

DOC Characterization

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Characteristics

- DOM is a hetergenous complex mixture of Aromatic and aliphatic hydrocarbon structures containing oxygen, nitrogen and sulfur functional groups:
 <u>Amine, Carboxyl, Hydroxyl, Ketone, Phenol, Th</u>iol, ...
- Few hundreds up to 100,000 Da
- DOC concentration: From 0.1 to 20 mgC/L (\rightarrow 60 mgC/L)
- DOM affects biogeochemical processes, metal complexation and production of disinfection byproducts (DBPs) during water treatment



Characteristics





Classifying DOM

Resolving the detailed components of dissolved organic matter (DOM) can be difficult and expensive.



Leenheer and Croué (ES&T, 2003)













Characterization ² Approaches:

- Analytical technics developped directly for the water phase
- Analysis after extraction/fractionation
 - Membrane filtration (reverse osmosis, nanofiltration)
 - Lyophilisation
 - Evaporation under vacuum
 - XAD resins



•DOC characterization – whole water

- TOC-meter (after filtration 0.45 μm)
 - Oxidation of organic carbon into CO_2 and quantification of CO_2 by infra-red
 - High temperature with a catalyst
 - Wet oxidation by persulfate



- Defined on biodegradability
 - BDOC biodegradable Dissolved Organic Matter
 - AOC Assimilable Organic cabon

Depending on the analytical protocole used











DOC characterization – water

Spectrophotometric analysis

- Spectrophotometry 254 nm (could vary in function of sites and season)
 - **SUVA** (Specific UV Absorbance related to the aromaticity)
 - Could be related to the reactivity or by-products formation



•DOC characterization – whole water

Spectrophotometric analysis

- Fluorescence (more sensitive than UV and specific)
 - Humic substances,
 - Fulvic substances,
 - Protein like fluorophores
 - 3 dimensional fluorescence spectroscopy





Example of fluorescence evolution of a surface water close to Lille (Marque River) C. Falantin Thesis (2014-2017)













Size characterization

- Size Exclusion Chromatography (SEC)
 - UV detector
 - DOC detector
 - Nitrogen detector
 - Electrochemical detection (EDC)



WATER TECHNOLOGY



SOUTH WEST WATER

UV detection







WATER. VANDAAG EN MORGE



de Lille

WATER TECHNOLOG



SOUTH WEST WATER

De Watergroep WATER, VANDAAG EN MORGEN **ŤU**Delft

de Lille

• UV detection

Carbon detection

2 Seas Mers Zeeën

European Regional Development Fund

DOC2C's







Interreg

DOC2C's

2 Seas Mers Zeeën

European Regional Development Fund



WATER, VANDAAG EN MORO

• Electron Donating Capacity detector:

could be usefull to characterize the redox propreties



Criquet, personnal data

Example of evolution of tannic acid electron donating capacity in function of chlorine addition (Criquet, unpublished results)



DOC characterization

- Small overview of existing technics usefull in the field of water treatment
- Numerous existing methods applied on NOM extracts:
- Pyrolysis GC- MS
- NMR
- FTIR
- LC –MS, ...



•A new technic soon available at Uni Lille 1



- Only one reference in the literature
- Could give informations on Fe, Mn, Al,...
 - binding to NOM

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Research Article

Determination of size-dependent metal distribution in dissolved organic matter by SEC-UV/VIS-ICP-MS with special focus on changes in seawater

Iron is an essential micronutrient for all marine organisms, but it is also a growth limiting factor as the iron concentrations in the open ocean are below 1 nmol/L in sea water iron is

• Brominated and iodinated by-product formation





Figure 1. Chromatograms of Suwannee River NOM in 50% artificial seawater (conditions given in Tables 1 and 2). Three DOM fractions can be distinguished in the SEC-UV/VIS chromatogram. The chromatograms obtained by SEC-ICP-MS signals clearly show that iron is predominantly bound to the largest size fraction, whereas zinc has a high affinity to the low molecular weight fraction (fraction 3).

• Ratgheb et al. 2016



<u>PhD Project between Uni. Lille – TU Delft</u>

 Characterization of Natural Organic Matter and processes during drinking water treatments

• Simone Bergonzi

- Italian
- Master's Degree in Industrial Chemistry
 - Università degli Studi di Milano, Milano (Italy)
- Internship for Master's thesis
 - Université Pierre et Marie Curie, Paris (France)
- Fluent in English and French
- Volonteer red cross in Italy, Cambodian Youth Action
- Different work experiences (shop salesman,...)



- Will have to gain more knowledge in the field of water treatment
- No doubt he will manage to get into the field in few months













• PHD project

 Risk assessment of disinfection by-product formation in the 2 seas area

Henry Mac Keown

- French and English (both nationalities)
- Master's degree sustainable management of pollution (Catholic University of Lille)
- Biology background
- MSc internship in Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa (FCT-UNL), Portugal. (waste water treatment)
- Excellent reference letters











Maria Clara Starling

 Brasilian PhD student got an ERASMUS grant to work in our Team for 6 months from January 2017



- Impact of different AOPs on the treatment of pollutants of emerging concern (PECs) in various water matrices: evaluation of toxicity and estrogenicity
- Will work on H_2O_2/UV in our lab

