Characterizing the dynamics of pollutant concentration and biodegradability in raw domestic wastewaters

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Introduction

The fractionation, especially of carbonaceous constituents is a critical input to activated sludge modelling (ASM).

Research objectives

1) **Characterize the pollutant concentration related to the chemical oxygen demand (COD) fractions over time in different weather conditions (dry weather & wet weather)**
2) **Determine the readily biodegradable COD by respirometry**
3) **Identify the hourly dynamics of the COD fractions by respirometry**

Study site and sampling point

Catchment:
A student residence with a parking lot and a garden

Sewer system:
A short combined sewer system

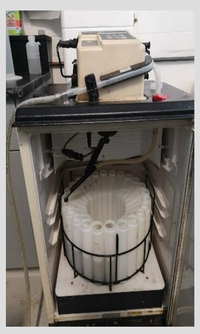
Sampling point:
A storage tank with a volume of 1.5 m^3, with auto-sampler

- **Three Scenarios → To understand the seasonal effect for pollutant concentration: Dry weather & Wet weather summer, and Dry weather winter**

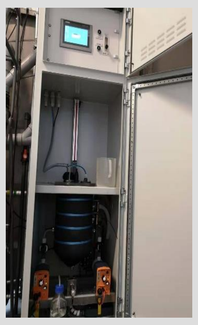
- **Variables → related to COD fractions**
  CODtotal, CODsoluble, BODultimate, short-term BOD

Methodology

1) Sensor & lab measurements:



