

INFLUENCE OF WASTEWATER COMPOSITION ON THE MICROBIAL COMMUNITIES OF AEROBIC GRANULAR SLUDGE

Aline Adler, Valérie Berclaz, Marie Horisberger, Julien Maillard and Christof Holliger





Microbial processes for wastewater treatment

Activated sludge

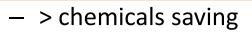
- Conventional microbial process in wastewater treatment plants
- Floccular structures, settle slowly

Aerobic granular sludge

- Granular structures, settle fast
- Allows high sludge concentration

footprint and energy saving







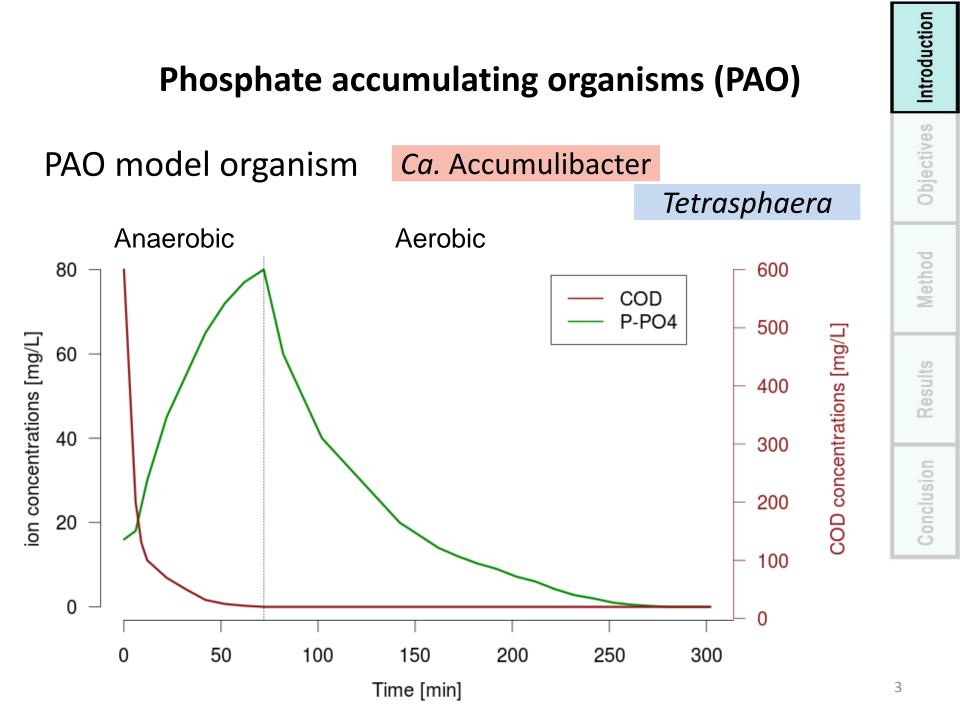




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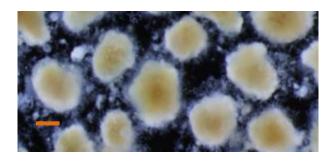
Method

Results

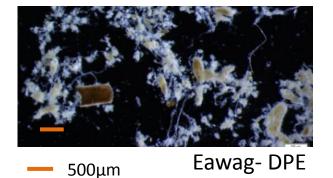


Aerobic granular sludge (AGS) for wastewater treatment

AGS fed with simple synthetic wastewater ...



... and with raw municipal wastewater

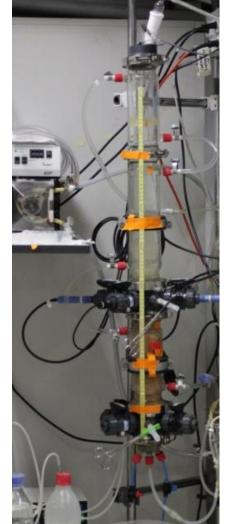


- Are fermentable or polymeric compounds responsible for this difference ?
- How do they impact the settling characteristics,
 - the nutrient removal,
 - the microbial communities of the AGS?

