Phosphorus-Recovery from Waste Activated Sludge (WAS) in Enhanced Biological Phosphorus removal (EBPR) Processes

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NEW ENGLAND WATER ENVIRONMENT ASSOCIATION
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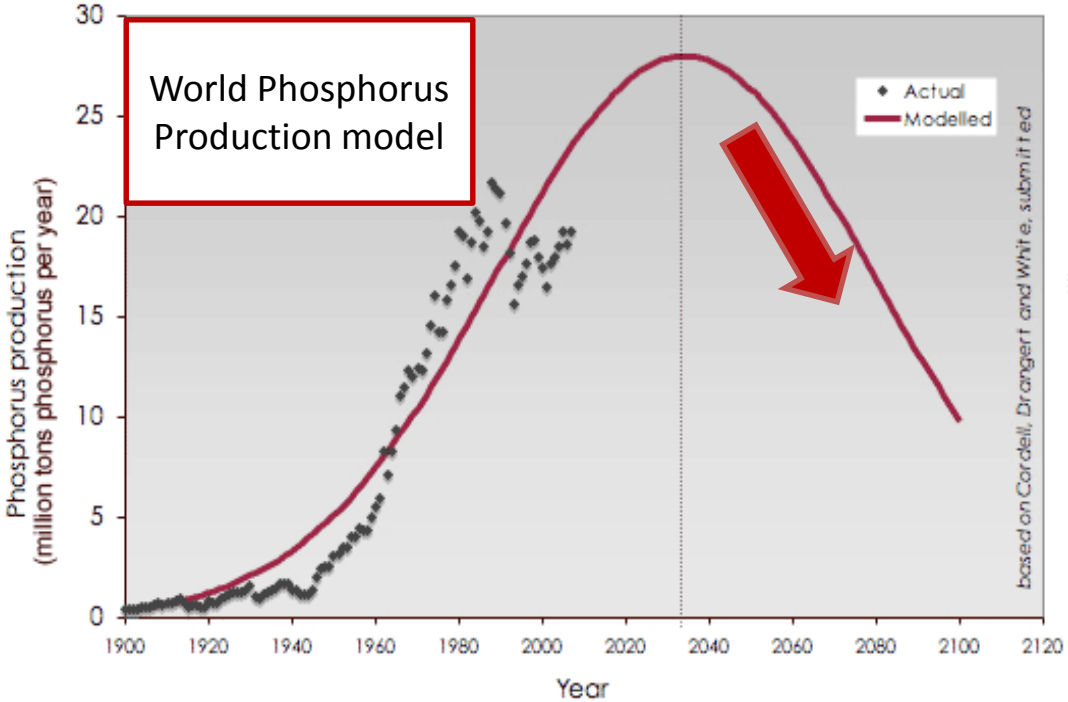
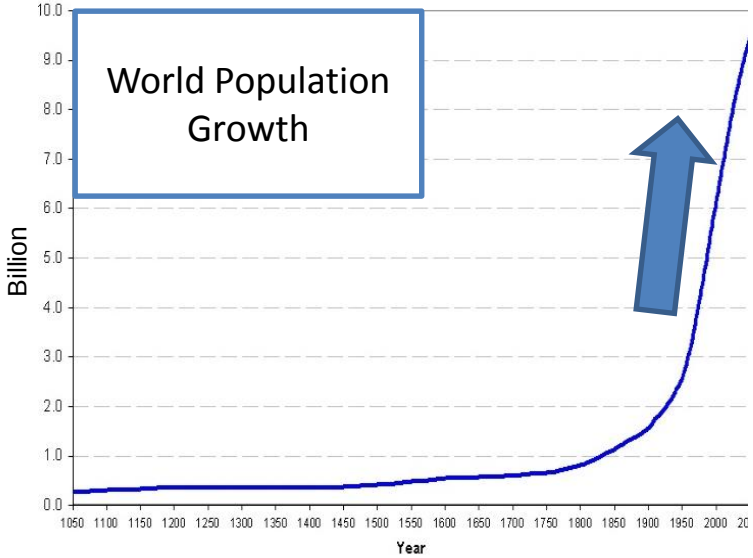
Phosphorus –- Not Reusable Resource

- ❑ Pollution
- ❑ Decreasing Stock
- ❑ Increasing Requirement

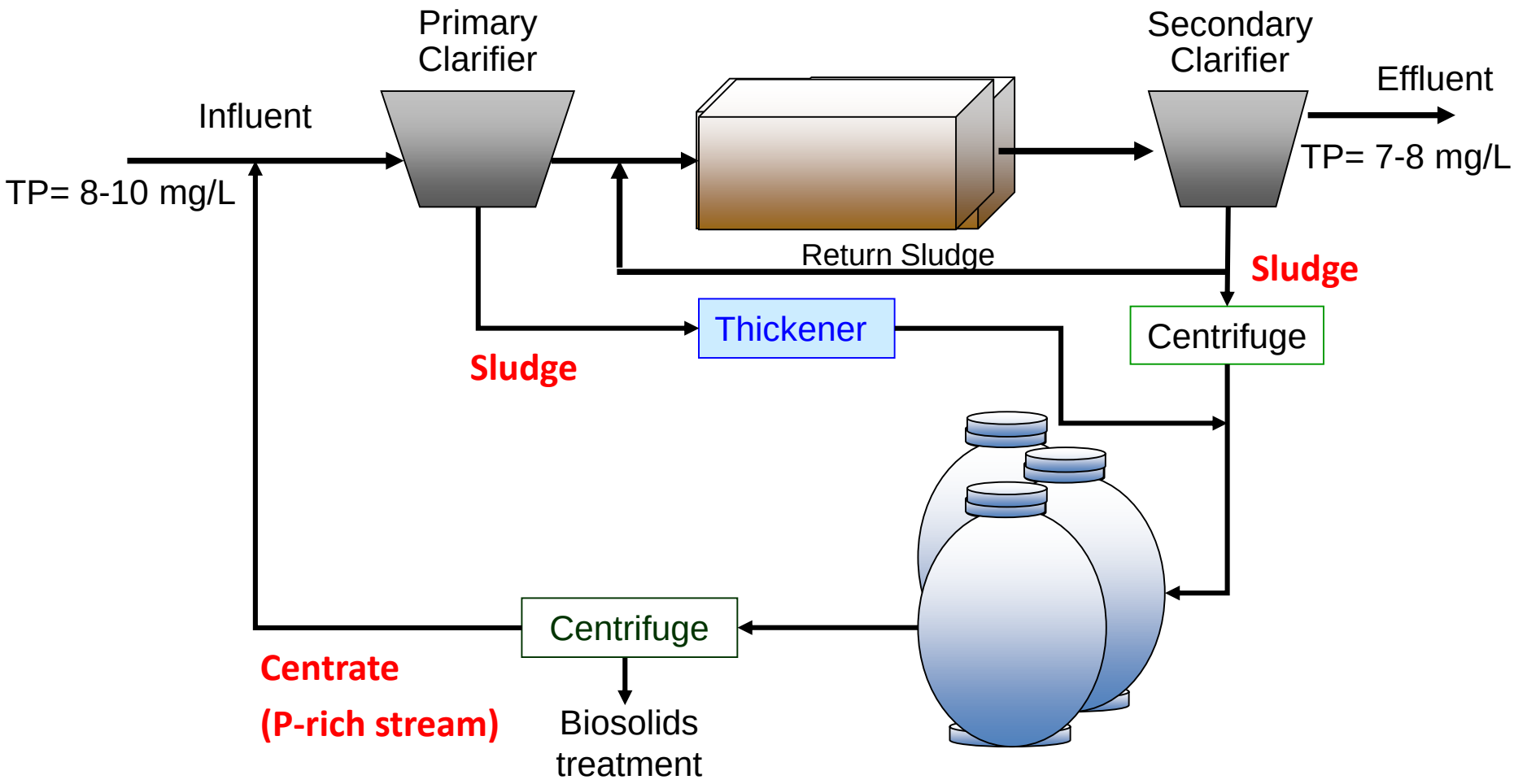
www.lincoln.ne.gov/city/pworks/watrshed/educate/fertiliz/



