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The Mermiss project (DK):
Environmentally friendly treatment of highly potent pharmaceuticals in hospital wastewater

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Agenda

- Background
- Introduction to the Mermiss project
  - Key results and conclusions
- The MerEff project
  - Preliminary findings
- Next step

Background

- Danish Technological Institute is an RTO
- Legislation in Denmark states that ”the polluter pays”
  - Also apply for hospitals
- R&D projects since 2013 on removal of pharmaceuticals using a biofilm-based solution
- Funded by the Danish EPA

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The MERMISS project

- Pharmaceuticals are unwanted in hospital wastewater discharge
- Approx. 5% of all medicine are consumed in hospitals in Denmark, the rest is consumed in private homes
- New super hospitals are under construction
  - What to do with the wastewater?
- Development of optimized biological performance based on intelligent biofilm alone (Moving Bed Biofilm Reactor, MBBR) and in combination with ozonation

The New University Hospital

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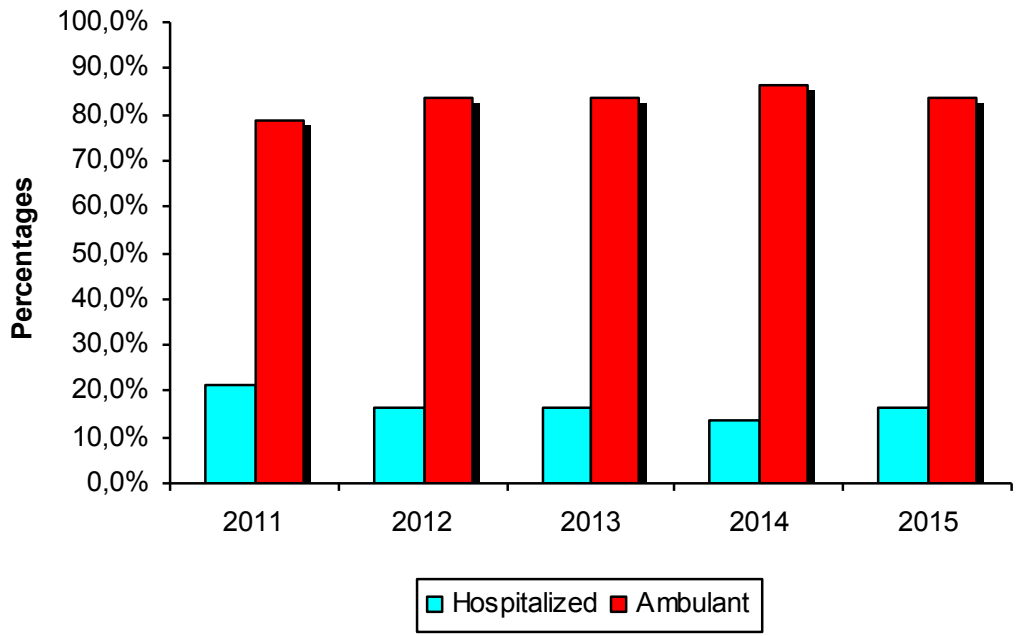
Treatment of patients in Denmark

- 4% of medicin from **hospital**
- 4 % of these are responsible for 96% of the **environmental** impact

