Algae Reactors for Wastewater Treatment

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Wastewater treatment: nutrient removal is ok to current standards

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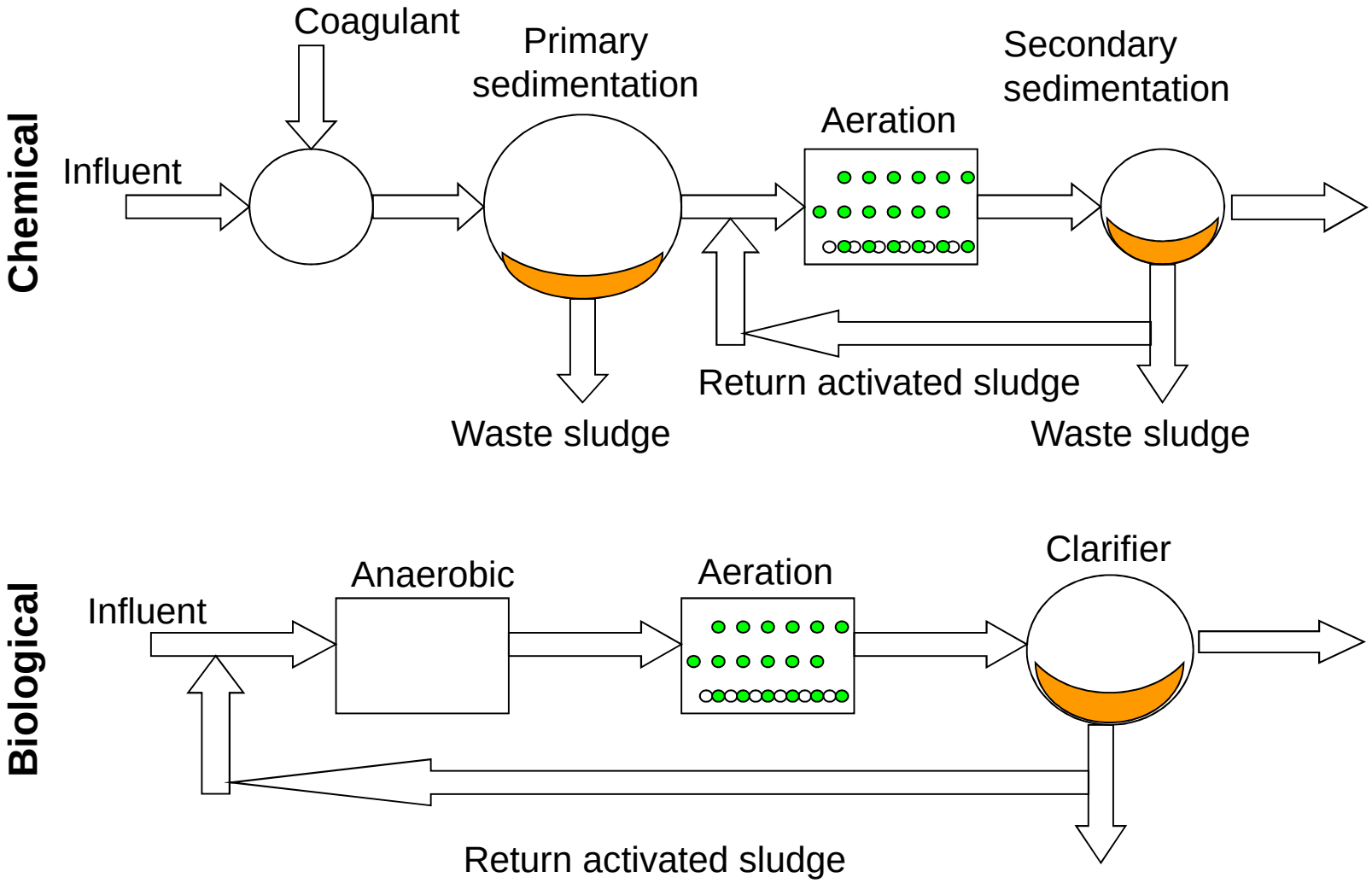

Need additional stage to reach tighter consents. Is this a role for algae?

