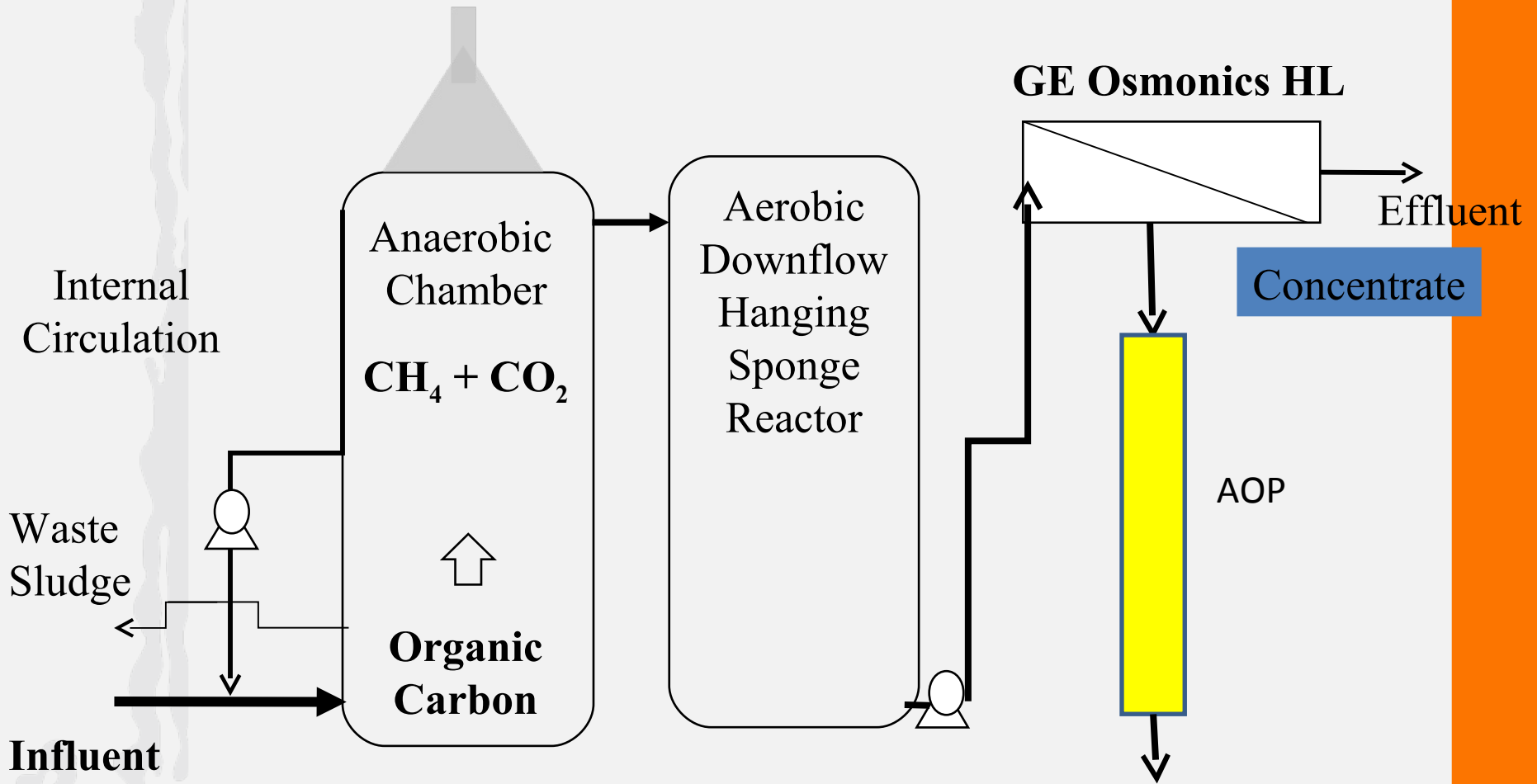


Advanced oxidation process treatment of
membrane filtration concentrate using
hydrogen peroxide and ultraviolet light

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Project overview

Membrane biological reactor, synthetic wastewater with $\approx 3300\text{ppm}$ of COD

