National Water & Wastewater Conference

Canadian Water & Wastewater Association

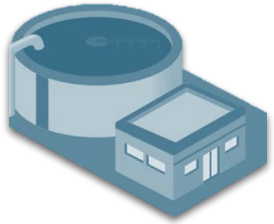
Comparison of the removal of more than 400 Contaminants of Emerging Concerns (CEC) in 25 Wastewater Resource Recovery Facilities (WRRF) in Québec

November 3rd, 2025

Coline Milhau and Peter A. Vanrolleghem

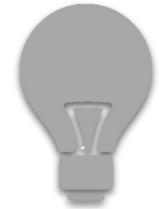
Summary

Context
Objective



Sampling
campaign

Results



Key points to
remember

Context

- 2009
Canadian Council of Ministers of the Environment : Strategy for the management of municipal wastewater effluents. **2012** : Wastewater Systems Effluent Regulations

- 2014
MELCCFP : *Règlement sur les ouvrages municipaux d'assainissement des eaux usées (ROMAEU)*

- 2022
Caractérisation Initiale : sampling campaign with 42 selected WRRFs, that represent Québec's infrastructure

Objective

State of the wastewater in Québec

Assessment of the performance of 42 WRRF in Québec province

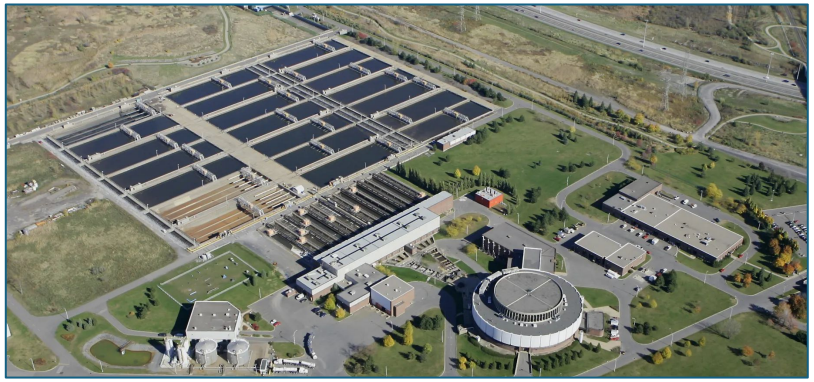
Sampling campaign

Sampling campaign

Activated Sludge (Victoriaville)

Biofiltration (Québec)

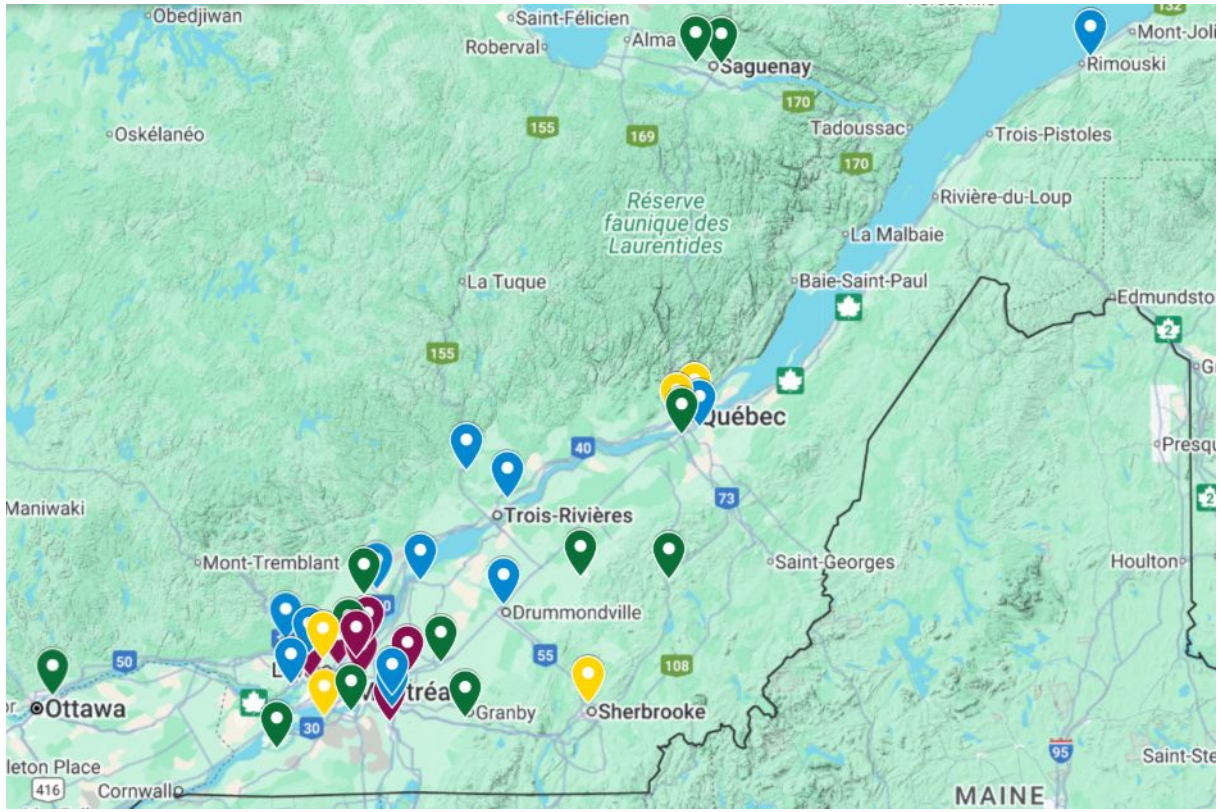
Aerated Lagoon (Terrebonne)

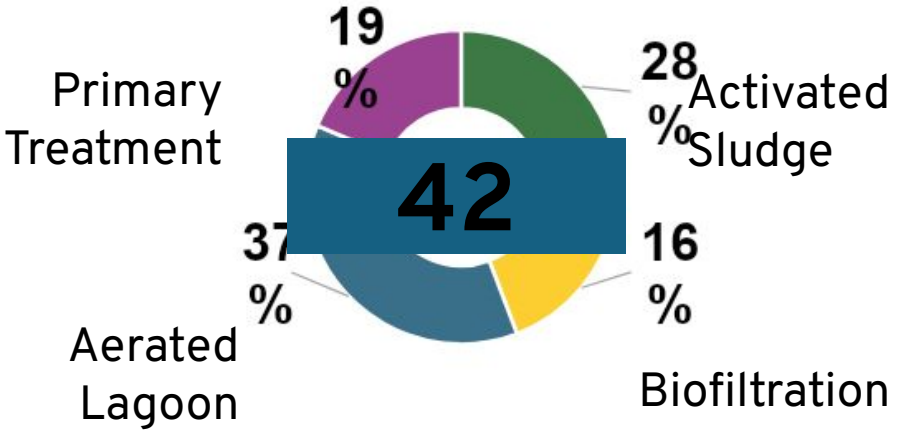


Primary treatment (Montréal)

Sampling campaign

> 17 000 m³/d **BF** **PT** **AL** **AS**





Substances :

- Classical parameters (pH, COD, BOD, TSS)
- Organic contaminants (medicines, PCB, PFAS, flame retardants, hormones)
- Inorganic contaminants (metals, nutrient)