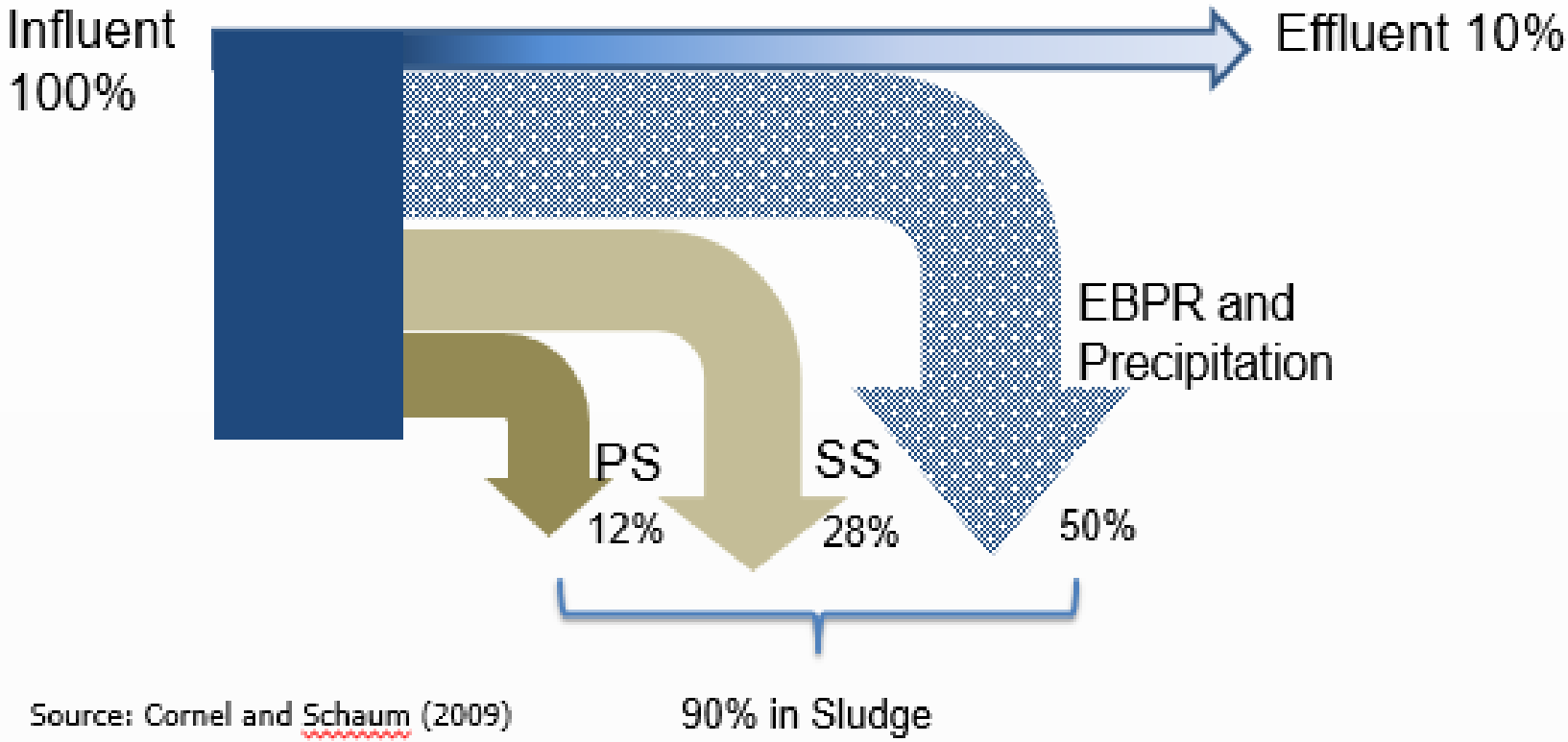


Peak phosphorus 'Hubbert' curve Source: Cordell, Drangert & WHite

P-Recovery Potential from wastewater



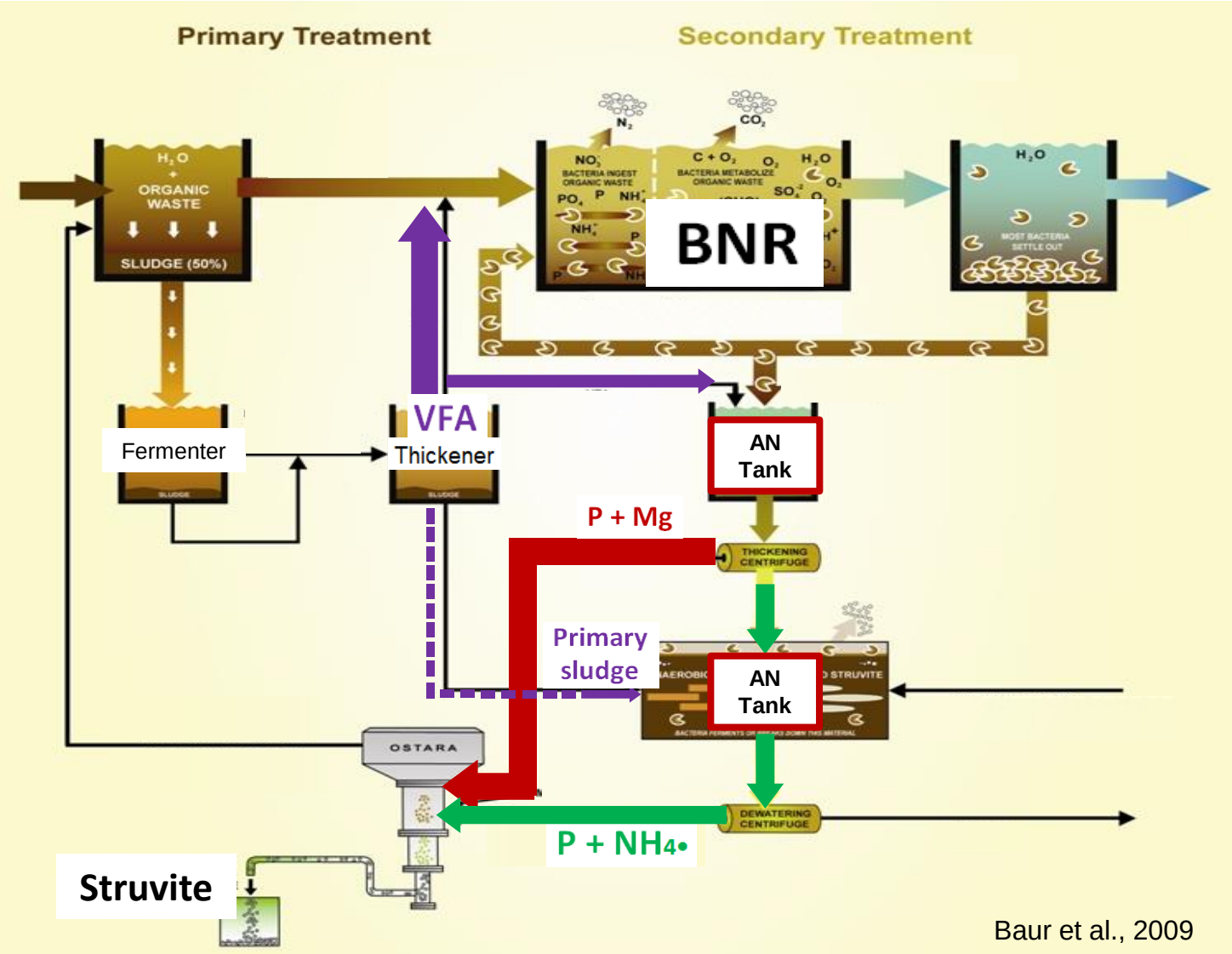
P-Recovery Potential in EBPR System



Source: Cornel and Schaum (2009)

