Comparison between treatment of KSWW only and mixture of KSWW and WMWW using subMBR

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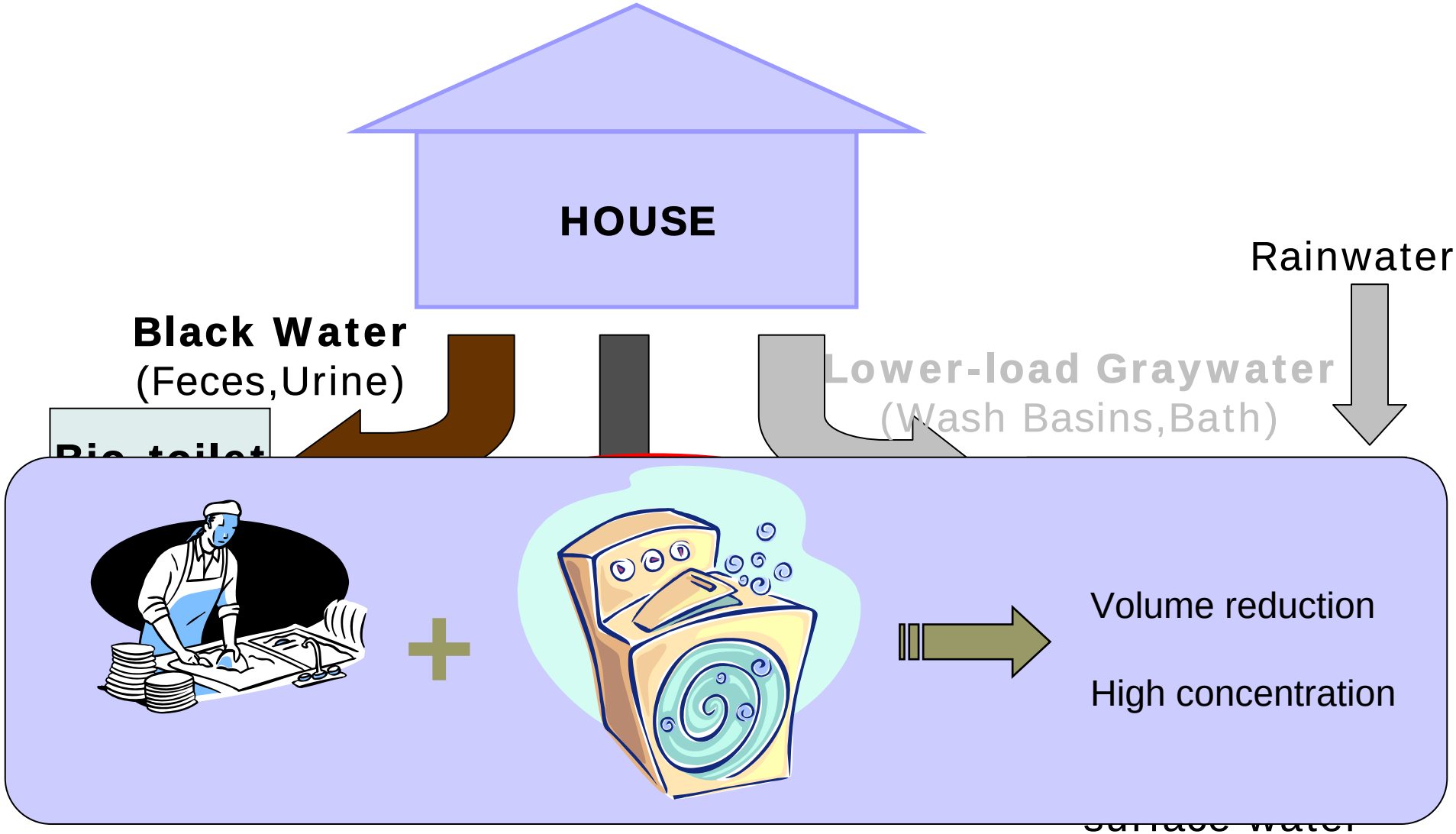
Background of Study

Onsite Wastewater Differentiable Treatment System



Submerged Membrane Bioreactor (SubMBR)

Advantages:

- longer sludge retention time (SRT) independent of hydraulic retention time
- smaller footprint
- small reactor volume due to higher MLSS concentration and loading rate
- complete removal of solids
- higher and more consistent effluent quality suitable for reuse
- reduced sludge production.

