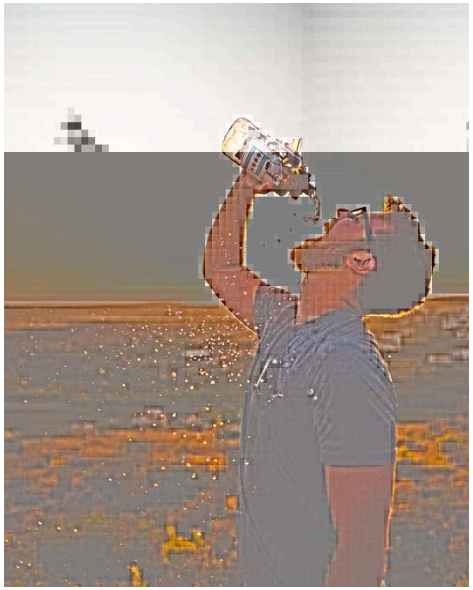
Detection and Characterization of Organic Stressors in Wastewater by HPLC SEC with DOC Detection

https://www.umweltbundesamt.de/themen/abfall-arzneien-alte-farben-was-darf-nicht-in-die

Photography: **Water Reclamation Plant, 2016**

Photography: Scott, HPLC-SEC-DOC, **2016**



https://www.pexels.com/photo/man-pouring-water-bottle-on-his-mouth-160060/

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WATER RECLAMATION PLANT

- 85% of San Diego's water is imported
- Demand is rising but rainfall is not

➔ Water reuse necessary

Photograpy:
https://www.sandiego.gov/sites/default/files/legacy/water/purewater/pdf/projectreports/section2demonstration.pdf

MOTIVATION

- More than 70,000 substances contaminate water
- Vide variety (relatively harmless or harmful for humans / wildlife)
- Effect: acute / long-term
- interaction of chemicals: some constituents only demonstrate toxicity in mixtures
- Danger to human and environmental health.

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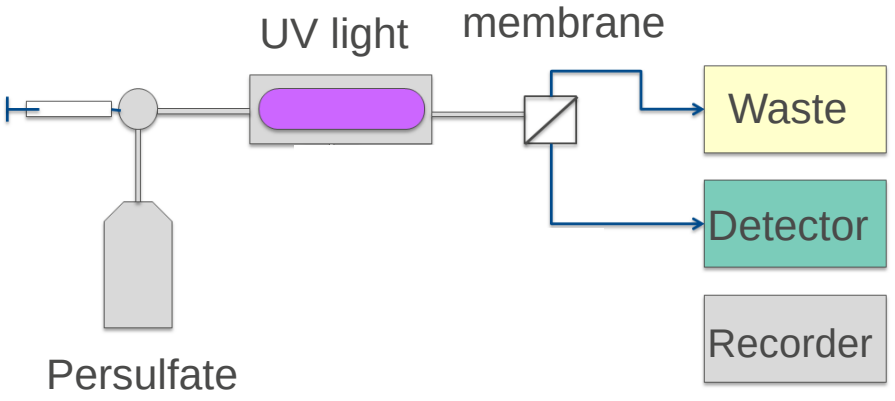
- ➔ Necessity to control water quality
- ➔ Limit the amount of contaminants
- ➔ Need for easy and cost-effective way to look at size fractions of all organics

TOTAL ORGANIC CARBON AND ITS MEASUREMENT

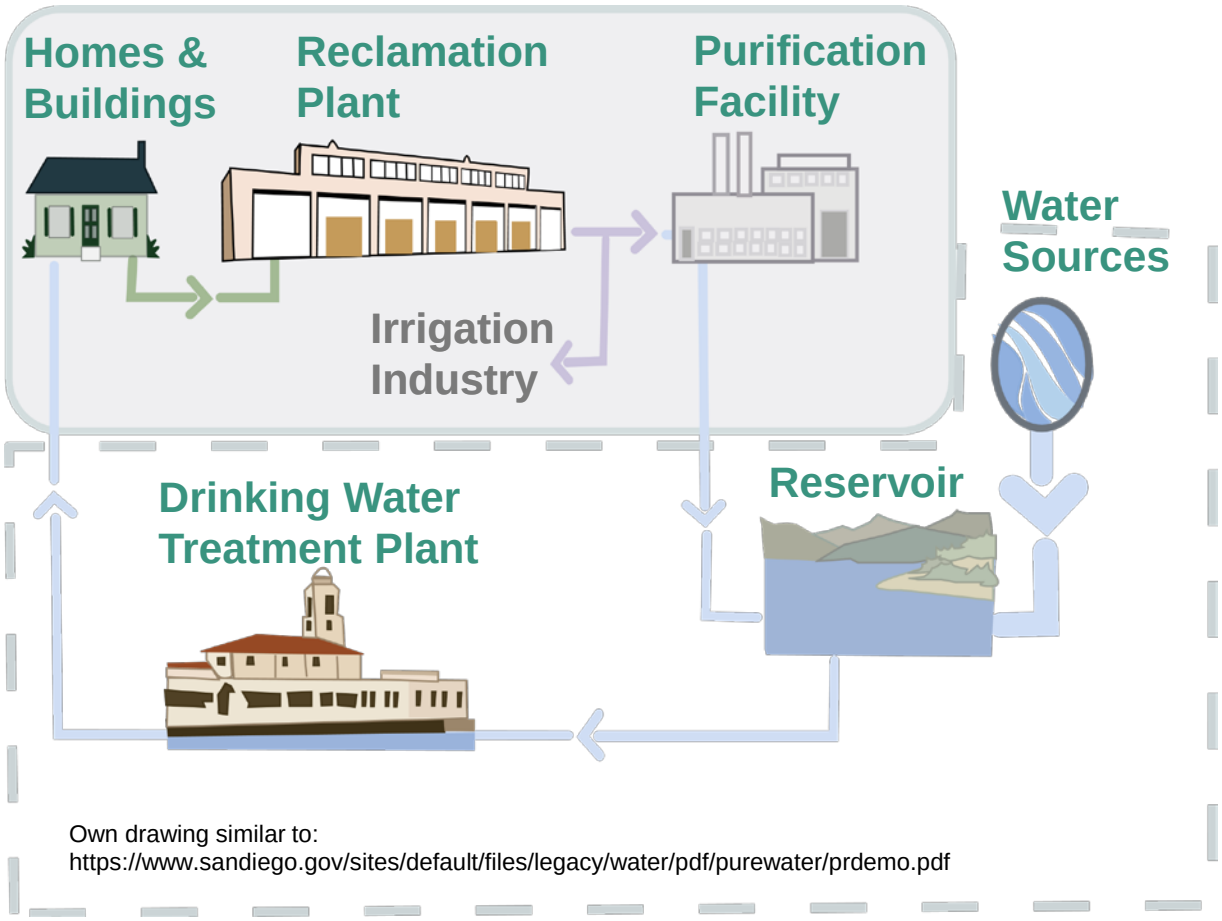


➔ Process analytics of the waste water treatment plant

DOC dissolved organic carbon
< 0.45 µm

- Oxidation of organic molecules forming CO_2 (UV persulfate)
- Detection of CO_2 via membrane conductivity.