MFC: SMP, dead cells, biofilm, low biodegradability, high organic concentration



Introducing

ADVANCED OXIDATION PROCESS

Chemistry

- $H_2O_2 + UV \rightarrow 2OH \cdot$
- $H_2O_2 + OH \cdot \rightarrow HO_2 \cdot + H_2O$
- $HO_2 \cdot + OH \cdot \rightarrow H_2O + O_2$
- $HO_2 \cdot + HO_2 \cdot \rightarrow H_2O_2 + O_2$
- $HO_2 \cdot + H_2O_2 \rightarrow H_2O + O_2 + OH \cdot$
- $OH \cdot + OH \cdot \rightarrow H_2O_2$
- **$OH \cdot + HCOOH + O_2 \rightarrow CO_2 + H_2O + HO_2 \cdot$**

One of the strongest oxidants in nature
(Zeta potential: +2.33V)

- Non-selectively reacts with organic molecules
- Break up cell membrane
- Remove COD, TOC, color and odor

Batch experiment

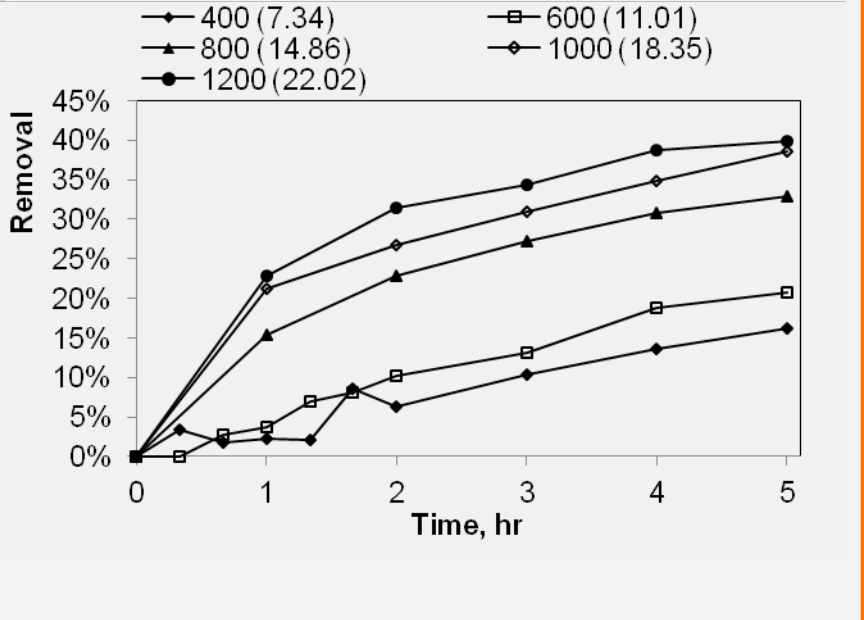
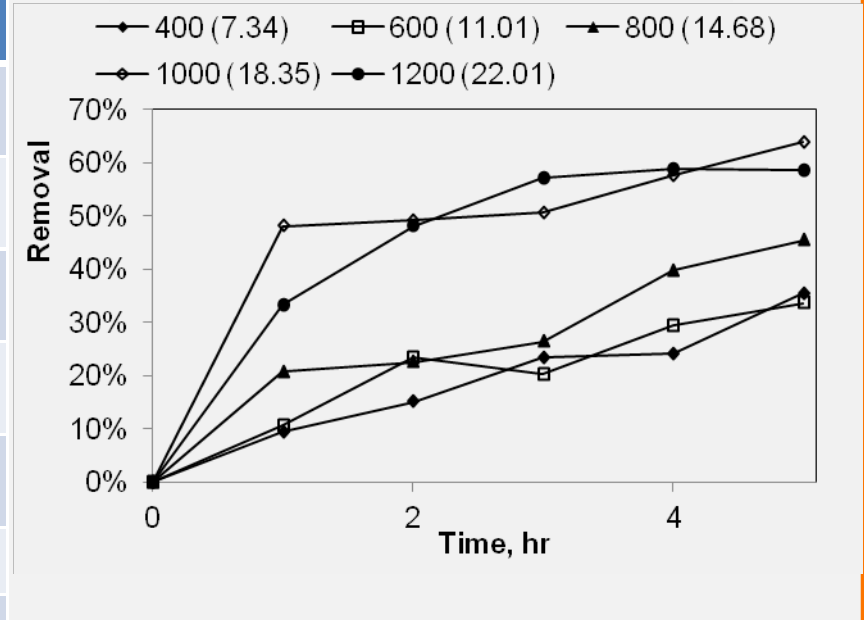
Table 1- Composition of NFC

