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Pollution Research Group

The Use of Effluent from an Anaerobic Baffled Reactor (ABR) for Agricultural Use in Peri-Urban Communities

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Background

- Urbanisation has resulted in clusters of informal settlements with high densities.
- Access to potable water and sanitation is sometimes difficult.
- Problems associated with implementation and maintenance of water and sanitation services.
- Concern that waterborne diseases could reach epidemic proportions.

Sanitation Options for Dense Peri-Urban Settlements

Waterborne

- Surrounding infrastructure often inadequate and overloaded.
- Need formalisation and servitudes.
- High cost.
- Not sustainable in long term.
- Costly long term intervention.

On-Site

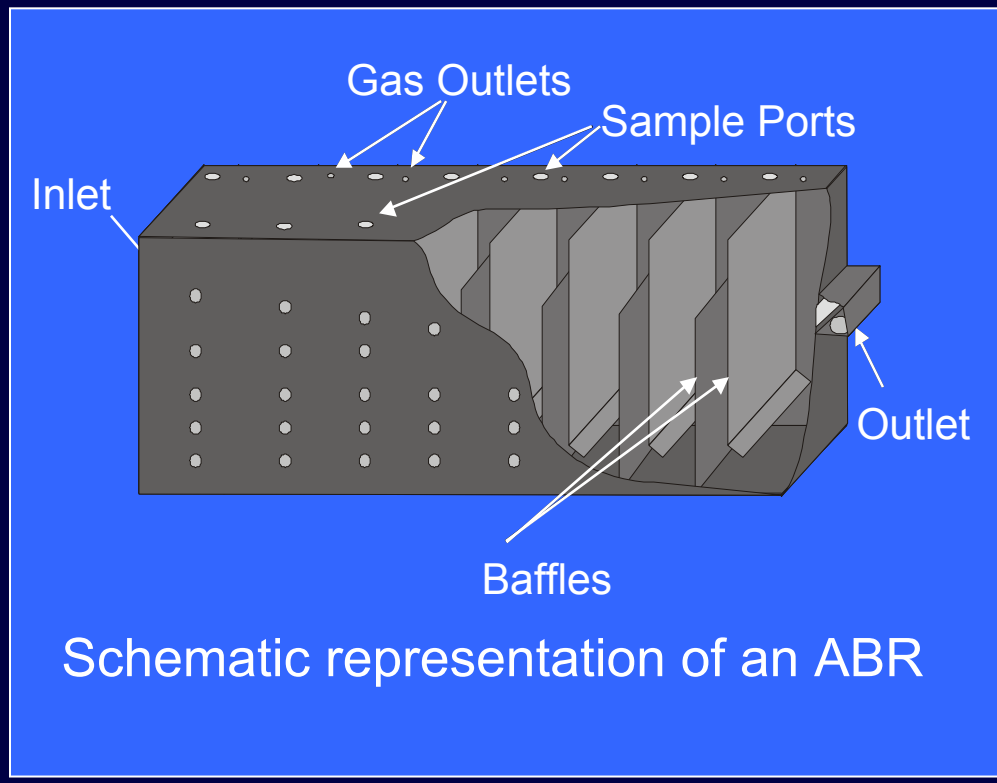
- Pit latrines and VIPs.
- High emptying cost.
- Contamination of surface and groundwater.
- Physical constraints.
- Unhygienic

South African Water Research Commission (WRC)

- Funding alternate on-site sanitation technologies.
- Suitable for operation in dense settlements.
- Be economic and environmentally friendly.

Anaerobic Baffled Reactor (ABR)

- Uses a series of vertical baffles to force wastewater to flow under and over baffles.
- Spatial separation of microbial consortia.
- Shown to be successful in the treatment high-strength wastes using lab-scale reactor.



Schematic representation of an ABR

Advantages of an ABR for Sanitation Treatment

- Wide range of flow and load conditions.
- No mechanical parts and no power requirements.
- Low maintenance and no highly-trained personnel.
- Biogas and effluent potential resources.

Objectives

- Examine operational performance of the pilot-scale reactor in relation to influent and effluent.
- Evaluate suitability of ABR effluent for agriculture.