POTABLE WATER FROM MUNICIPAL WASTE WATER



Own drawing similar to:
https://www.sandiego.gov/sites/default/files/legacy/water/pdf/purewater/prdemo.pdf

- Tertiary treatment
- Ozone O_3
- Bio. Activated Carbon (BAC)
- Ultra filtration (UF)
- Reversed osmosis (RO)
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- Time in Reservoir
- Water Treatment Plant
- Portable Water Supply

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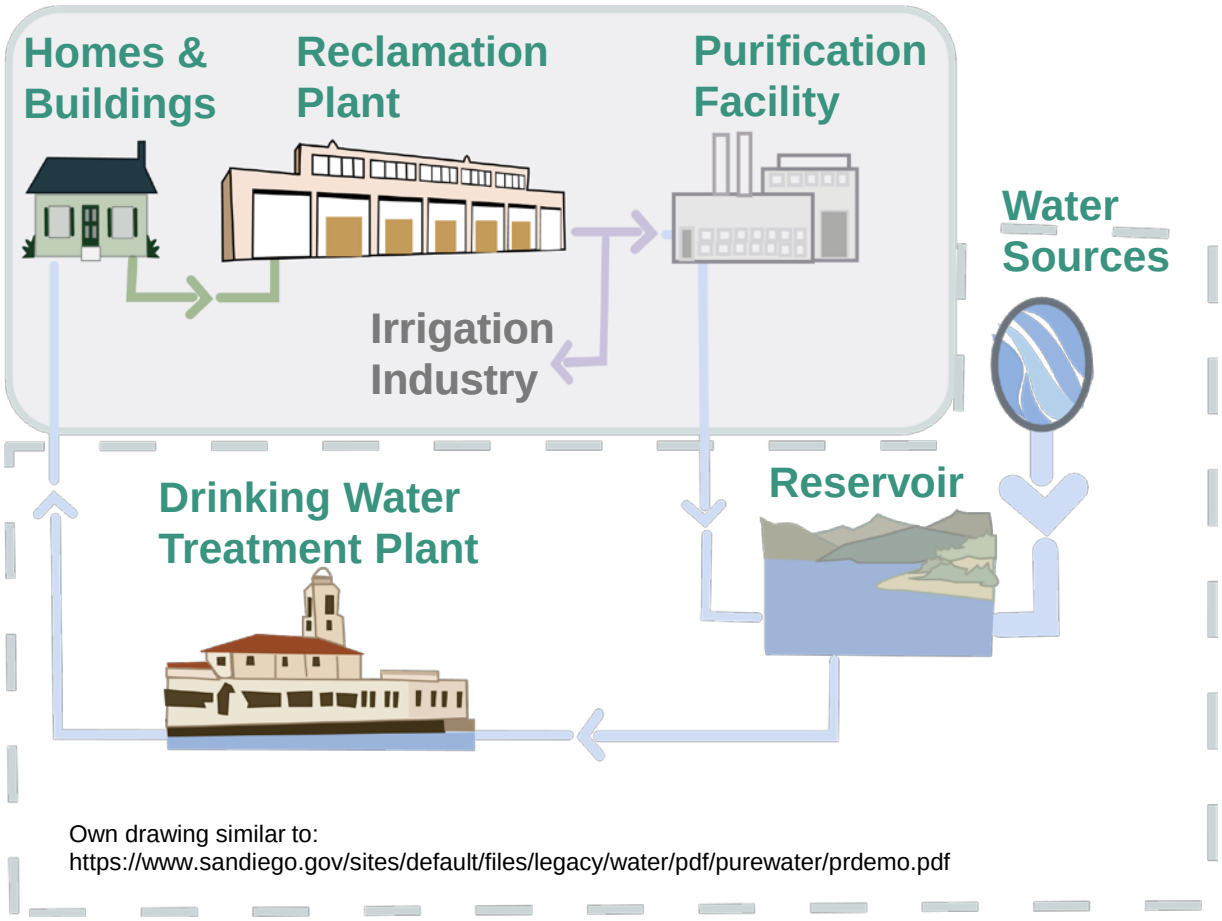

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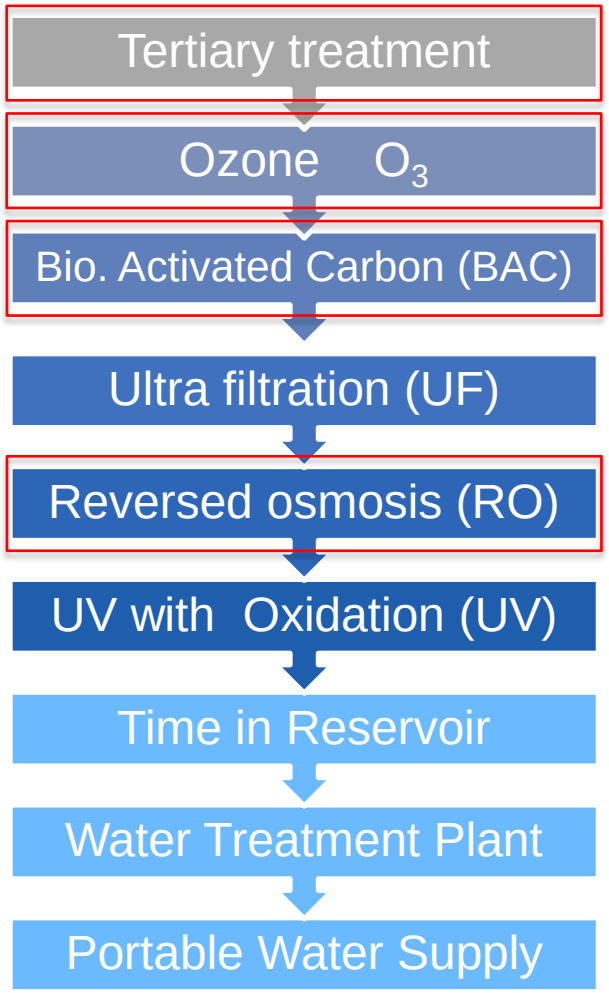
COMPARISON OF TOC AND DOC

Sample	TOC Average	%RSD	DOC Average	%RSD
Tertiary Effluent	9.95 ± 0.06 ppm	0.6 %	9.6 ± 0.04 ppb	0.4 %
Ozone Effluent	10.1 ± 0 ppm	0.0 %	9.2 ± 0.04 ppb	0.4 %
BAC Effluente	5.4 ± 0.01 ppm	0.2 %	5.3 ± 0.01 ppb	0.1 %
RO Permeate	79.9 ± 0.6 ppb	0.7 %	–	–



