

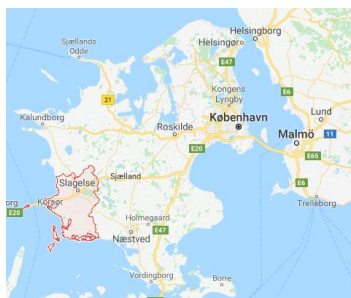


## Pilot plant in Slagelse - Experiences with GAC and UV

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## Where are we?



- **Micropollutants can be measured > PNEC**
- **E.g. diclofenac, venlafaxine, benzotriazole, tramadol, PFOS and sertraline**



### Municipality of Slagelse

- 79,000 inhabitants
- 32,000 in Slagelse City

### Slagelse Utility

- Multi-utility company
- Operating three large scale and 24 smaller WWTP's

### Water area

- Tude Stream
- Great Belt

## Focus of the project: Slagelse WWTP

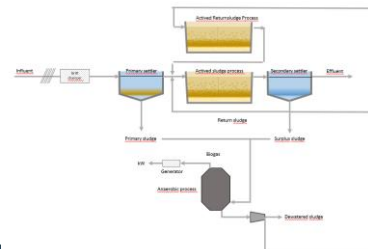
- Capacity 125.000 PE
- Flow: 10,000 m<sup>3</sup>/d
- Effectiveness of treatment
  - Organic matter 99%
  - Nitrogen 91%
  - Phosphorus 98%



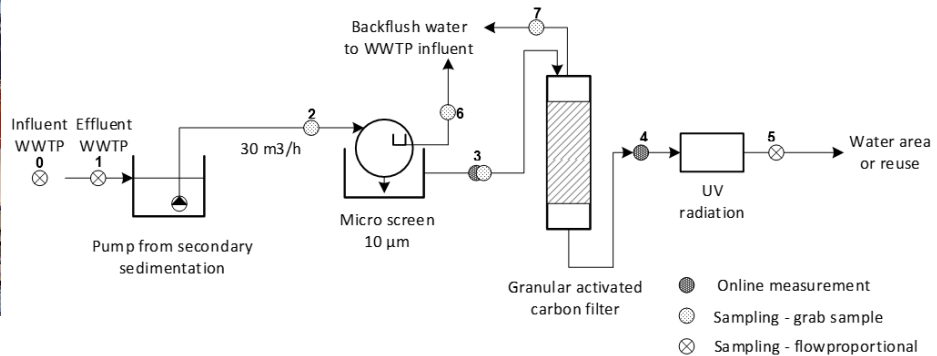
- DOC in effluent: 7-9 mg/l

Sewer catchment:

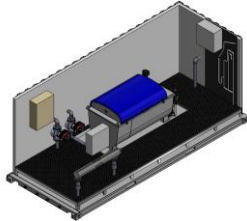

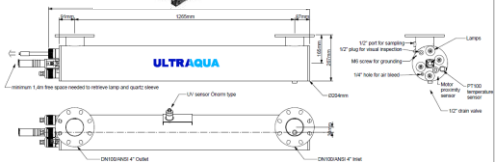
- Slagelse Hospital (372 beds)
- Slagelse Psychiatric hospital (194 beds)



## Fourth treatment step - Pilot plant setup



## Key figures

- Test period from January 2019 to August 2020
  - Design flow rate: 30 m<sup>3</sup>/h (8% of total flow)
  - Drum filter: 10 μm filtration
  - GAC: 17 m<sup>3</sup>
  - UV design dose: > 40 mJ/cm<sup>2</sup>, 4 lamps
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- Total flow amount treated (august 2020): 255,000 m<sup>3</sup> or **14,900 BV**
  - Average electricity use: **0.24 kWh/m<sup>3</sup>** (Microfiltration, pumps, GAC filtration, UV and online measurement)

## GAC filter with reactivated carbon

Reactivated carbon (Organosorb 20) was used

- Virgin fossil carbon: 11-18 tons CO<sub>2</sub>-equivalents per tons produced
  - Reactivated carbon: 2-3 tons of CO<sub>2</sub>-equivalents per tons produced
- = Carbon footprint: **6 times lower than virgin fossil carbon**

Carbon particle size: 1.7 mm (0.42-2.8)

