Characterisation Methods for Optimised Dissolved Organic Carbon (DOC) Removal from Potable Water

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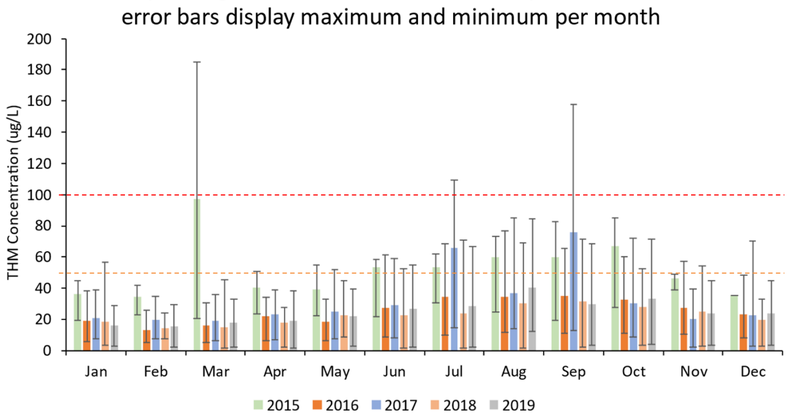
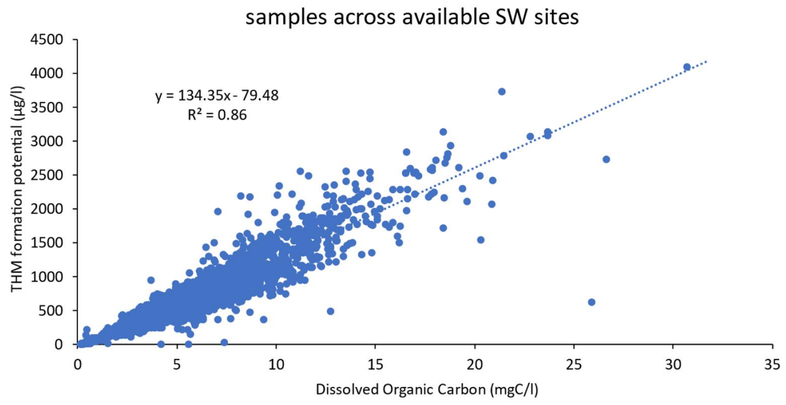
Background

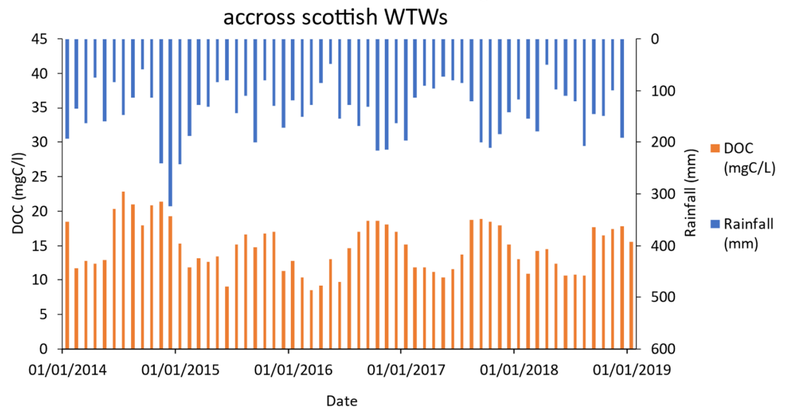
Monthly average THM concentrations for the years 2015 - 2019: error bars display maximum and minimum per month



DOC concentration vs THM formation potential for all raw water samples across available SW sites