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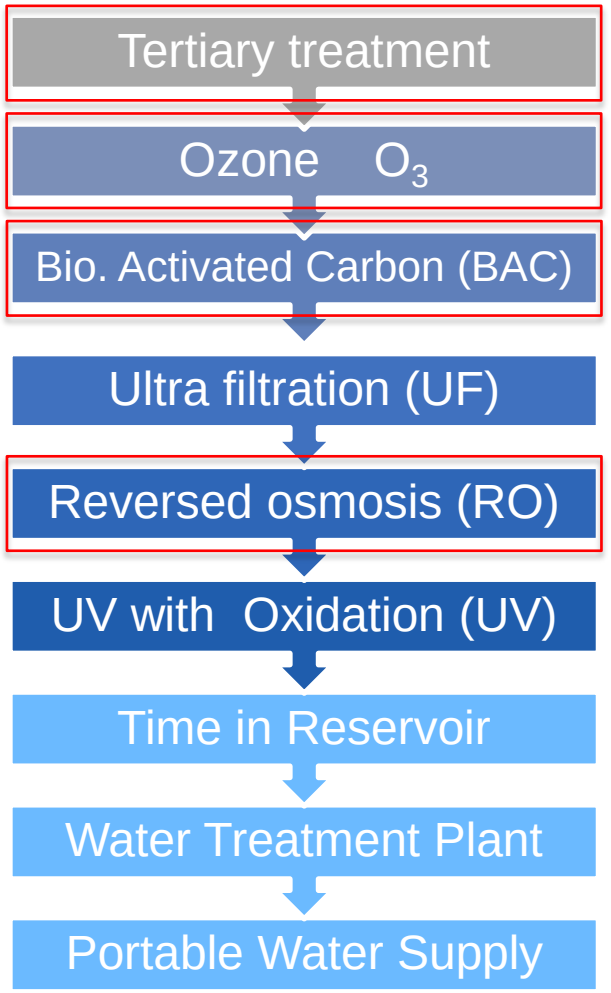
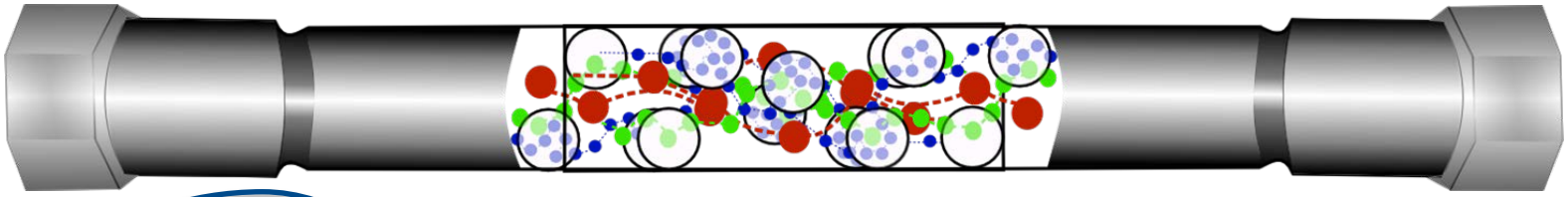
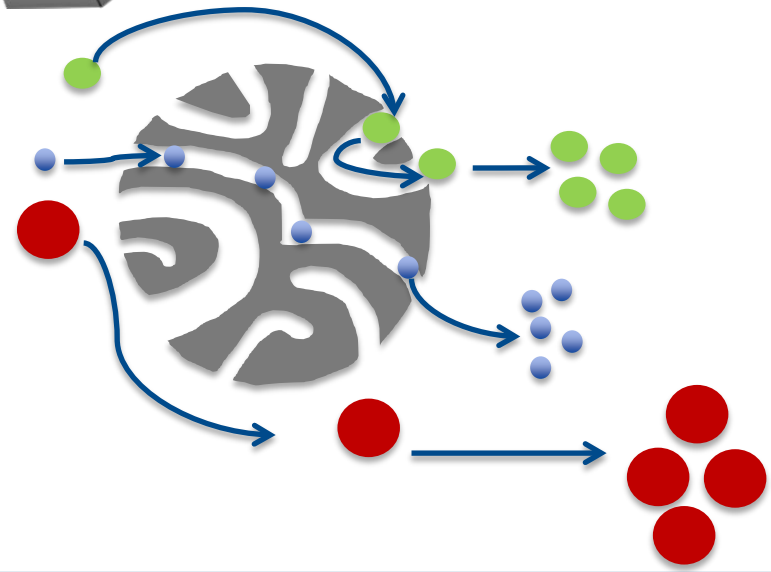
BAC Effluente	5.4 ± 0.01 ppm √	0.2 %	5.3 ± 0.01 ppb	0.1 %
RO Permeate	79.9 ± 0.6 ppb √	0.7 %	–	–

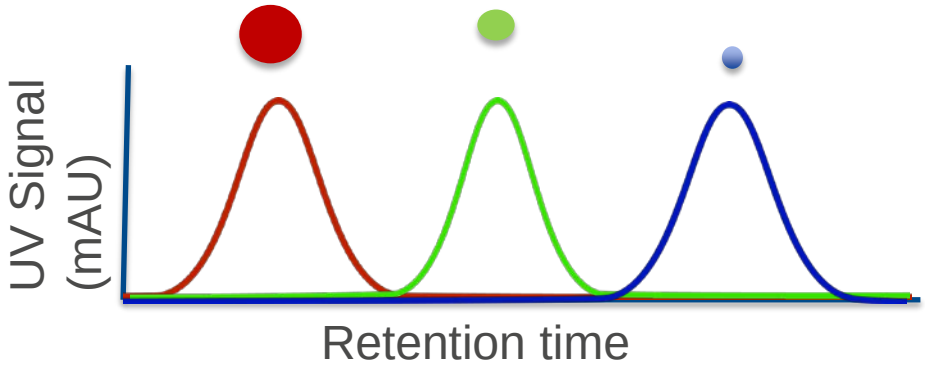


SIZE EXCLUSION CHROMATOGRAPHY (SEC)

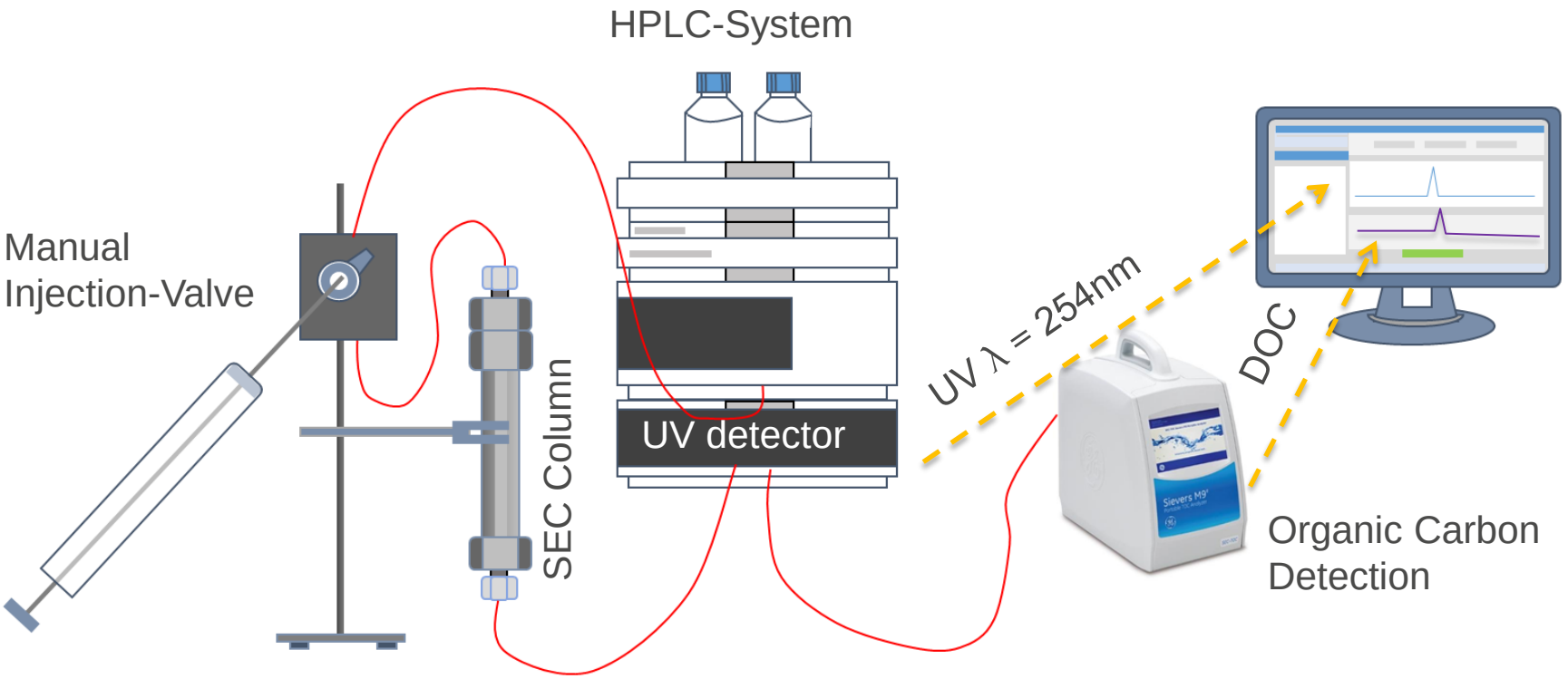
- Quality and quantity of organic matter
- Separation of molecules by size / hydrodynamic volume