EBCT was between 34 to 43 minutes

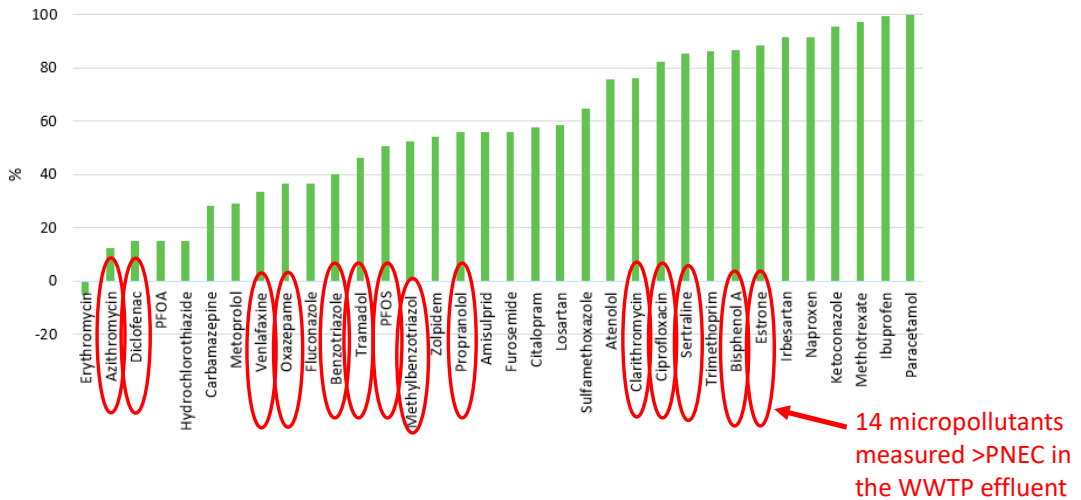
Carbon usage after 14,900 BV: 30 mg GAC/l

Backwashed six times:

| Backwash   | BV     | Comments   |
|------------|--------|--|
| 03-06-2019 | 2,323  | Treated wastewater. Sampling of backwash water after 15 minutes    |
| 31-07-2019 | 3,769  | Treated wastewater.  |
| 11-11-2019 | 5,987  | Treated wastewater. Sampling of backwash water after 5 and 10 min. |
| 04-03-2020 | 10,482 | Treated wastewater   |
| 17-03-2020 | 11,044 | Treated wastewater   |
| 07-07-2020 | 14,066 | Treated wastewater and air   |

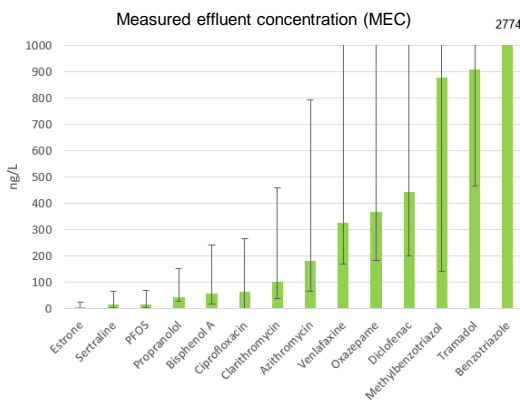


### Removal in the conventional WWTP



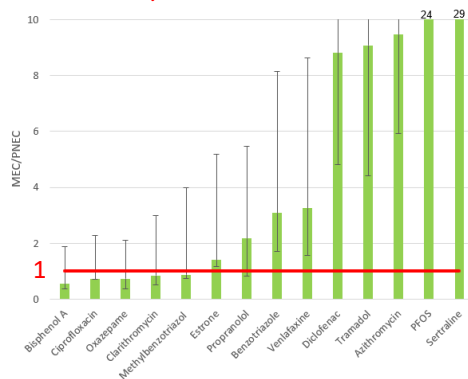
### Conventional WWTP effluent

14 critical micropollutants measured >PNEC<sub>Freshwater</sub>



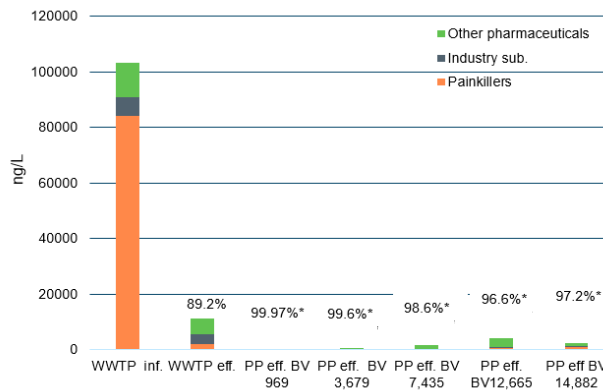
Average concentrations of pollutants measured above PNEC<sub>Freshwater</sub>.

How many times is PNEC exceeded?