Parameters	Unit	Concentration
TSS	mg/L	8.8 ± 0.96
VSS	mg/L	5.1 ± 0.68
COD	mg/L	46.0 ± 8.21
TOC	mg/L	16.0 ± 4.03
Ca	mg/L	40.1 ± 4.3
Mg	mg/L	31.9 ± 0.7
K	mg/L	572.2 ± 29.9
Na	mg/L	329.3 ± 5.4
pH	-	8.8 ± 0.098

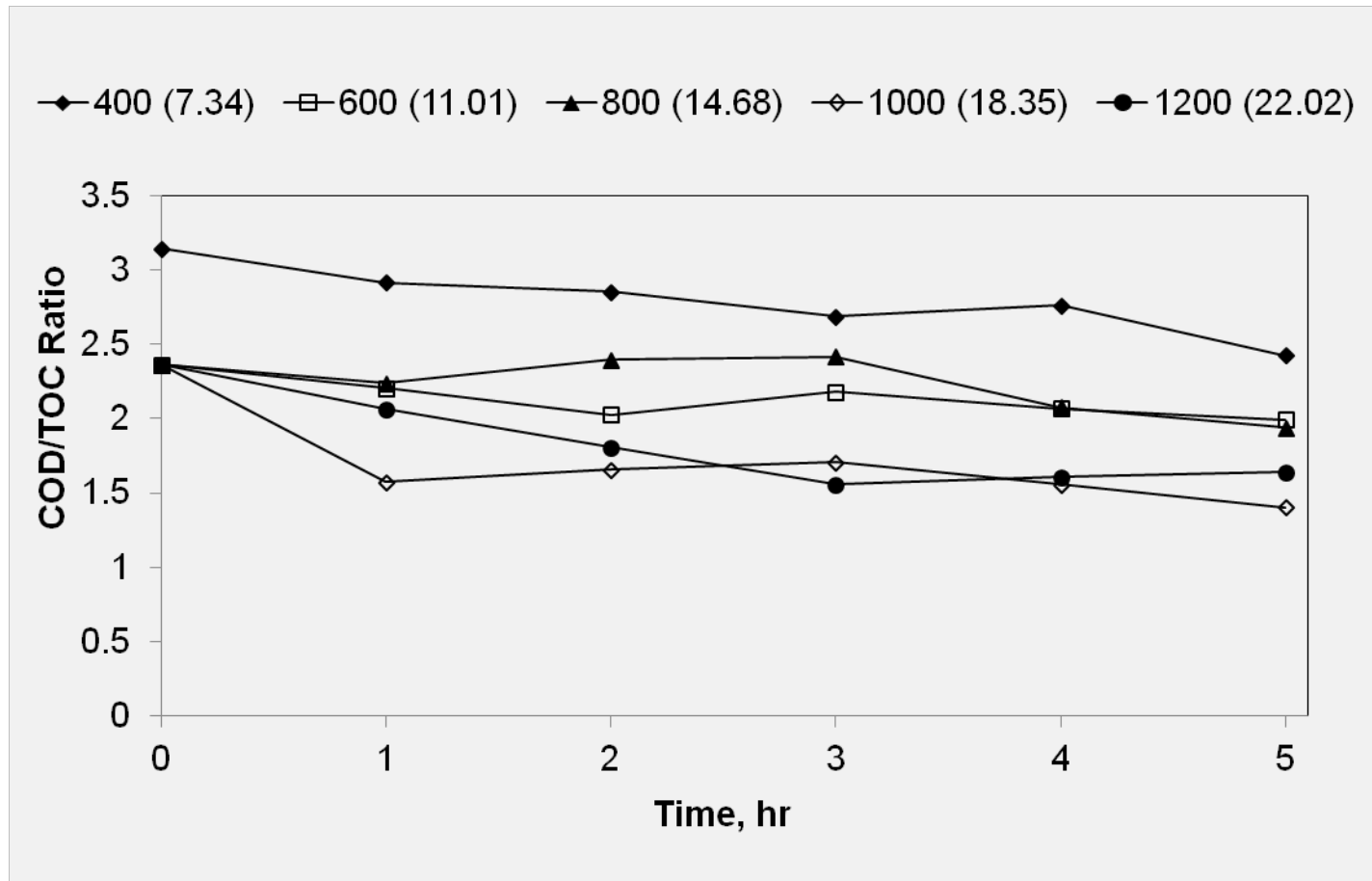
Table 2-Composition of Urbana WWTP secondary effluent