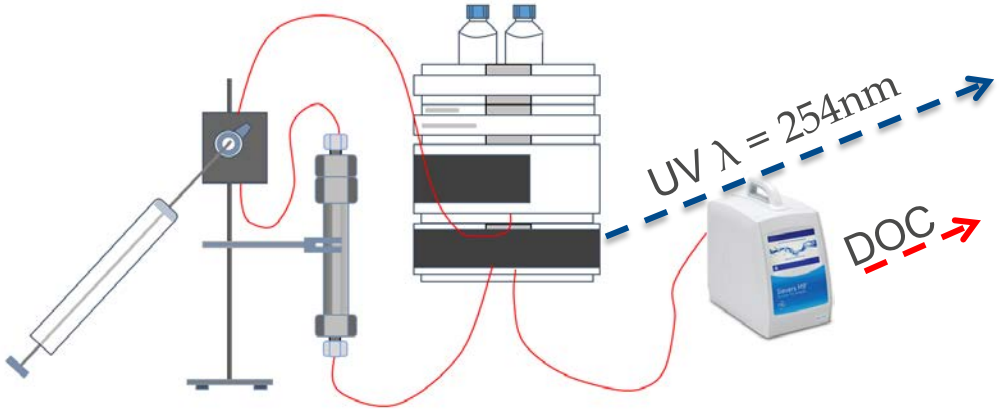


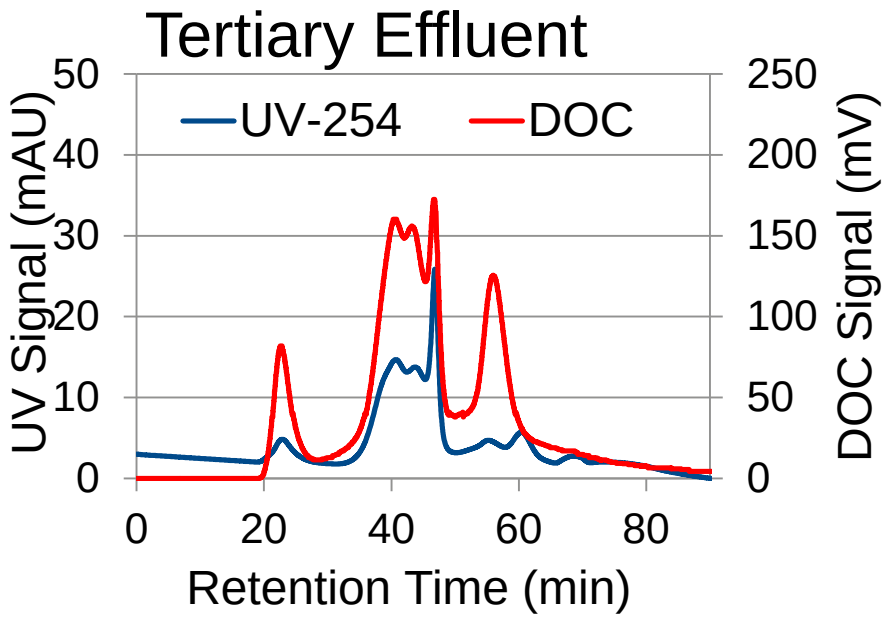
EXPERIMENTAL SETUP - HPLC SEC UV



Chromatography **stationary phase**: Tosoh Bioscience 44782 **Temp.:** 24° C
20 x 350 mm, 30µm, **Flow:** 1 mL/min
mobile phase: 0.004M phosphate buffer with 0.025M sodium sulfate

