

Supplementary Information for:

Partial Nitrification and Enhanced Biological Phosphorus Removal in a Sequencing Batch Reactor Treating High-Strength Wastewater

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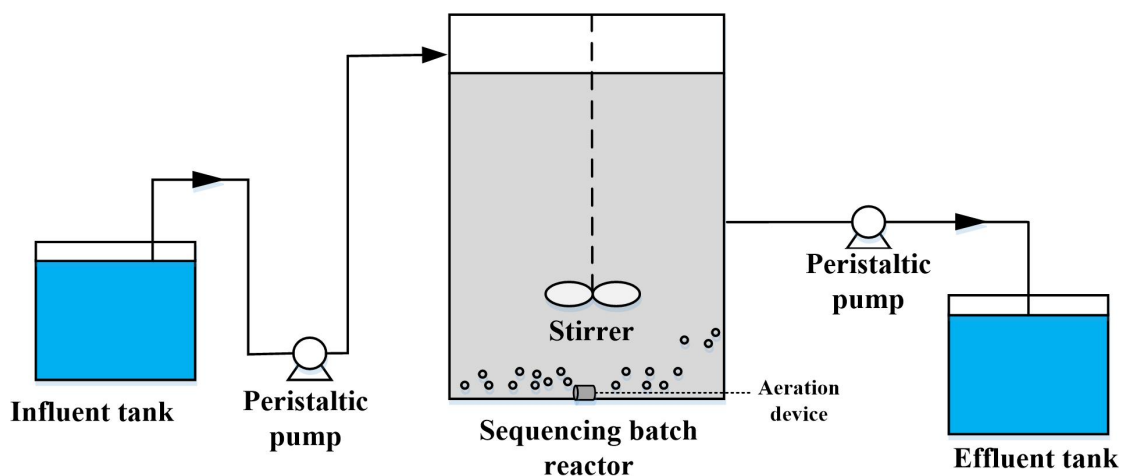
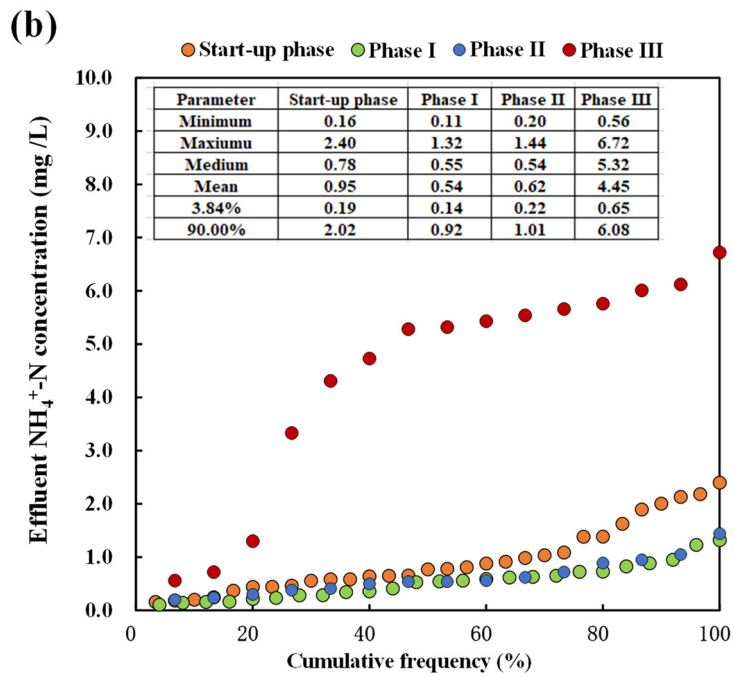
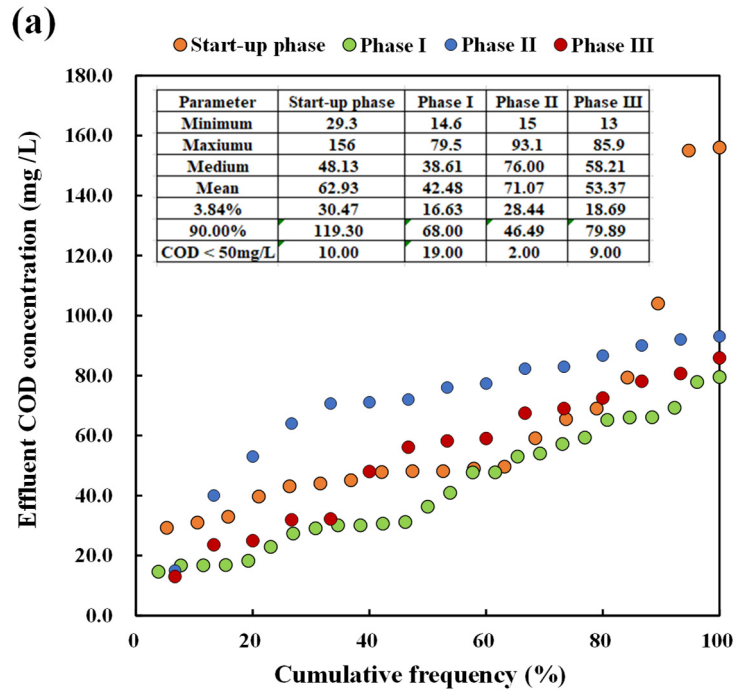