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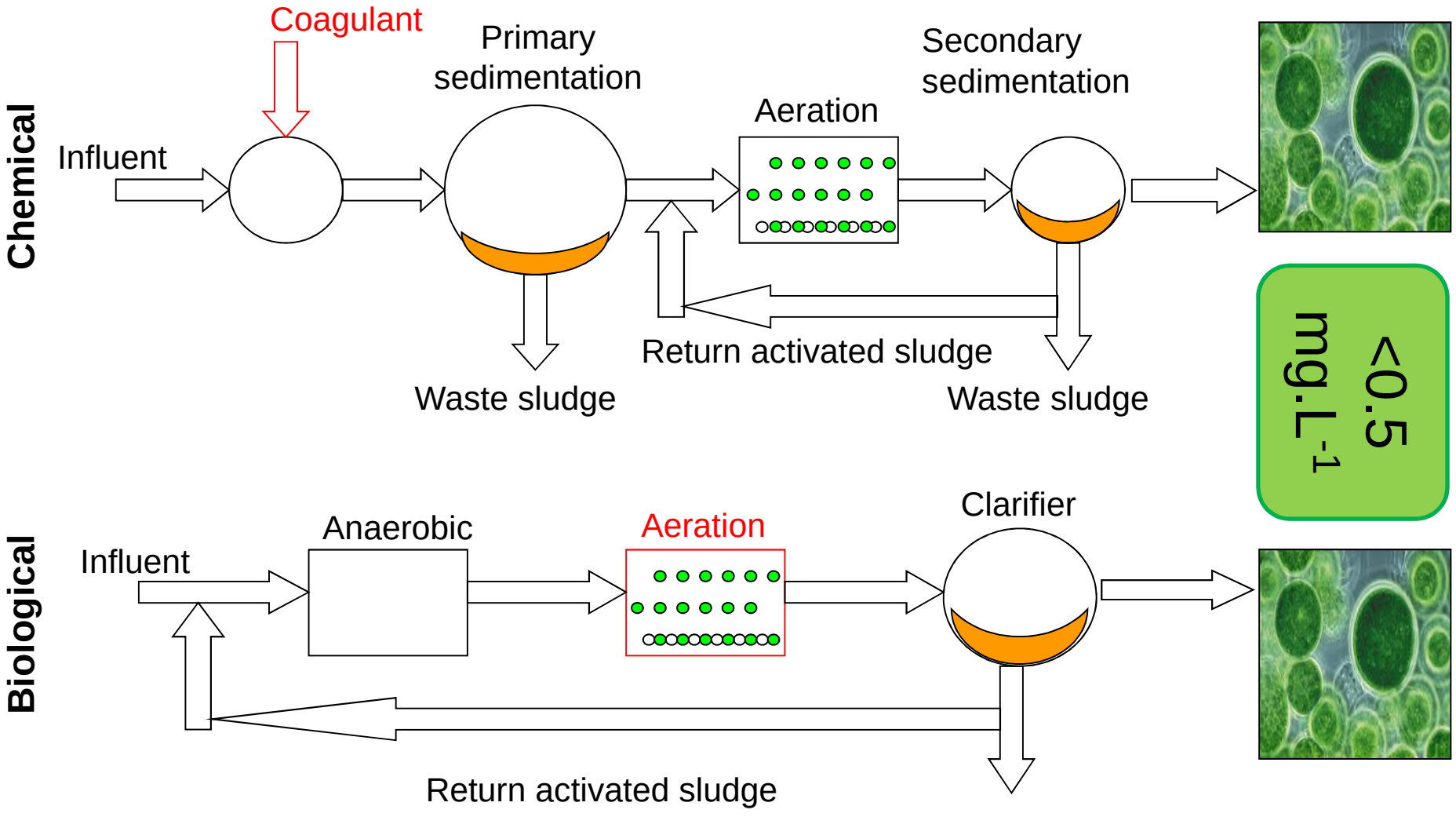

Which type of reactor should we use?

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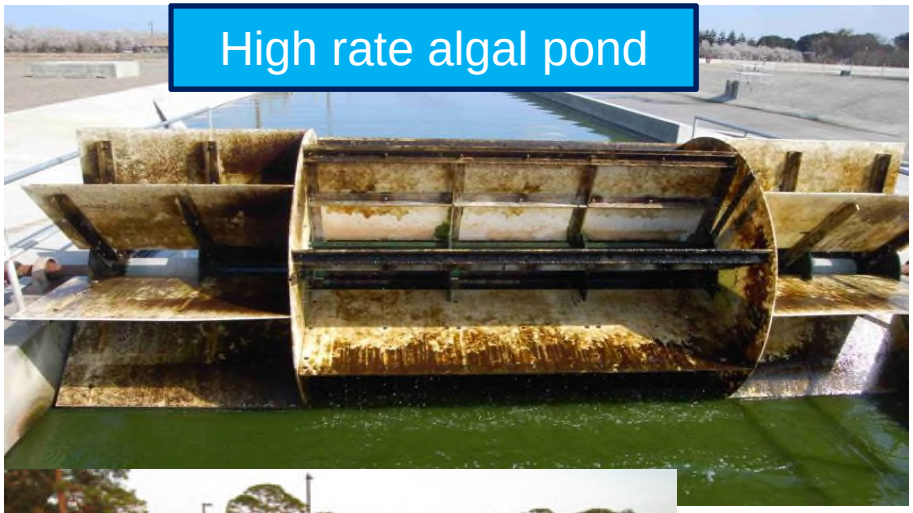
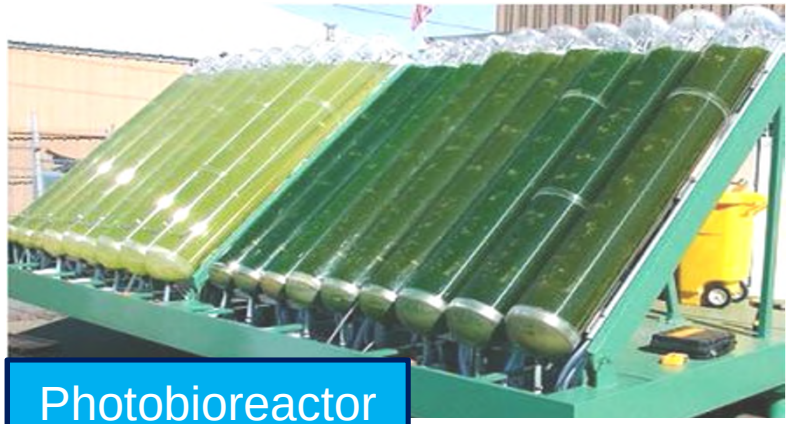
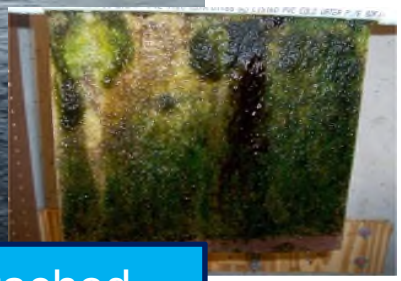