COMPARING UV-254 AND DOC





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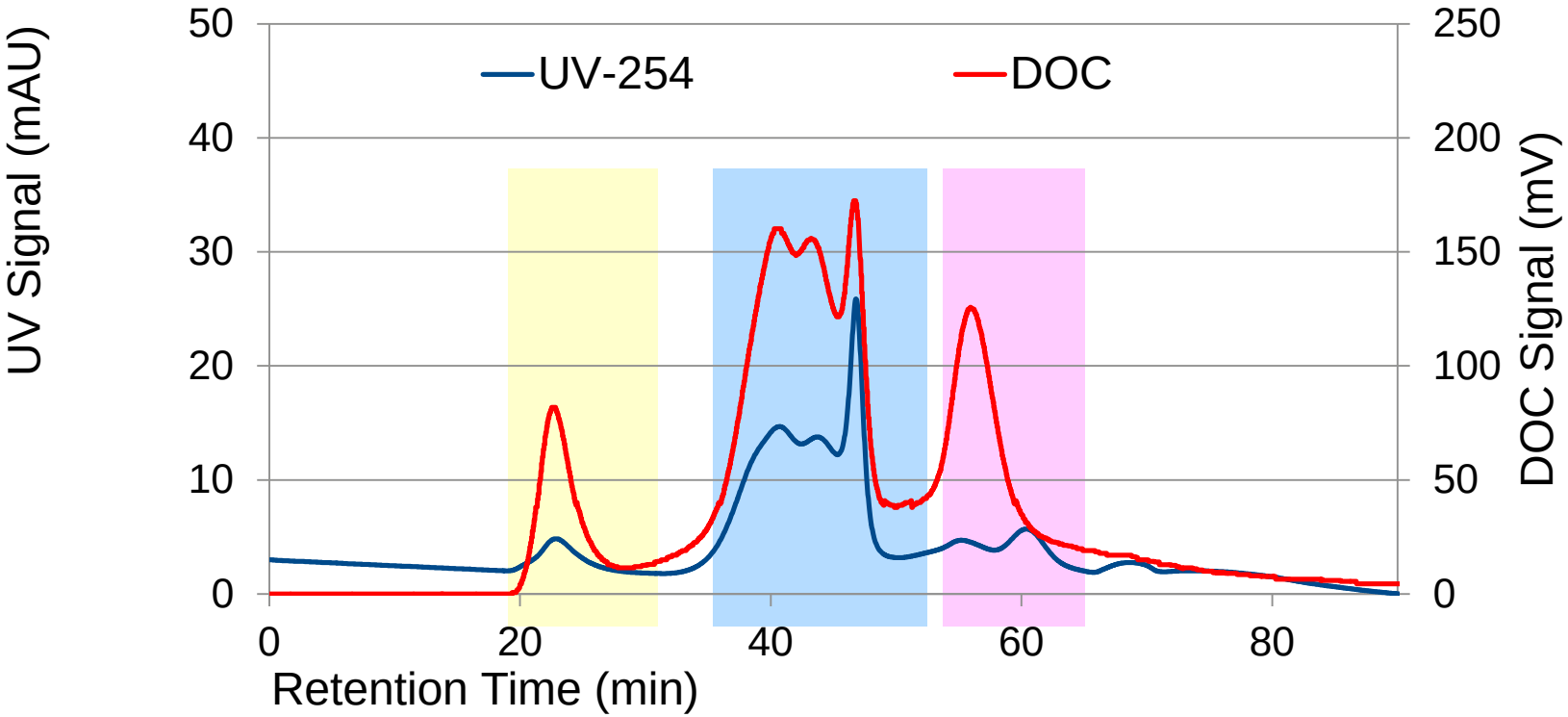
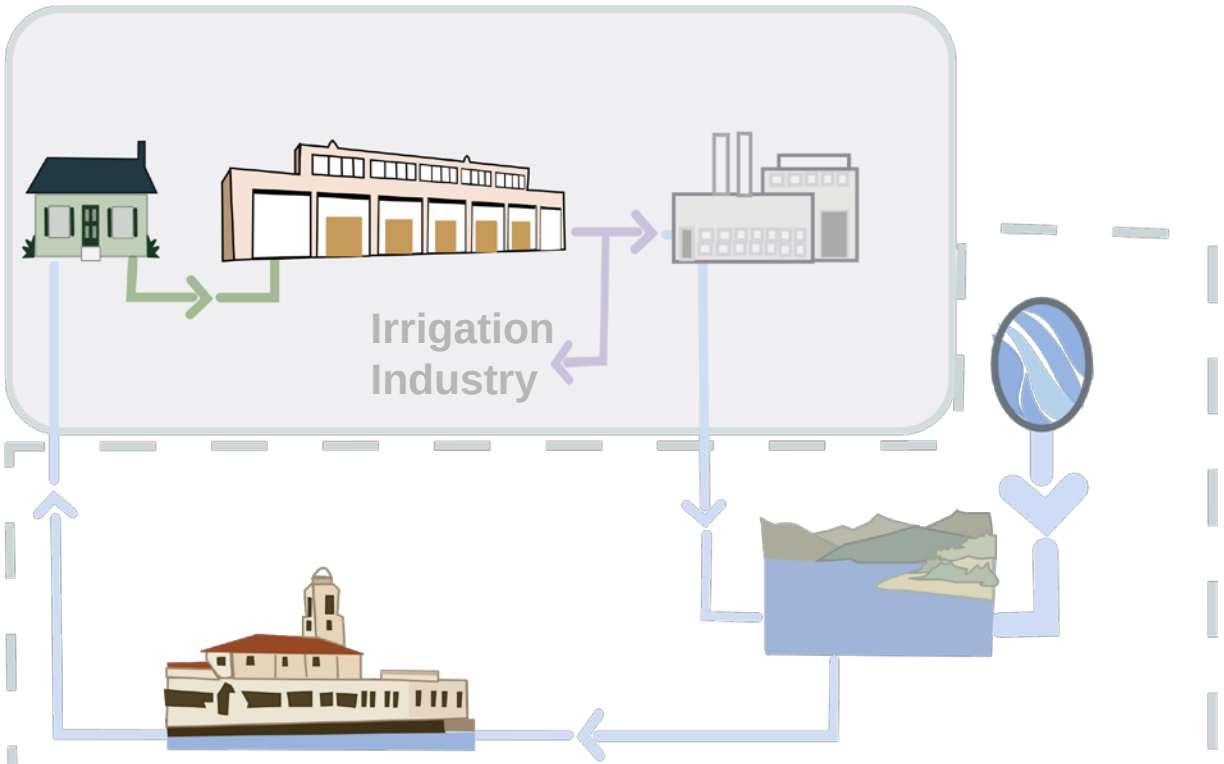
COMPARING UV-254 AND DOC FOR TERTIARY EFFLUENT



POTABLE WATER FROM MUNICIPAL WASTE WATER



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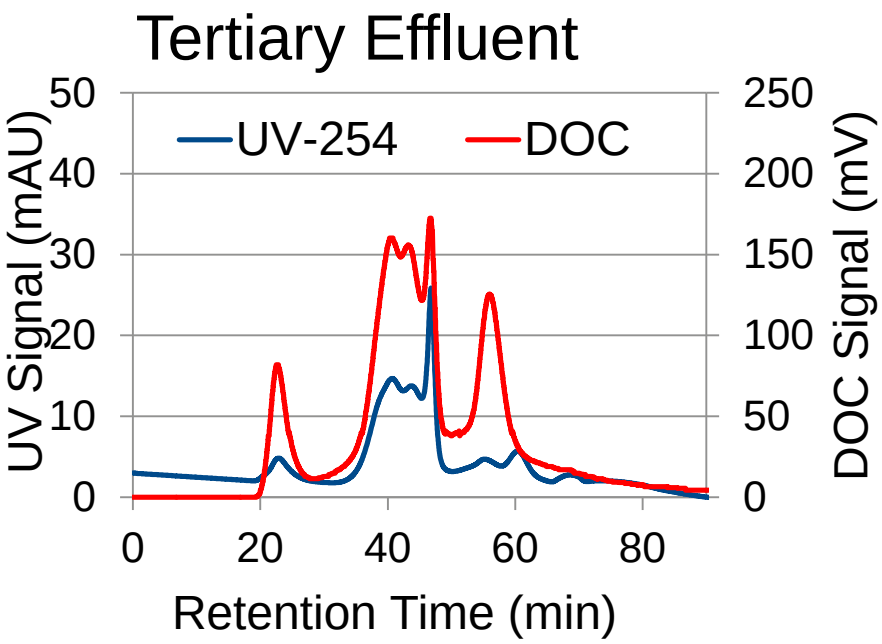
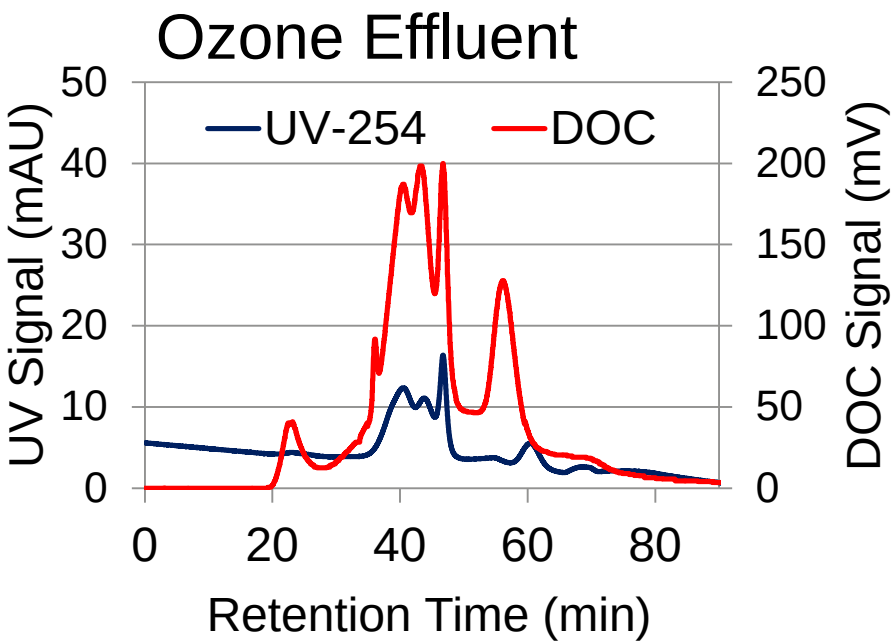
COMPARING TERTIARY AND OZONE EFFLUENT





