SMALL & SMART

Real time control of the SBR process for the treatment of variable wastewater, using robust and low-cost online sensors

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Content

- The problem
- A potential solution
- Back in the “old days”
- Conclusion

The **T**ank-**T**ruck **C**leaning case

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Sludge toxicty

Discharge limits (COD)

ECO-toxicity

Variability

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Problem n°1 = variable wastewater

Composition of pre-treated TTC wastewater

	Min.	Max.	Avg. ± SD	% CV
COD (mg/L)	1024	3000	2078 ± 409	20
NH_4-N (mg/L)	57	194	115 ± 30	26
COD/N (-)	9	33	19 ± 5	28

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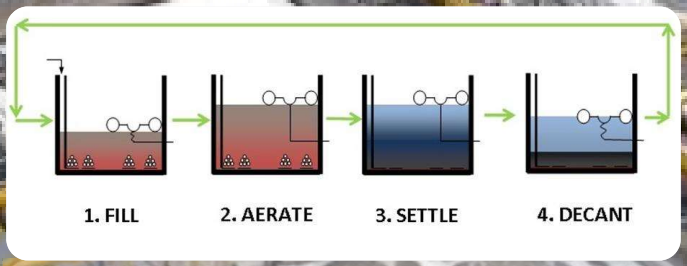
Problem n°2 = fixed SBR cycle



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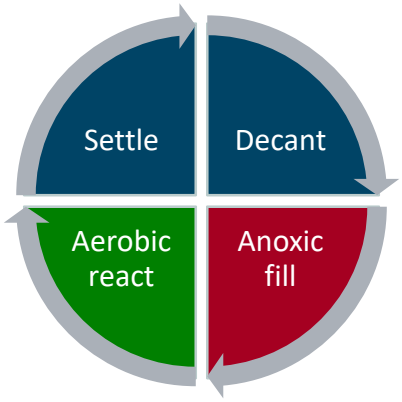
The solution = dynamic process



Anoxic fill phase:
- denitrification
- ORP profile (pH)

Aerobic react phase:
- COD oxidation
- nitrification
- OUR profile

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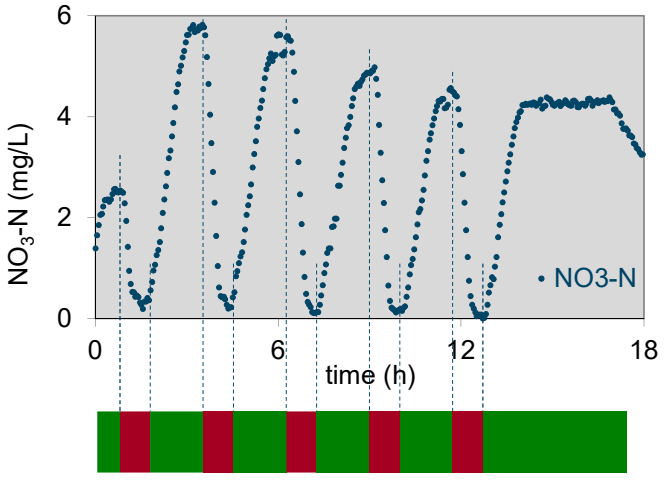
Anoxic phase control in a step-feed SBR



Anoxic fill

Aerobic react

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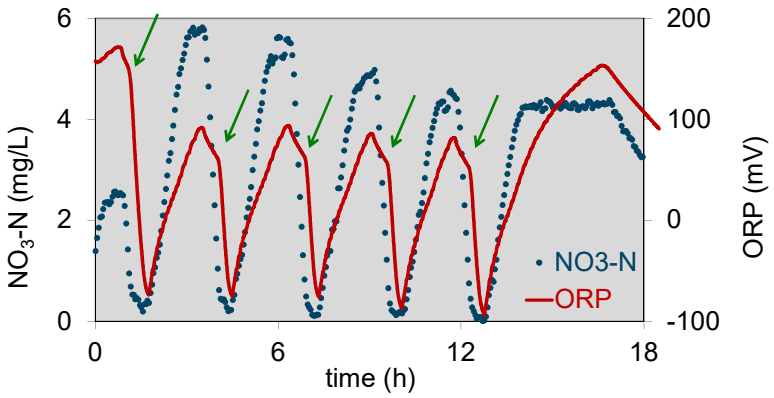
Anoxic phase control: **ORP knee**



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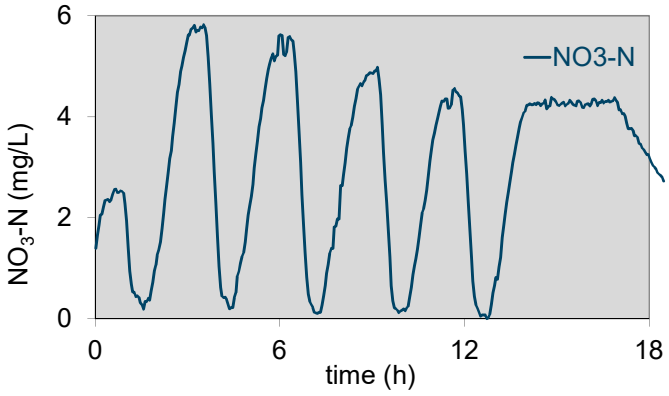
Aerobic phase control