Sampling frequency: 1/hour



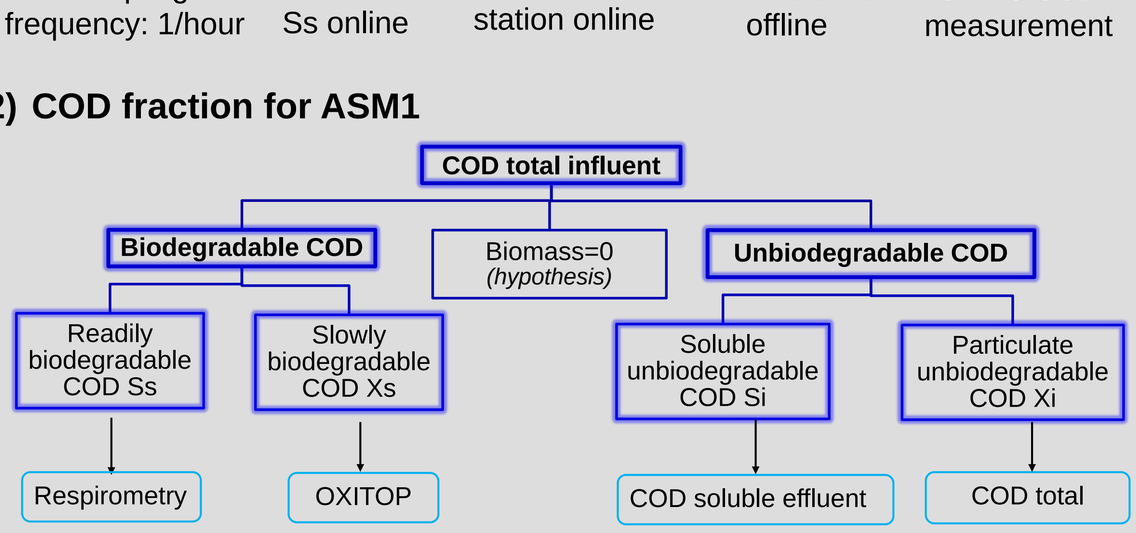
RODTOX: Ss online

mon*EAU* station online

Ultimate BOD offline

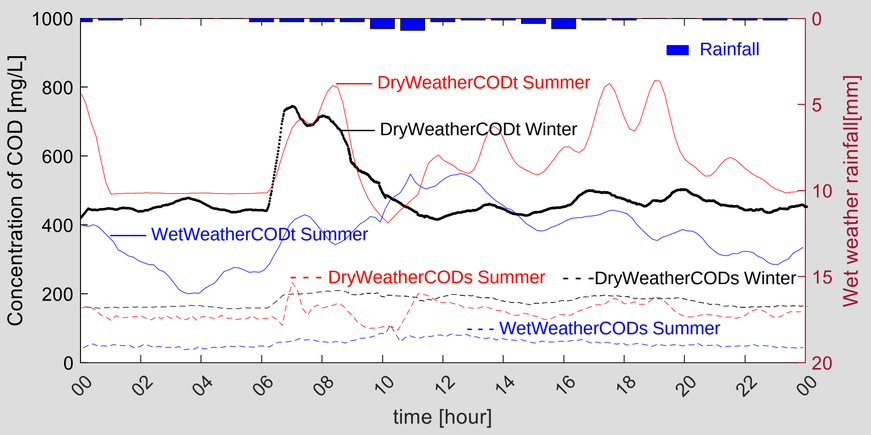
Offline COD measurement

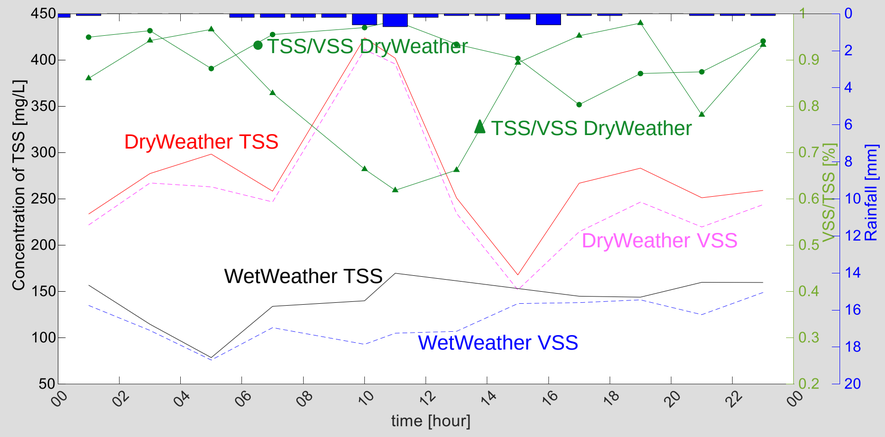
2) COD fraction for ASM1



- **Nitrification inhibitor : Nitrapyrin (0.1g/L sludge) → to eliminate nitrification**
- $BODultimate \approx bCOD = rbCOD + sbCOD = BOD(t)/(1 - e^{-kt})$
- $bCOD = BODtotal/(1 - f_{BOD})$ **with correction factor** $f_{BOD} = 0.15$

Results and analysis



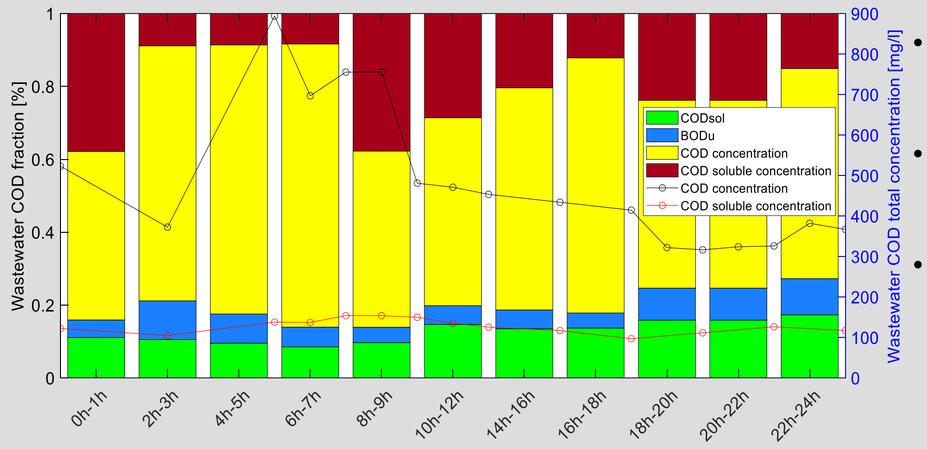


The pollutant concentrations follow a diurnal pattern (high peak in the morning and low concentrations at night) according to the students' activities. Wet whether has a dilution effect and shows a first flush event at 10h.

Two possible reasons might explain the difference between summer and winter:

1. The snow melt water enters into the sewer.
2. The students' diurnal activities are different in summer and in winter sessions.

Figure 1 . Pollutant (TSS COD) concentrations in dry weather (summer & winter) and wet weather (summer)



- The COD fractions vary over time
- Typical fractions of domestic wastewater
- no industry discharge in the catchment

Figure 2 . COD fractions diurnal dynamics of the influent wastewater

Table1 . COD fraction average value compared with typical value

	Ss	Si	Xs	Xi	Biodegradable fraction (Ss+Xs)
Results average	12.4%	4.7%	57.7%	24.8%	60%-86%
Henze *et al.*	25%	10%	40%	15%	65%
Rossle & Pretorius	8%-25%	4%-10%	50%-77%	7%-20%	75%-85%

Conclusion

The dynamics of pollutant concentration and biodegradability follow a diurnal pattern, influenced by seasonal and weather conditions.

Compared to typical values for domestic wastewater (Table 1), the study site's wastewater is highly organic and its biodegradability is in the normal range.

Application in the future

- The characterization of biodegradability helps decision-making for the operation of the treatment process
- The characterization of wastewater will be applied as input to the influent generator, in particular as its 'dry weather pattern'.

Henze M., Grady C.P.L. Jr., Gujer W., Marais G.v.R., Matsuo T.; IAWPRC Task Group on Mathematical Modelling for Design and Operation of Biological Wastewater Treatment, IWA, London, UK, 1987.
Rossle W.H., Pretorius W.A. A review of characterization for on-line prefermenters. Paper 1: Wastewater characterisation. Water S.A. 27, (3), 405, 2001.

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