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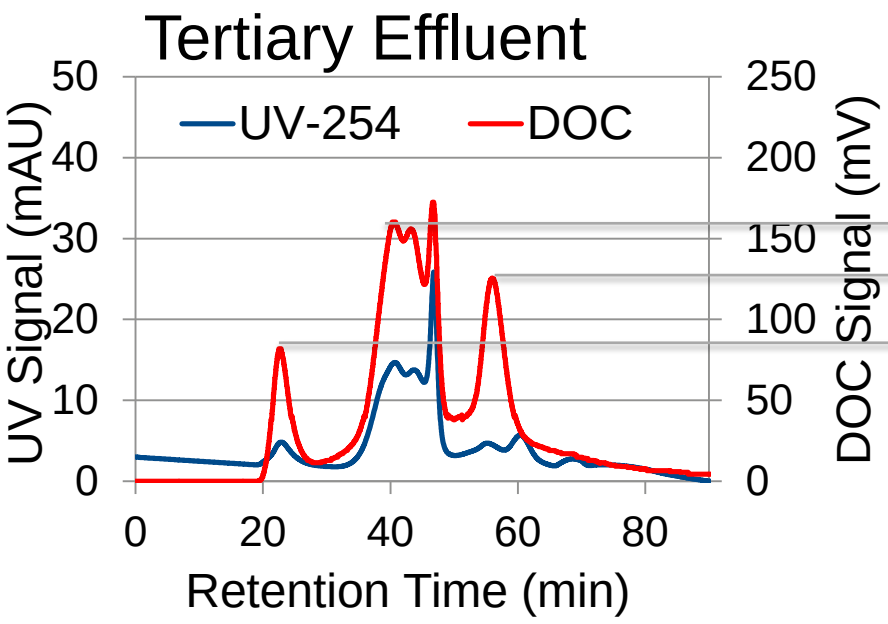

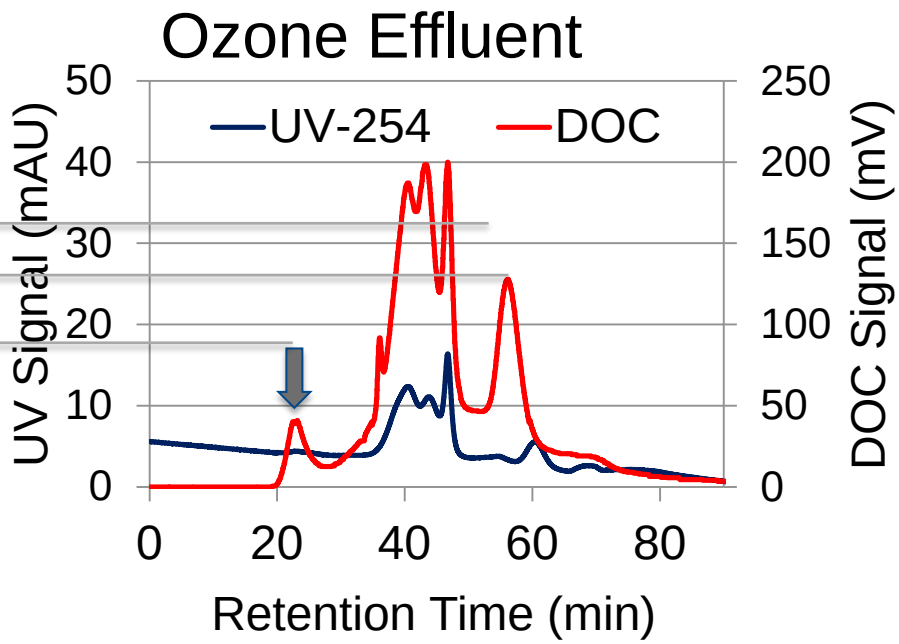

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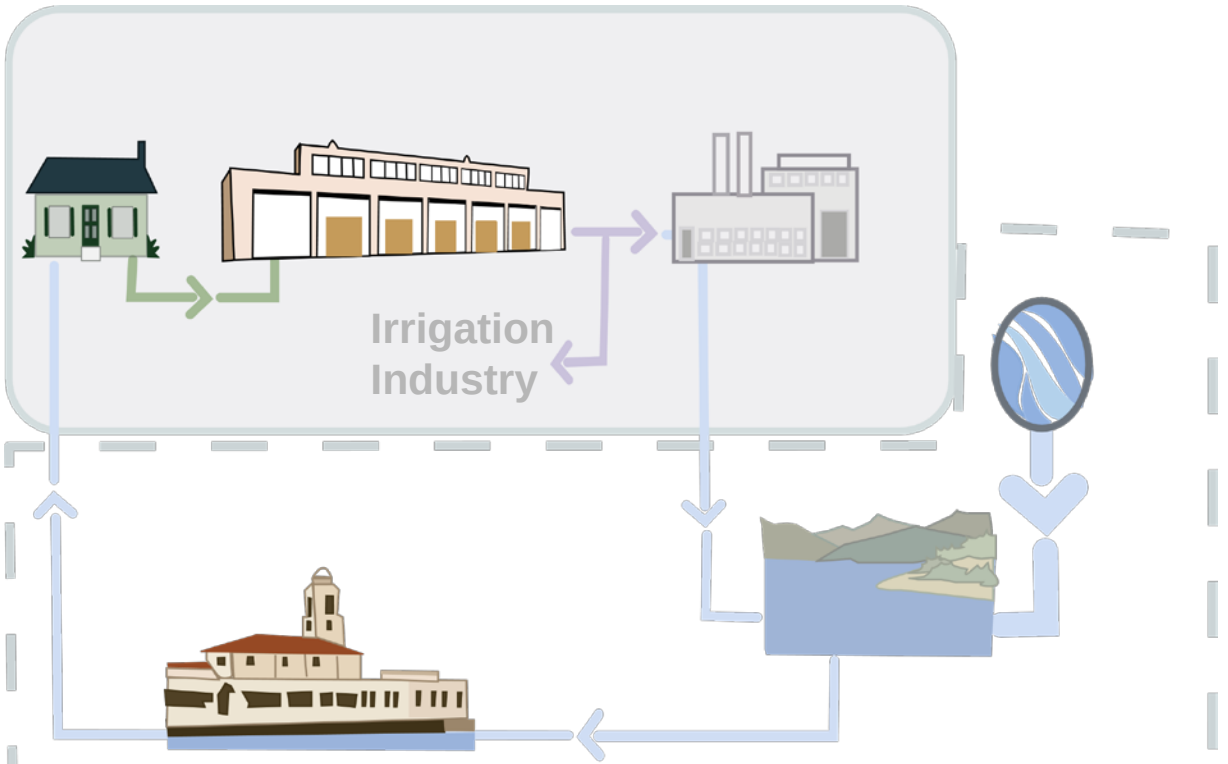