Environmental impact from medicine used at The New University Hospital



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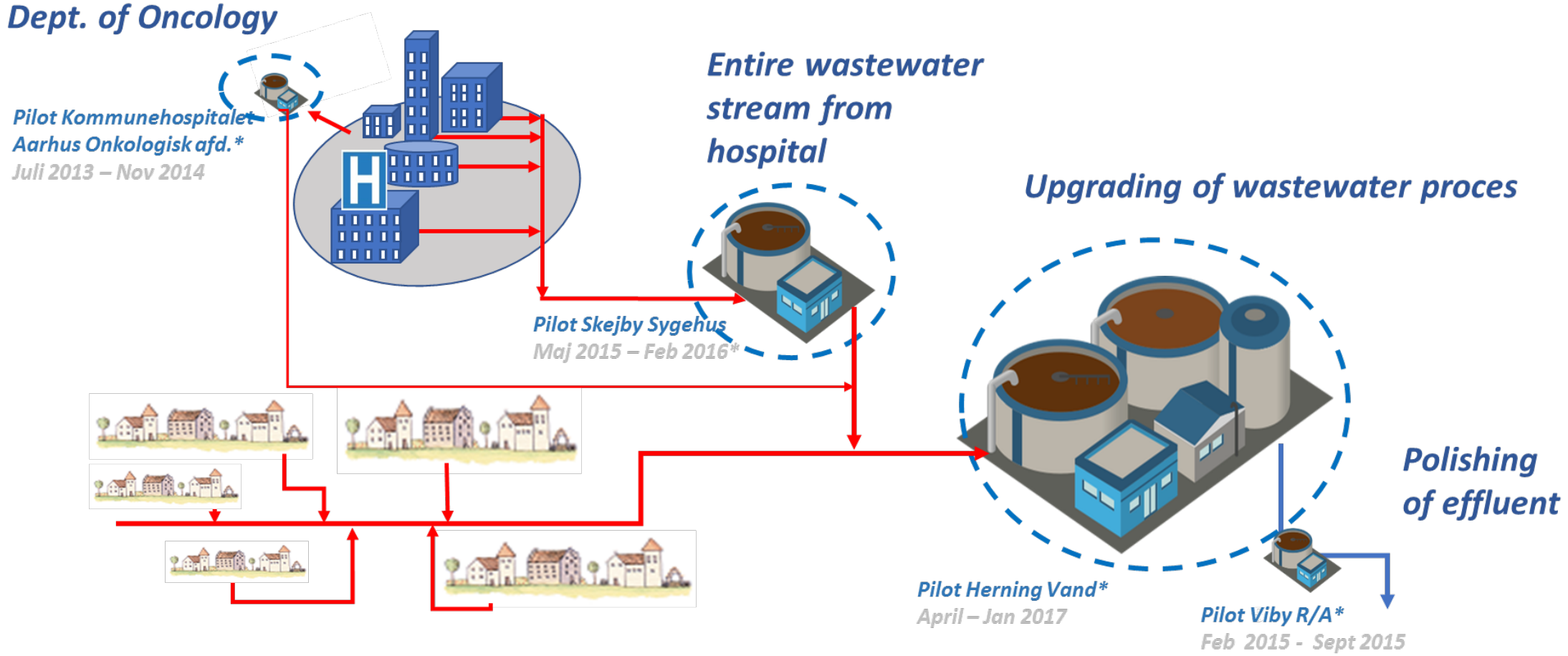
Mermiss Benchmarking: where to remove pharmaceuticals?



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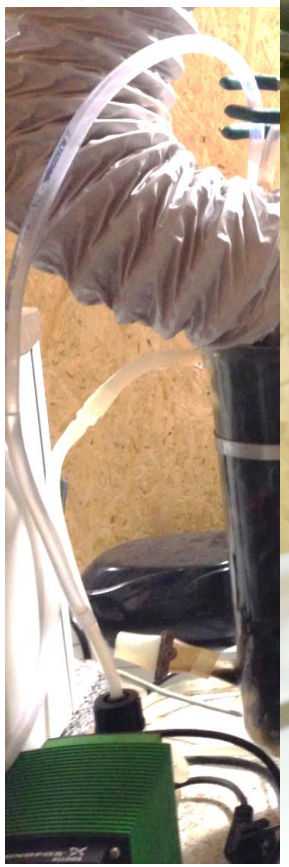
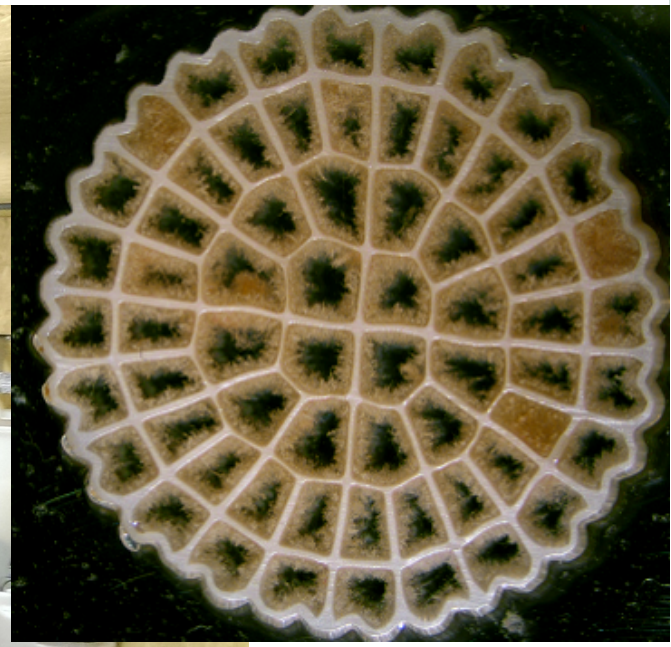
Wastewater treatment in different scale