Parameters	Unit	Concentration
COD	mg/L	24 ± 0.075
TOC	mg/L	7.2 ± 0.082
pH	-	8.2 ± 0.06

Filtration concentrate

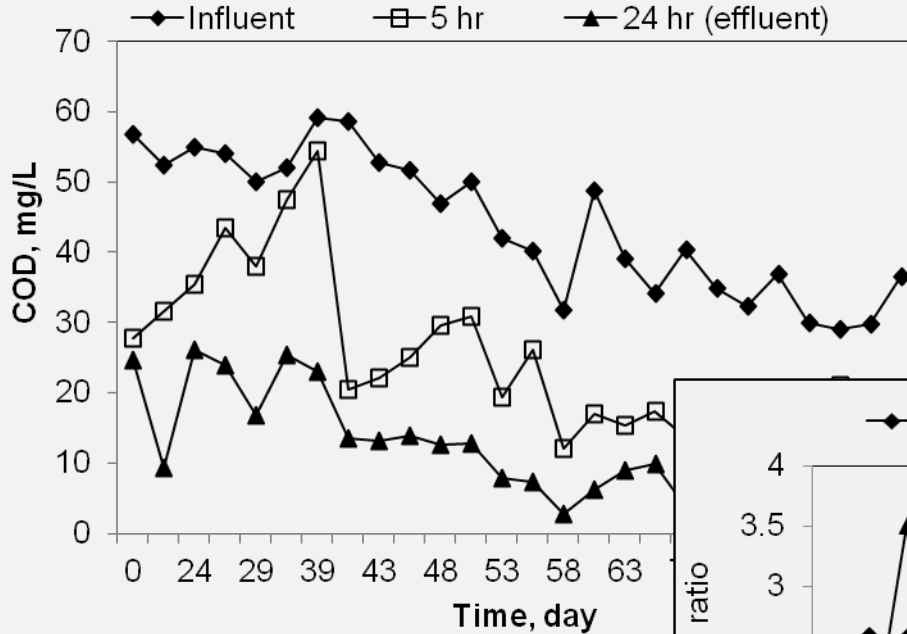


Results and COD/TOC ratio change



Resistance to dichromate oxidation increased

AOP running in sequential batch mode