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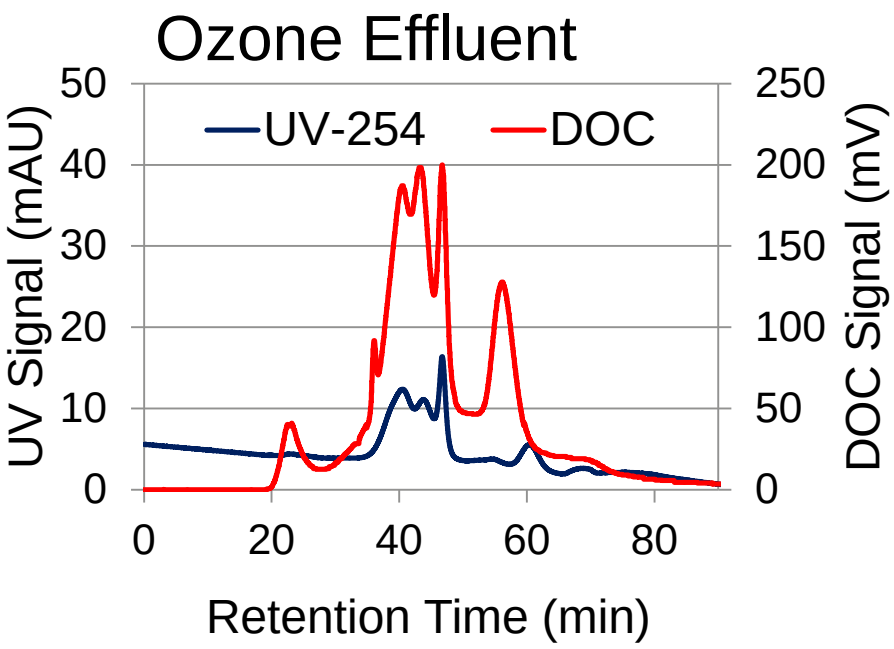
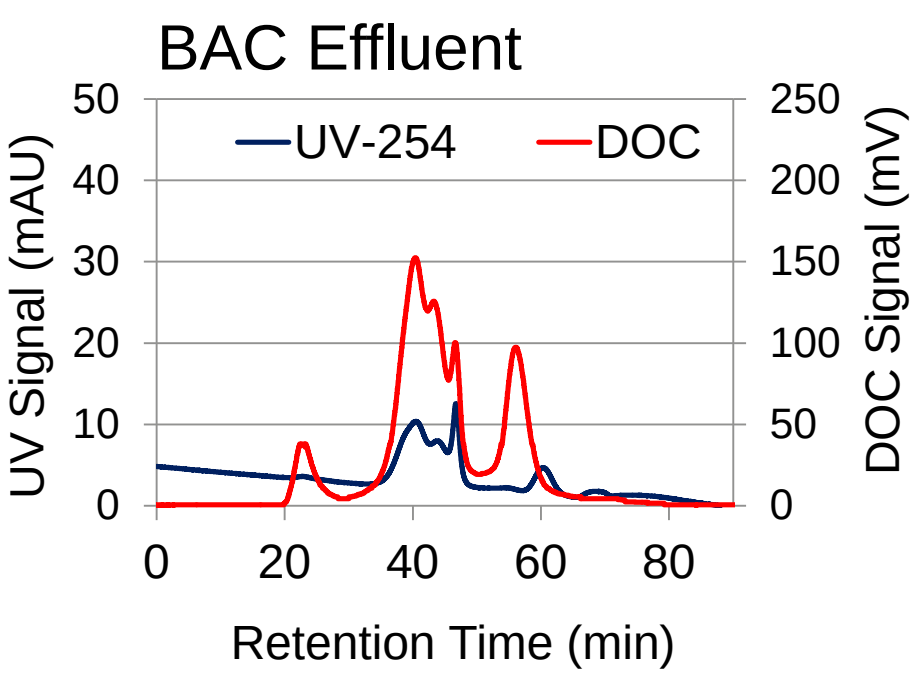
COMPARING OZONE AND BAC EFFLUENT





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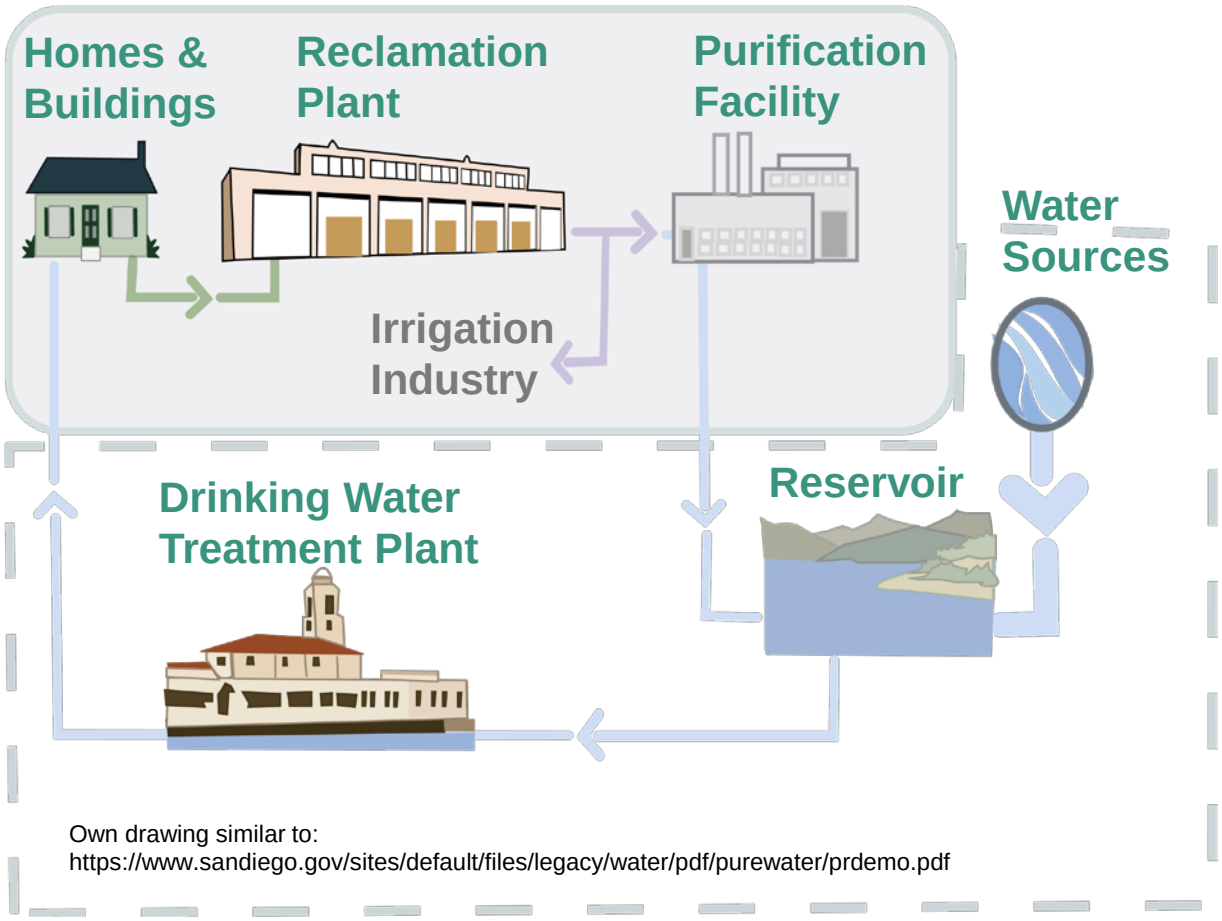