High rate algal pond



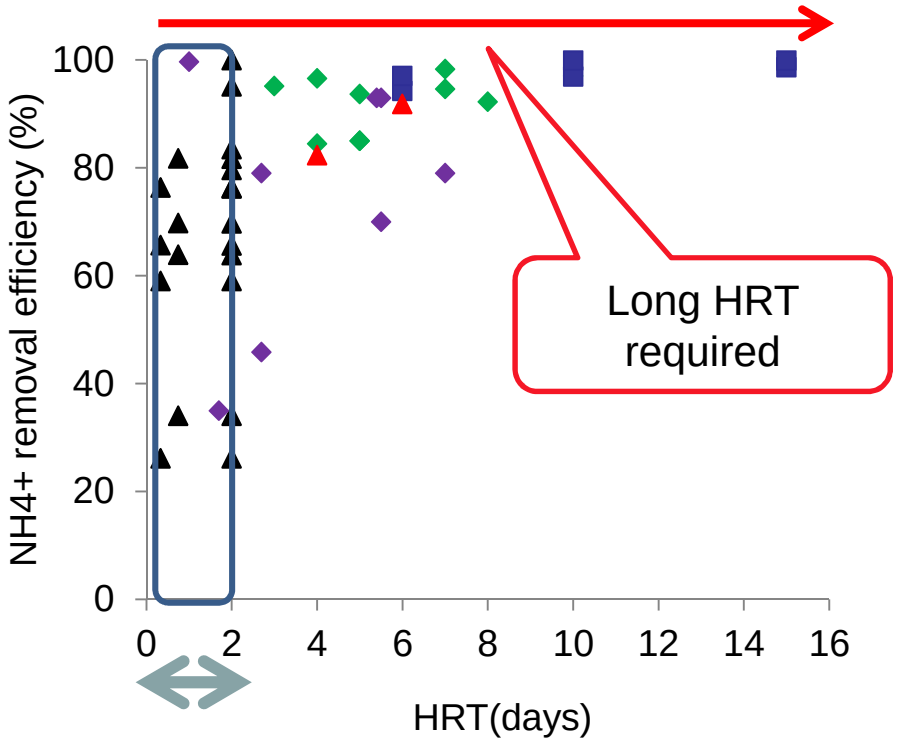
Photobioreactor

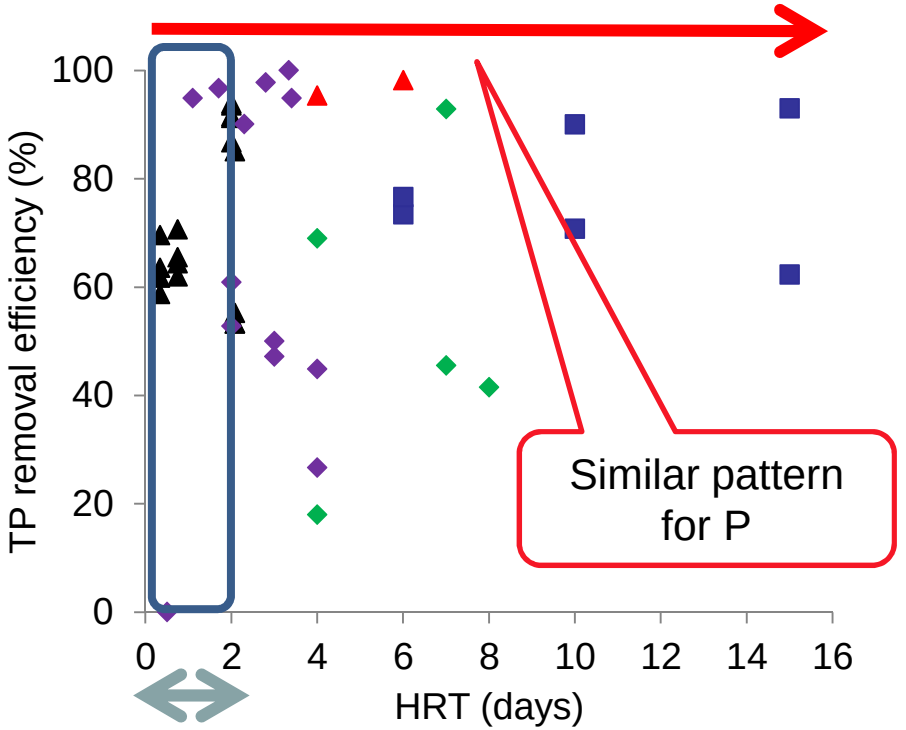


Attached

Immobilisation

Need appropriate HRT & footprint



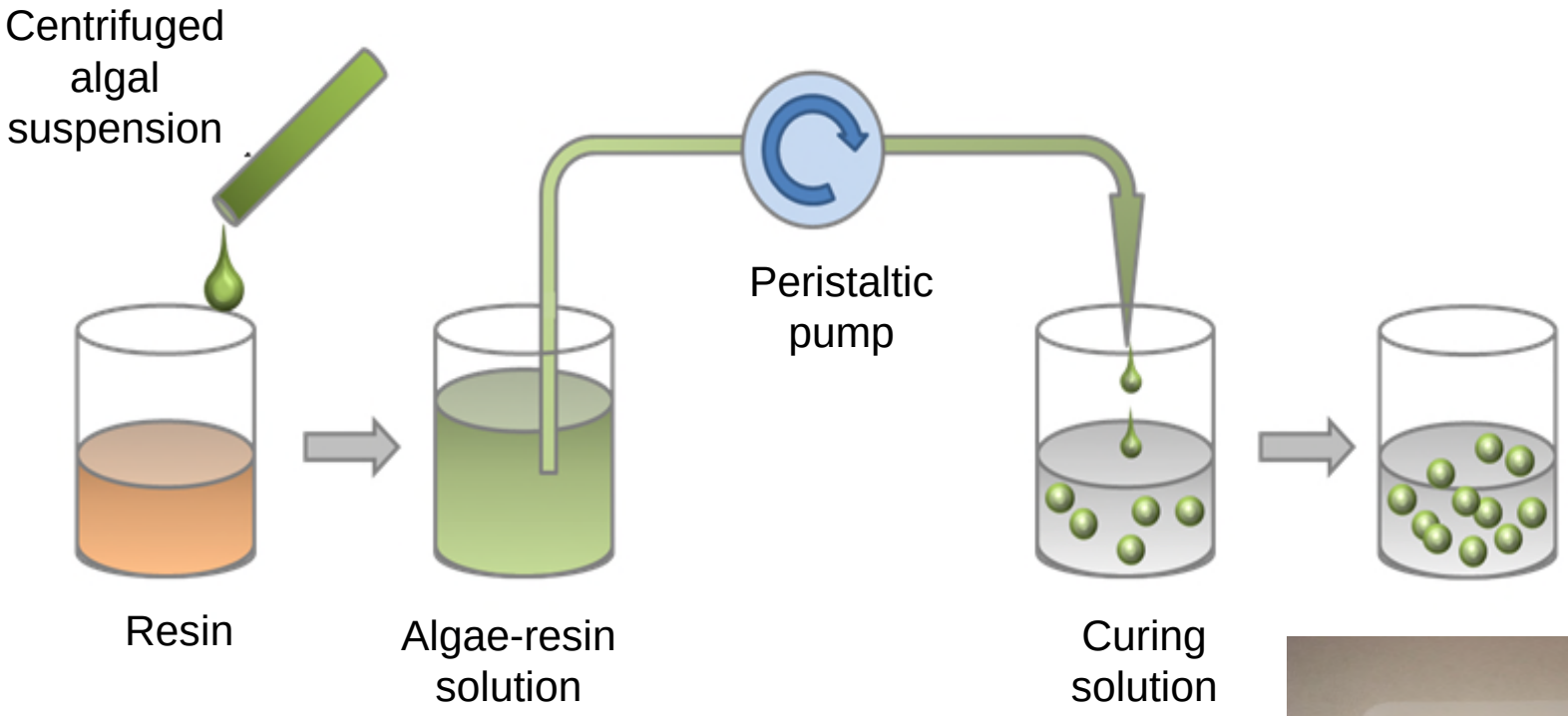


Within viable range

HRAP Floway Substrate Immobilisation PBR

Ponds and biofilm systems long retention times

What is immobilisation?



- Concentrates biomass
- Reduced footprint
- Easy removal – gravity settlement post-treatment

