PeCOD® vs Traditional Methods for Measuring NOM

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Introduction

- Natural organic matter (NOM) is a critical target for drinking water treatment
- NOM can be associated with;
  - Taste, odour, colour issues
  - Coagulant, oxidant demand
  - DBP precursors
- Tools for bulk NOM estimation: DOC, TOC, UV254, SUVA
- NOM compounds are known to react with common disinfectants to produce harmful and potentially carcinogenic disinfection by products (DBPs) such as:
  - Trihalomethanes (THMs)
  - Haloacetic acids (HAA)

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Chemical Oxygen Demand (COD) Measurement in Drinking Water

- Traditional NOM surrogates may not be suitable for assessing NOM removal in all cases
  - UV254, SUVA
    - Rely on aromaticity, which is not a chemical feature of many organic compounds, example; sugars
  - Carbon (e.g., as TOC, DOC)
    - Does not quantify the reactivity (*oxidizability*) of the organic, example; benzene and glucose have similar TOC values
- COD is the amount of oxygen required to fully oxidize organic matter and measures reactive organic contamination
  - NOMs that are potential precursors to DBPs

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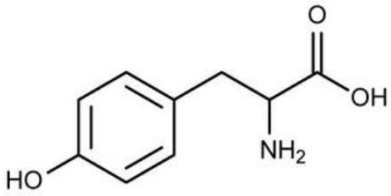
Chemistry of COD & TOC

TOC measures conversion to CO_2



$$+ O_2 \rightarrow CO_2 + H_2O + NH_3$$

COD measures "demand" for oxygen

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Value of COD Measurement Principle

- Measures chemical reactivity of organics
- Benzene approximately 3x higher COD than glucose
- Can be lower, the same or higher than TOC
- Similar to other NOM tools, potential for:
  - Prediction of DBP_{fp} from source waters
  - Assist in biological oxidation processes
  - Optimize coagulation
  - Water quality monitoring in IPR and DPR applications

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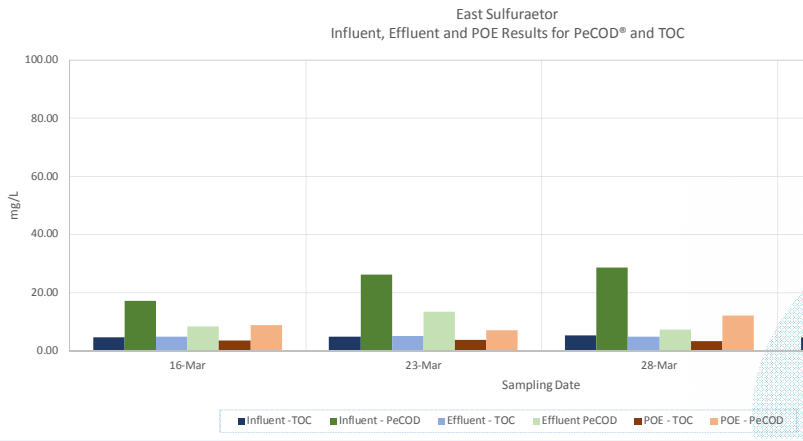
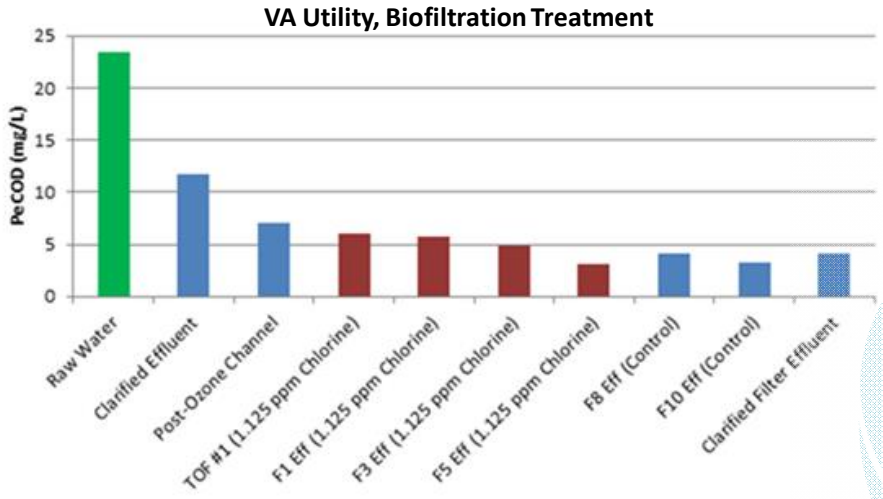
Case Study I: PeCOD is more sensitive than TOC



East Sulfuraetor – A Florida Drinking Water utility with THM Problems – TOC is not responsive

Date	Influent -TOC	Influent - PeCOD	Effluent - TOC	Effluent PeCOD	POE - TOC	POE - PeCOD
16-Mar	4.40	17.10	4.70	8.15	3.40	8.60
23-Mar	4.60	26.02	4.90	13.33	3.60	6.94
28-Mar	5.20	28.56	4.80	7.10	3.20	11.90
04-Apr	4.50	**93.70**	4.70	23.00	3.20	11.90

Case Study II: PeCOD vs TOC



The PeCOD performed well at this plant. In general, raw PeCOD was around 20-25 mg/L, and filter effluent was around 3-4 mg/L (TOC around 2-2.5 mg/L). The post-ozone channel measured lower than the clarified effluent, possibly because ozone oxidized part of the COD

Raw TOC is ~ 6.5-7 mg/L
Filter influent ~ 2.8 – 3.5 mg/L
Filter effluent ~ 2 – 2.5 mg/L

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Comments: TOC and COD

"It would definitely be useful to have something presented on PeCOD®

…helpful to have something on the basics for utilities and regulators, …particularly the wide range of reactivity that can be encountered

…for example why does North Sydney 1.6 mg/L TOC produce 50 ug/L DBPs at the plant which grows to 100 ug/L in the system

…while Winnipeg at 4 mg/L TOC produces 10 ug/L at the plant which grows to 20-30 ug/L in the system?"

- Health Canada

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Comments: TOC and COD

"TOC on its own sheds no light on the oxidizability of the measured carbon or the amount of oxygen needed for its biodegradation."

- HACH

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Why PeCOD now?

- Dichromate COD method has limitations that do not make it suitable for NOM detection, namely:
  - 2-3 hour test result, too slow
  - 10mg/L detection limit, much too high
  - Hazardous chemicals, dichromate, mercury and concentrated acid
  - Only a laboratory based test, cannot be made on-line
- Why PeCOD?
  - 10 min or less test results: FAST
  - 0.7mg/L detection limit: Excellent for NOM monitoring
  - Green Chemistry: Safe
  - Available in laboratory, portable and on-line models: everywhere it can be used
  - …and simple to use

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