Approaches to Recovery P from Wastewater

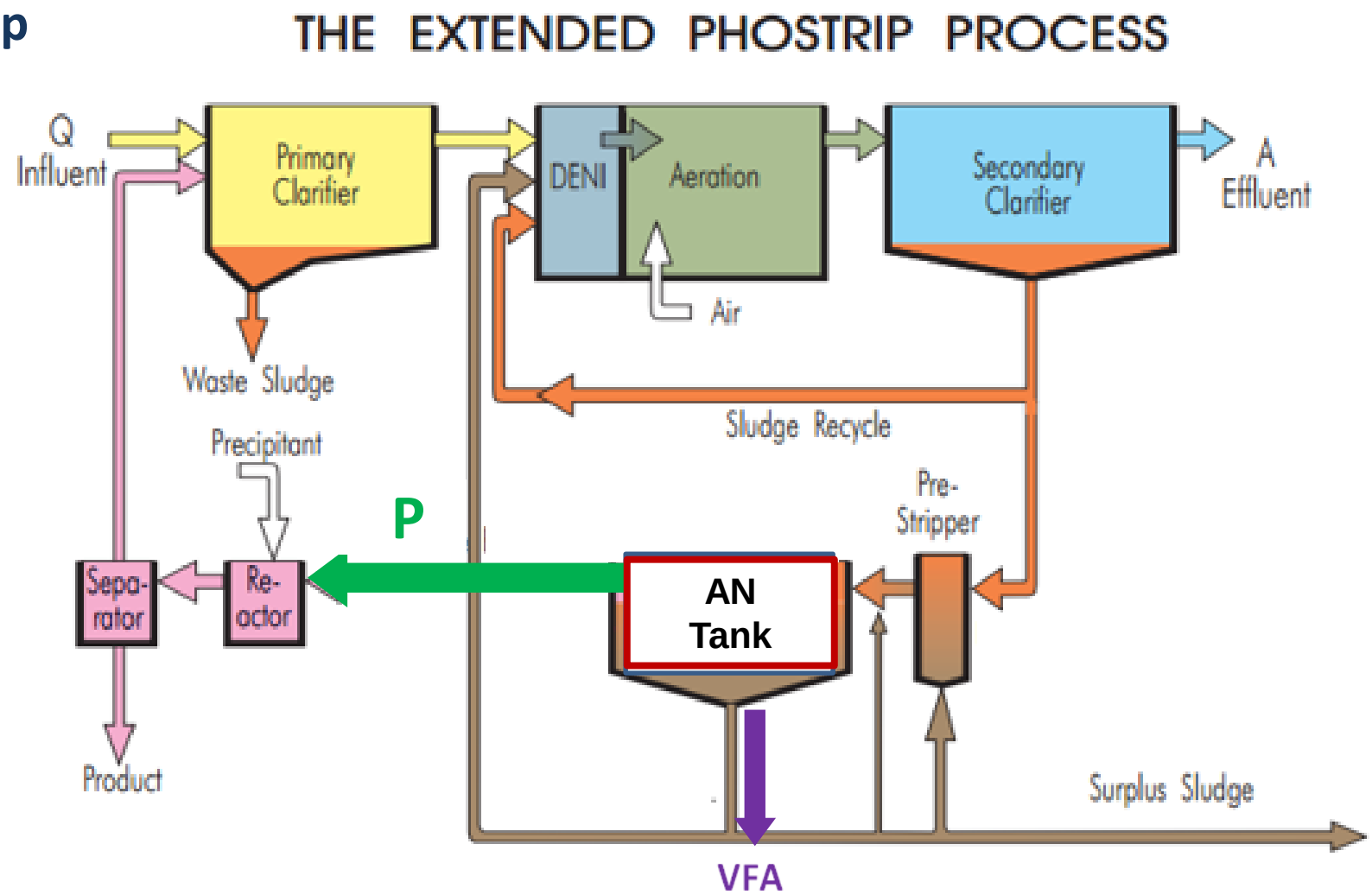
WASSTRIP



Baur et al., 2009

Approaches to Recovery P from Wastewater

PhoStrip

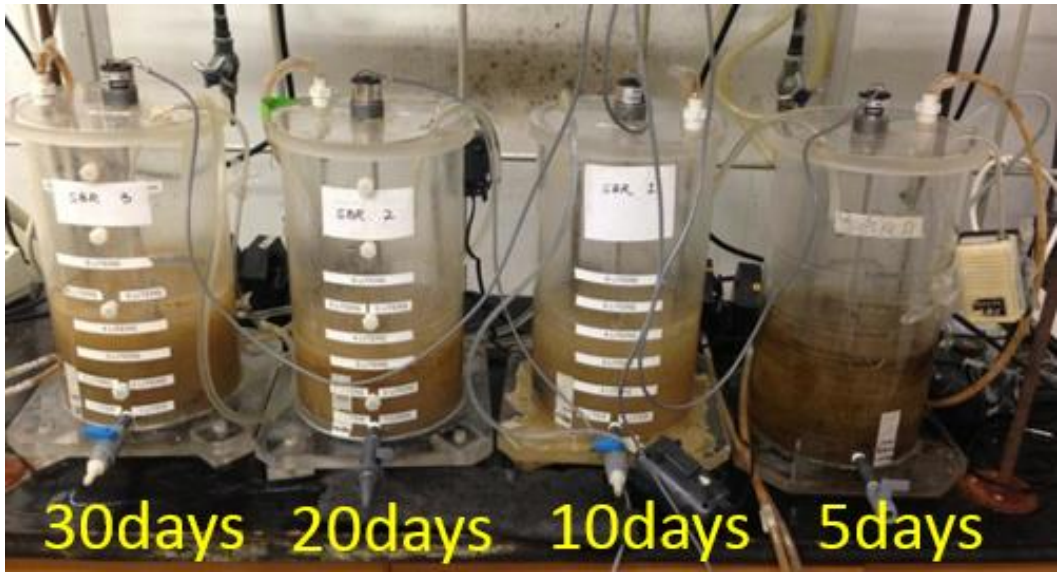


Kaschka et al., 1999

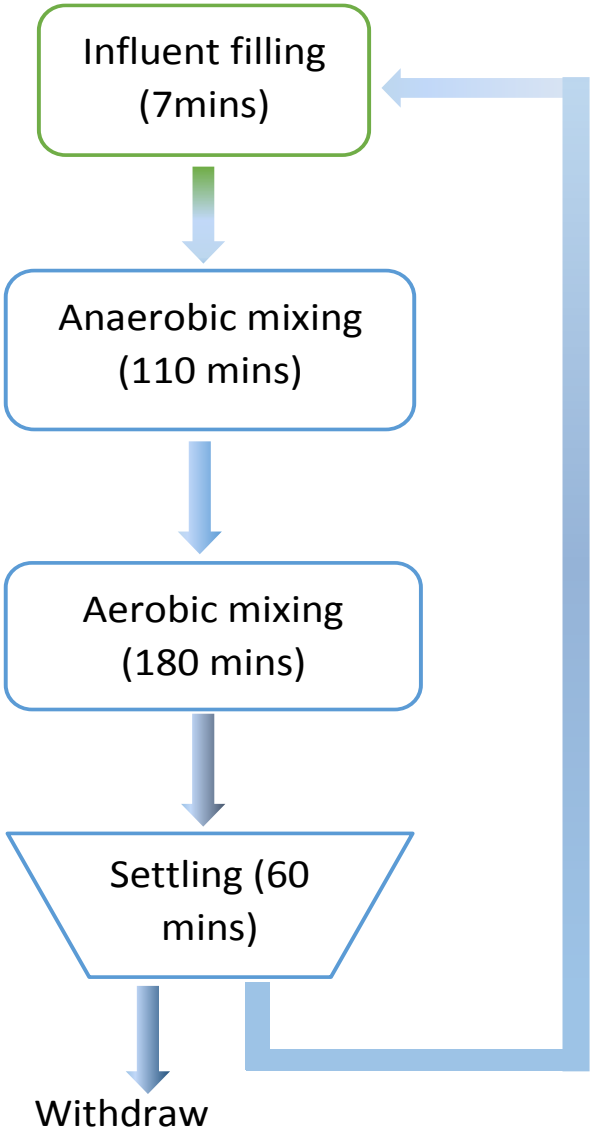
Objectives

Objectives	Approaches
Evaluate the operation conditions impacts on P-release	• Lab scale SBRs • 24hrs endogenous digestion tests
Investigate the mechanisms of P-release in the Bio-P anaerobic digestion during 0-24 hrs	• Live/Dead • Phosphate and metal ion concentration
Explore the effect of anaerobic digestion process on the PAOs	• FISH • P-release tests with VFA addition