Methodology

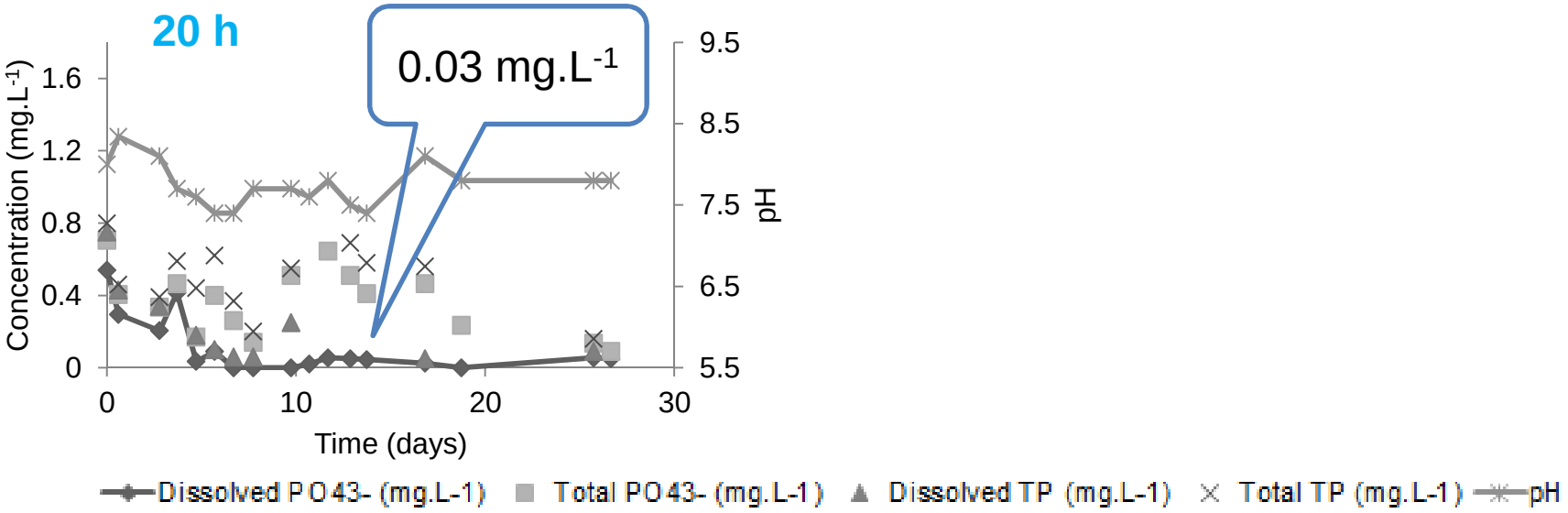
Algem™ Environment Modelling Labscale Photobioreactor

www.algenuity.com

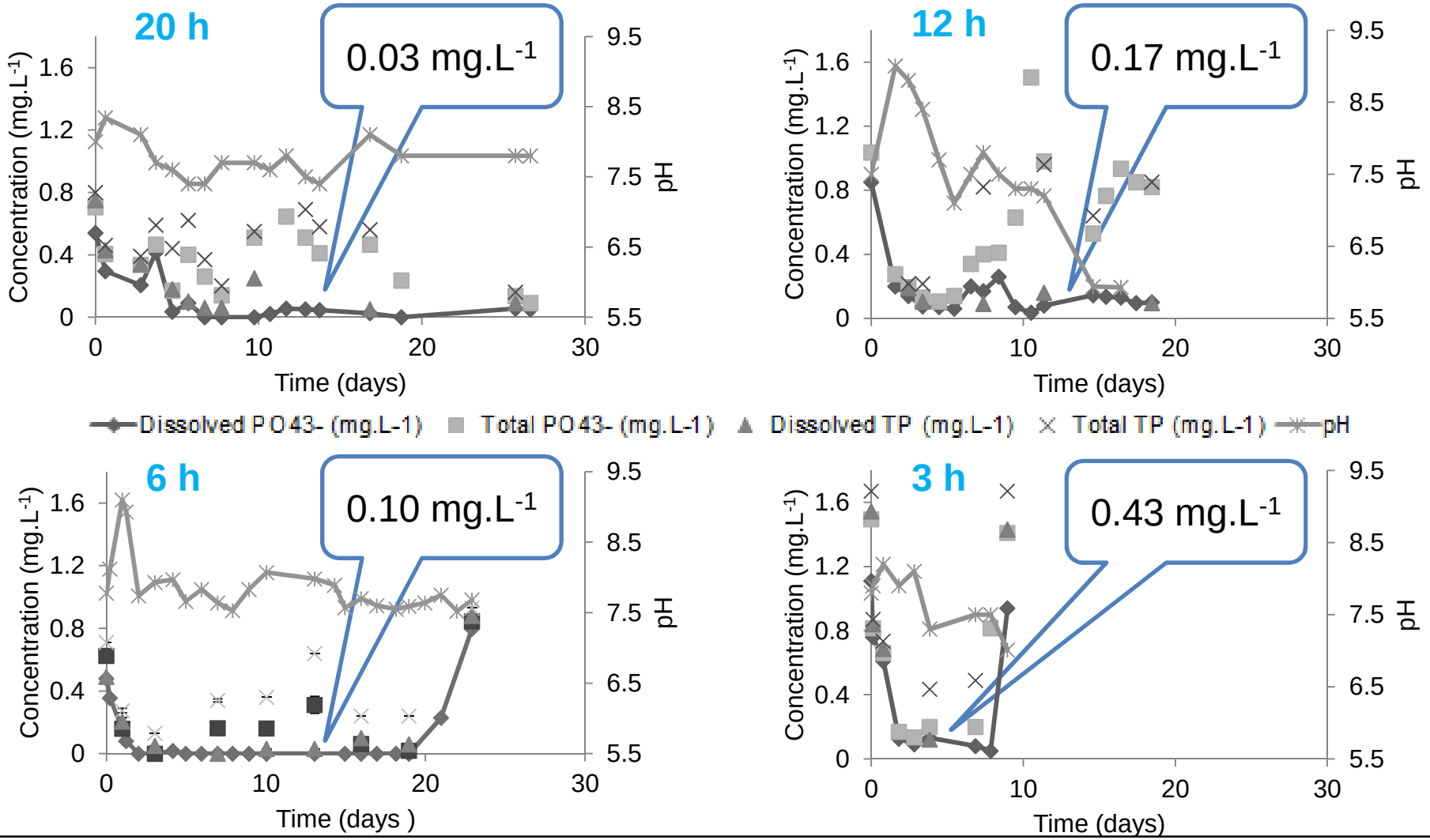
Parameter	
Cells.bead^{-1}	10^5 (Hameed et al., 2007)
Beads.mL^{-1}	10 (Hameed et al., 2007)
Temperature	20^{o}C
Microalgal species	*Scenedesmus obliquus*
Resin & curing solution	2% Na-alginate and 2% $CaCl_2$
Light – wavelength & intensity	200 µmol.m^{-2}.s^{-1}, white light
HRT	***3, 6, 12 and 20 hours***