Sidestream and entire stream from **hospital wastewater**

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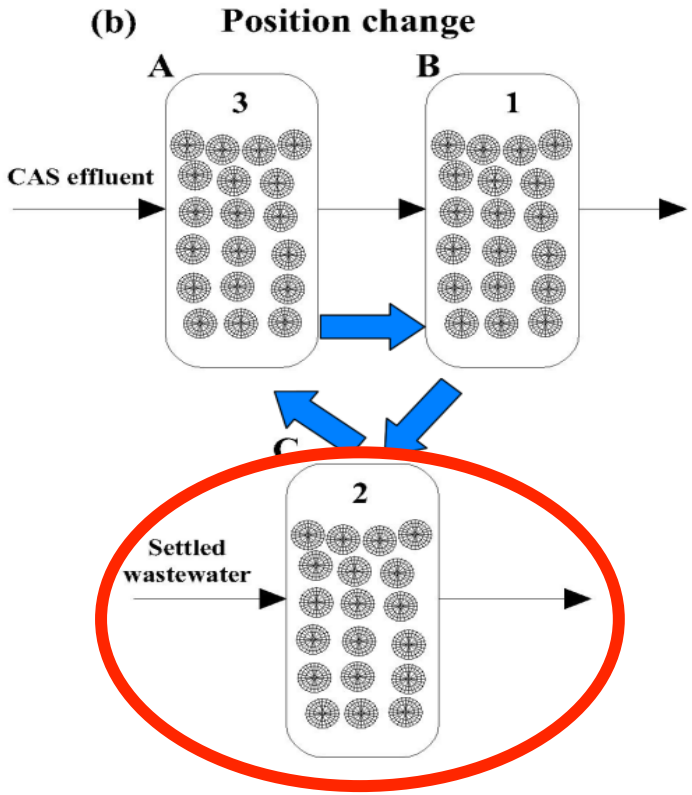
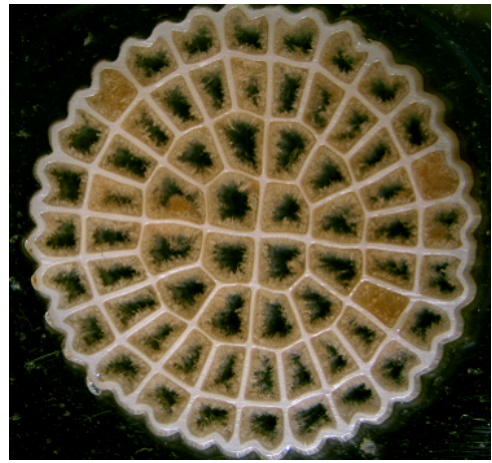
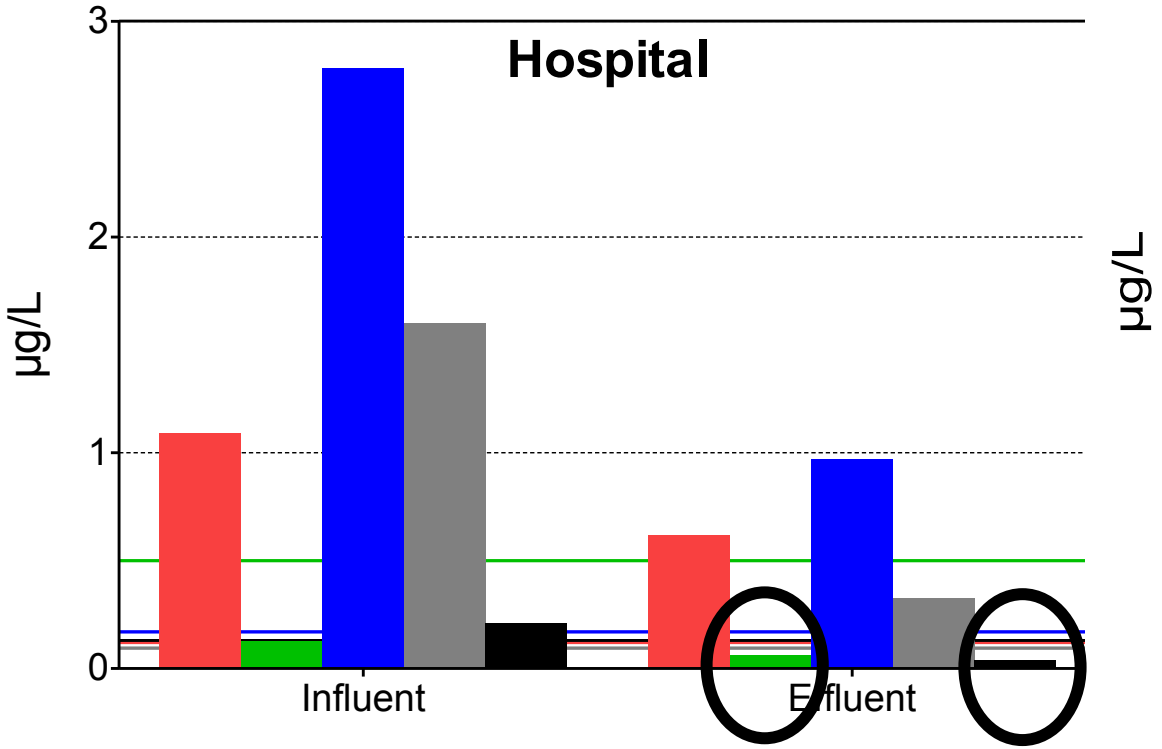
Post treatment at Viby municipality