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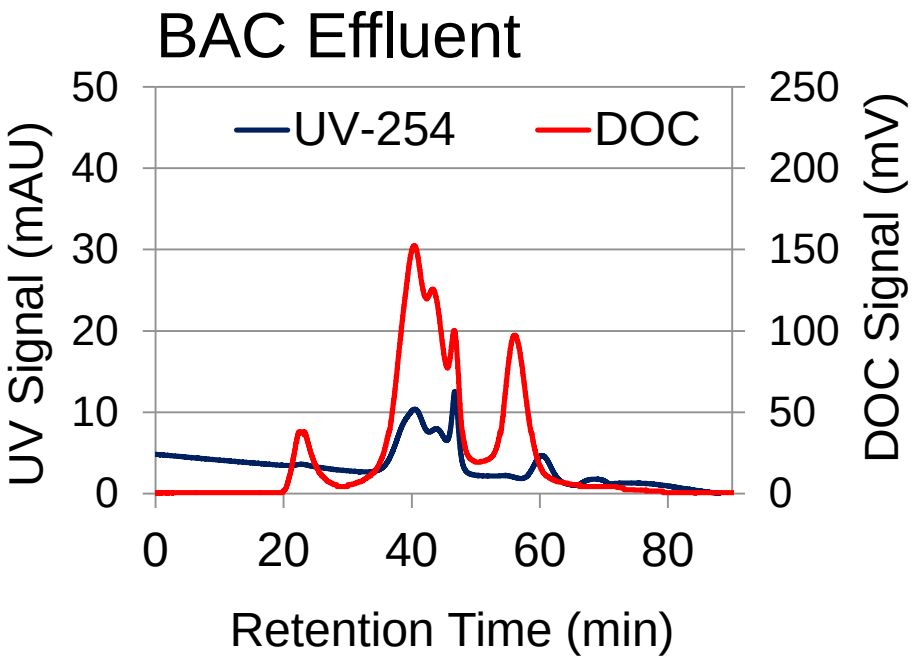
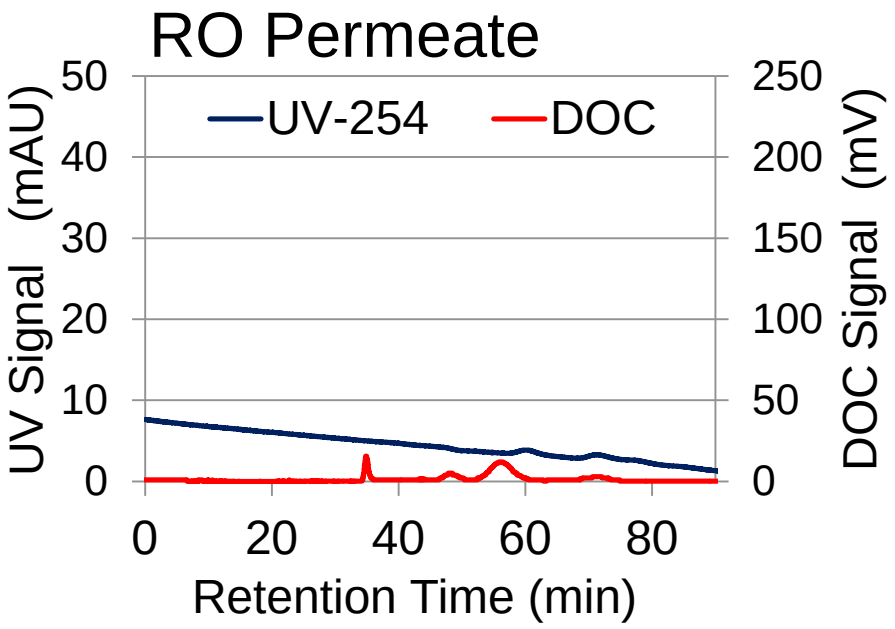
COMPARING BAC AND RO PERMEAT





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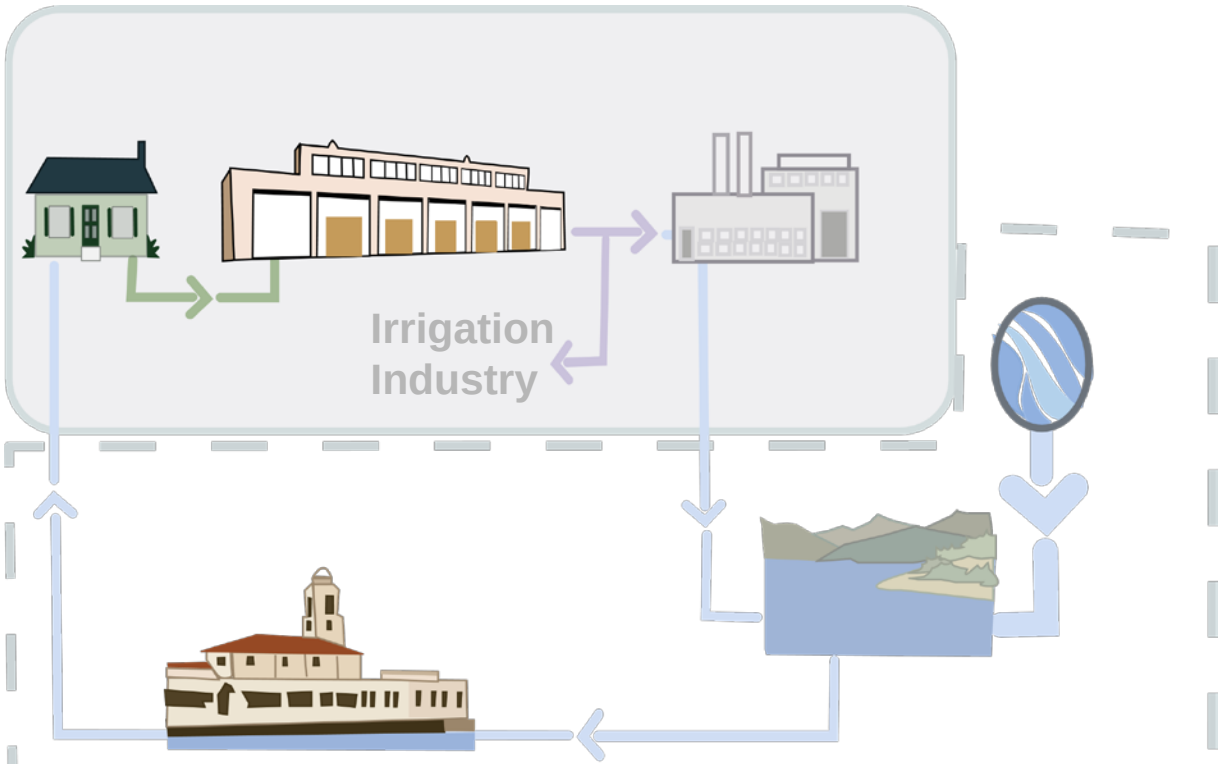

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- Analysis of TOC, DOC, and TOC-SEC provides information on water characteristics.
- TOC and TOC-SEC can be used to control the efficiency of various water treatment processes
- Combined analysis like UV and TOC –SEC provides a more comprehensive view into the removal of the various size fractions of organic carbon.

➔The SEC-UV-TOC information can be used to optimize the performance of the cleaning process.

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MINT ovation

Gute Chemie abcr

ZIM Zentrales Innovationsprogramm Mittelstand

Our latest publication in the field:

- Scott, A., Schuhen, K., Water Quality Control in Various Water Treatment Processes Using TOC-SEC A Potential Analysis, in WaterSolutions 2017, 3, S. 3-12.
- Schuhen, K. , Stahl B., Scott, A., submitted for GIT lab journal
- Come and visit our Posters: You find them located No. 30 and No. 32

THANK YOU VERY MUCH!

Contact: stahl.beate@gmail.com