Sampling campaign

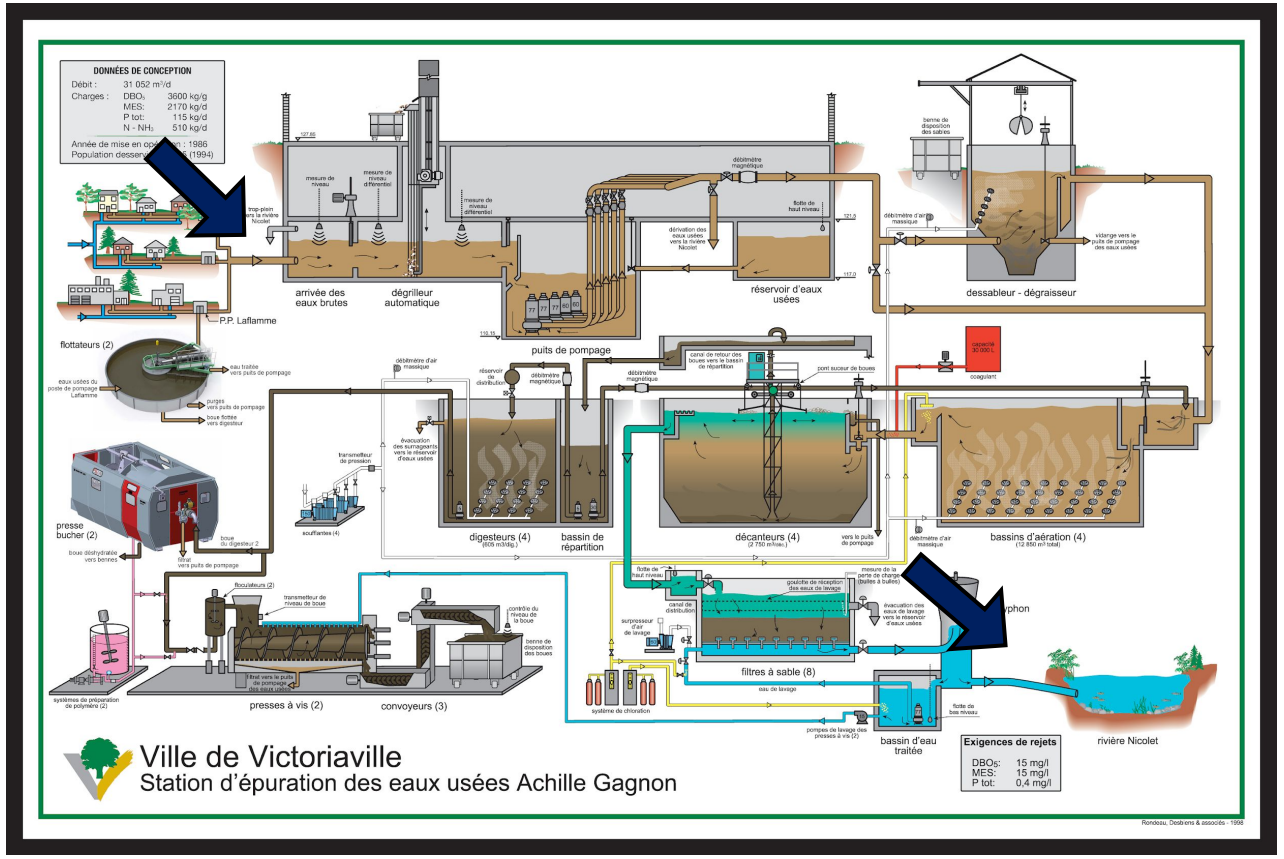
$$\text{Removal (\%)} = \frac{[\text{Influent}] - [\text{Effluent}]}{[\text{Influent}]}$$

→ **20 000 available values**
400+ chemicals, cold/warm, 25 WRRF
→ **only 2 800 values**

$$\text{Minimal Removal (\%)} = \frac{[\text{Influent}] - \text{Limit of Detection}}{[\text{Influent}]}$$

→ **1 500 extra values of removal (%)**

-- 24h composite samples --



-- Warm and Cold --

Sampling campaign

$$\text{Removal (\%)} = \frac{[\text{Influent}] - [\text{Effluent}]}{[\text{Influent}]}$$

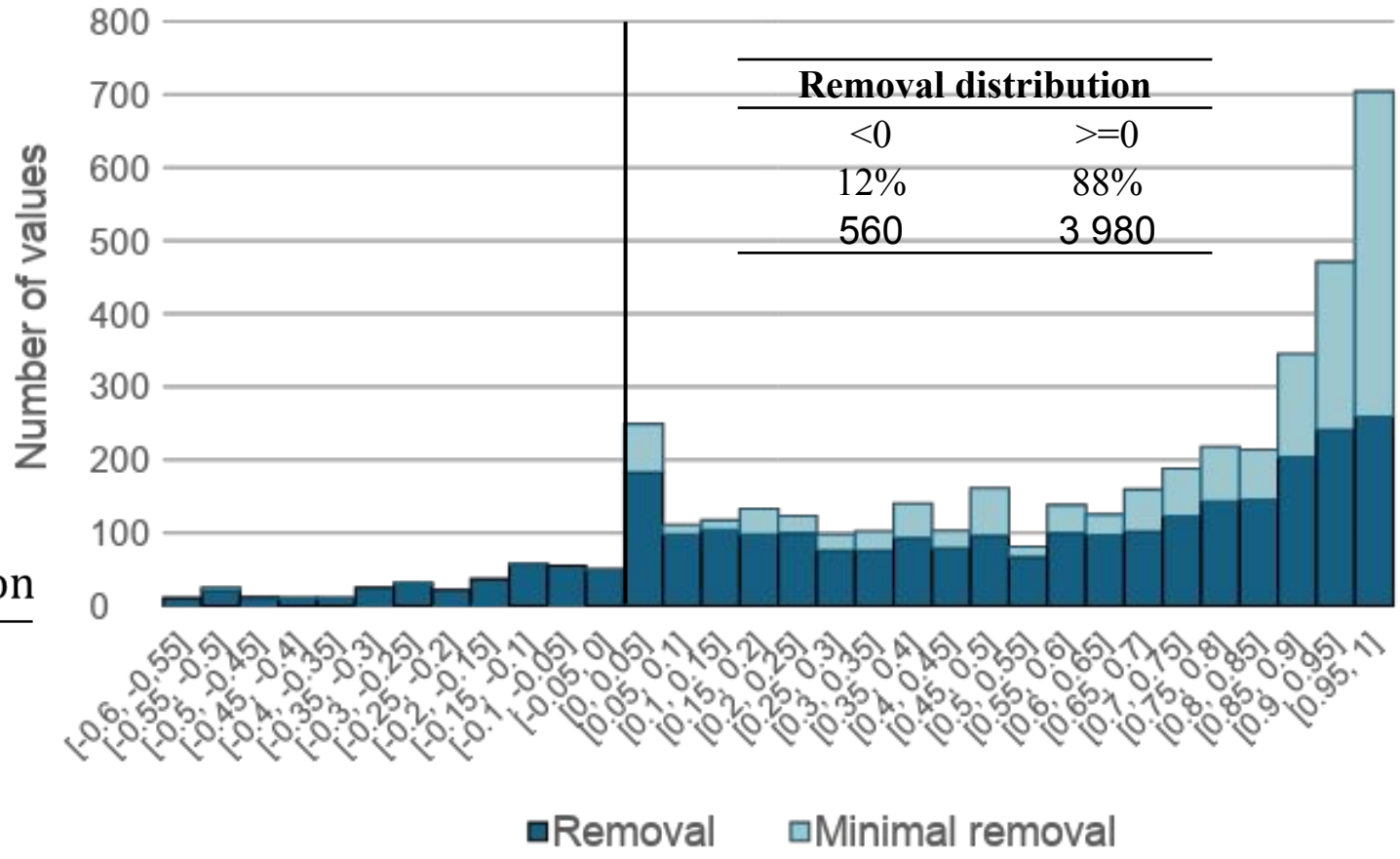
→ **20 000 available values**

→ **only 2 800 values**

$$\text{Minimal Removal (\%)} = \frac{[\text{Influent}] - \text{Limit of Detection}}{[\text{Influent}]}$$