Key results Mermiss



Azithromycin
Carbamazepine
Ciprofloxacin
Clarithromycin
Diclofenac

Danish guiding limit values

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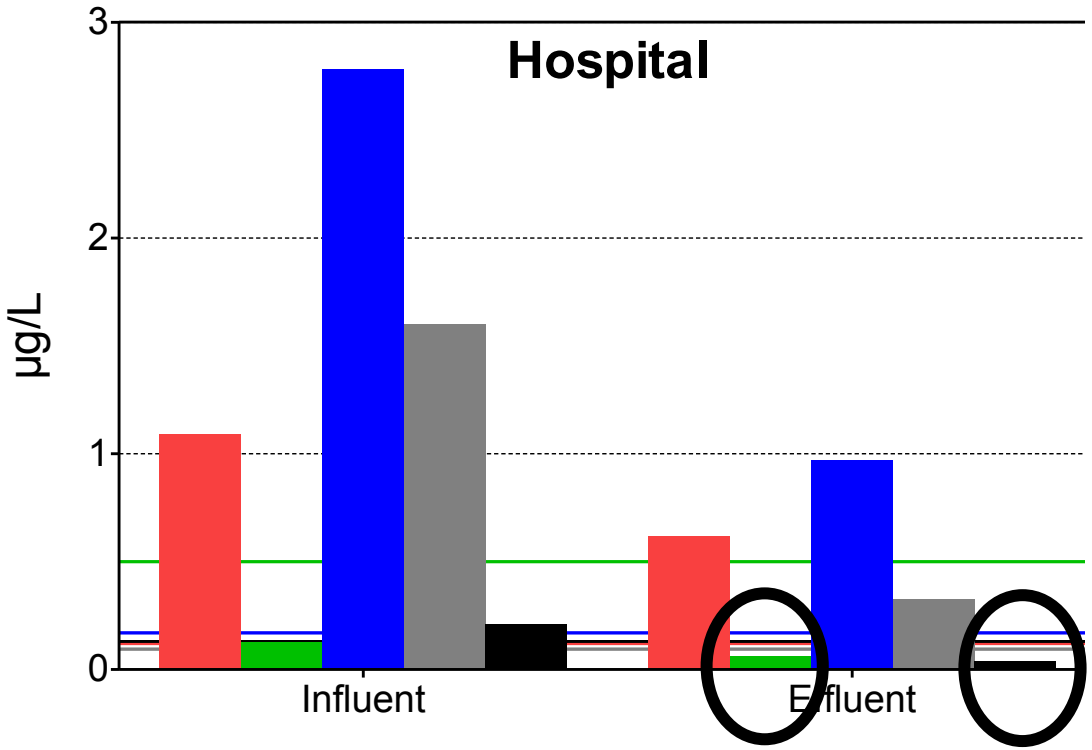
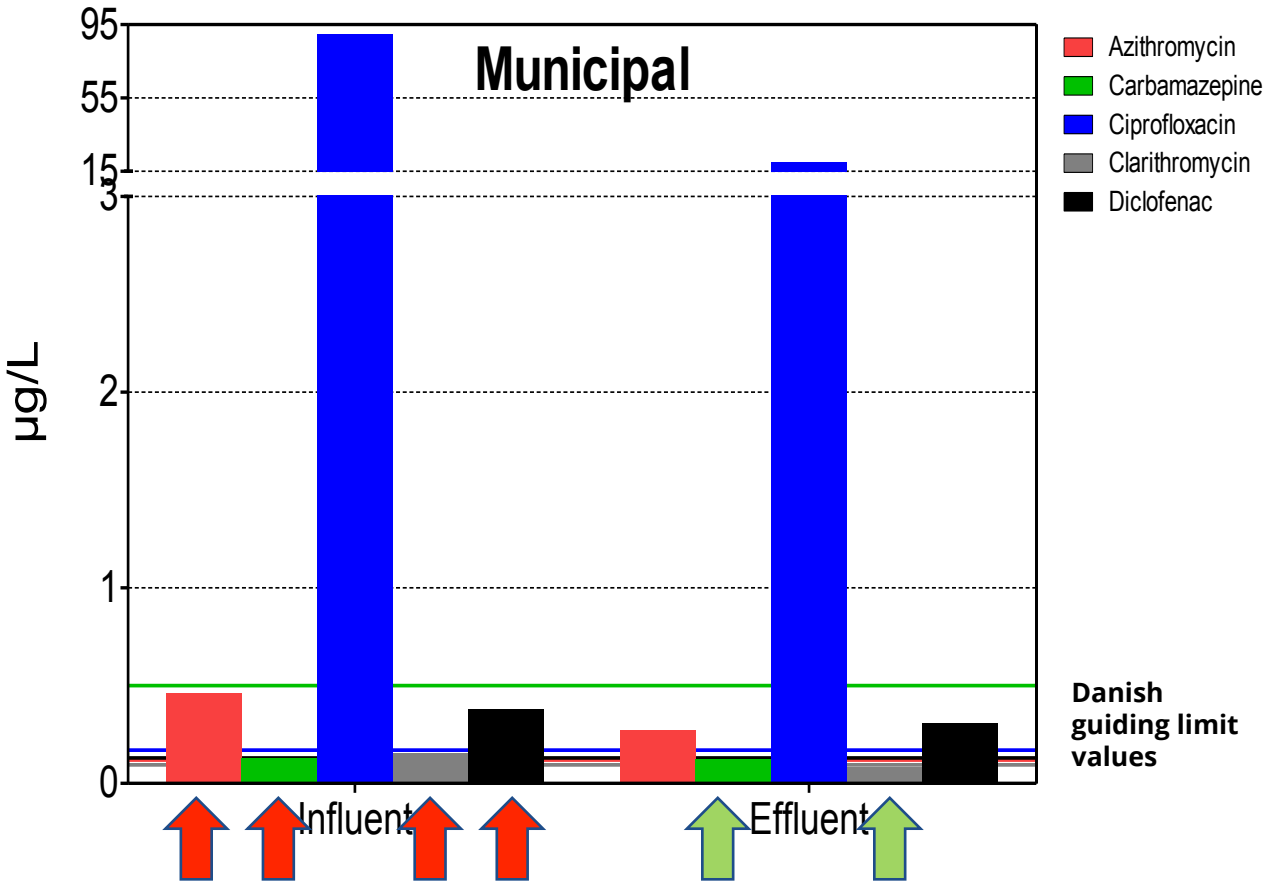
Key results Mermiss