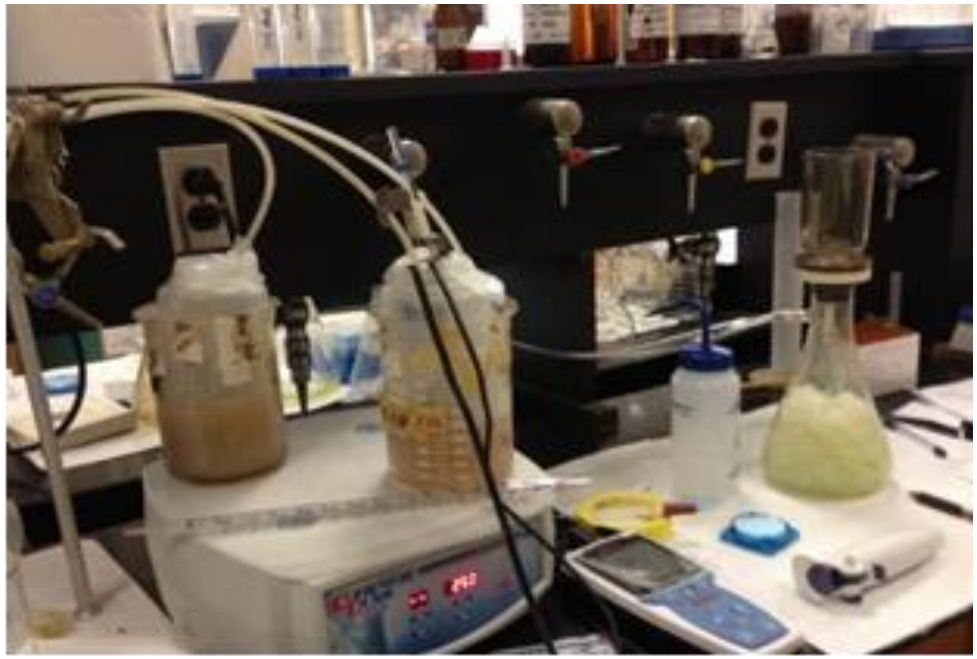
Methods: SBRs operation

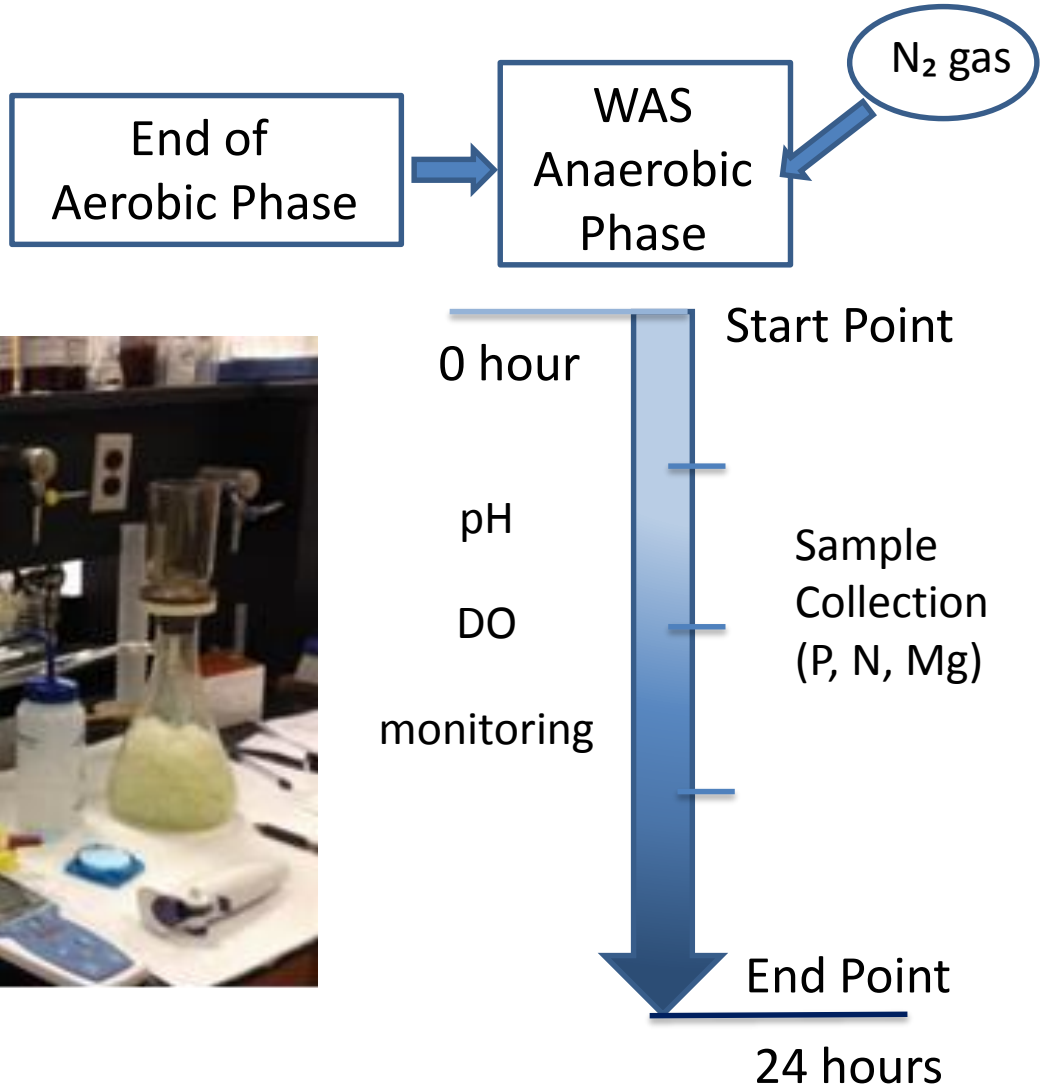


- HRT: 12 hours
- Temperature: 20 °C
- DO: < 0.1 mg/L (AN)
  > 4 mg/L (AE)
- Weekly monitoring of TSS/VSS, effluent phosphate concentration.