DOC concentrations in raw water fluctuating with rainfall accross scottish WTWs

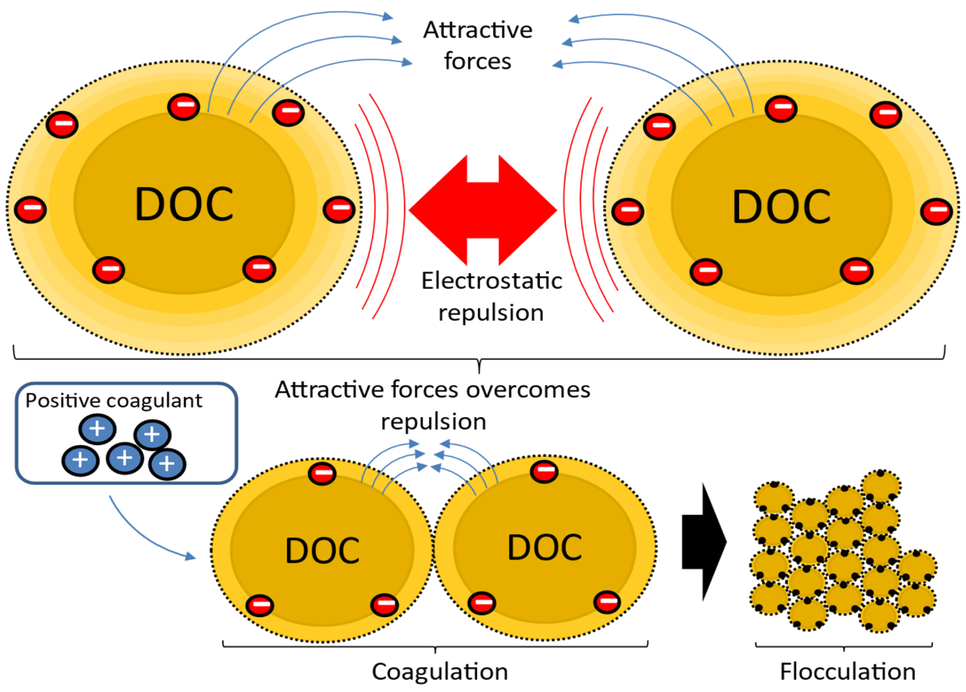


- Tri-Halomethanes (THMs) are currently the main focus of regulatory bodies in Scotland (DWQR)
- Temporally and seasonally variable
- Regulated at 100µg/L with an aim to be keep under 50µg/L
- Online analysis required to ensure variability of raw water captured at treatment sites

- DOC correlates with the formation potential (FP) of THMs in raw water (R^2 = 0.86)
- Correlation weaker at higher concentrations likely due to more variable DOC character
- Further study into treated water DOC concentration and THM-FP required to identify treatment link

- DOC varies across Scottish water treatment works (WTWs) with rainfall
- Rain events cause mobilisation of DOC in soils to leach into nearby tributaries
- Current methods do not allow for rapid reactions to concentration and character changes in the raw water leading to possible suboptimal treatment

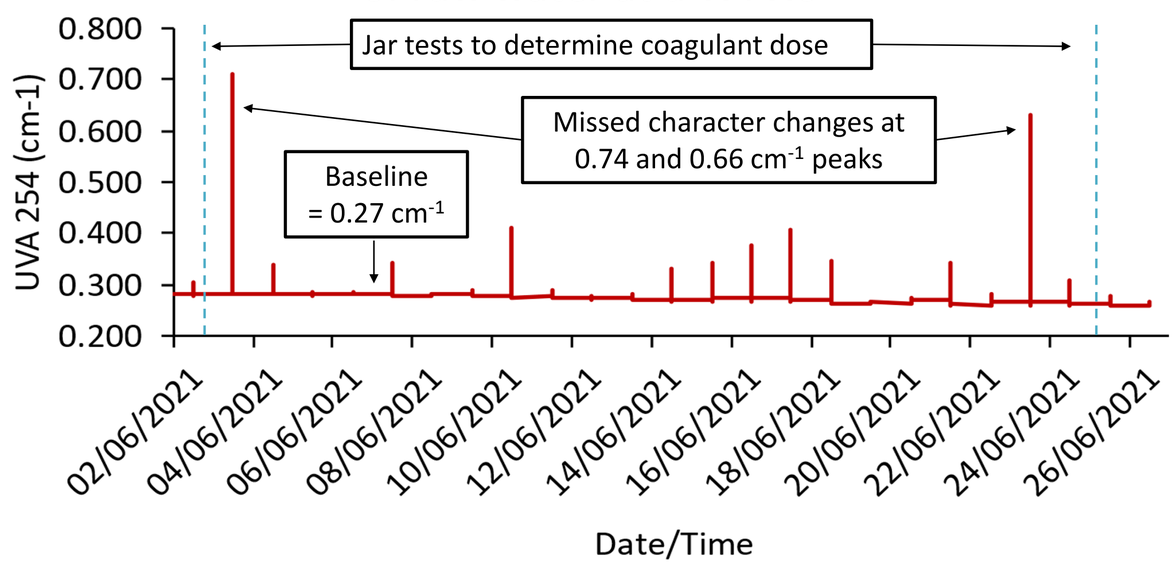
DOC Removal from Raw Water



- DOC is removed by coagulation which is a **charge based** reaction
- Positively charged metal salts added to DOC-laden water
- These neutralise negative charge on DOC molecules
- DOC can then more easily flocculate and be removed
- Current methods do not monitor charge and miss the key removal mechanism which can identify optimal coagulation

Current Coagulant Dosing Practice

Online monitoring of UV254 absorbance (cm -1) of raw water at a WTWs



- Jar tests used to determine coagulant demand of raw water
- Performed infrequently using grab samples
- Misses rapidly changing water character and DOC concentrations
- Online instruments are needed to ensure a rapid response is available to water character changes
- Available online technique do not measure charge related parameters