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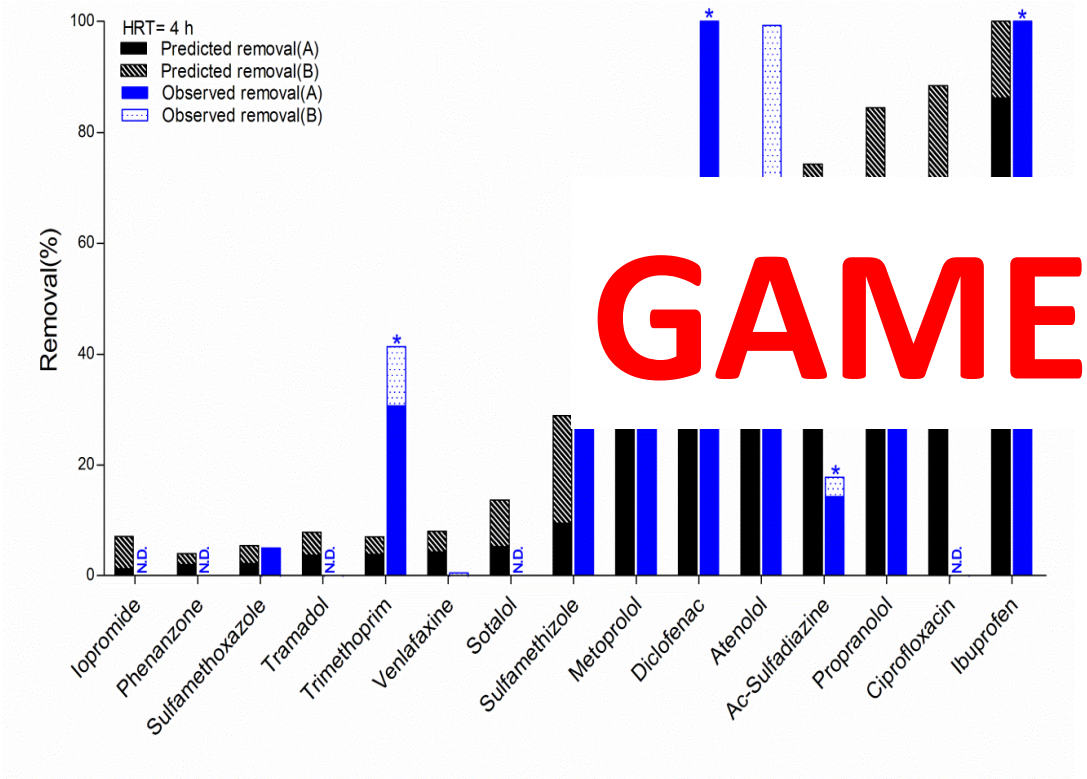
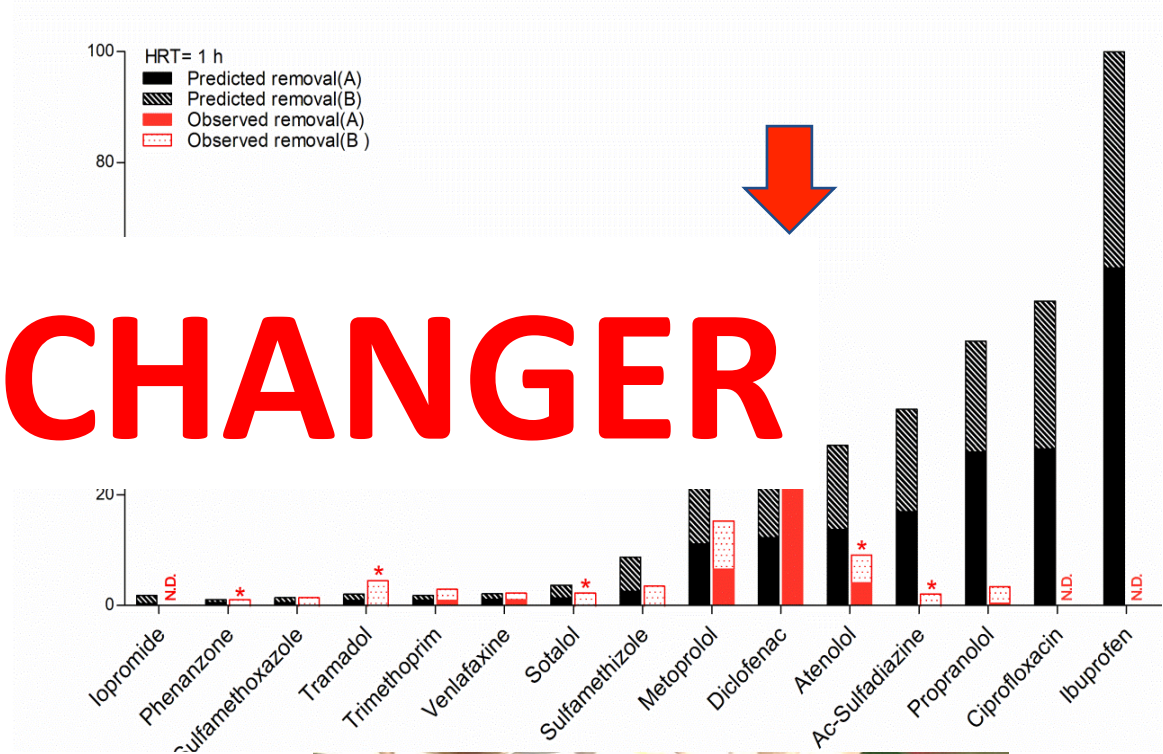
Pharmaceutical removal by polishing municipal wastewater



