

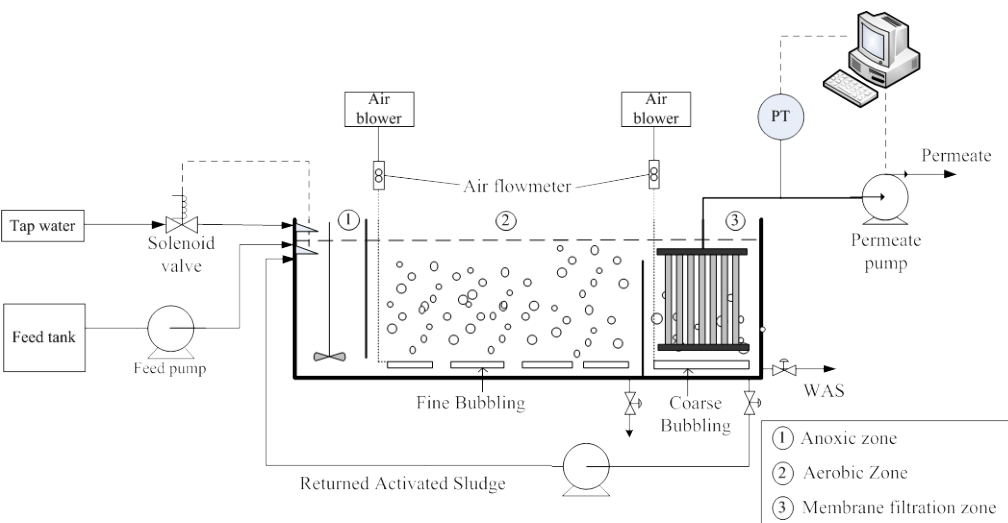
Optimisation of Nutrient Removal, Membrane Fouling and Sludge Dewatering in Hybrid Coagulation/Submerged Membrane Bioreactor of Wastewaters

In this issue, you will find the information on the laboratory scale and pilot scale studies undertaken by UNSW

LABORATORY SCALE STUDIES

Three bench scale membrane bioreactors, with a working volume of 30 L each, are operated at UNSW. The reactors were initially seeded with iron-free activated sludge from Sydney Water’s St. Marys WWTP and fed with synthetic wastewater. Synthetic wastewater is prepared to mimic the typical compositions of primary treated (after sedimentation) effluent of Bondi STP. The three reactors have identical configurations

- Anoxic zone (6L)
- Aerobic zone (18L)
- Membrane filtration zone (6L)
- Microfiltration hollow fibre membranes provided by Beijing Origin Water (nominal pore size 0.1 – 0.3 μm)



Schematic diagram of bench scale MBR

Influent compositions and operating parameters

Parameters	Concentration (mg/L)	Total membrane area	0.2 m ²
BOD ₅	200	Filtration/Relaxation ratio	9 min : 1 min
COD	400	Filtration flux	16.7 LMH
TOC	180-220	Hydraulic retention time	10 hr
Ammonia-N	20 - 30	Sludge retention time	30 days
Total Nitrogen as N	40 - 60	Recirculation ratio	300%
Total Phosphorus as P	8 - 10	MLSS	8 g/L

Test Conditions

1) Test on dosing amount

- Coagulant: Ferric chloride
- Dosing amount:
 - ✓ MBR #1: Fe/P molar ratio = 4
 - ✓ MBR #2: Fe/P molar ratio = 2
 - ✓ MBR #3: Fe = 0 (no dosing)
- Dosing point: Anoxic zone
- Dosing frequency: Continuous

2) Test on salt type and dosing location

- Coagulant: ferrous sulphate
- Dosing amount: Fe/P molar ratio = 2
 - ✓ MBR #1: Anoxic zone
 - ✓ MBR #2: Aerobic zone
 - ✓ MBR #3: No dosing
- Dosing frequency: Continuous

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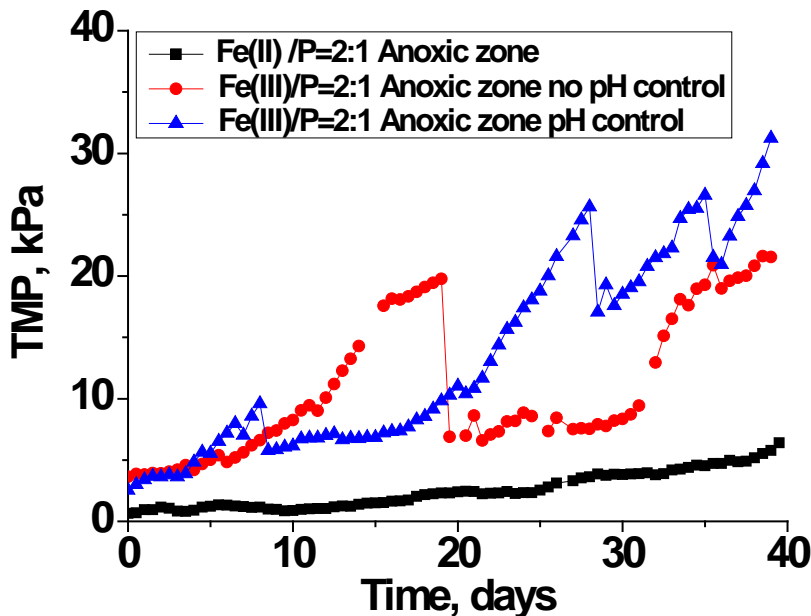
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Key Findings from Bench Scale Studies

- Overdosing of Fe(III) (at Fe/P molar ratio > 4) led to severe membrane fouling but had insignificant improvement on P removal and excess sludge dewaterability compared to lower dosage rate (Fe/P = 2)
- All salts and dosing regime could reach total P concentration in MBR effluent close to or lower than 0.03 mg/L
- Extended operation time without the need for membrane cleaning: Fe(II) might be slightly better than Fe(III) (studies still on-going) (see figure below)
- Sludge dewaterability: Fe(III) salts were better than Fe(II) salts. Varying dosing locations did not result in significant differences
- Addition of the iron may adversely affect nitrogen removal at high dosage rate (Fe/P = 4) due to the drop of the pH of mixed liquor however nitrogen removal can be recovered when the pH was adjusted back to neutral



Trans-membrane pressure (TMP) of bench scale MBR with different iron dosage

PILOT PLANT

A pilot scale MBR (1250L in volume) was installed at Sydney Water’s Bondi WWTP with a designed treatment capacity of 4kL/day. The pilot plant MBR consists of:

- Primary anoxic zone (250L)
- Aerobic zone (550L)
- De-aeration zone(60L)
- Secondary anoxic zone (140L)
- Membrane filtration zone (250L); with reinforced PVDF hollow fibre membranes provided by Beijing Origin Water

This pilot plant was designed to mimic the configurations of the full-scale MBR in Brooklyn.

Bondi WWTP was selected because no iron salts are added in the Bondi catchment reaching the wastewater treatment plant. Therefore, the feed to the pilot plant MBR is largely iron free. This was an important factor for the selection of feed material to the pilot plant.

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