Objectives

- To determine effect of organic loading rate (OLR)
  - organic matter removal
  - nitrogen and phosphorus
  - LAS removal*

* Mixture only

Ultrafilter-Hollowfiber (UF-HF)

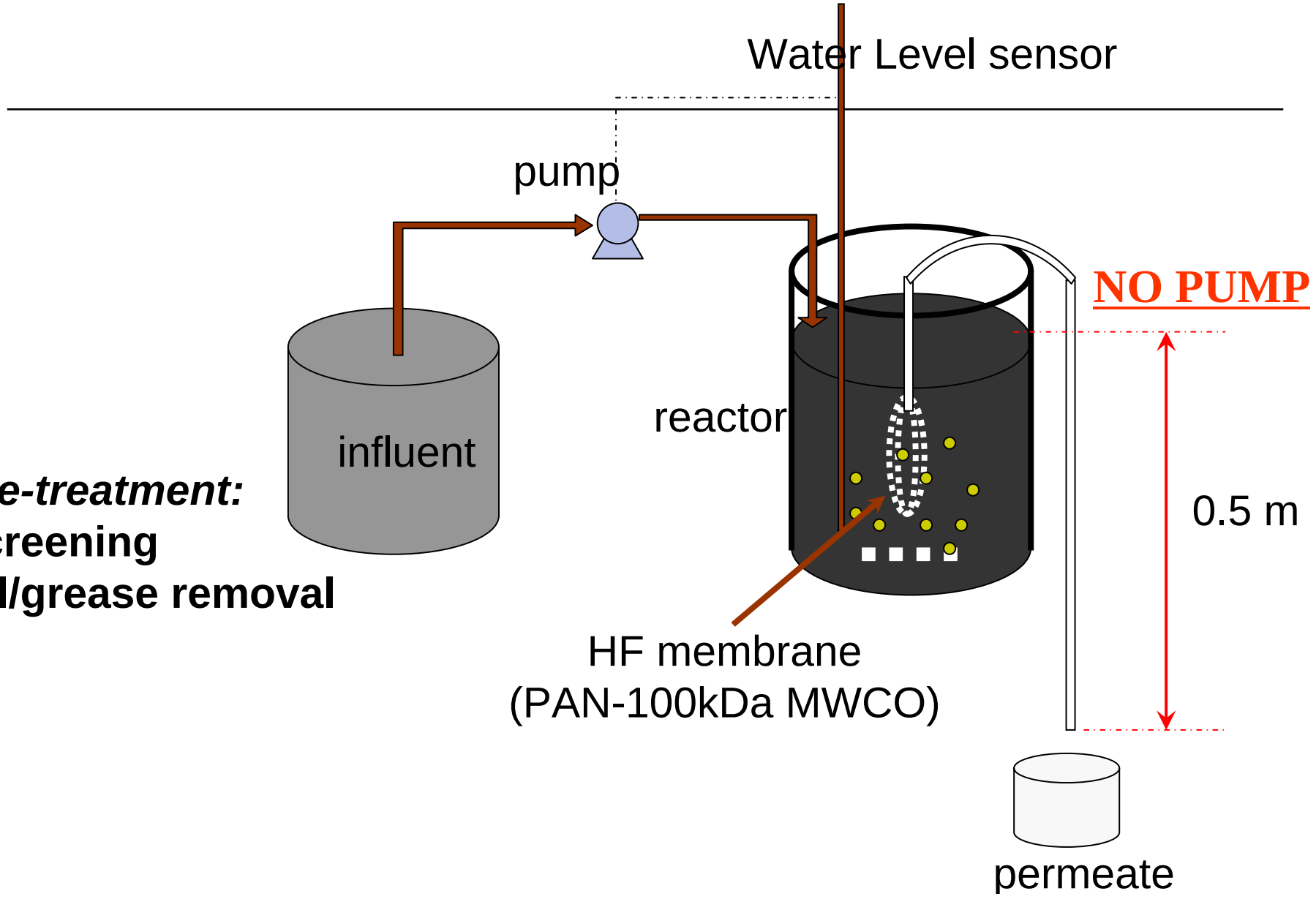
Kitchen Sink (KS)

1. Effect of organic loading rate (OLR) on:
   organic matter(OM) removal; characteristics of OM; nitrogen and phosphorus (N and P)

Kitchen Sink and Washing Machine (KS + WM)