Ratio between measured concentrations (MEC) and predicted no-effect concentrations (PNEC<sub>Freshwater</sub>)

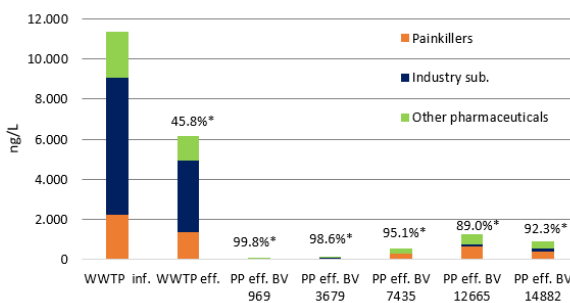
## Removal efficiency from WWTP influent to pilot plant effluent All 34 micropollutants (excl. contrast media)



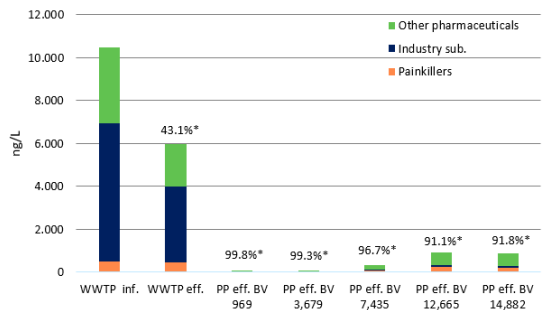
\* Reduction of total concentration relative to WWTP influent

## Removal efficiency from WWTP influent to pilot plant effluent

### 14 critical micropollutants

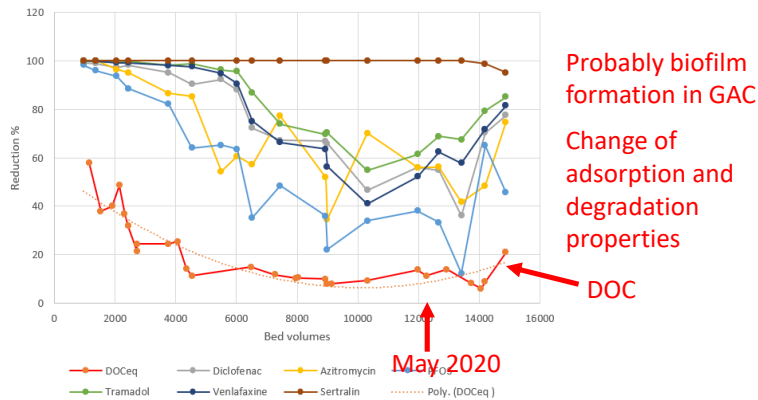


### 11 Swiss substances



\* Reduction of total concentration relative to WWTP influent

## GAC breakthrough of the 6 critical pollutants (>PNEC)



Reduction of critical pollutants plus DOCeq in the pilot plant. The dotted line indicates the trend for the development of the DOCeq

## Investment and operational costs

- Total pilot plant investment: **210,000 EUR**
- Man-hours for operation: 3 hours / week

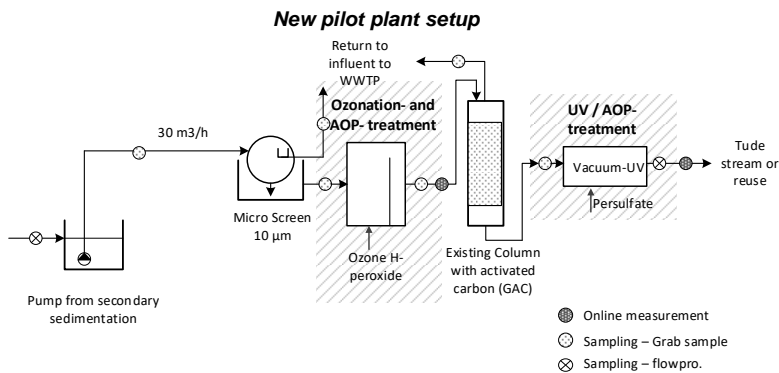
### Estimate of future cost for full scale implementation

- Estimate based on a linear write-off over 15 years and assuming a GAC-filter loading of 46,000 BV (five filter shifts) which corresponds to a **carbon usage of 10 mg/l**
- Drum filter, building, pumps & pipes, GAC filter unit and UV: 120,000 EUR, and each GAC filter filling (including GAC transport costs) is estimated to 16,200 EUR.
- Including electricity consumption (0.013 EUR/m<sup>3</sup>) and manpower for maintenance (0.019 EUR/m<sup>3</sup>) the total estimate amounts to:

**0.088 EUR/m<sup>3</sup> (0.66 DKK/m<sup>3</sup>)**

## Next steps in Slagelse

- A new project (OxyTreat) with expansion of the pilot plant with oxidation processes
- Funded by Danish EPA, Time schedule: 2021-2022
- Planning is started – new technologies will be in place after summer holiday
- Full-scale solution are to be implemented before 2025



## Most important takeaways

- Overall GAC was effective ( $\geq 97\%$ ) for removal of analysed micropollutants
- 6 pollutants were breaking through  $>PNEC$  after 15,000 BV
- Effluent complies with criteria from DK drinking water and EU regulation on water reclamation (microbiology)
- Total cost for full scale implementation is estimated to 0.088 EUR/m<sup>3</sup>
- A new follow-up project (Oxytreat) is to reduce breakthroughs and increase GAC durability

THANK YOU FOR YOUR ATTENTION!

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ULTRAQUA  
GROUP



- altid i nærheden



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