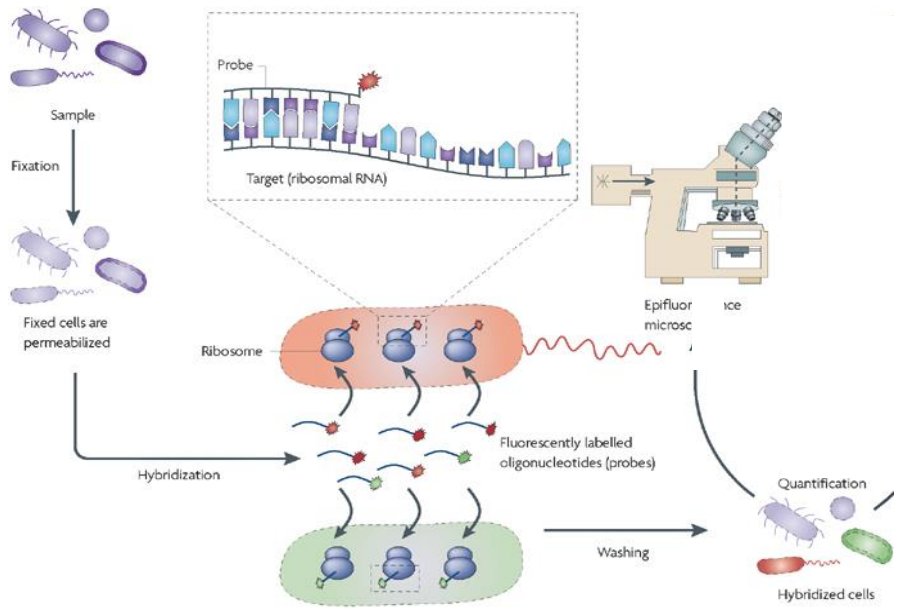
Methods: P: release activity

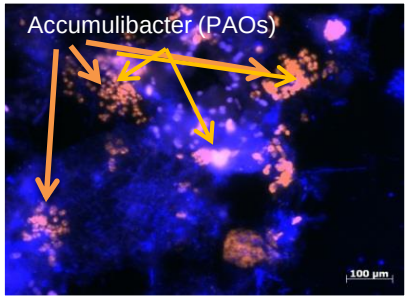


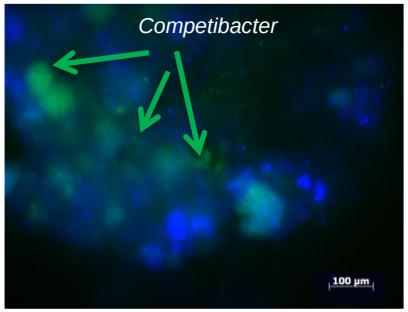


Methods: Microbial analysis

Fluorescence in *situ* hybridization (FISH) → specific PAOs and GAOs

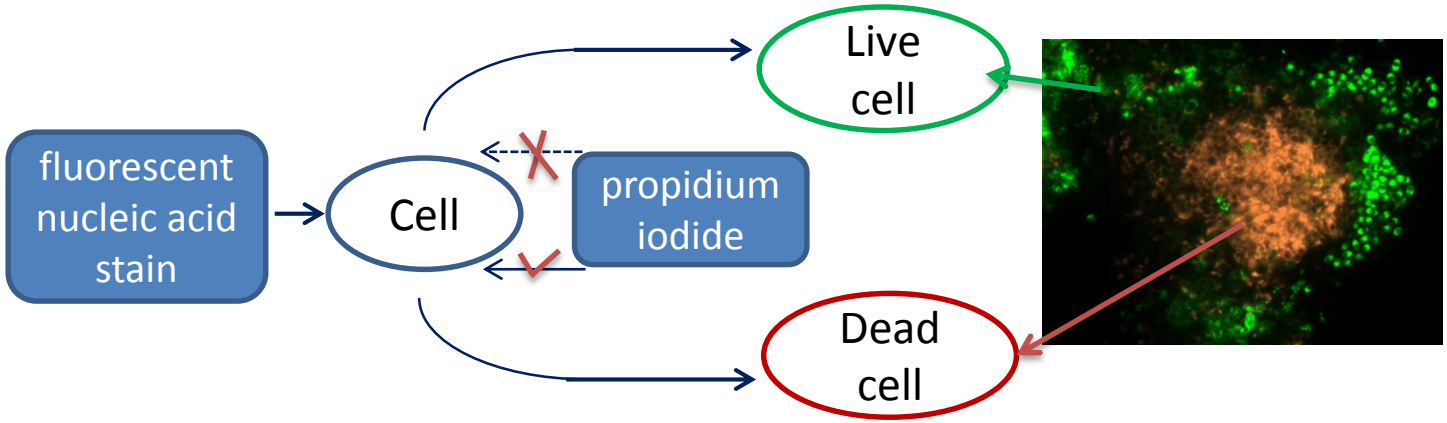




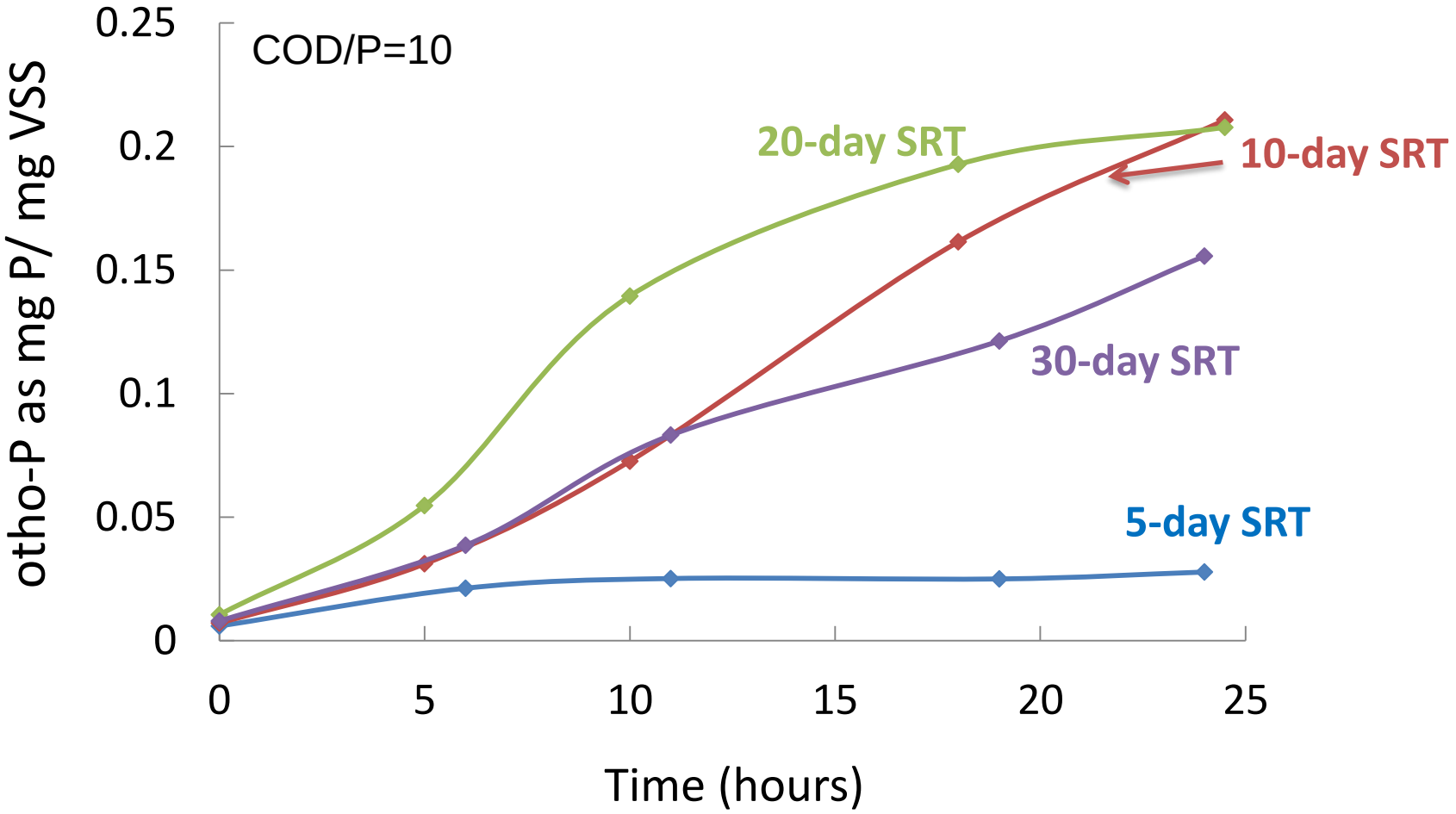


Source: nature.com

Live/Dead Analysis

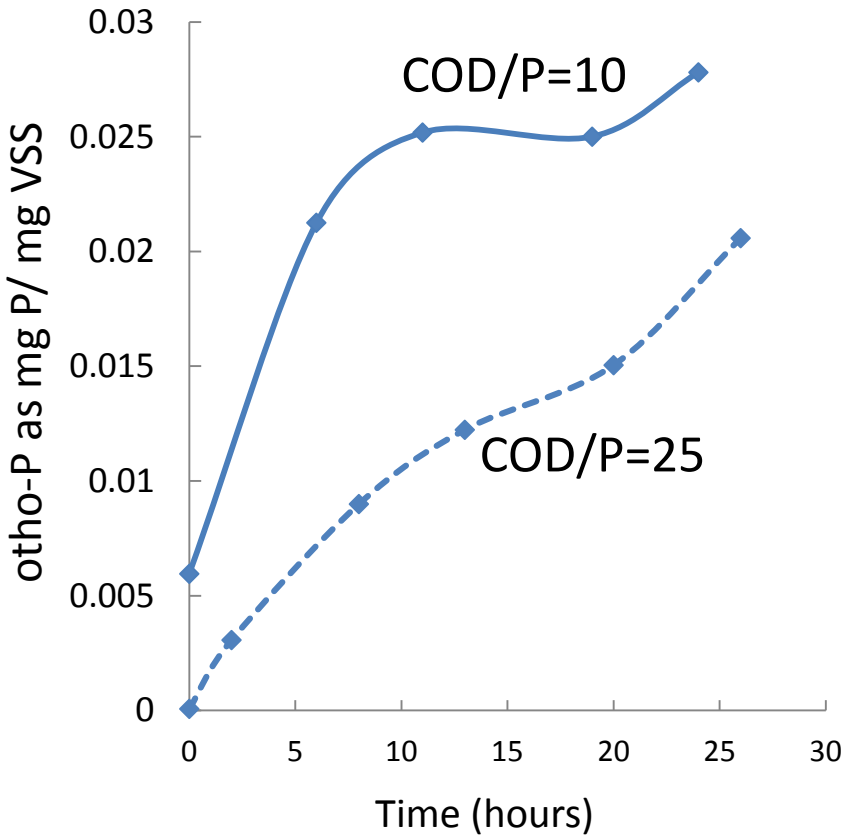


How does SRT effect the P-Recovery Potential?

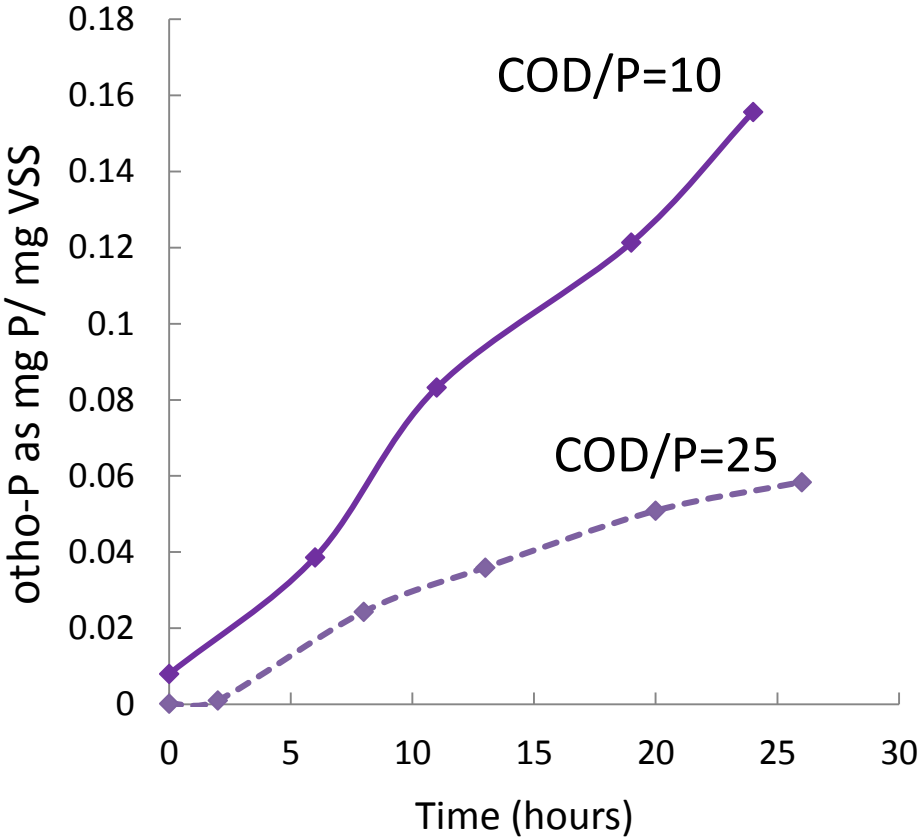


How does COD/P effect the P-Recovery Potential?