→ **1 500 extra values of removal (%)**

4 300 removal values



Results

- Effluent concentrations
- Removal performance of WRRF

Effluent concentrations

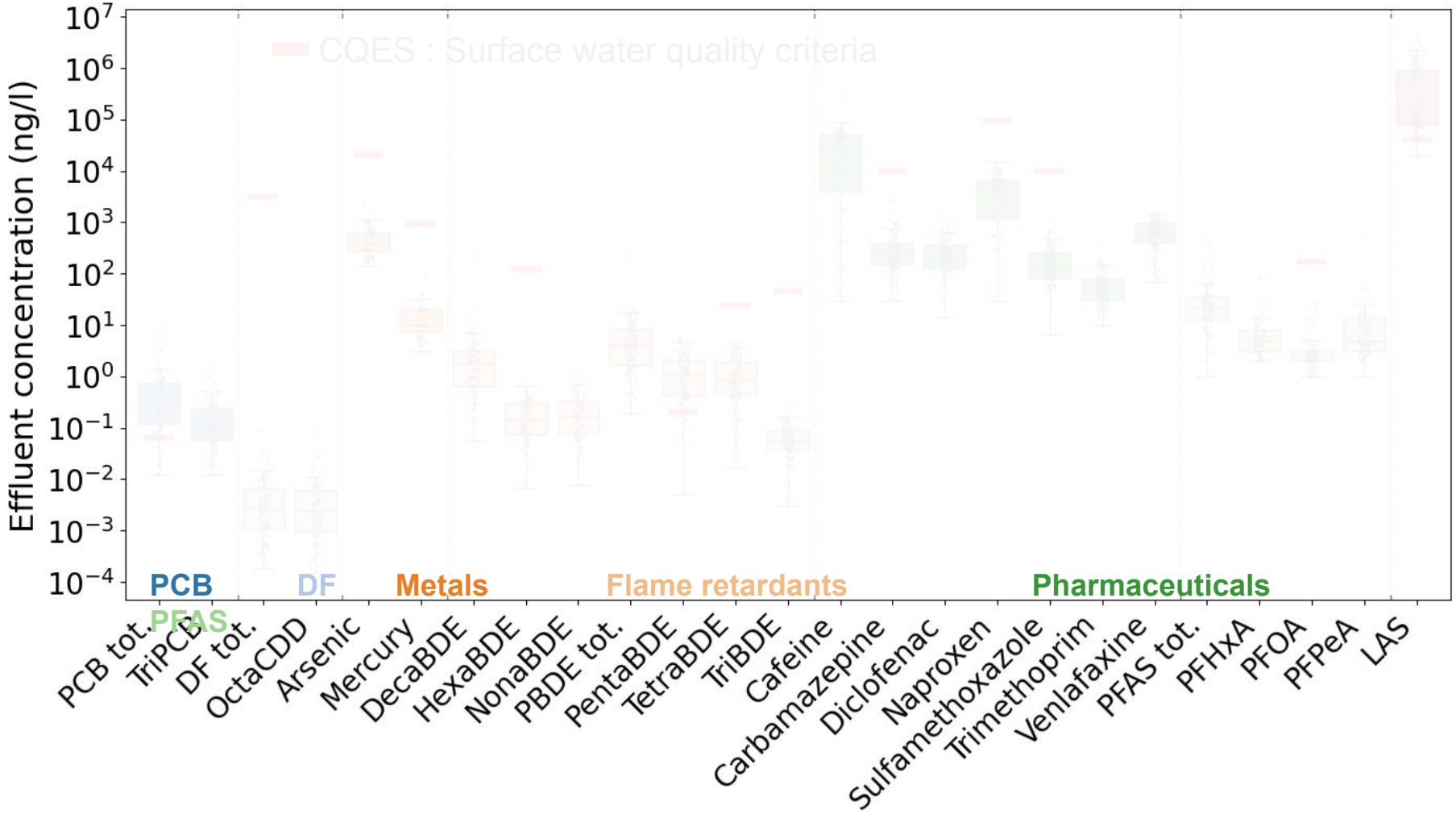
Low detection frequency

250+ substances are never detected, or has a very low DF (<25%)

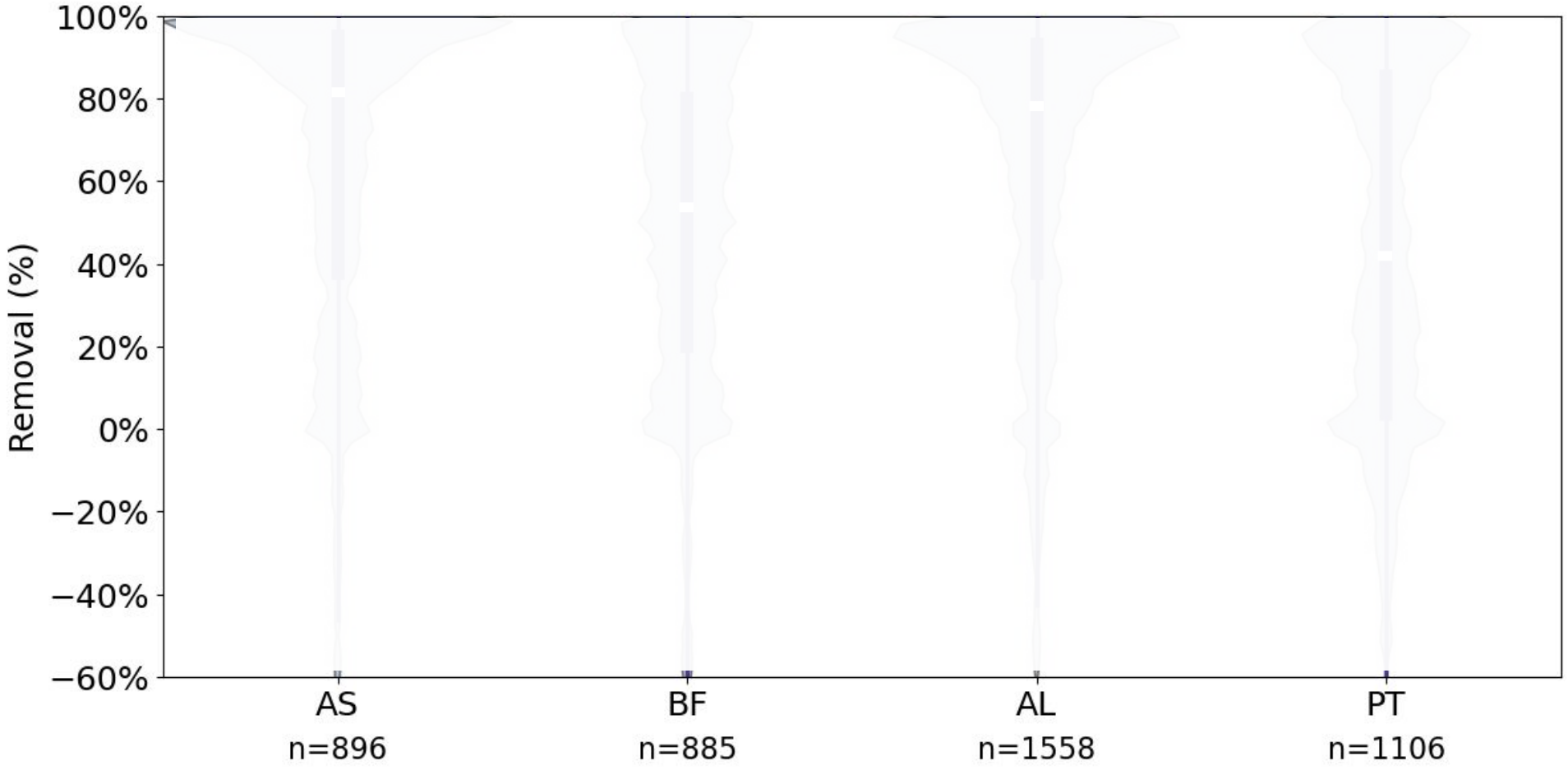
Most of the hormones, surfactants, volatiles compounds, PHA

