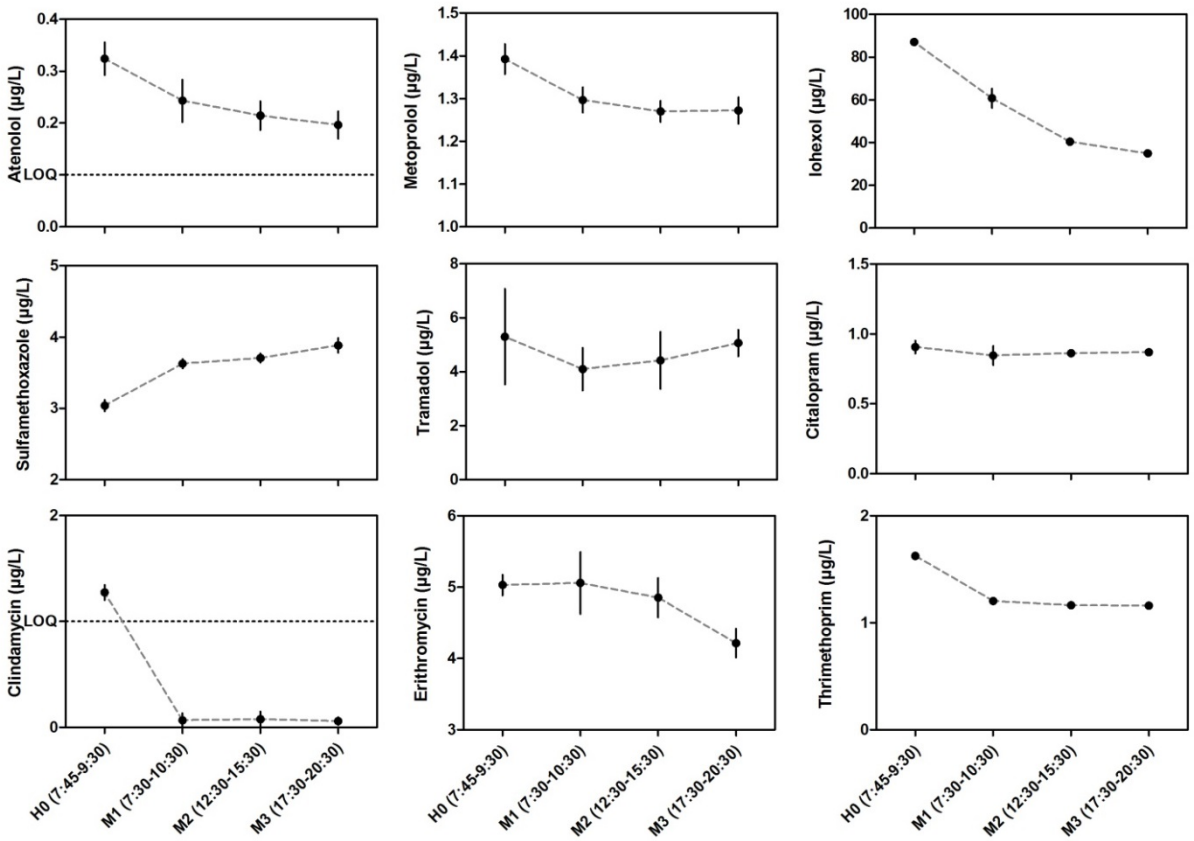
No other technology can remove x-ray contrast media