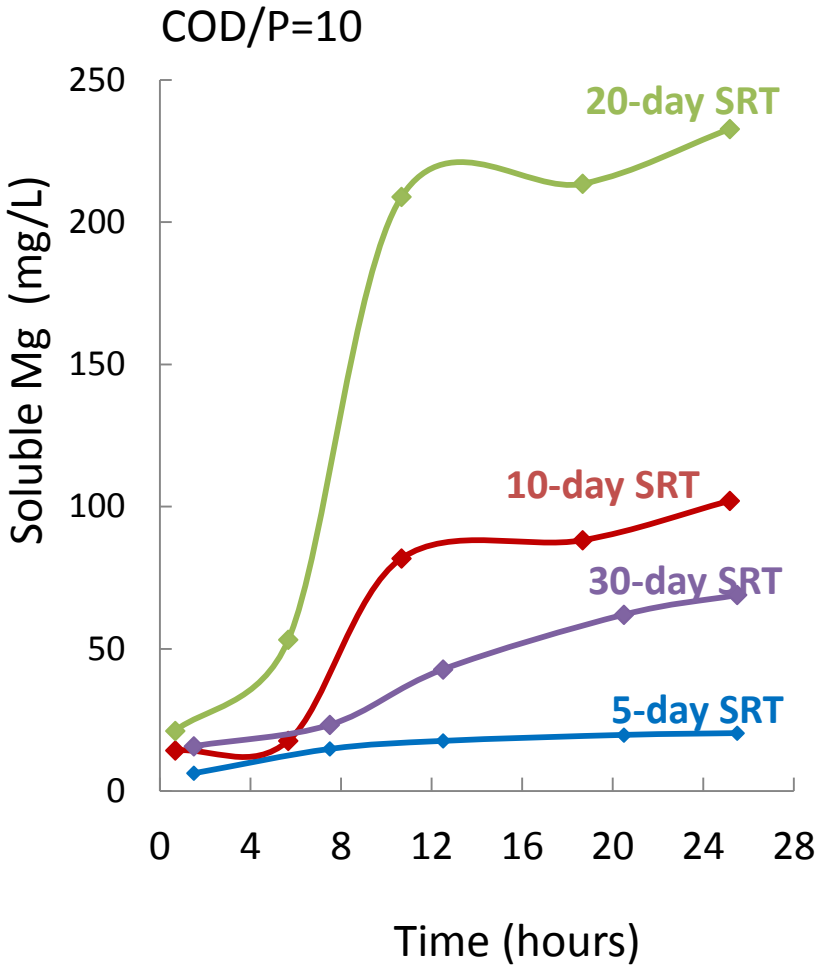
5-day SRT



30-day SRT

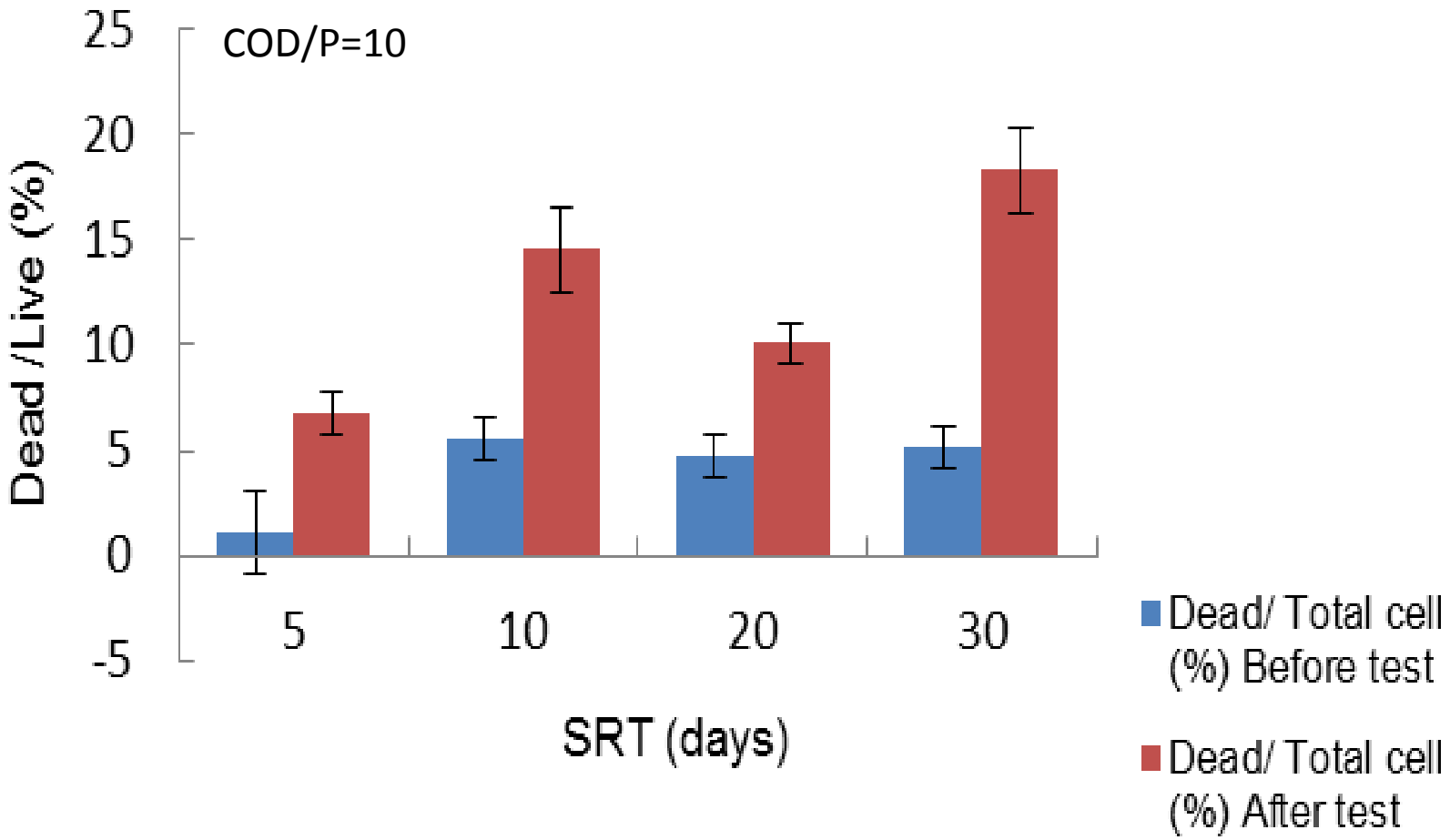


What's the Mechanisms of P release under AN Condition?



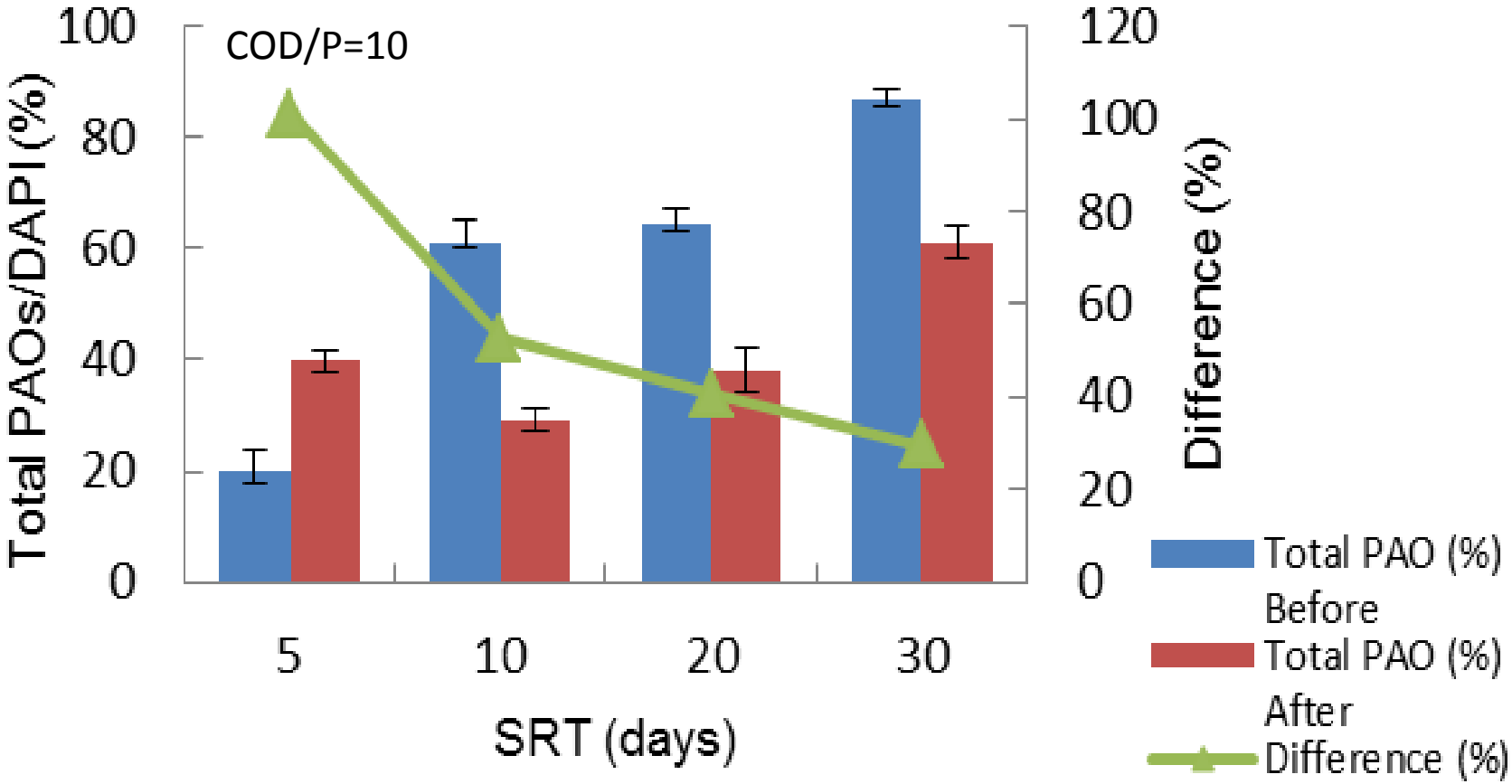
SRT (days)	Mg/P		
	0-12 hrs	12-24 hrs	Average*
5	0.15	0.07	0.17
10	0.25	0.03	0.11
20	0.49	0.11	0.38
30	0.15	0.14	0.15