Figure S1. Schematic diagram of the SBR system.



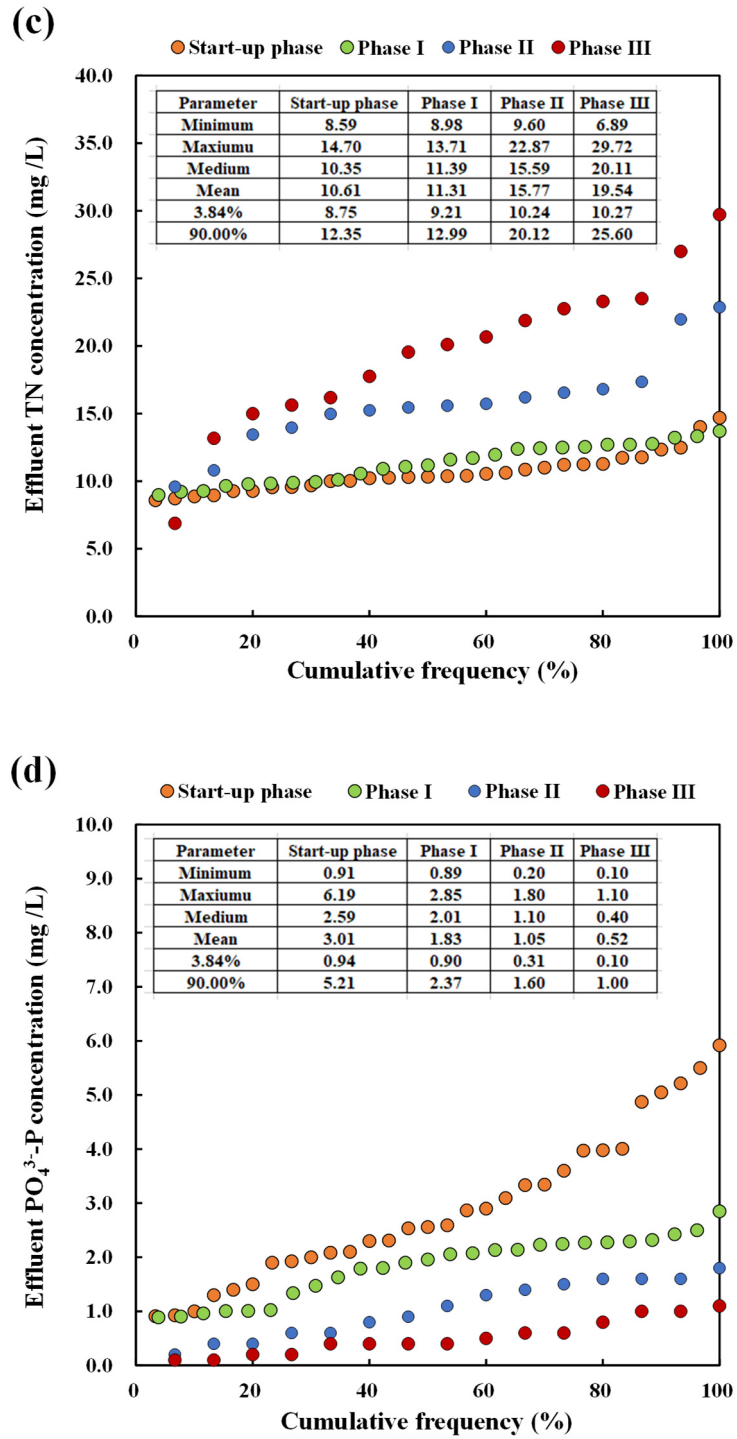
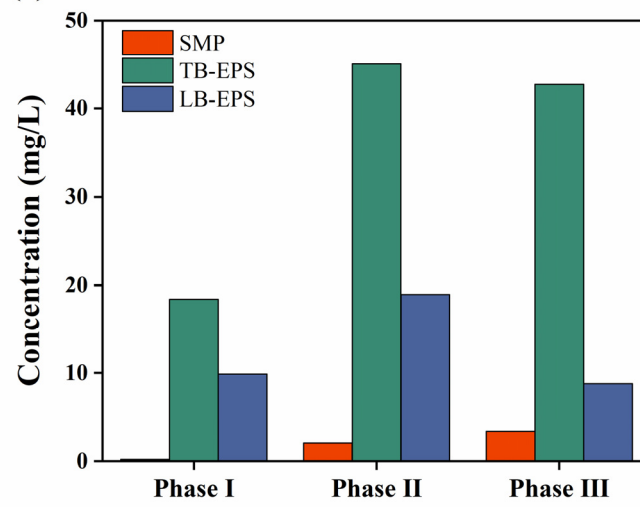
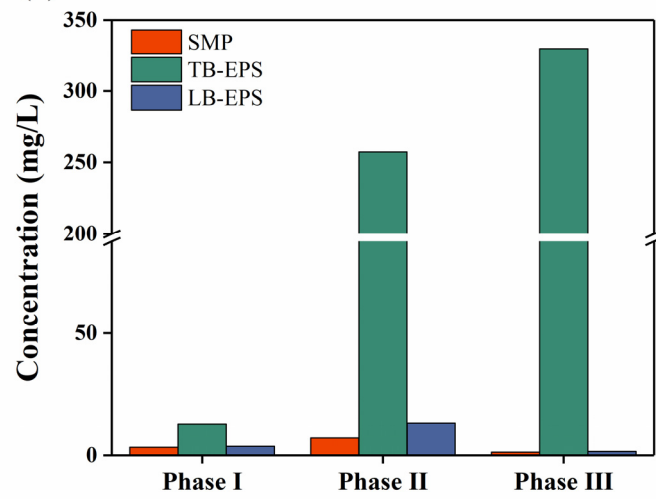


Figure S2. Cumulative frequency curves of (a) COD, (b) $\text{NH}_4^+\text{-N}$, (c) TN and (d) $\text{PO}_4^{3-}\text{-P}$ concentrations in the effluent during the experiment.

(a)



(b)



(c)