2. Effect of OLR on:
   OM removal; N and P; permeate flux; LAS

Configurations of a single subMBR

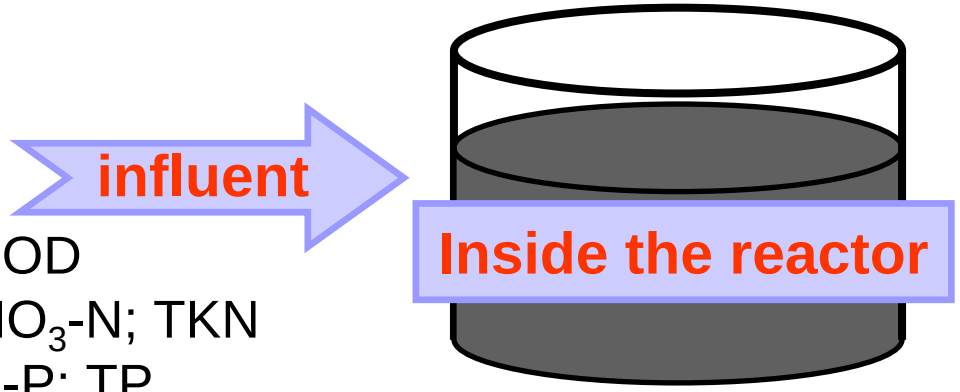


Pre-treatment:
Screening
Oil/grease removal

Operating conditions at different HRT to give different OLR

Parameters	Reactor 1	Reactor 2	Reactor 3	Reactor 4
TMP, kPa	5	5	5	5
HRT, hr	**4.5**	**7**	**12**	**24**
MLSS, g/L	11-13	11-13	11-13	11-13
Airflow Rate, L/min	2.5	2.5	2.5	2.5

Parameters monitored



COD
NH_4-N; NO_3-N; TKN
PO_4-P; TP

Dissolved:
COD; DOC for MWD; NH_4-N;
NO_3-N; TKN; PO_4-P

COD; NH_4-N; NO_3-N;
TKN; PO_4-P; Flux

Kitchen sink wastewater characteristics

Parameters (mgL^{-1})	Kitchen sink	Gr	Mixture	nestic[2]
COD	770-2050	495	540-1200	0-800
Total Nitrogen (TN)	21.9-43.5	8.0-	10-35	0-70
Particulate Organic N	12.7-24.4			
Dissolved Organic N	6.1-14.2		9-32	
NH_4-N	0.3-2.7		0.9-2.6	
NO_3-N	0.9-5.3		0.2	
Total Phosphorus(TP)	2.9-14.5	4.6	0.6-1.3	-12
Phosphates (PO_4-P)	0.4-1.5			

[1]Palmquist & Hanæus 2005
[2] Tchobanoglous *et al* 2003

Operating conditions and permeate quality of the reactors of different organic loading rate

	Reactor 1	Reactor 2	Reactor 3	Reactor 4
HRT, hr	4	8	12	24
OLR, kg COD/m^3-day	5.3	2.7	1.8	0.9
MLSS, g/L	9-11	9-11	9-11	6-7
SRT, days	-	30	58	Almost infinite
F/M, kgCOD/kgMLSS-day	**0.53**	**0.27**	**0.18**	**0.14**
F/M for KS only	**0.575**	**0.375**	**0.217**	**0.165**
Permeate				
COD, mg/L	**53**	**29**	**17**	**17**
COD for KS only		**(82.5)**	**(59.4)**	**(29.3)**
NH_4-N, mg/L	-	0.1*	0.55*	0.06*
NO_3-N, mg/L	-	0-0.01	0-0.41	0-3.67
PO_4-P, mg/L	-	-	-	0-0.54

*ave value

Dissolved matter inside each reactor of different OLR

	Reactor 1	Reactor 2	Reactor 3	Reactor 4
COD, mg/L	-	97-272	64-240	58-235
NH_4-N, mg/L	-	0.21*	0.63*	0.07*
NO_3-N, mg/L	-	0-0.2	0-0.47	0-3.72
PO_4-P, mg/L	-	-	-	0-0.65

*ave value

Measurement of LAS

- LAS concentration in washing machine wastewater:
  → 20.59 - 46.24mg/L

- LAS concentration in permeate
  → 0.008 – 2.400 mg/L

Summary

- Biological treatment of WMWW only is not feasible
- HRT = 8 hours or longer / OLR = 2.7 kgCOD/m^3-day or lower
- High organic matter in the permeate of the system treating the mixture compared to KSWW only
- WMWW has some components that are not completely degraded
- Remaining OM is not LAS

THANK YOU…

Operating conditions and permeate quality of the reactors of different organic loading rate

	Reactor 1	Reactor 2	Reactor 3	Reactor 4
HRT, hr	4.5	7	12	24
OLR, kg COD/m^3-day	6.9	4.5	2.6	1.3
MLSS, g/L	11-13	11-13	11-13	7-9
SRT, days	15	25	140	Almost infinite
F/M, kgCOD/kgMLSS-day	0.575	0.375	0.217	0.1625
Permeate				
COD, mg/L	35-73 (53)	11-53 (29)	10-26 (17)	7-34 (17)
NH_4-N, mg/L	-	-	-	-
NO_3-N, mg/L	-	-	-	13
PO_4-P, mg/L	-	0.05	0.8	2.4

Dissolved matter inside each reactor of different OLR

	Reactor 1	Reactor 2	Reactor 3	Reactor 4
COD, mg/L	44-1213	34-207	19-131	23-54
NH_4-N, mg/L	-	-	-	-
NO_3-N, mg/L	-	-	-	13
PO_4-P, mg/L	-	0.1	0.9	2.3