Measurements

Microbial Indicators:

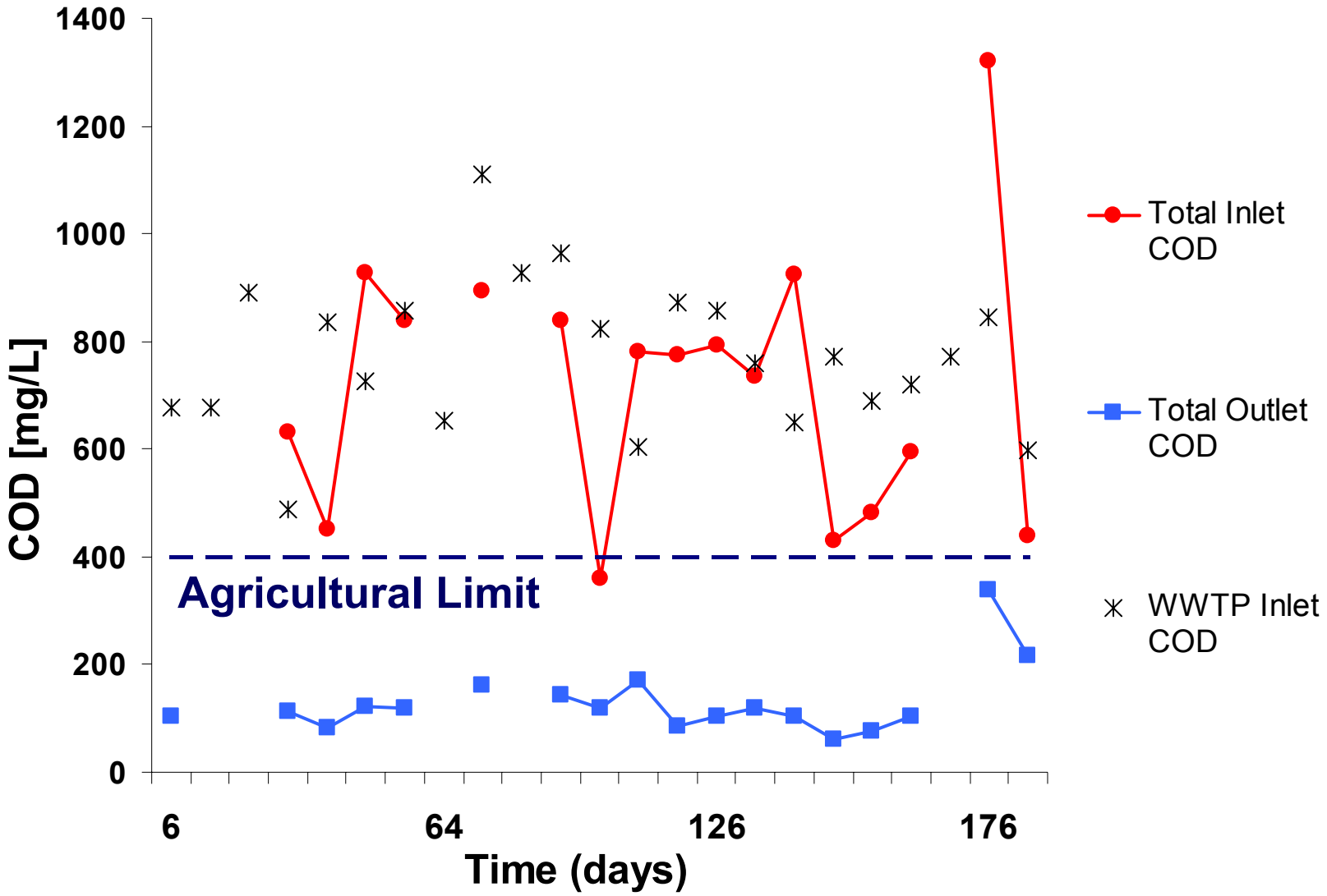
- Coliforms
- Coliphages
- *Ascaris* eggs

Chemical:

- Chemical oxygen demand (COD)
- Free and saline ammonia
- Total suspended solids (TSS)
- Free and saline ammonia
- Phosphate

