#EUGREENWEEK

PRISTINE

Innovative and versatile integrated solution to remove contaminants of emerging concern in water treatment systems

UV-LED based Advanced Oxidation Process

Photolytic ozonation as a promising technology for disinfection and CEC removal?

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Basics in advanced oxidation processes (AOPs)

Generation of highly reactive spices /radicals (OH·) oxidizing pollutants

H_2O_2-UV

- ⊕ Well suited for **clean water, UV-transmittance > 90%** (high quantum yield) and for **conventional UV lamps** (wavelength around 254 nm)
- ⊕ Provides **disinfection, no bromate**
- ⊕ **Low footprint** (hydraulic retention time (HRT) ~ 1 min)
- – Higher energy usage because of higher UV-dose required
- – Losses efficiency for **dirtier water** (low molar extinction coefficient) and **higher wavelengths** as UV-LEDs (around 270 nm)

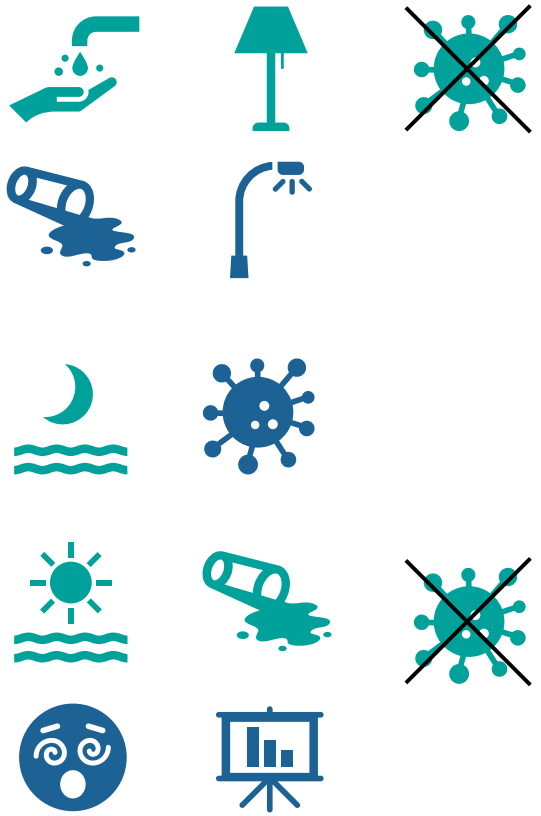
H_2O_2-O_3

- ⊕ **No energy use by UV light**, high **radical efficiency**
- – **Typically not considered for disinfection**
- – Higher foot print (HRT ~ 3-5 min) depending on the water matrix

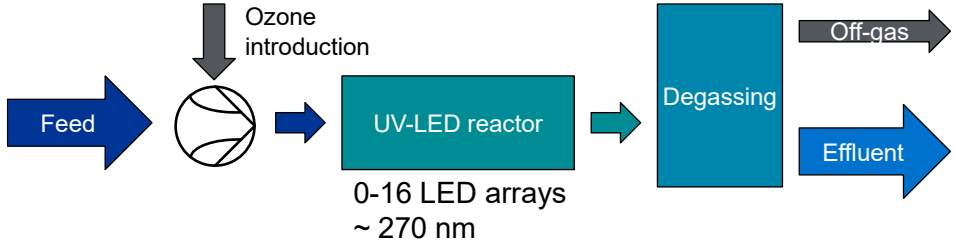
O_3-UV

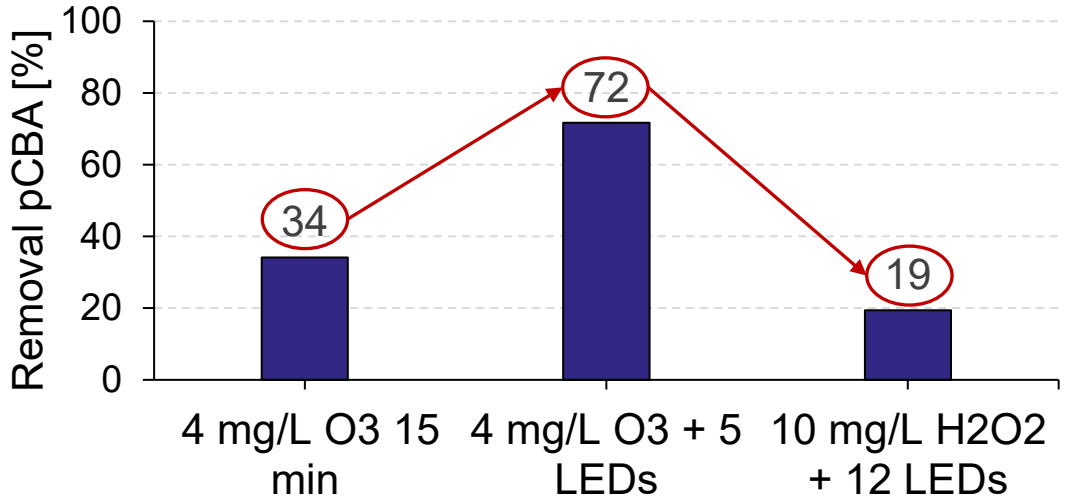
Photolytic ozonation

- ⊕ Requires **less UV light**
- ⊕ Better suited for **dirtier water** (high molar extinction coefficient and radicals by O_3 / H_2O_2-O_3 reactions) and **higher wavelengths** (using UV-LEDs)
- ⊕ Provides **disinfection**?
- ⊕ Low footprint, higher reaction speed (HRT can be reduced to ~ 1 min)
- – **Complex process**, **energy for O3**, **radical yield** might be lower than for H_2O_2-O_3



The PRISTINE UV-LED based Advanced Oxidation Skid





Experiments tap water + humic acids (UV transmittance ~ 87%, pH = 7.4-7.7) + Br^- + pCBA as probe compound:

→ **High boost of pCBA** removal when **adding UV irradiation** (more than double)

→ **> 3 times higher pCBA removal by O_3-UV** with 5 LED Arrays **than for H_2O_2-UV AOP** with 12 LED arrays

→ Reaction 15 min Ozone / 1 min O_3-UV/ 1 min UV/H_2O_2

On going tasks and outlook

- Tests needed in real water matrixes; **benefits of O_3-UV** seem to **depend** on **water matrix**
- **AOP pilot experiments with NF permeate currently** ongoing, but removal of O_3 on its own too large to quantify effects (perform spiking?)
- **O_3-UV** especially **promising** in water **with low O_3 decay** and **radical yield;** performance boost to sole O_3
- **O_3-UV** might **outperform H_2O_2-UV** especially **for dirtier waters (e.g. interesting when using NF feed) and higher wavelengths (UV-LEDs)**, but costs for O_3 generation must be accounted for (currently ongoing)
- **O_3-H_2O_2** shows **better removal**, but **O_3-UV** offers **low physical footprint and disinfection**
- **O_3-UV** might be a **great** option for **retrofitting** in scenarios where **CEC removal** and **disinfection** are required (typical UV doses for disinfection)

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Thank you!

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