Influence of particulate substrates on AGS

1st experiment (DPE-Eawag)

- Start-up AGS from activated sludge
- 4 reactors in parallel with different wastewater
 - Simple synthetic (VFA)
 - Complex synthetic (VFA, glucose, amino acids, starch, peptones)
 - Primary effluent wastewater
 - Raw wastewater



Objectives

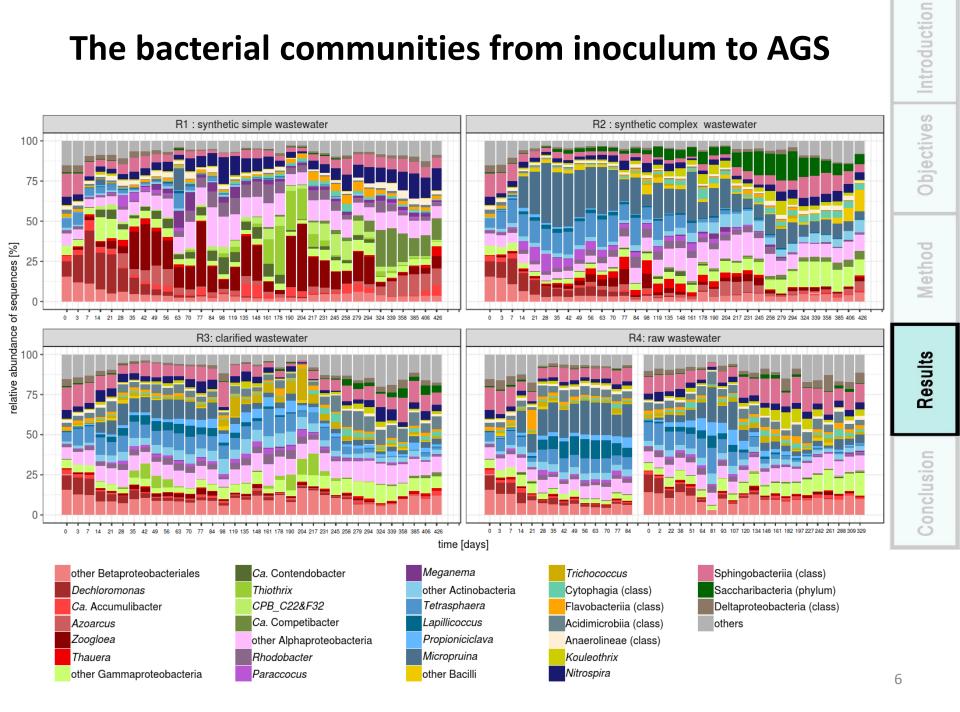
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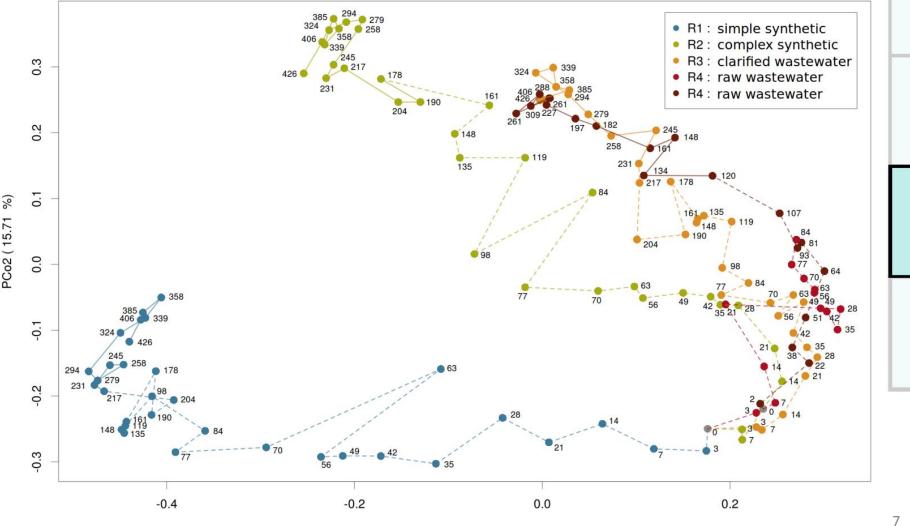
Conclusion

lab-scale reactor

The bacterial communities from inoculum to AGS



Principal component analyses of the bacterial communities from activated sludge inoculum to AGS



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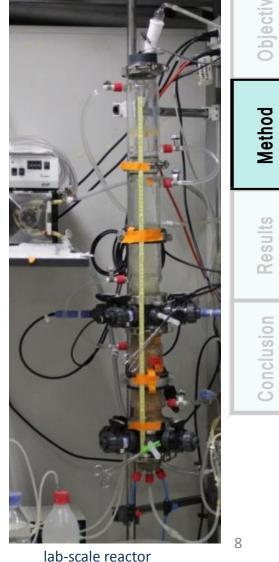
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Influence of particulate substrates on AGS