How Microorganism Population Change?



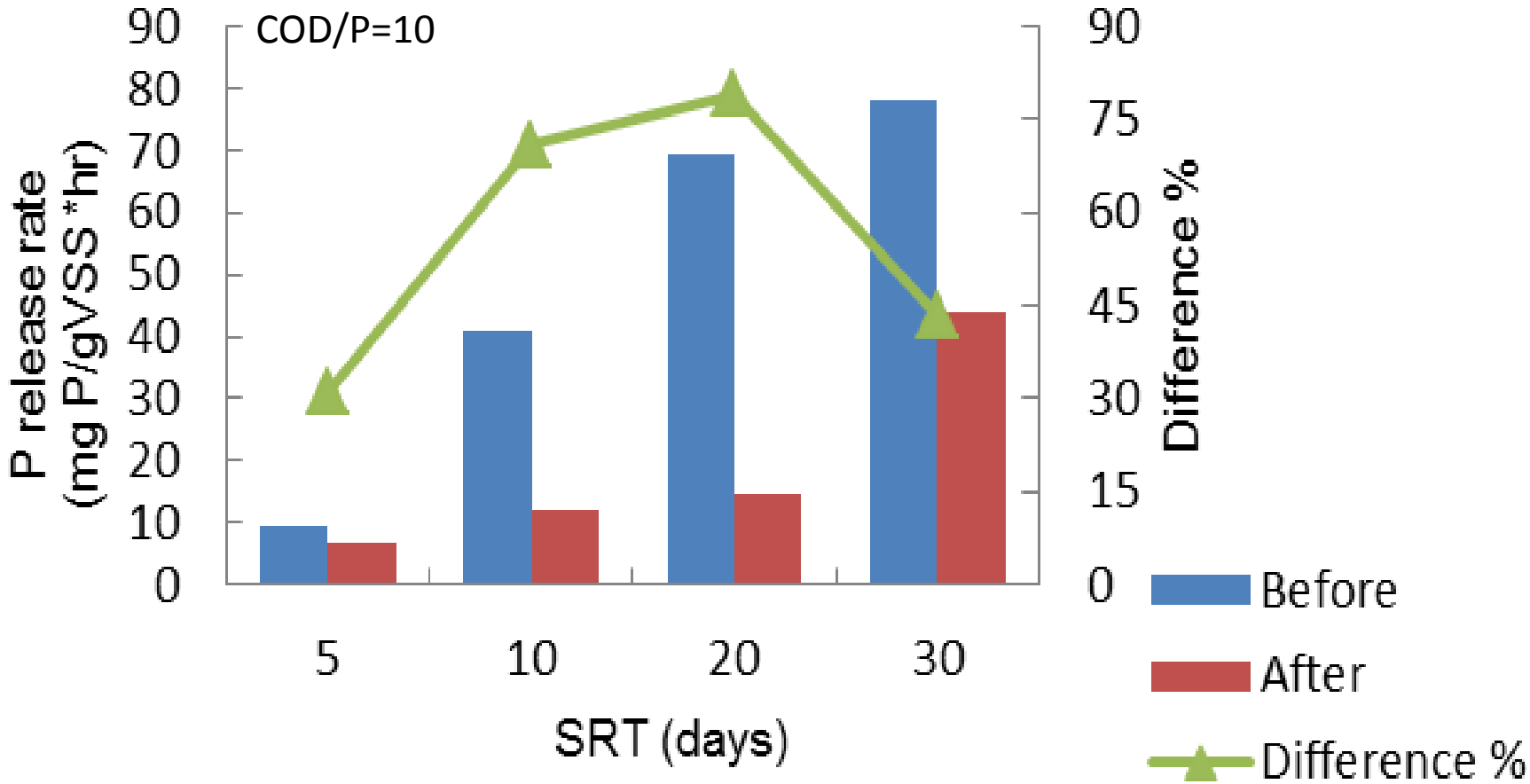
How Microorganism Population Change?

PAOs Abundance



How Microorganism Population Change?

PAOs Activities



Conclusions

- Lower influent COD/P ratio perform better in terms of quantity and rate of P release under anaerobic conditions -- might be preferable when operating P-recovery scheme
- SRT in the range between 10-20 days showed also the highest P released, in terms of both quantity and rate -- lower footprint for the P release tank
- The majority of released P was due to poly-P depletion at all SRTs condition
- Different mechanisms are responsible at different time intervals
- PAO activity was reduced after the digestion test

Acknowledge

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Professors:

- Annalisa Onnis-Hayden
- April Gu
- Philip Larese-Casanova

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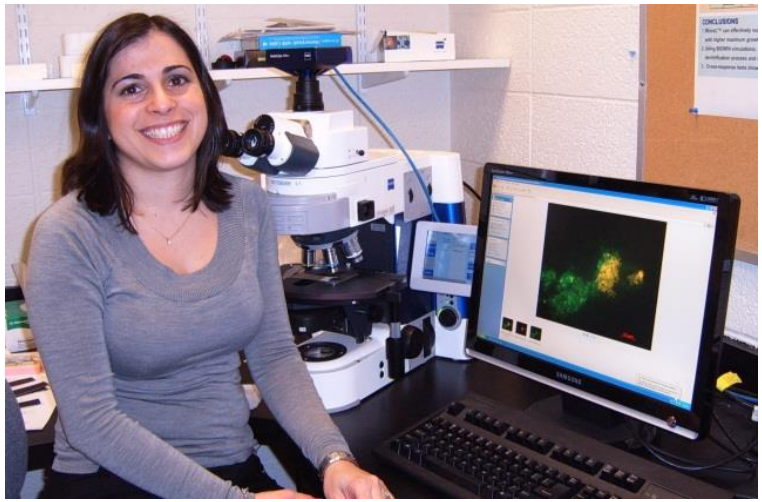
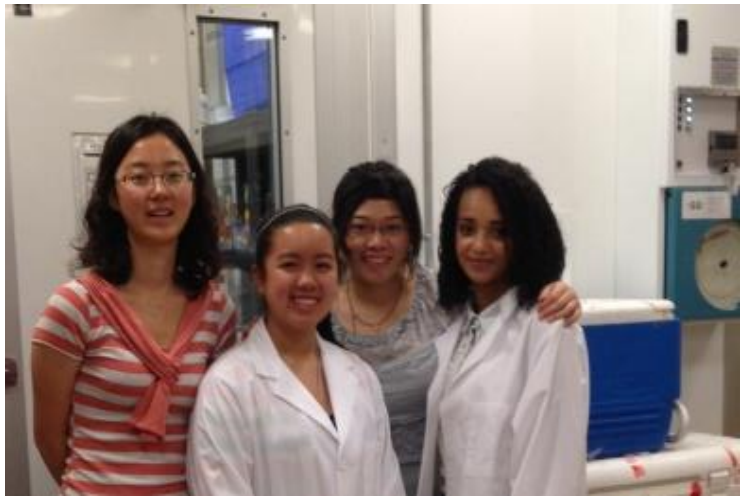
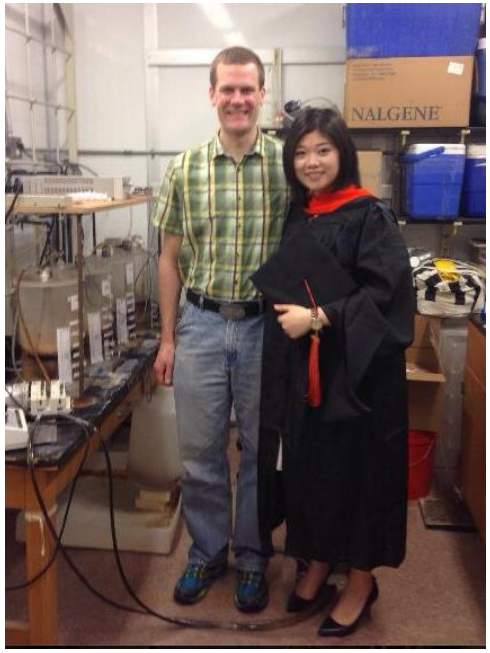
- Yueyun Li
- Nick Tooker







Thank you!