Performance analysed for three wastewaters

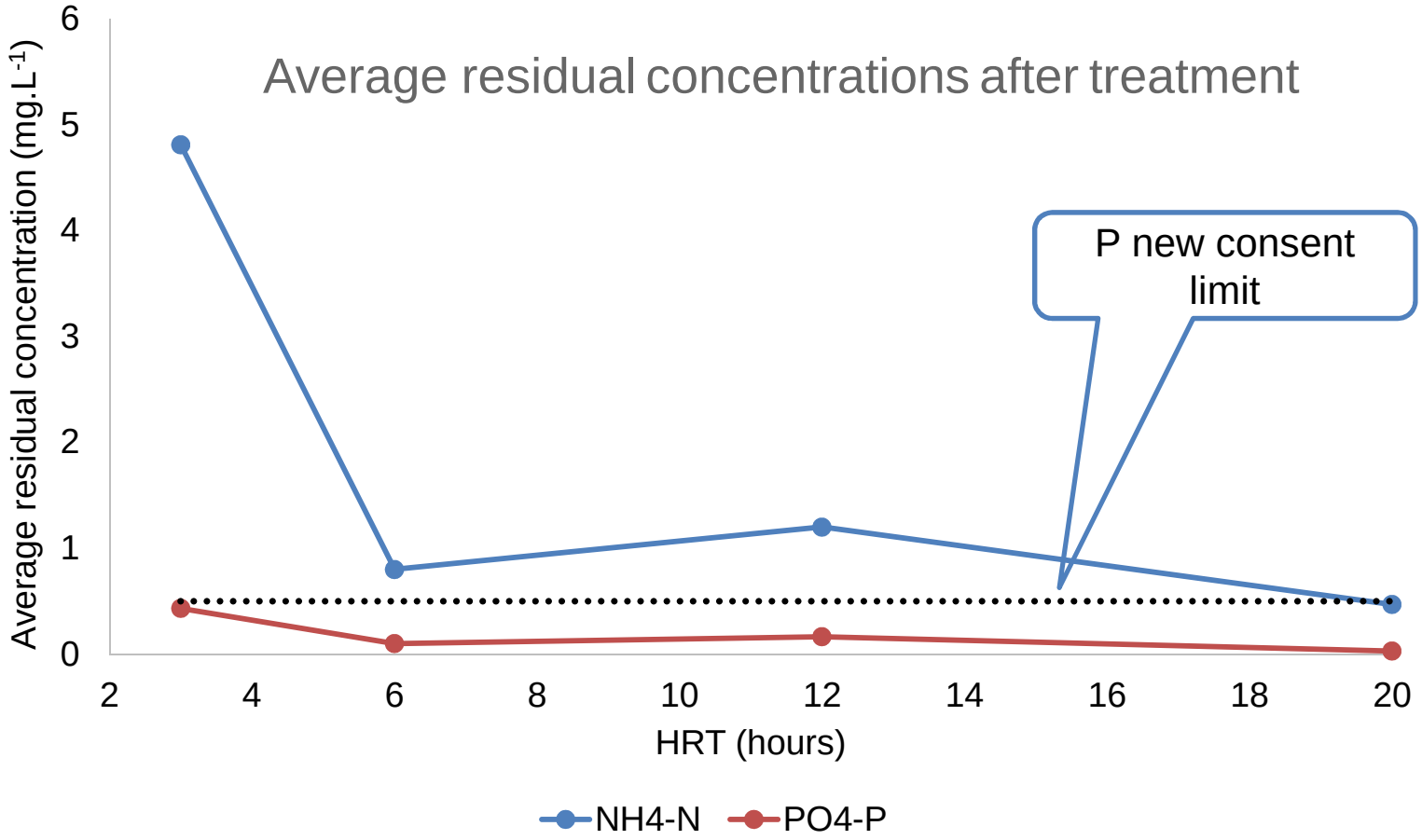
How did it perform?



How did it perform?



And works for ammonium too..



Suitable for poor performing N sites too!