High detection frequency

Penta-BDE (flame retardant)
PCB and LAS



Removal performance of WRRF



Median

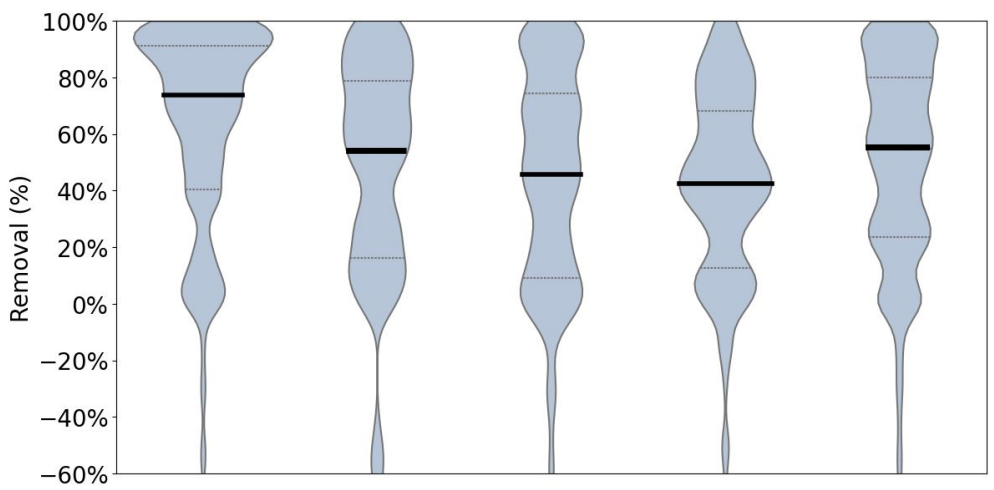
AS	80%
BF	52%
AL	77%
PT	37%

- AS and AL seem more efficient
- Negative removal

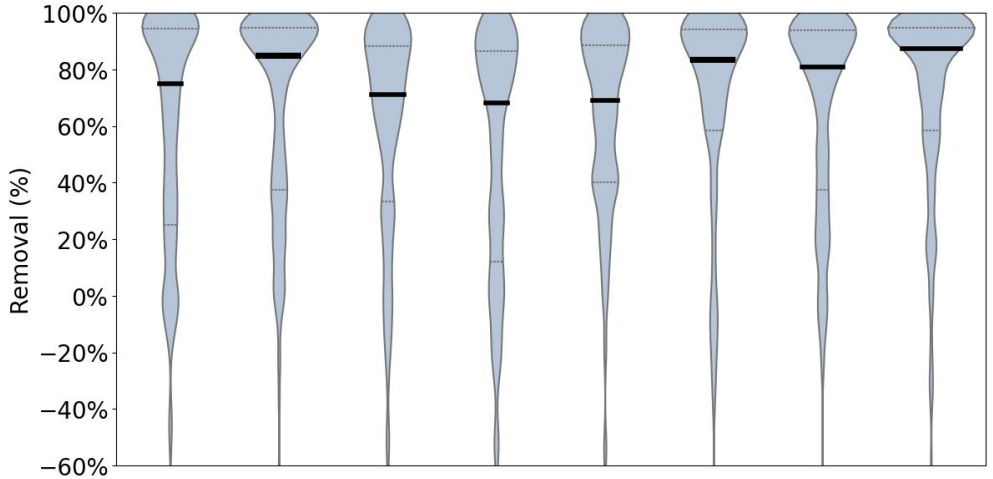
Comparison of the removal of more than 400 CEC in 25 WRRF in Québec.