Removal efficiency without UV malfunction

5 hours: COD- 53.04%±8.85%

TOC- 35.48%±3.53%

24 hours: COD- 82.98%±7.94%

TOC- 63.09%±5.19%

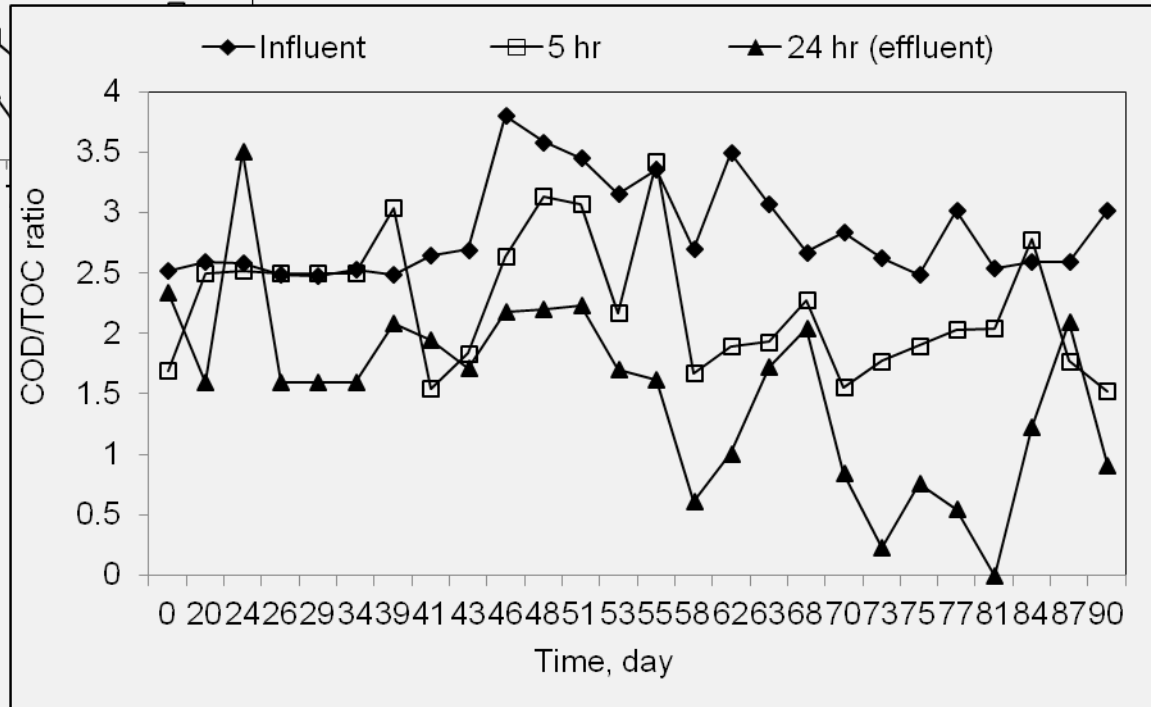
Removal efficiency

5 hours: COD- 45.92%±14.32%

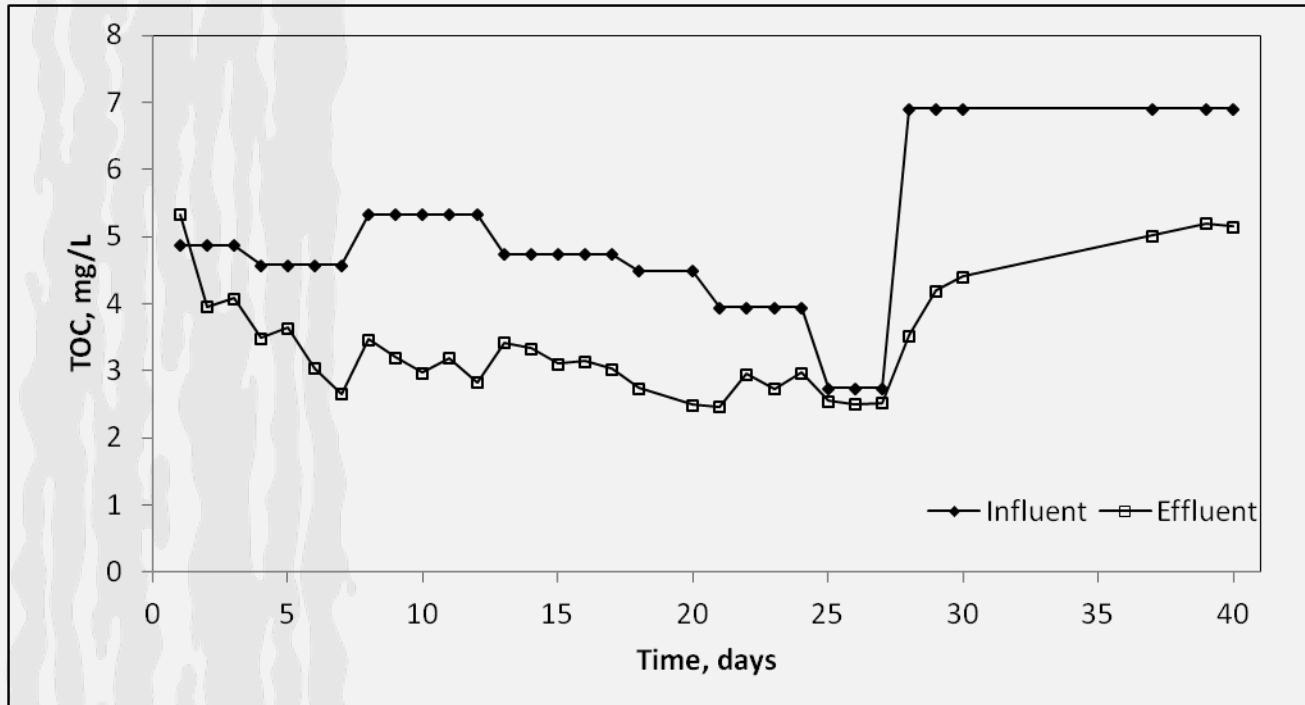