IBR design parameters beginning to be understood

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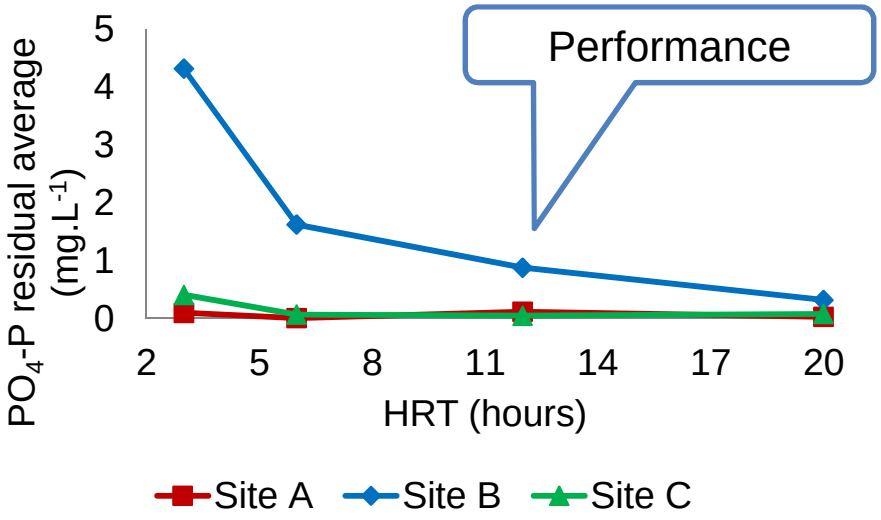