Removal performance of WRRF

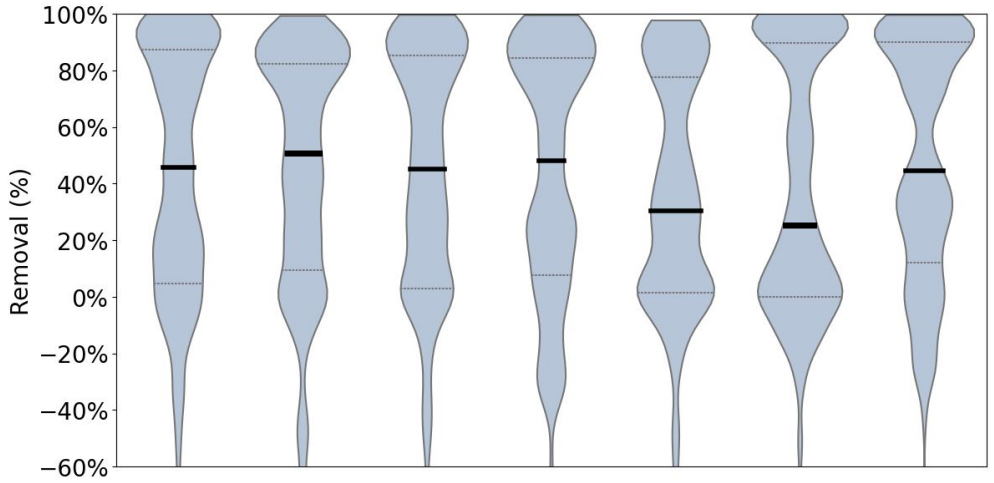
Activated Sludge



Biofiltration

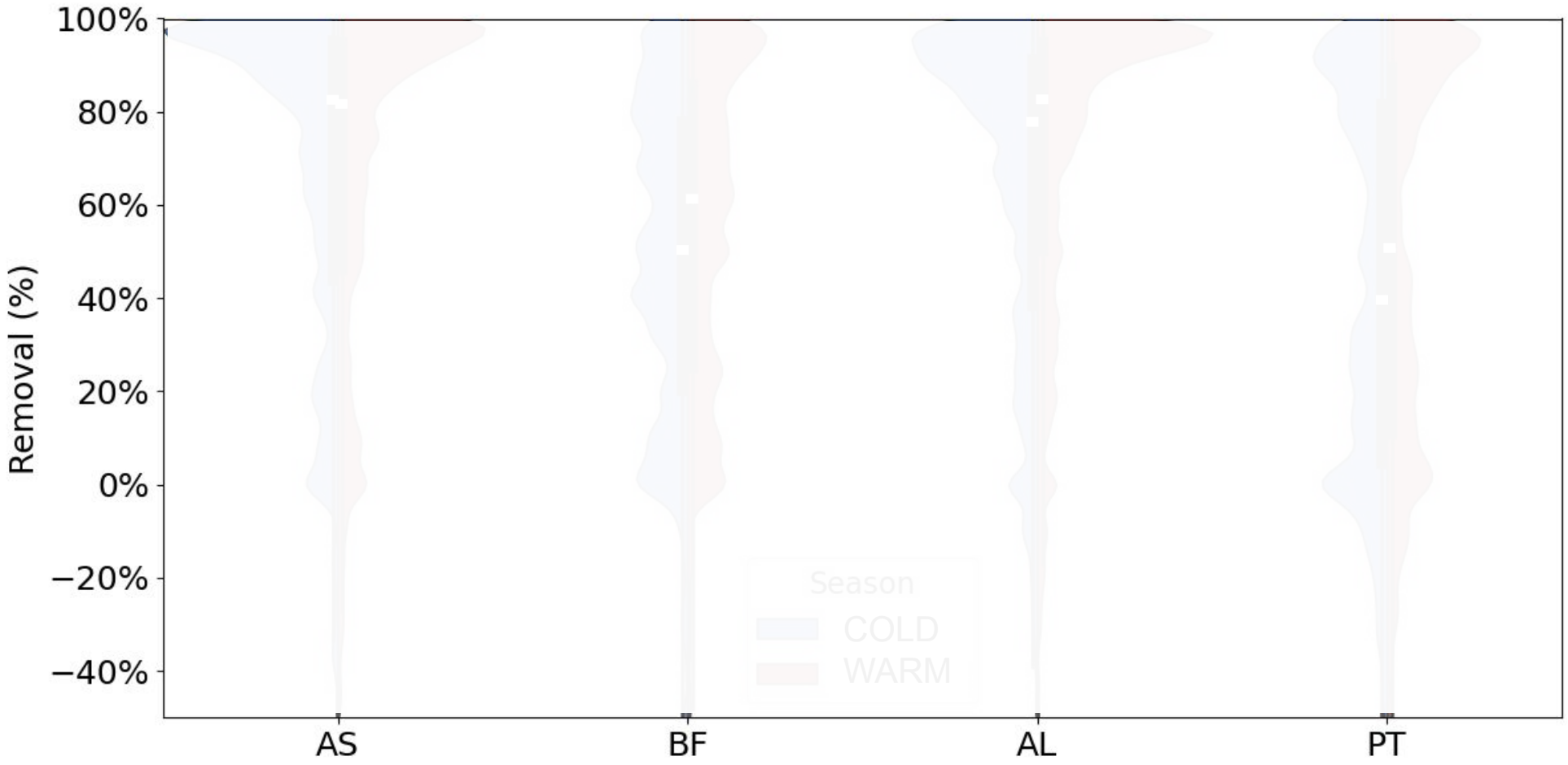


Aerated Lagoon



Primary treatment

Removal performance of WRRF



Median

	WARM	COLD
AS	78%	80%
BF	59%	47%
AL	81%	76%
PT	41%	33%

- **Little impact on removal**
- **BF & PT little more sensitive**

Conclusion

- Use of **detection limit** when the effluent concentration is under the LOD to get data on **minimal removal**
- **AL and AS appear to be better** performing than BF and PT for the molecules analyzed
- The **season has little impact** on the removal percentage for the molecules analyzed

What's next ?

- Collect **metadata** about WRRF and substances and use them to **understand observed removal** (SRT, HRT, nitrification, log Kow, H…)
- **Fate modelling** with WEST simulator (with micropollutant model library) to better understand the removal