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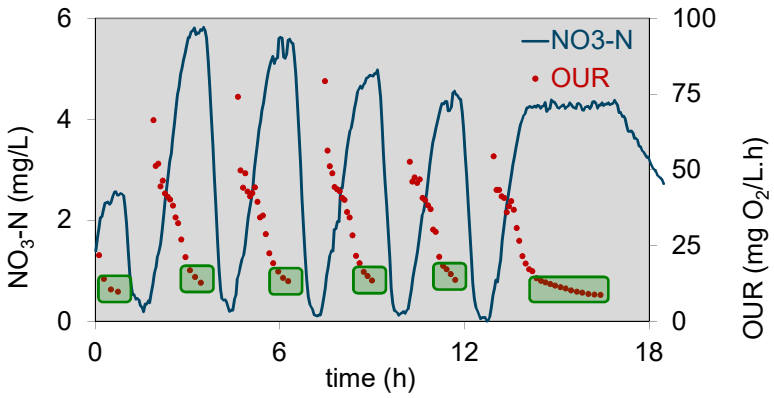
Aerobic phase control: **low & constant OUR**



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Impact on effluent quality?

COD & N in the effluent

	Min.	Max.	Avg. ± SD
COD (mg/L)	63	283	153 ± 50
NH_4-N (mg/L)	0.8	7.2	3 ± 1
NO_3-N (mg/L)	0.7	4.2	2 ± 1

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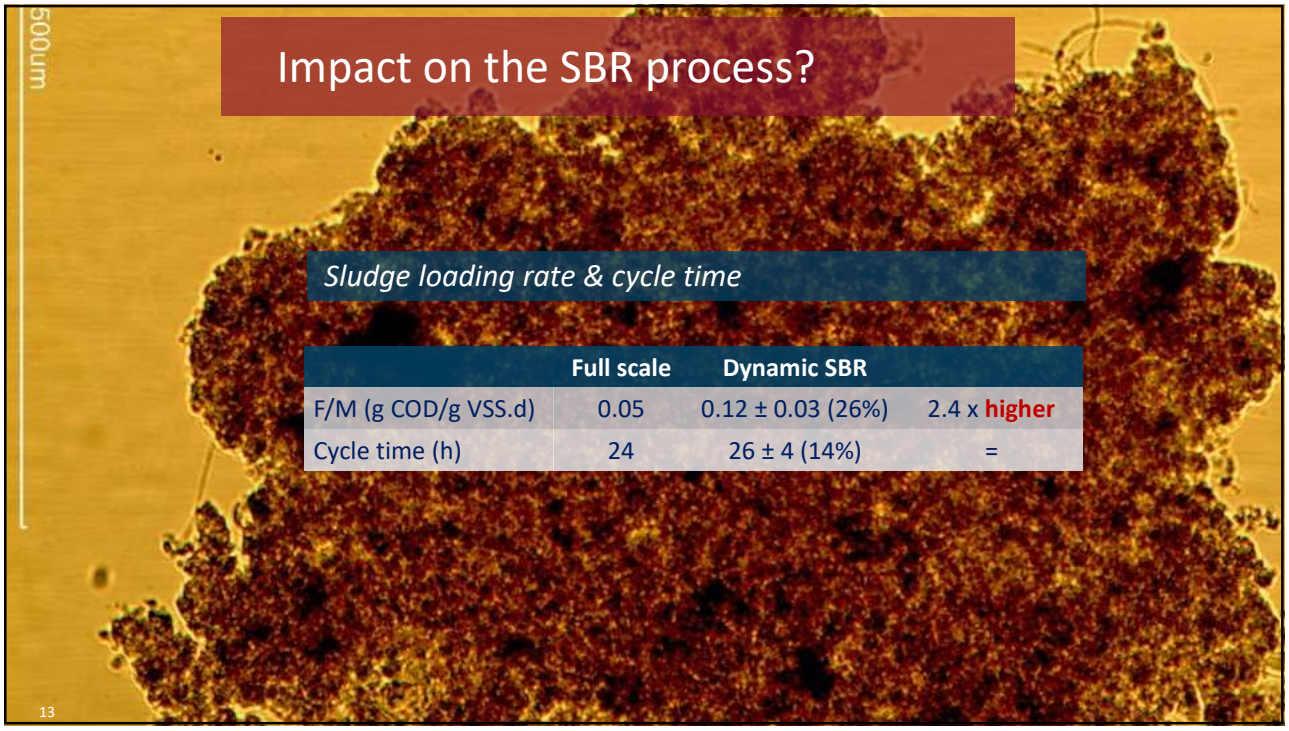

Impact on the SBR process?