TOC- 32.67%±5.54%

24 hours: COD- 77%±10.9%

TOC- 59.36%±7.9%



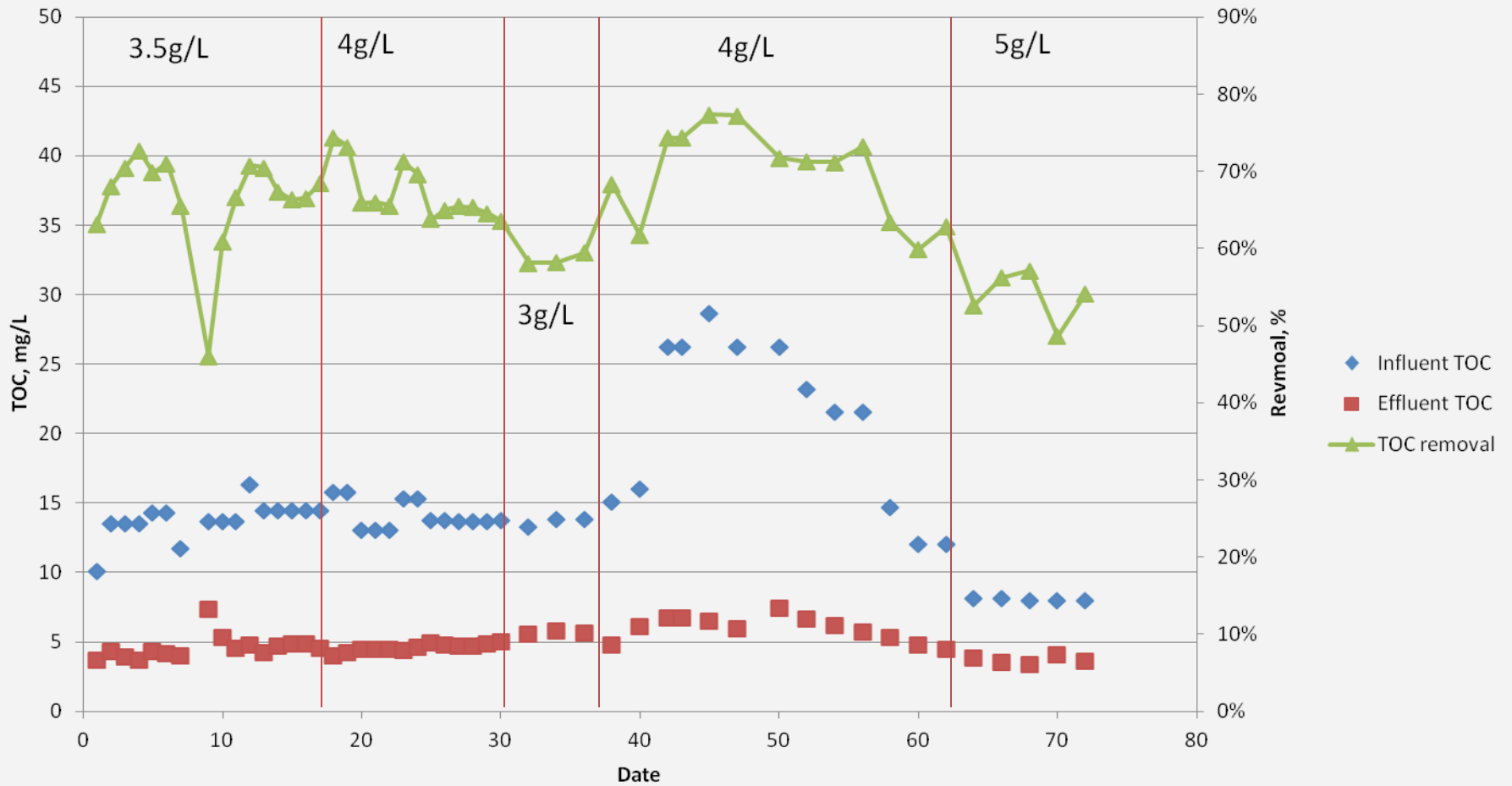
Post treatment- Biofilm reactor



- Average TOC removal: 30.63%±9.13%
- COD/TOC ratio increased and COD concentration increased
- Overall TOC removal: 78.65%