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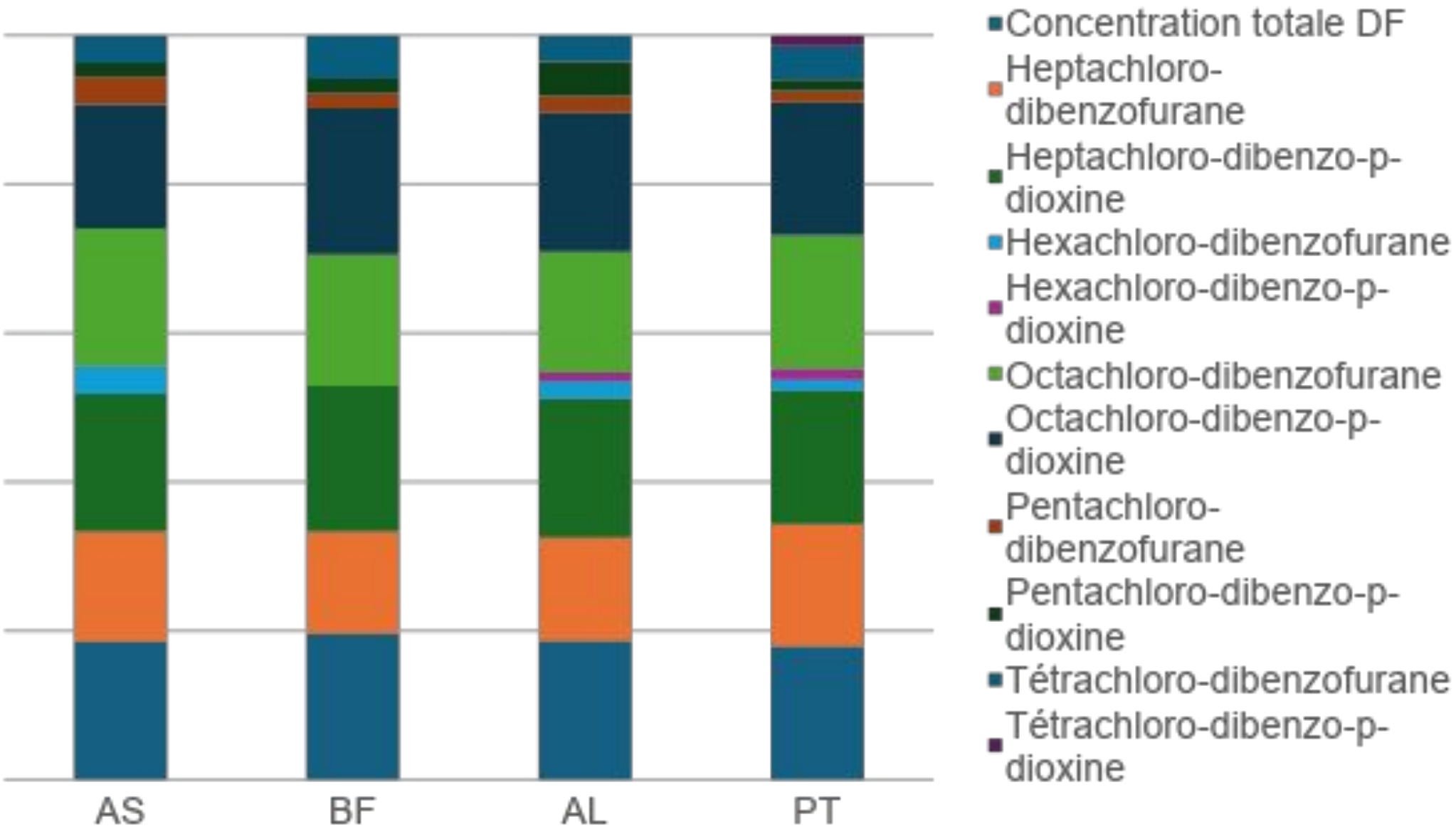