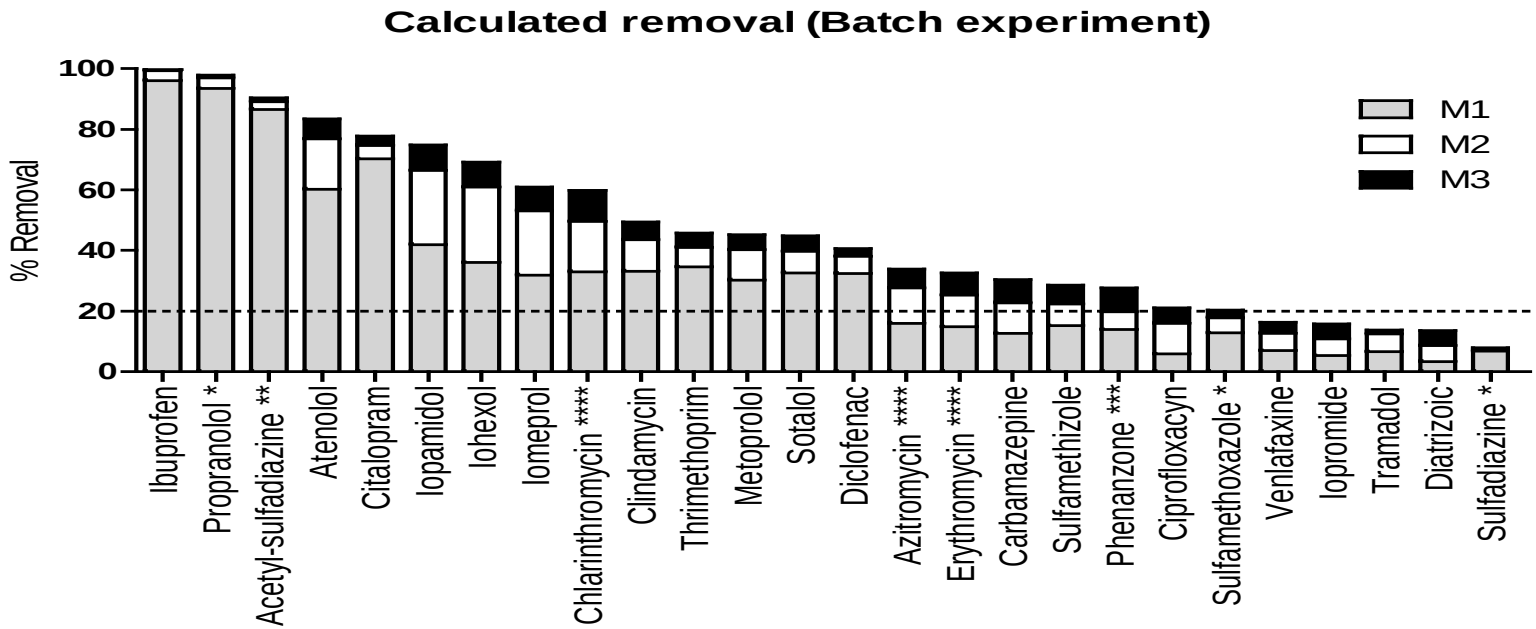


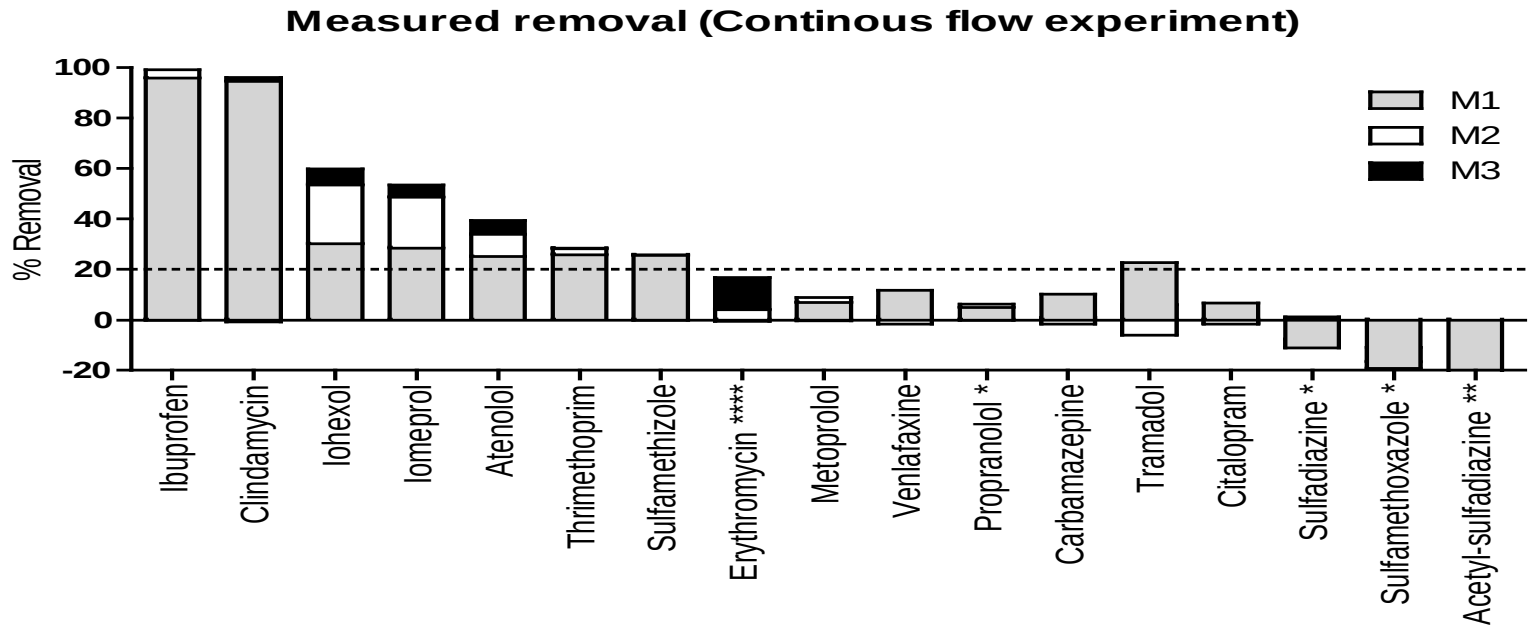
Moving-Bed Biofilm Reactors: MBBR

Continuous flow experiment



- 7/17 compounds degraded >20%
- Reasons for no degradation or production
  - Recalcitrant
  - Conjugate


Calculated removal (Batch experiment)
% Removal
100
80
60
40
20
0
M1
M2
M3
Ibuprofen
Propranolol *
Acetyl-sulfadiazine **
Atenolol
Citalopram
Iopamidol
Iohexol
Iomeprol
Chlarinthromycin ****
Clindamycin
Thrimethoprim
Metoprolol
Sotalol
Diclofenac
Azitromycin ****
Erythromycin ****
Carbamazepine
Sulfamethizole
Phenanzone ***
Ciprofloxacyn
Sulfamethoxazole *
Venlafaxine
Iopromide
Tramadol
Diatrizoic
Sulfadiazine *


Measured removal (Continous flow experiment)
% Removal
100
80
60
40
20
0
-20
M1
M2
M3
Ibuprofen
Clindamycin
Iohexol
Iomeprol
Atenolol
Thrimethoprim
Sulfamethizole
Erythromycin ****
Metoprolol
Venlafaxine
Propranolol *
Carbamazepine
Tramadol
Citalopram
Sulfadiazine *
Sulfamethoxazole *
Acetyl-sulfadiazine **

Assessment

- MBBR and ozone reactor together can solve the problem
- Still a lot of open scientific questions
- Getting close to an operational system

Benefits

- DNU

  A good solution to a striving problem

- AU

  One master thesis supported
  Partial support for a PhD thesis
  co-supervision DTU PhD thesis
  Postdoc and permanent staff hours
  A foot into a strategic technology
  3-4 papers authored/co-authored

- Annox/Kruger

  A proven solution to be sold to more hospitals
  With a strategic involvement into polishing wastewater

Thank you for your attention