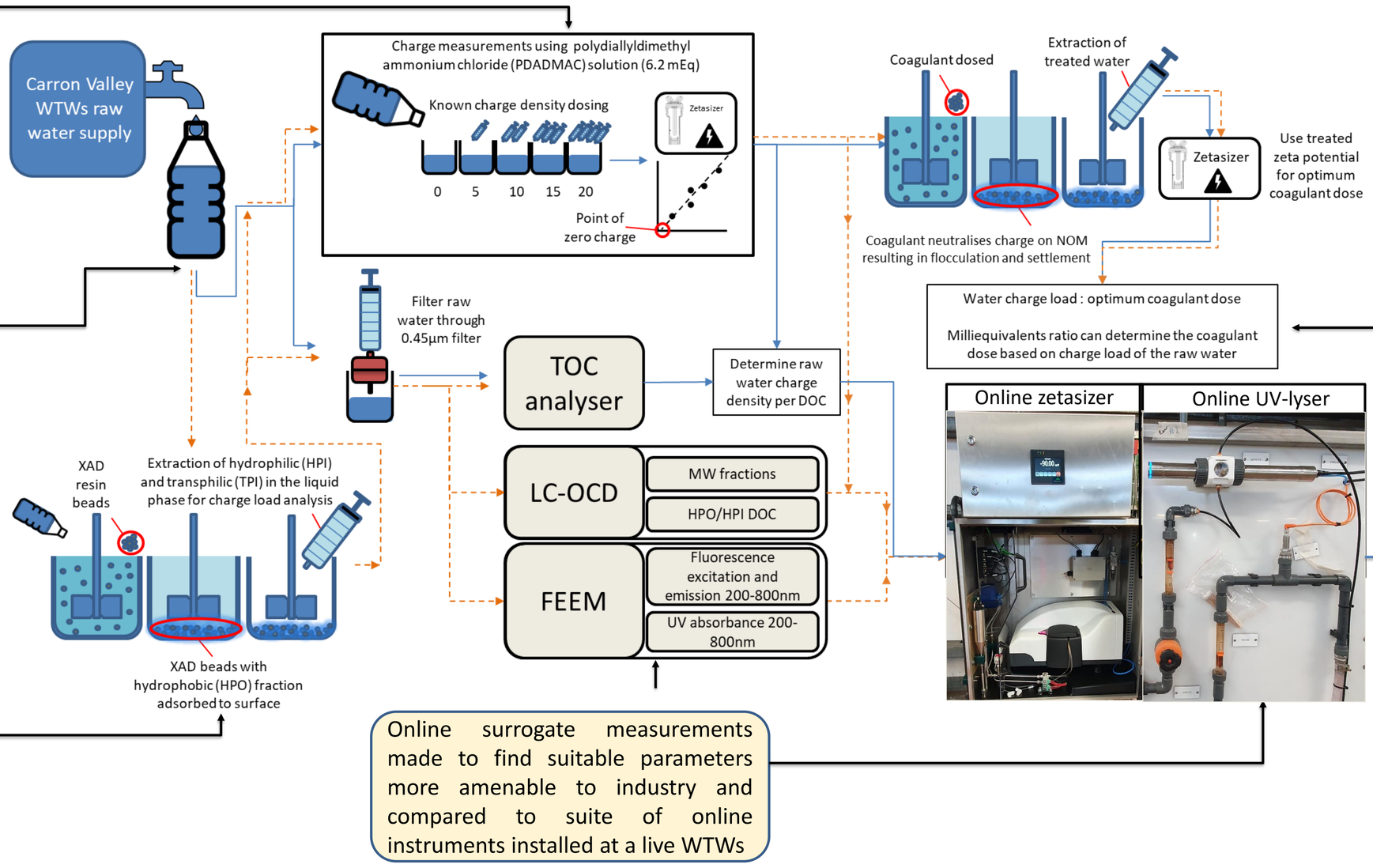
Charge Analysis and Online Surrogate Measurement Method

Charge load (mEq/L) determined with a stepwise dilution of PDADMAC in water to obtain point of zero charge

Carron Valley WTWs raw water supply

Raw and fractionated, water will be measured by all techniques

Batch-mixed XAD-8 resin fractionates raw water and allows characterisation of organic matter preferentially removed during coagulation



Online surrogate measurements made to find suitable parameters more amenable to industry and compared to suite of online instruments installed at a live WTWs

Charge load (mEq/L) of raw water under varying weather conditions compared with sub/optimum coagulant doses to outline a mEq ratio and impacts of under/over dosing on treated water quality

Future work

- Validate findings at live WTWs
- Compare results at multiple locations
- Creation and implementation of a coagulant dosing algorithm based on surrogate parameters

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