2nd experiment at EPFL (LBE)

- Progressively change the wastewater composition
 - From **simple** synthetic (VFA)
 - To complex synthetic monomeric (VFA, glucose, amino acids)
 - To complex synthetic polymeric (VFA,

glucose, amino acids, starch, peptone)

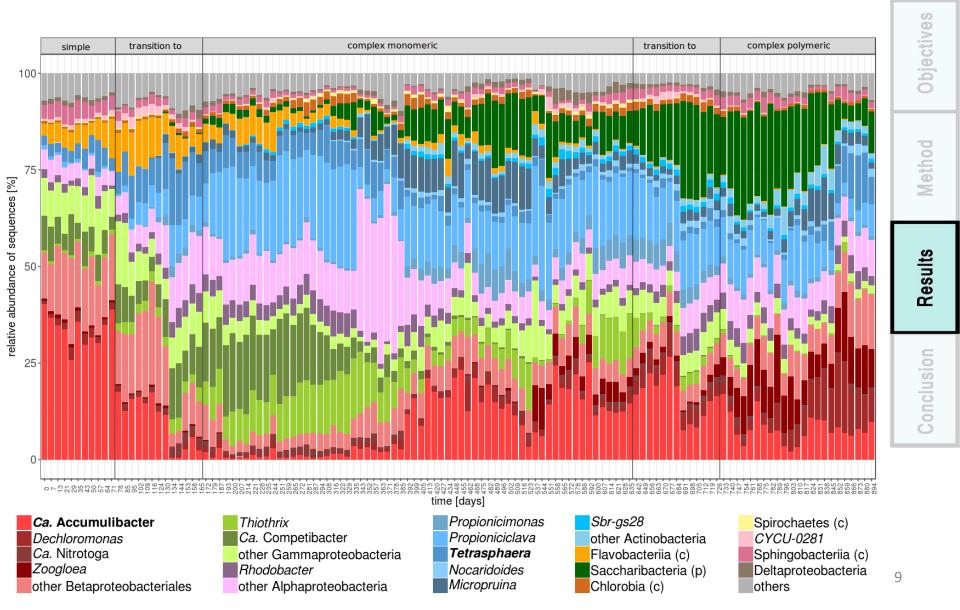


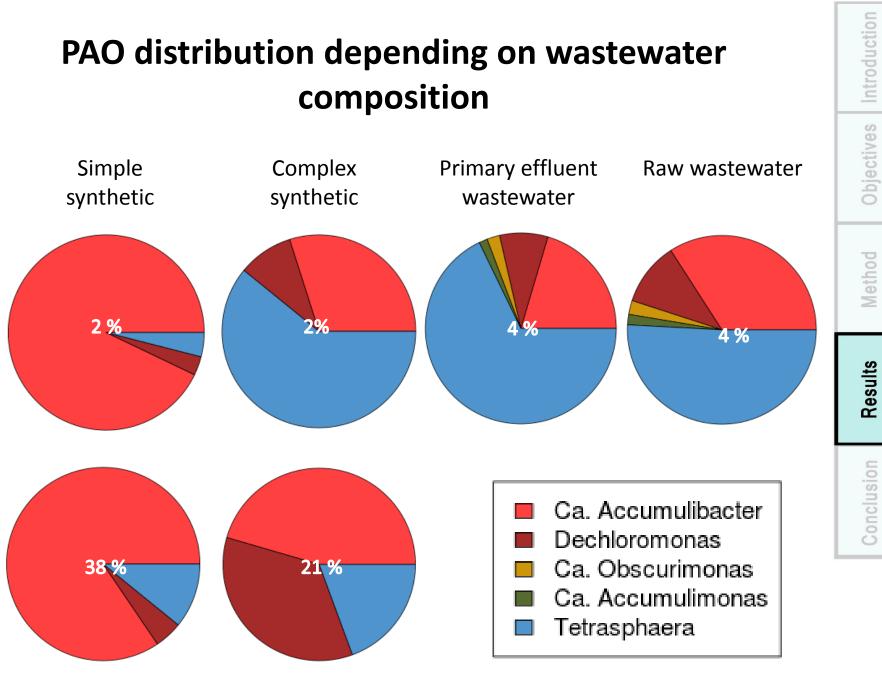
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The bacterial communities during the transition from simple to complex polymeric wastewater