Results

Inlet and Outlet COD



Average Measured Values

Parameter	Influent	Effluent	% Reduction
COD	719	130	81
pH	6.7 – 7.4	6.2 – 7.4	-
Ammonia	55	51	8
Total Suspended Solids	416	135	68
E. coli	2 E + 07	5 E + 06	76
Total Coliforms	5 E + 07	8 E + 06	83
Coliphage	2 E + 04	4 E + 03	64
Ascaris *spp.*	772	16	98

Average Measured Values

Parameter	Influent	Effluent	Target Quality
COD	719	130	400†
pH	6.7 – 7.4	6.2 – 7.4	6 - 9
Ammonia	55	51	30*
Total Suspended Solids	416	135	50*
E. coli	2 E + 07	5 E + 06	1 E + 03
Total Coliforms	5 E + 07	8 E + 06	1 E + 04
Coliphage	2 E + 04	4 E + 03	20
Ascaris spp.	772	16	≤ 0.1

† 500 kL/d discharge

* Tentative guideline

Implications

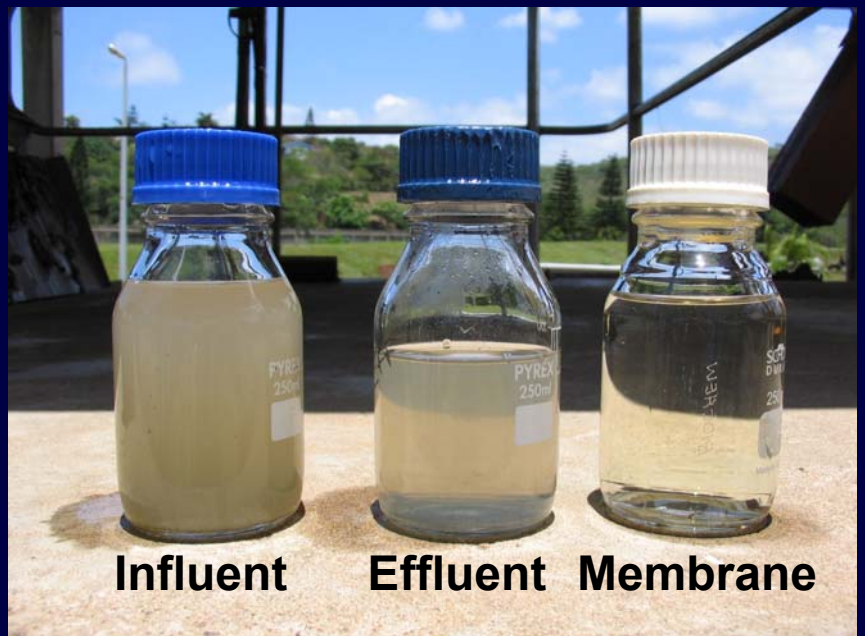
- Effluent exceeded most re-use guidelines.
- High concentrations of plant nutrients suggest use as a fertiliser for crops.
- Main constraint affecting effluent re-use is the high level of microbial contaminants.
- Effluent a potential threat to public health.
- Post-treatment necessary.

Membrane Post-Treatment

- Possible post-treatment option.
- Forms an integral part of the ABR.
- Physical barrier preventing the passage of microorganisms.
- Advantages of membrane treatment:
  - Produces high quality water.
  - Chemical addition not required.
- Preliminary trial using Kubota membrane.

Preliminary Results

- Significant removal of coliform indicators ($p < 0.05$).
- TSS not detected in permeate.
- Permeate quality varied according to feed.
  - Fouling layer had not developed significantly.
  - Membrane integrity compromised.



Growth Trials

- Small-scale study conducted to assess the effects of ABR effluent on plant growth.
- Maize, sweet peppers and spinach subjected to three treatments:
  - Hydroponic (positive control)
  - ABR effluent (experimental)
  - Tap water (negative control)
- Comparable plant growth between hydroponic and effluent treatments.

Agricultural Use Possible

- ABR and membrane operated as a single treatment system.
- Worker protection and education on effluent use.
- Irrigation occurs at safe distance from surface and groundwater to prevent eutrophication.
- Plant sensitivity to nutrients should be considered.

Further Research

- More extensive tests on membrane + ABR.
- Large-scale growth trial to access the effects of effluent irrigation on a variety of crops.
- Development of guidelines and/or recommendations for effluent re-use in peri-urban communities.
- Capacity to generate electricity/heating from methane.

Acknowledgements

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