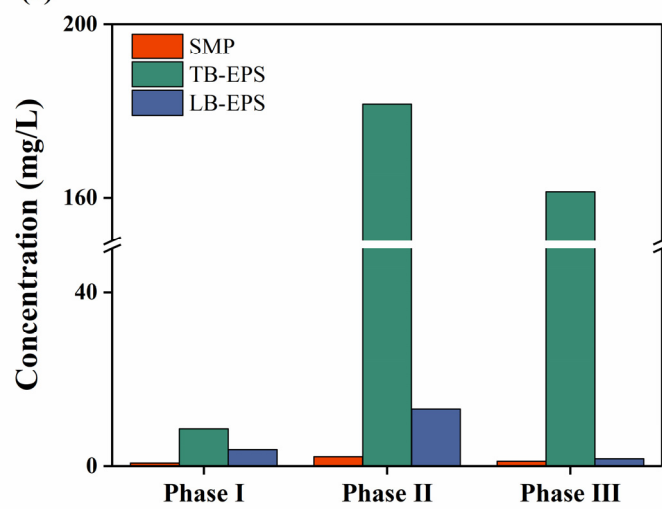
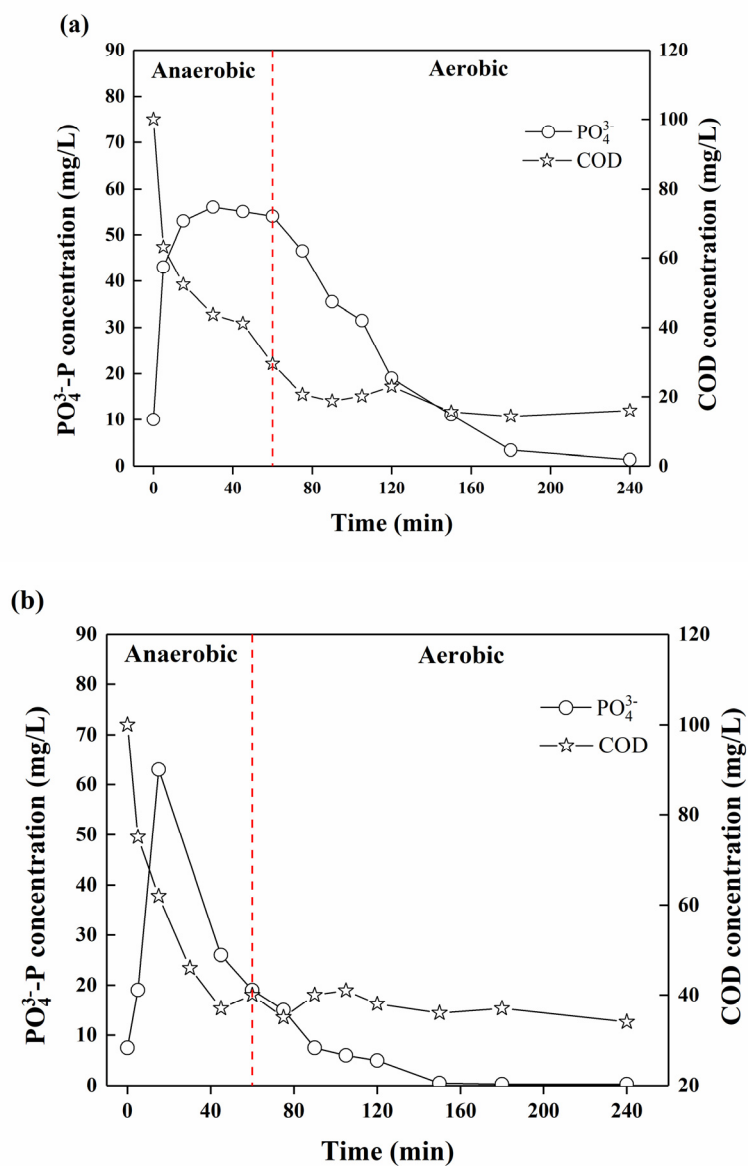


Figure S3. The concentrations of (a) proteins, (b) humic acids, and (c) polysaccharides in the soluble microbial products (SMP), loosely bound (LB-EPS) and tightly bound extracellular polymeric substances (TB-EPS) of the activated sludge during the experiment.