Recent works- AOP CSTR

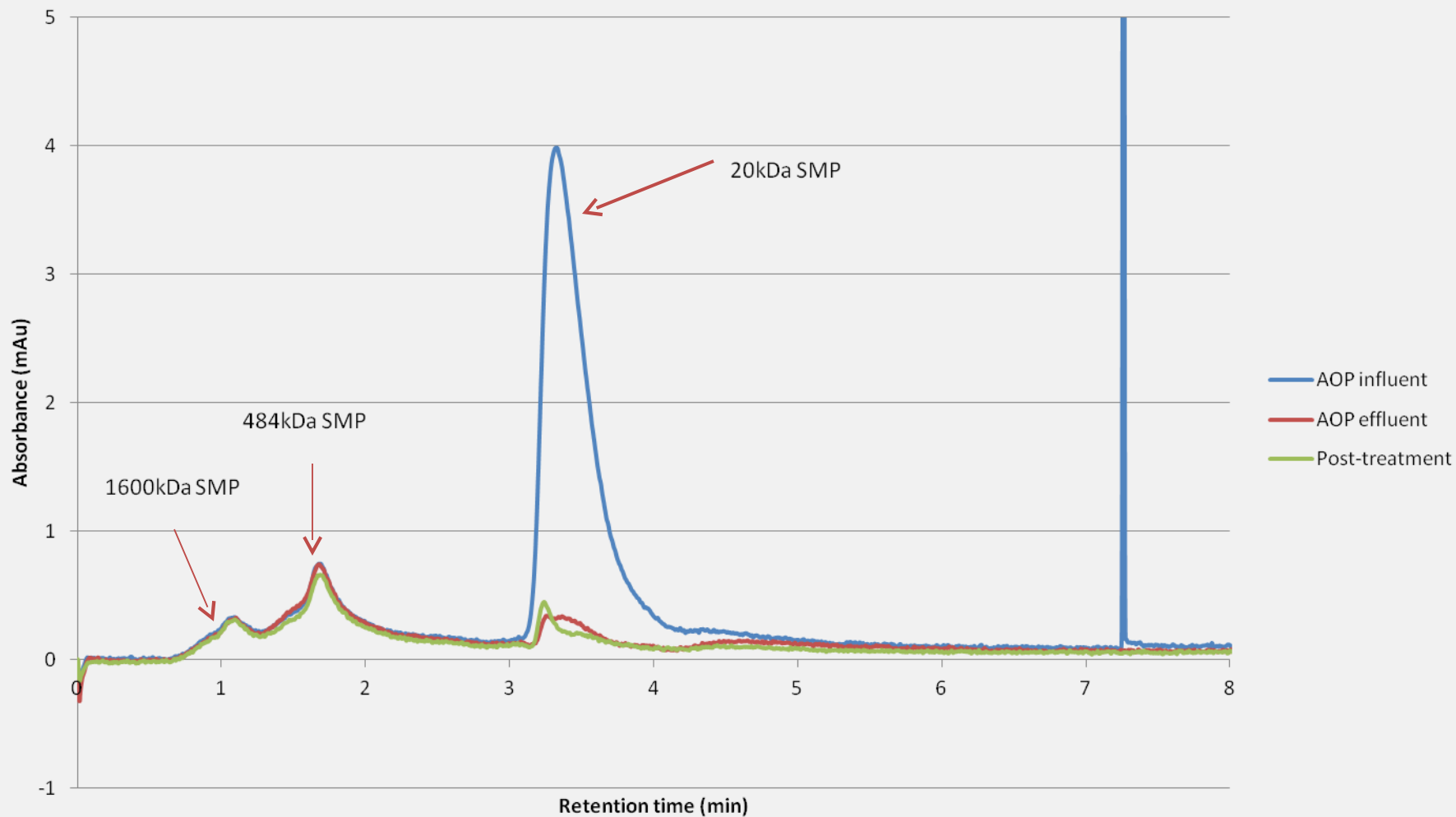
CSTR AOP performance-TOC



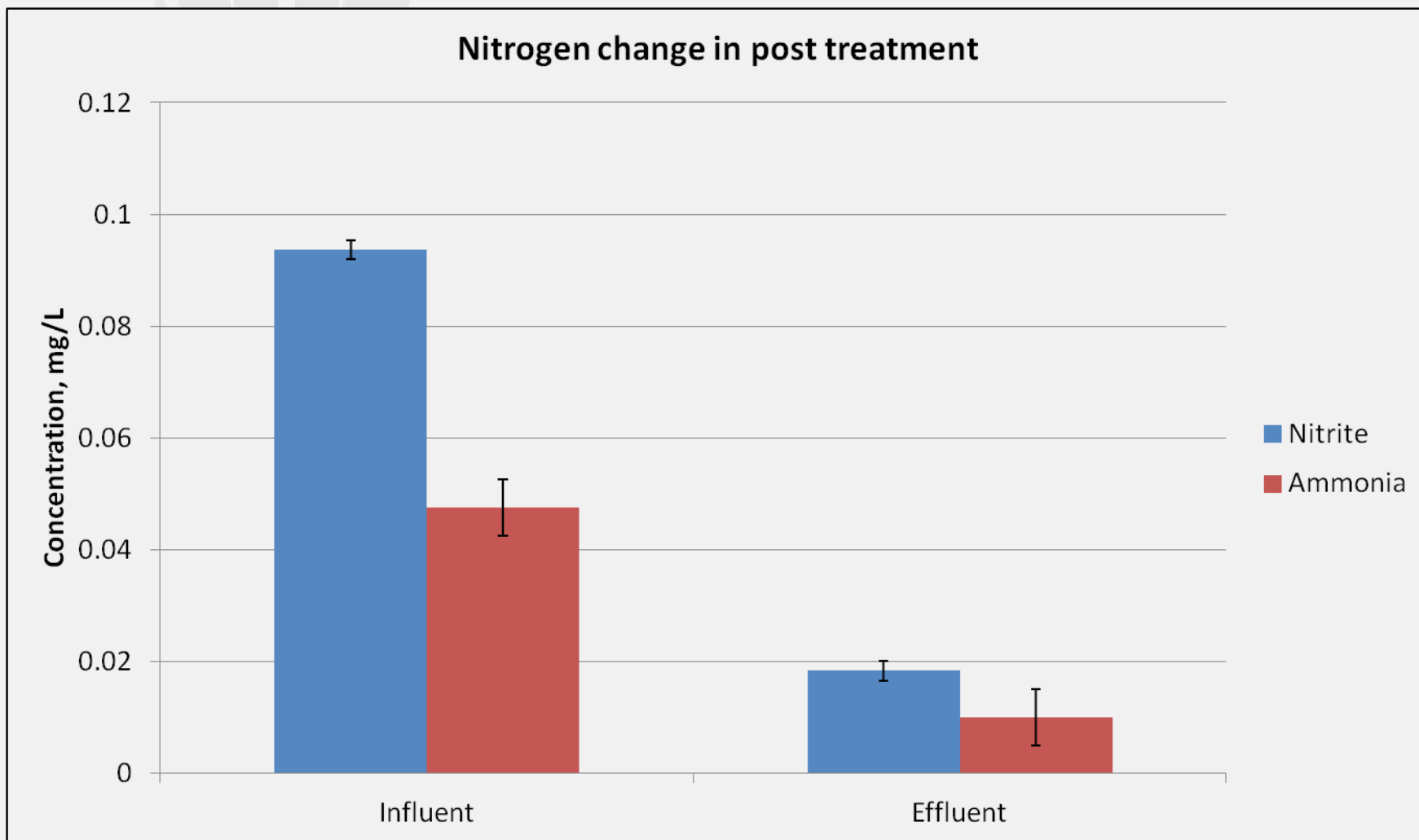
Average removal efficiency: COD- 76.46%±7.29%, TOC- 65.79%±5.27%

Recent works-HPLC analysis

HPLC Chromatograph



Recent works-Post treatment



Average TOC removal: 35.88%±9.93%

Questions?



Post treatment performance-COD