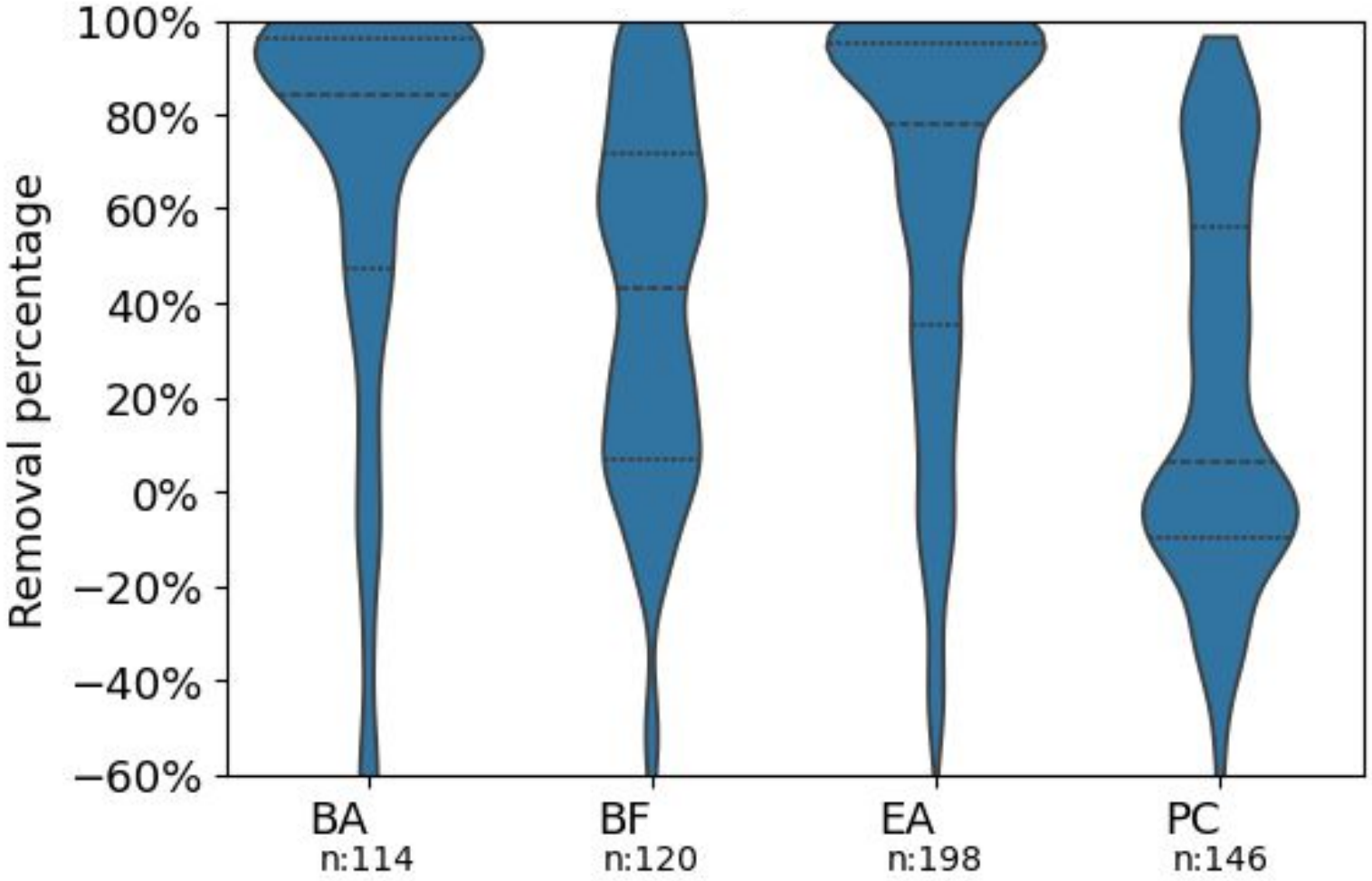
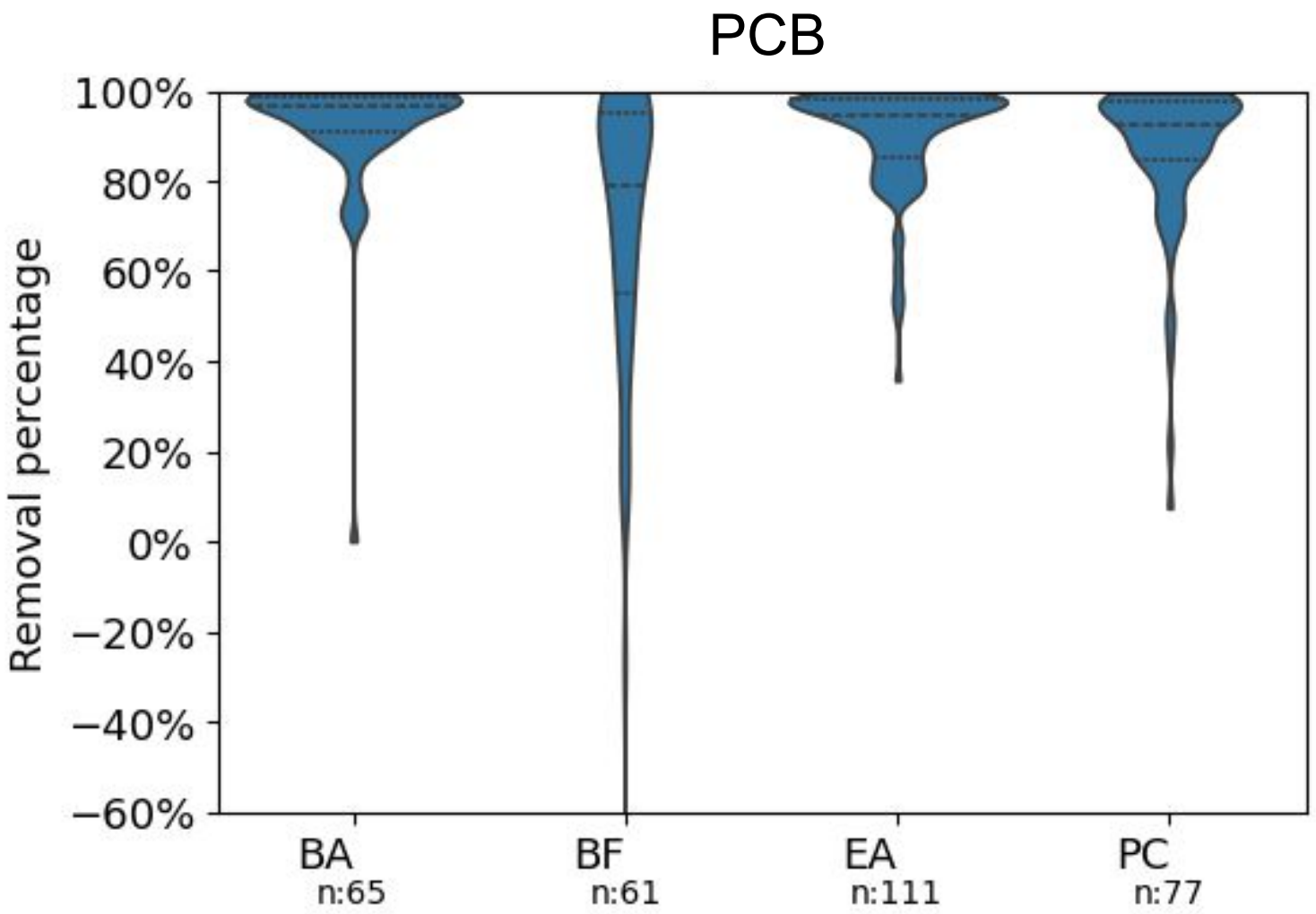
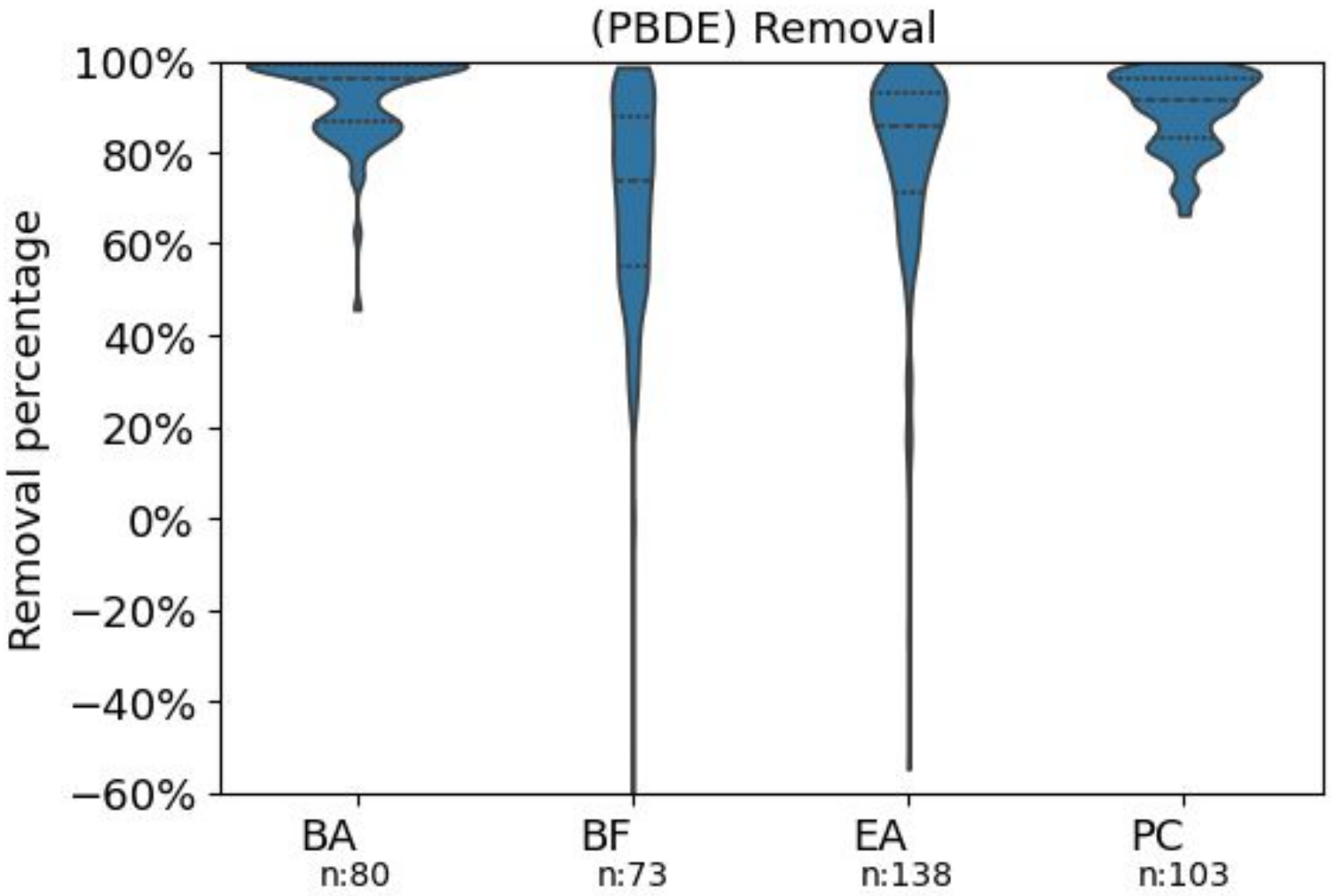