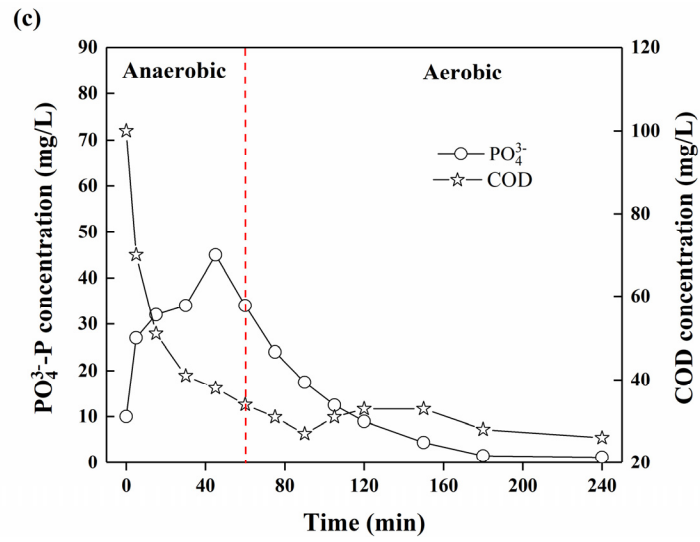
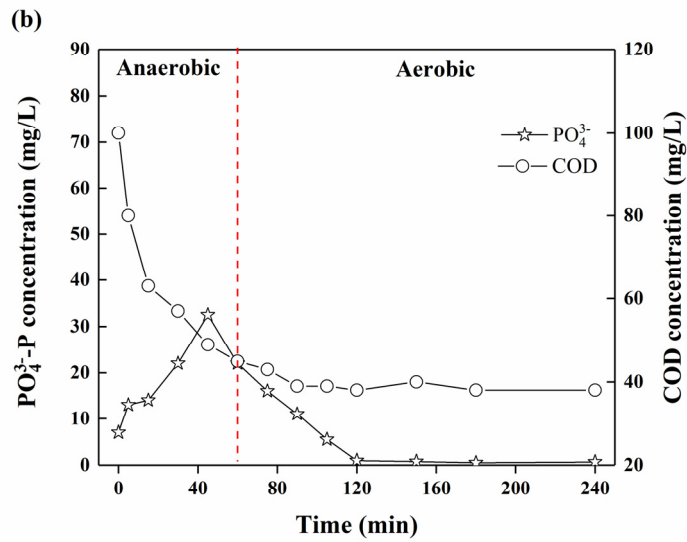
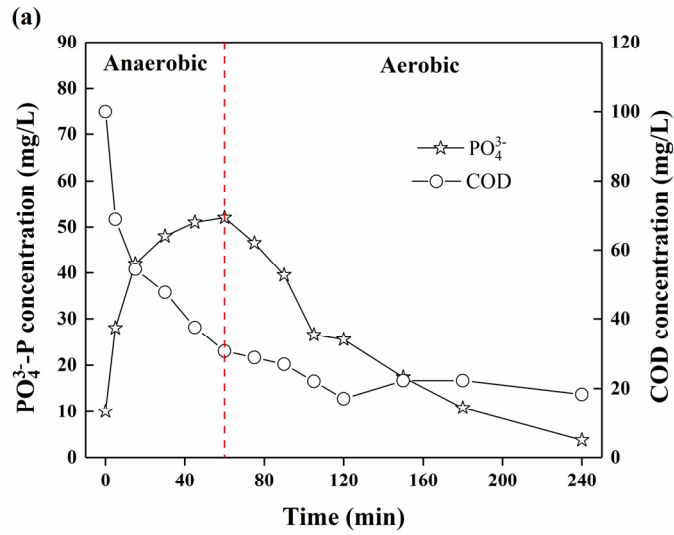


Figure S4. Profiles of $\text{PO}_4^{3-}\text{-P}$ and COD during P release and uptake batch tests fed with acetate in (a) Phase I, (b) Phase II, and (c) Phase III.



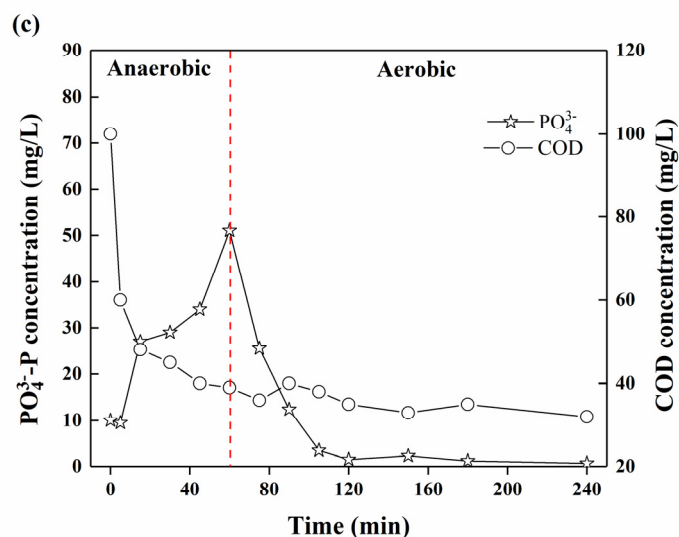


Figure S5. Profiles of PO₄³⁻-P and COD during P release and uptake batch tests fed with propionate in (a) Phase I, (b) Phase II, and (c) Phase III.