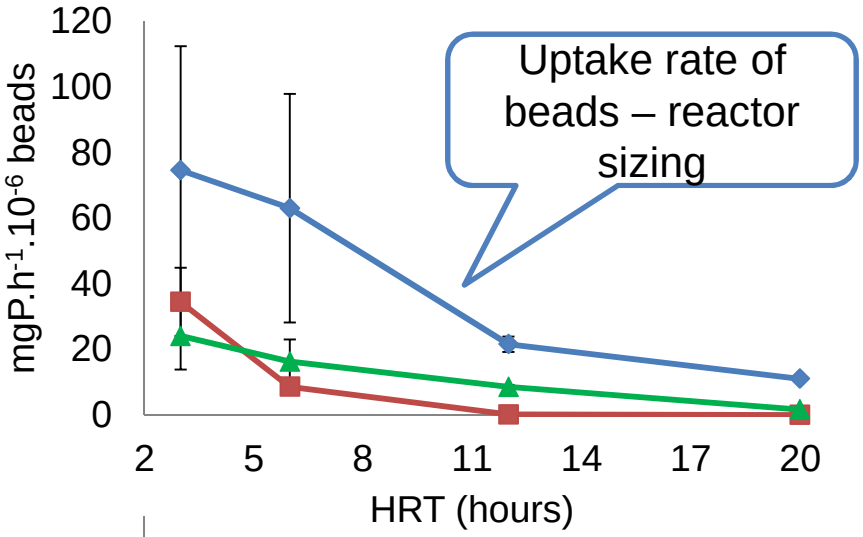

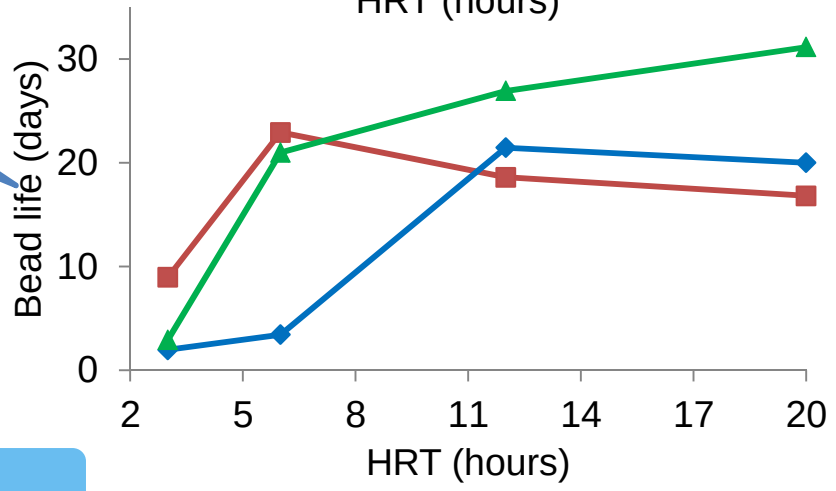

Trade off between cost and performance

Inform pilot scale trials

IBR performance when scaled up

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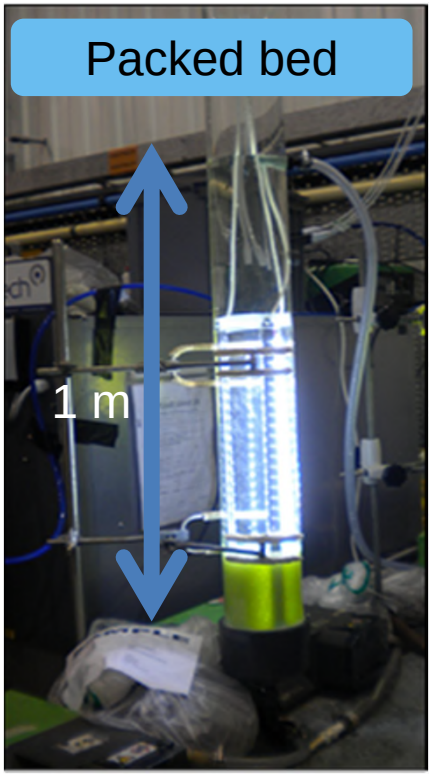
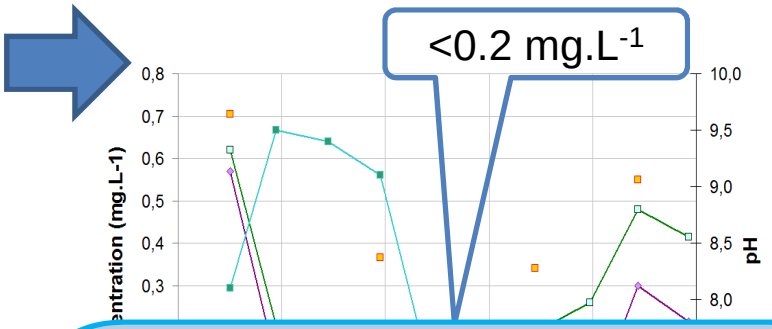
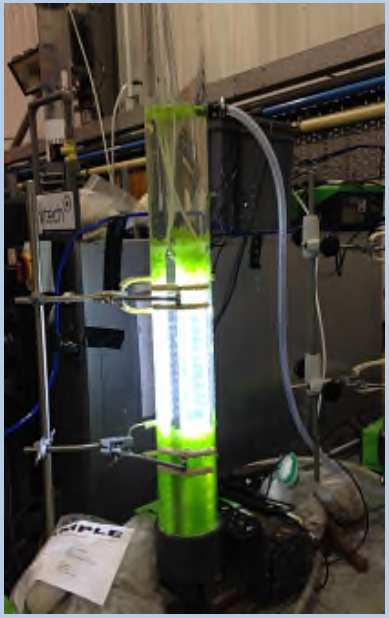
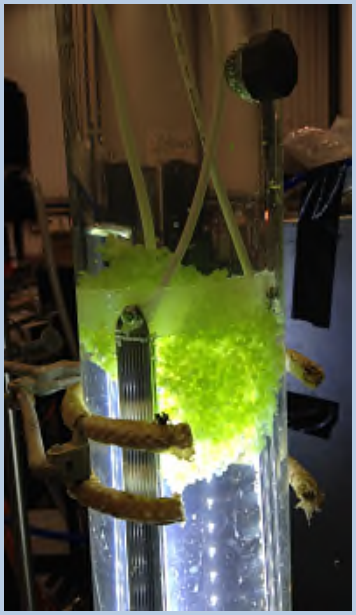
Packed bed



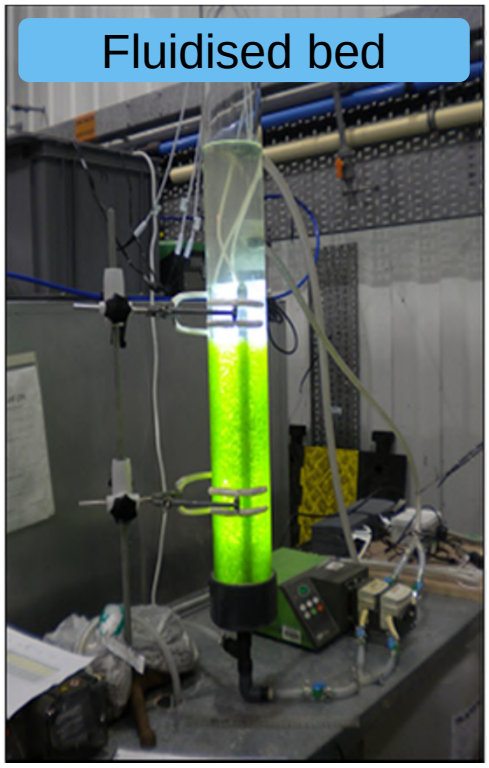


<0.2 mg.L^{-1}





Fluidised bed



Is an IBR a viable option for nutrient polishing?

Option	NPC (£k)	Risk reduction (DR)	Risk Index (NPC/dR)
Increase Fe dosing	--	--	0.2
Sand filter and Fe dosing	--	--	11.6
FBBR IBR + AD (thermal pre-treatment)	--	--	11.6
PB IBR + AD (thermal pre-treatment)	--	--	11.0

RI <4 = a really good option, 4 – 8 = a good option,
>8 = an option that is not as good value for money

Is an IBR a viable option for nutrient polishing?

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Further development of an IBR

- Currently over performing, adjust OPEX for savings
- 10 beads.mL^{-1} to 8 beads.mL^{-1}
- Light regime 24 h.d^{-1} to 12 h.d^{-1}
- Extension of bead life

love every drop anglianwater

RI <4 = a really good option, 4 – 8 = a good option,
>8 = an option that is not as good value for money

Option	NPC (£k)	Risk reduction (DR)	Risk Index (NPC/dR)
FBBR IBR + AD (thermal pre-treatment)	--	--	7.2
PB IBR + AD (thermal pre-treatment)	--	--	6.7

Highlights areas for further development

Many thanks

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stream
The Industrial Doctorate Centre for the Water Sector

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