EPFL

Eawag

Properties of aerobic granular sludge treating different wastewaters

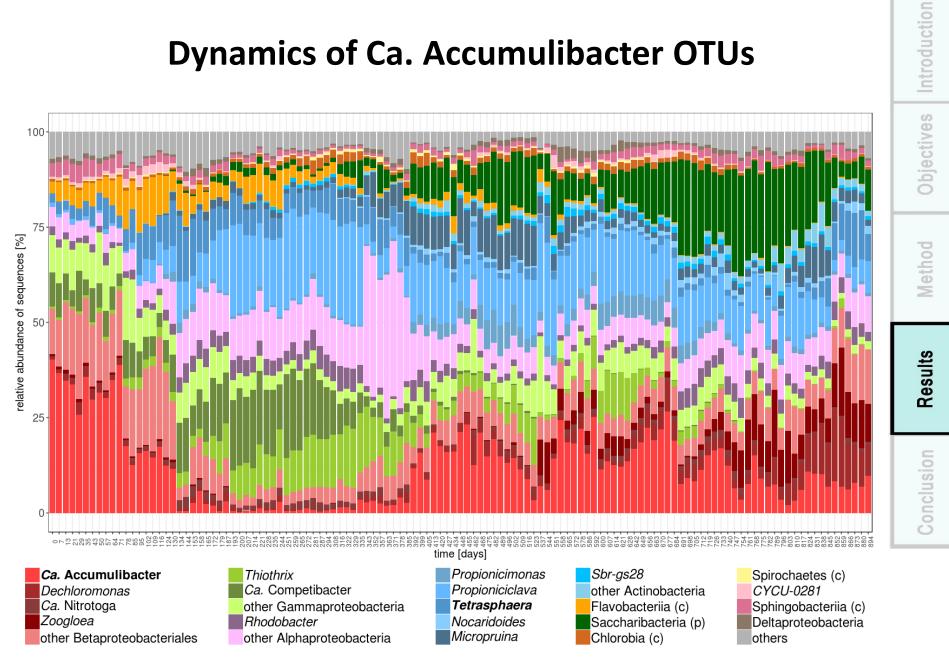
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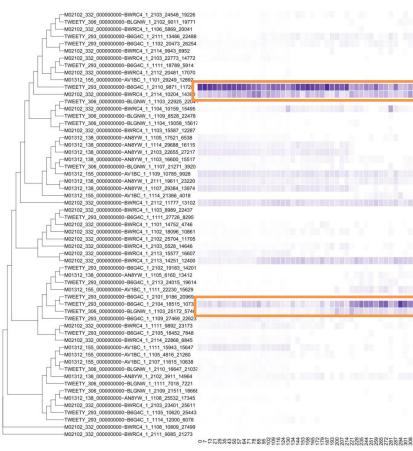
Results

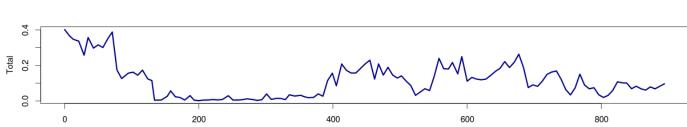
Wastewater	Dominant PAO	N-removal	P-removal	Settling properti	ies
synthetic simple	Accumulibacter	++	+++	+++	
synthetic complex monomeric	Accumulibacter Tetrasphaera (Dechloromonas)	++	+++	+++	
synthetic complex polymeric	Accumulibacter Tetrasphaera (Dechloromonas)	+	++	+	flocs
municipal wastewater	Accumulibacter Tetrasphaera (Dechloromonas)	+	++	+	

Dynamics of Ca. Accumulibacter OTUs



Dynamics of Ca. Accumulibacter OTUs





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Conclusions

- AGS fed with complex synthetic wastewater is more similar to AGS treating municipal wastewater than the traditional simple synthetic wastewater. It offers a tunable model to study AGS systems.
- Ca. Accumulibacter was the predominant PAO with the simple wastewater. With the fermentable and polymeric compounds, the guild of PAO was more diverse.
- Different OTU affiliated to a single genus can have different dynamics.