GAME CHANGER



Environmental impact of treatment

- CAPEX and OPEX almost identical
  - Hospital WWTP(150,000 – 200,000 m3/y) and
  - Post-treatment at municipality as polishing (1200 m3/h)

Measured concentrations of pharmaceuticals in danish wastewater

	Hospital (150.000 m3/year)	Municipal (10.000.000 m3/year)
Diclofenac	0.2-0.6 µg/l	0.4 µg/l
Metoprolol	3.0 µg/l	2.2 µg/l
Environmental impact	60 g diclofenac 450 g metoprolol	4 kg diclofenac 30 kg metoprolol

Conclusions from the Mermiss

- Possible to remove pharmaceuticals from all locations
  - Hospital wastewater: Sidestream, entire stream
  - Municipal wastewater: entire stream, polishing
- Patented operational modes selects for pharmaceutical degraders
  - Termed **eXeno Technology**
- Strict biological removal and high removal rates observed
- Attractive CAPEX/OPEX estimates

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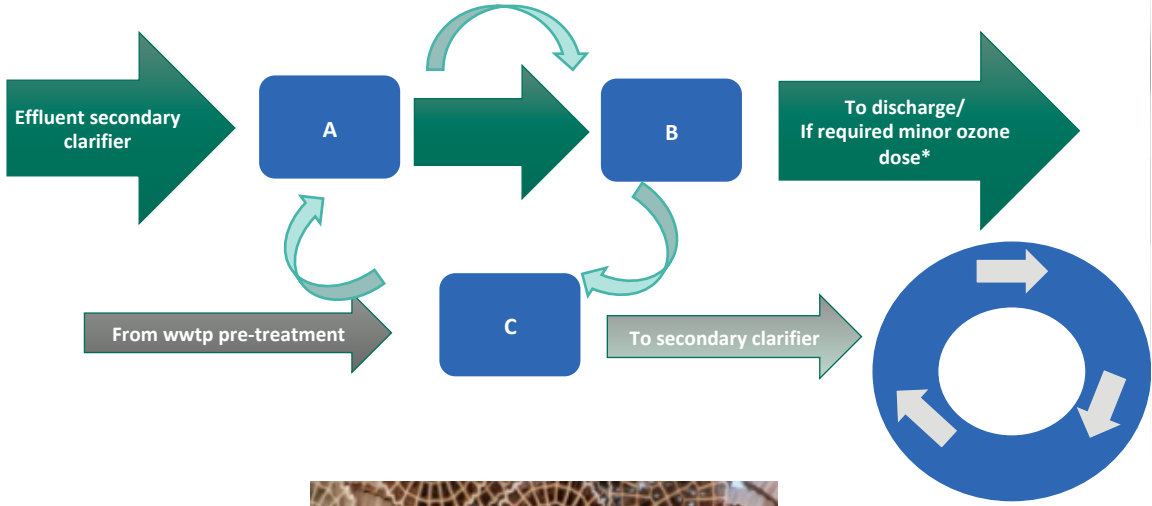
The MerEFF project