Table S1 Summary of COD/P and COD/N ratios in high-strength dairy and manure wastewater.

Wastewater source	COD/P	COD/N	Reference
Synthetic digested manure	25.0	10.0–20.0	[1]
Synthetic dairy processing	19.5	24.1	[2]
Digested dairy manure	27.7	6.9	[3]
Diluted digested dairy manure	99.0	6.9	[4]
Diluted dairy manure	41.6	20.6	[5]
Poultry farm	37.5–42.1	6.8–8.0	[6]
Livestock farm	23.4–51.2	8.9–19.7	This study

Table S2 Component and concentrations of other trace elements in the synthetic pre-fermented high-strength wastewater.

Component	Concentration (mg/L)
Yeast extract	8
MgCl ₂ ·6H ₂ O	219
MgSO ₄ ·7H ₂ O	14
KCl	98
CaCl ₂	46
H ₃ BO ₃	0.061
Na ₂ MoO ₄ ·2H ₂ O	0.031
KI	0.015

$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$	0.061
$\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$	0.075
$\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$	0.3

Table S3. Average specific ammonia oxidation rate (AOR) and specific nitrite oxidation rate (NOR) in typical cycles of SBR reactor during the experiment.

Phase	AOR [mg N/(g VSS·h)]	NOR [mg N/(g VSS·h)]	Reference
I	0.51	0.61	This study
II	0.66	0.42	This study
III	0.72	0.18	This study
Other activated sludge systems	3.25-3.62	4.68-5.57	[7,8]

AOR: specific ammonia oxidation rate; NOR: specific nitrite oxidation rate.

References

1. Yuan Z., Kang D., Li G., Lee J., Han I., Wang D., Zheng P., Reid M.C., Gu A.Z., Combined Enhanced Biological Phosphorus Removal (EBPR) and Nitrite Accumulation for Treating High-strength Wastewater. *bioRxiv*. **2021**.
2. Bickers P., Bhamidimarri R., Shepherd J., Russell J., Biological phosphorus removal from a phosphorus-rich dairy processing wastewater. *Water Sci Technol*. **2003**, 48, 43-51.
3. Sooknah R.D., Wilkie A.C., Nutrient removal by floating aquatic macrophytes cultured in anaerobically digested flushed dairy manure wastewater. *Ecol Eng*. **2004**, 22, 27-42.
4. Wang L., Li Y., Chen P., Min M., Chen Y., Zhu J., Ruan R.R., Anaerobic digested dairy manure as a nutrient supplement for cultivation of oil-rich green microalgae *Chlorella* sp. *Bioresource Technol*. **2010**, 101, 2623-8.
5. Qureshi A., Lo K.V., Mavinic D.S., Liao P.H., Koch F., Kelly H., Dairy manure treatment, digestion and nutrient recovery as a phosphate fertilizer. *Journal of Environmental Science and Health, Part B*. **2006**, 41, 1221-35.
6. Zheng T., Li P., Ma X., Sun X., Wu C., Wang Q., Gao M., Pilot-scale experiments on multilevel contact oxidation treatment of poultry farm wastewater using saran lock carriers under different operation model. *Journal of Environmental Sciences*. **2019**, 77, 336-45.
7. Li S., Fei X., Chi Y., Jiao X., Wang L., Integrated temperature and DO effect on the lab scale A2O process: performance, kinetics and microbial community. *International Biodeterioration & Biodegradation*. **2018**, 133, 170-9.
8. Yao Q., Peng D.-C., Nitrite oxidizing bacteria (NOB) dominating in nitrifying community in full-scale biological nutrient removal wastewater treatment plants. *Amb Express*. **2017**, 7, 1-11.