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<u>LBE - EPFL</u>

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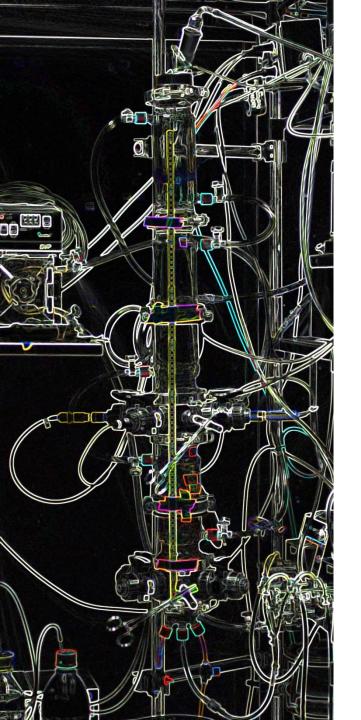


DPE - Eawag

Manuel Layer Nicolas Derlon Eberhard Morgenroth

<u>SIB - Vital-it</u> Marco Pagni

Swiss National Science Foundation



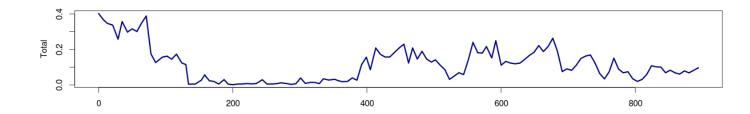
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wastewater compositions

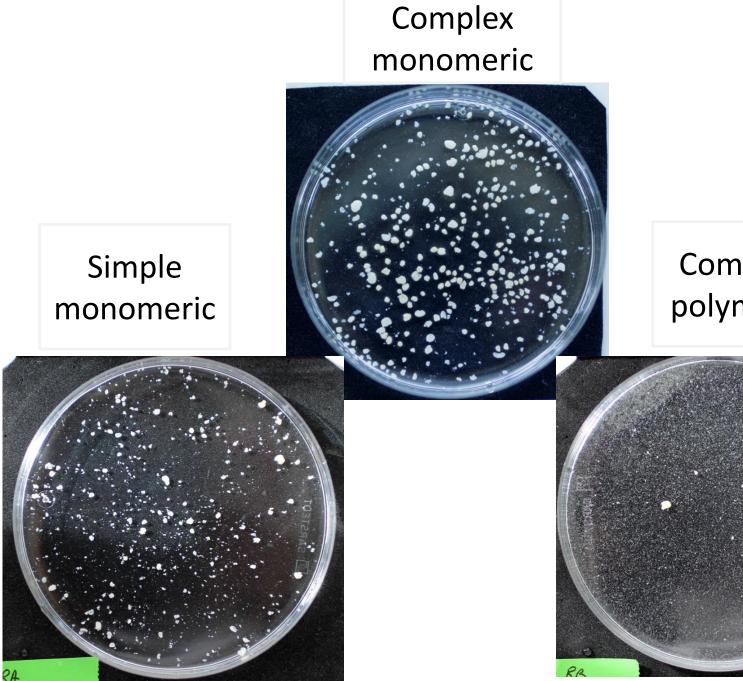
wastewater compositions						Introduction		
	Medium	COD [mgO2/L]	VFA	Glucose and amino acids	Starch and peptones	Phosphorus [mg/L] (filtered)	Nitrogen [mg/L] (filtered)	Objectives 1
EPFL	Simple synthetic	450	100 %	-	-	22	56	
	Complex synthetic monomeric	600	33 %	66 %	-	22	56	Method
Eawag	Simple synthetic	600	100 %	-	-	6	44	Results
	Complex synthetic polymeric	600	33 %	33 %	33 %	6	38	Conclusion
	Primary effluent wastewater	370	10 %	NA	NA	3	28	0
	Raw wastewater	800	5 %	NA	NA	3	30	17

OTU dynamic of Ca. Accumulibacter

	M02102_332_00000000-BWRC4_1_2103_24548_19226	
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	TWEETY_293_00000000-B6G4C_1_2111_13486_22488	
	TWEETY 293 00000000-B6G4C 1 1102 20473 26254	
	M02102_332_00000000-BWRC4_1_2114_9943_6952	
	M02102 332 00000000-BWRC4 1 2103 22773 14772	
	M02102_332_00000000-BWRC4_1_2112_20481_17070	
	M01312 155 00000000-AV1BC 1 1101 29249 12892	
— — — — — — — — — — — — — — — — — — —	TWEETY_293_00000000-B6G4C_1_2110_9871_11728	
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Complex polymeric

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