- The **eXeno technology** is based on MBBR, and is the only strict biological technology for removal of pharmaceutials

- Optimized biological removal is possible due to alternating periods of starvation (only effluent) and feast (addition of raw wastewater)



Biofilm formation on MBBR carriers

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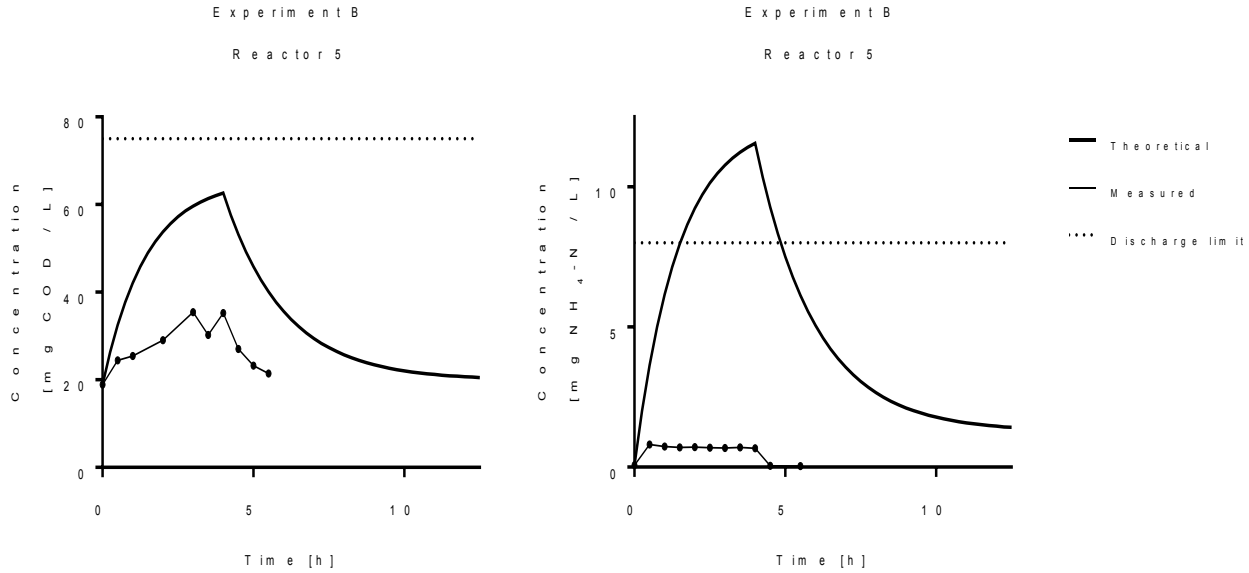
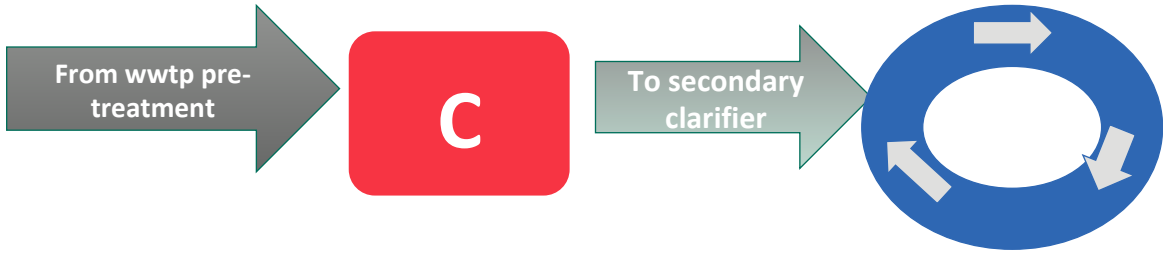
Ongoing MerEFF experiments

- Confirmed results from Mermiss
  - Increased of removal pharmaceuticals
- Discharge limits of COD and ammonia are met
  - Dispite feast regimes
- Investigations of starve/feast periods are ongoing
  - Identify the optimal combination



Regeneration mode



Next step

Hillerød Forsyning
– en bæredygtig fortælling

herningvand

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Thank you for the attention!

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