A Modeling Tutorial to Evaluate the Fate of Emerging Contaminants in Wastewater Treatment Plants

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Problem statement

The fate of emerging contaminants (ECs) in WWTPs is different from one treatment train to another because they behave differently according to their chemical and physicochemical properties.

Objective

Develop a tool to predict the fate of selected emerging contaminants in various types of treatment trains.

Context

June 2011: 27 Canadian students & young water professionals in Quebec City for the CWN workshop "Micropollutants in the water environment: Measure, predict and protect."

Figure 1. Students and YWPs in action.

Modeling and results

Table 1. Importance of different fate processes on the removal of three ECs.

Fate processes →	Volatilization	Biodegradation	Sorption
17α-ethinylestradiol (EE2)	-	+	++
Trichloroethylene (TCE)	+++	-	-
Bis(2-ethylhexyl) phthalate (DEHP)	-	++	+++

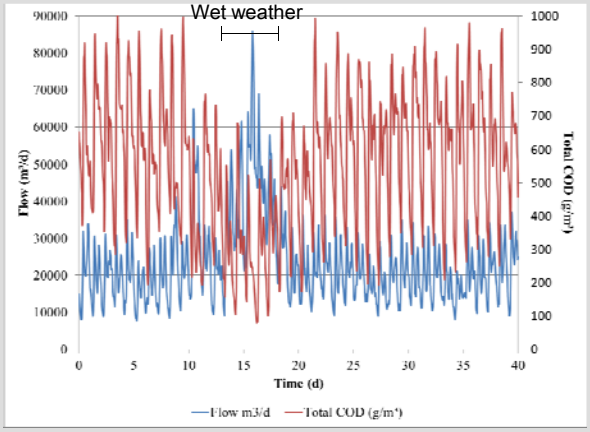

Figure 2. Influent flow rate and influent total COD.

5 treatment trains:

- Conventional Activated Sludge (CAS)
- Nitrifying Activated Sludge (NAS)
- Biological Nutrient Removal (BNR)
- CAS + Sand Filter (SF)
- Enhanced primary clarifier + Ozonation (PC+O_3)

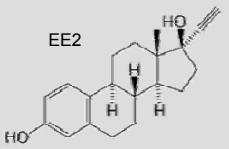

Table 2. Removal efficiency of selected ECs in various treatment trains.

Pollutants ↓	Treatment trains →	CAS	NAS	BNR	SF	PC+O_3
EE2	Dry weather	47%	52%	54%	49%	99%
	Wet weather	24%	23%	23%	25%	95%
TCE	Dry weather	99%	100%	99%	99%	82%
	Wet weather	96%	100%	99%	96%	62%
DEHP	Dry weather	98%	98%	98%	100%	95%
	Wet weather	89%	77%	74%	92%	81%
NH_4	Dry weather	0%	95%	98%	6%	1%
	Wet weather	7%	64%	69%	8%	2%

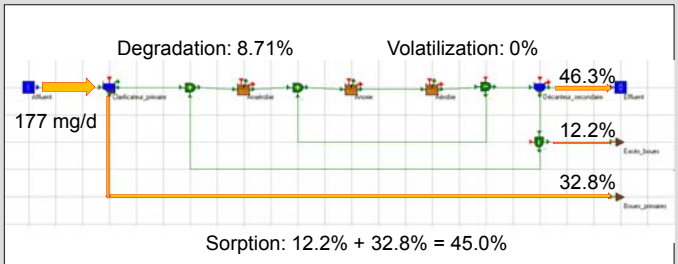

Figure 2. Removal of EE2 in a BNR system.

TAKE HOME MESSAGE

- An easy-to-use tutorial was created to quickly predict the fate of emerging contaminants in WWTPs using their physicochemical and biodegradation properties.
- Tertiary treatment (ozone) and high sludge age systems are more efficient to remove recalcitrant pollutants.

ACKNOWLEDGEMENT

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http://modelEAU.fsg.ulaval.ca

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