Sludge loading rate & cycle time

	Full scale	Dynamic SBR	
F/M (g COD/g VSS.d)	0.05	0.12 ± 0.03 (26%)	2.4 x **higher**
Cycle time (h)	24	26 ± 4 (14%)	=

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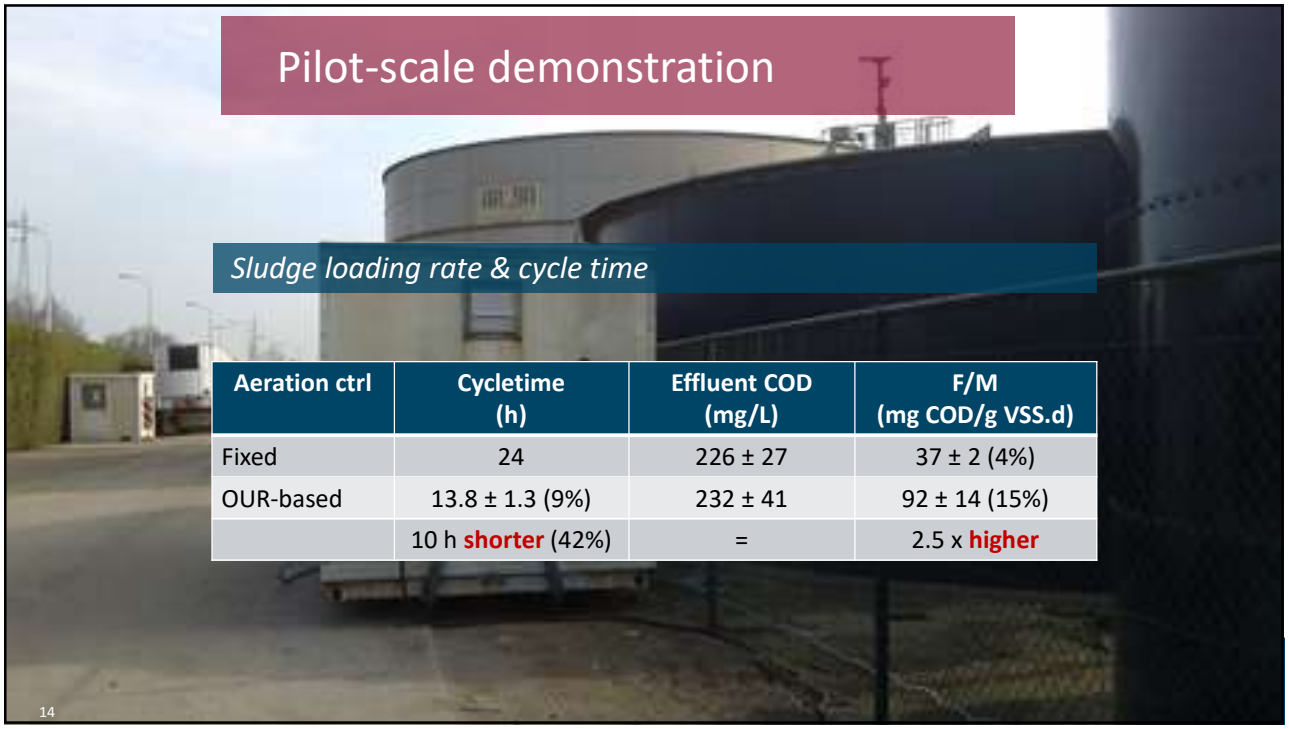

Pilot-scale demonstration

Sludge loading rate & cycle time

Aeration ctrl	Cycletime (h)	Effluent COD (mg/L)	F/M (mg COD/g VSS.d)
Fixed	24	226 ± 27	37 ± 2 (4%)
OUR-based	13.8 ± 1.3 (9%)	232 ± 41	92 ± 14 (15%)
	10 h **shorter** (42%)	=	2.5 x **higher**

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Conclusions, *part 1*

Simple *rule-based* control strategy using robust sensors

SBR cycle with variable length, depending on

- characteristics of the wastewater
- activity of the micro-organisms

But…

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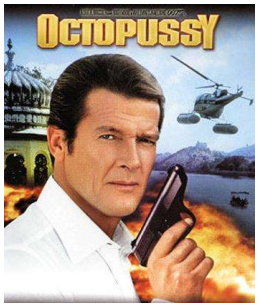
Images of 1983



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Conclusions, *part 2*

400 industrial AS systems

48% SME

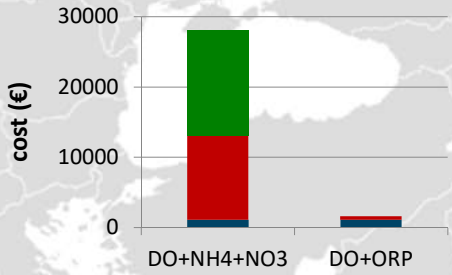
64% BNR

35% SBR

23% has energy data

96% equipped with DO

< 10% NO_3 and/or NH_4



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More info?

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- Real-time control:
  Dries (2016) WST 73: 740-745
- Ecotoxicity in industrial effluents:
  Caluwé *et al*. (2018) Environmental Technology 39: 2524-2533
- Industrial WWTP survey in Flanders:
  Cornelissen *et al.* (2018) WST 78: 957-967

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