Questions?

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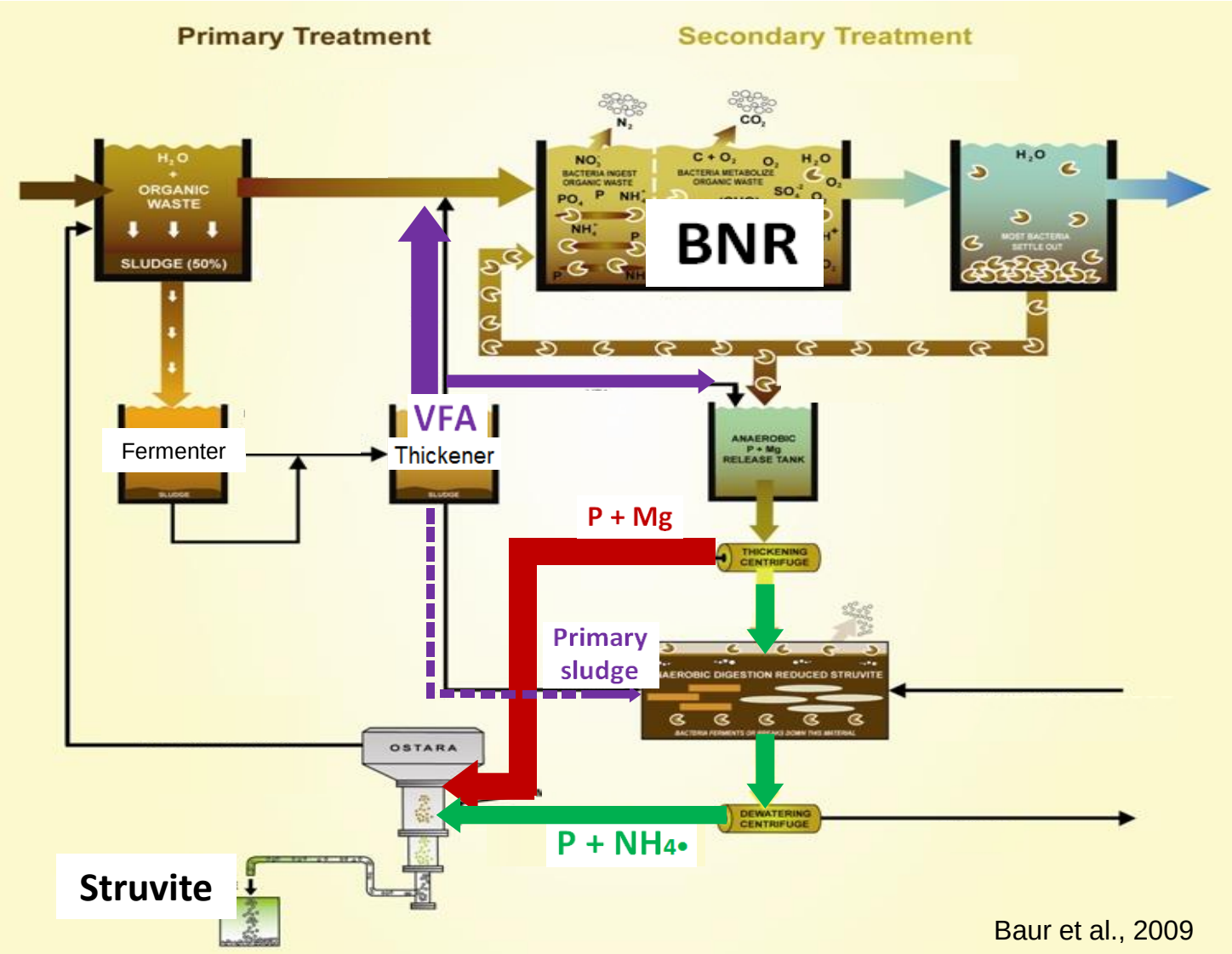

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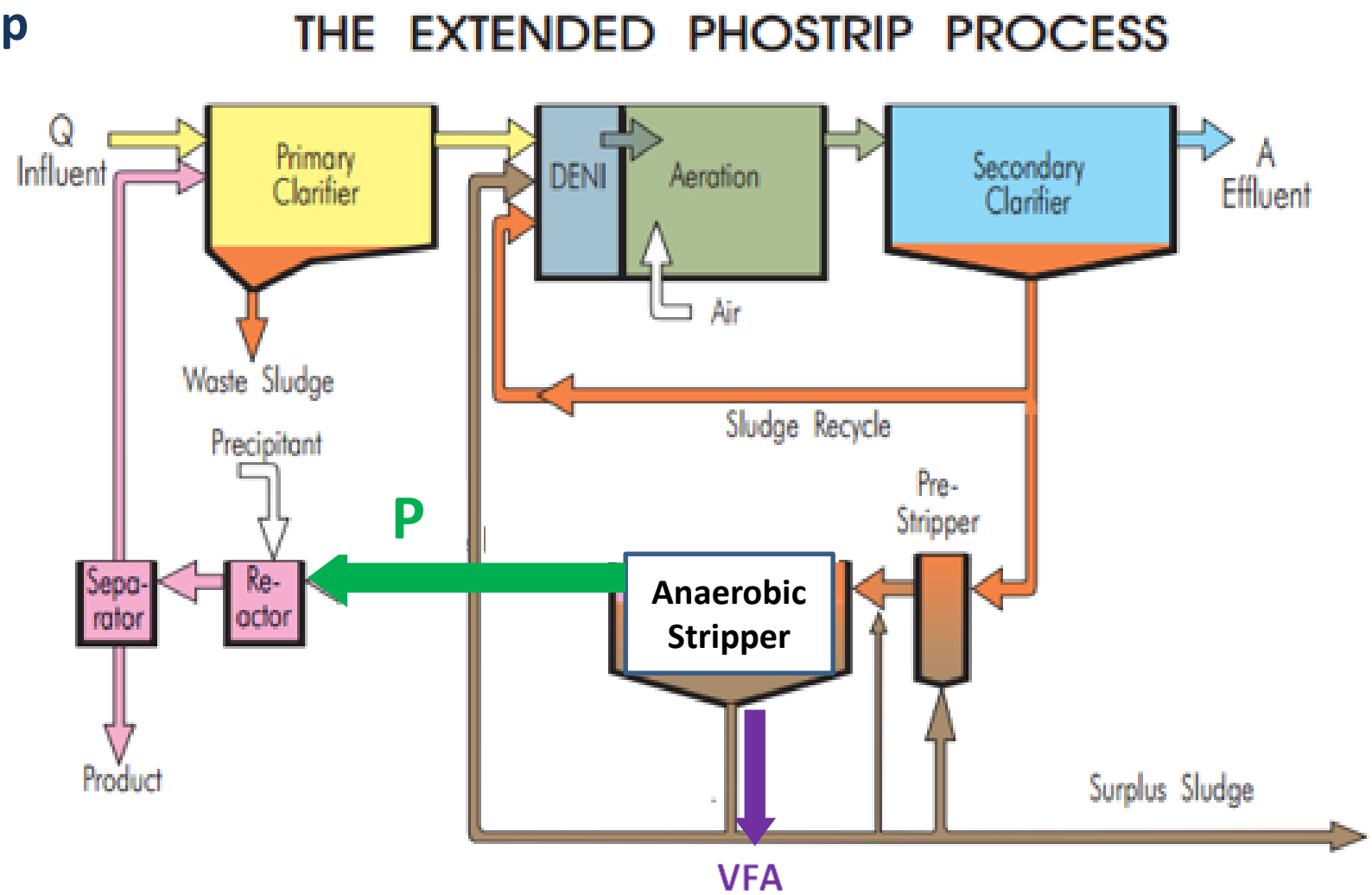

Kaschka et al., 1999