AS
BF
AL
PT
Concentration totale DF
Heptachloro-dibenzofurane
Heptachloro-dibenzo-p-dioxine
Hexachloro-dibenzofurane
Hexachloro-dibenzo-p-dioxine
Octachloro-dibenzofurane
Octachloro-dibenzo-p-dioxine
Pentachloro-dibenzofurane
Pentachloro-dibenzo-p-dioxine
Tétrachloro-dibenzofurane
Tétrachloro-dibenzo-p-dioxine

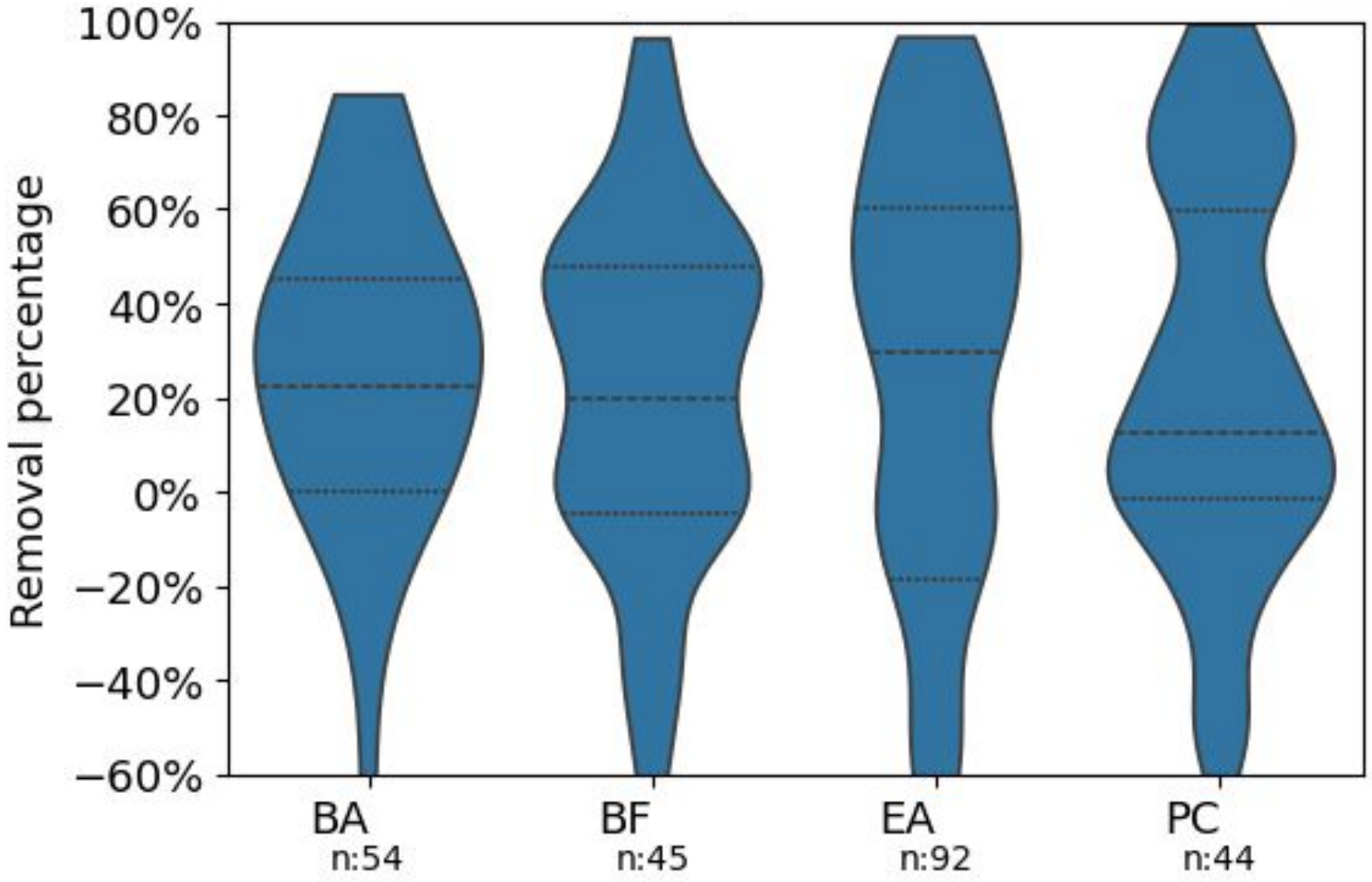
Pharmaceutical and Personnal Care Products



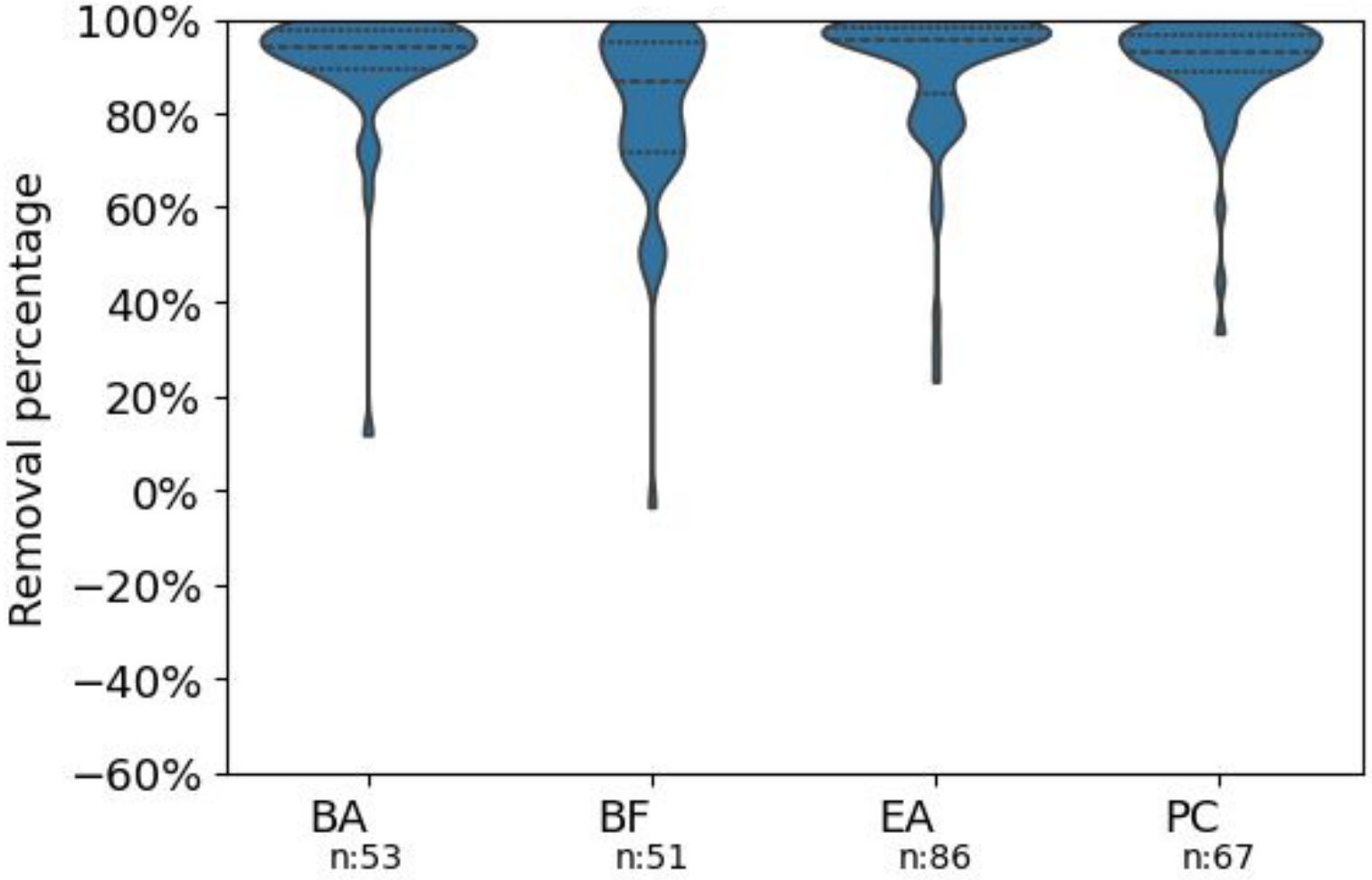

PCB
Removal percentage
100%
80%
60%
40%
20%
0%
−20%
−40%
−60%
BA
n:65
BF
n:61
EA
n:111
PC
n:77


(PBDE) Removal
Removal percentage
100%
80%
60%
40%
20%
0%
−20%
−40%
−60%
BA
n:80
BF
n:73
EA
n:138
PC
n:103

PFAS


Removal percentage
100%
80%
60%
40%
20%
0%
−20%
−40%
−60%
BA
n:54
BF
n:45
EA
n:92
PC
n:44

PFAS


Removal percentage
100%
80%
60%
40%
20%
0%
−20%
−40%
−60%
BA
n:53
BF
n:51
EA
n:86
PC
n:67