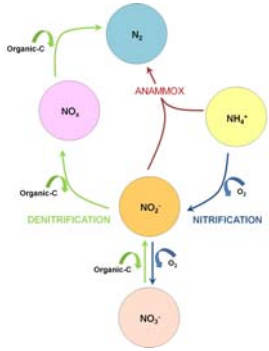




Use of immobilization techniques results in better anammox biomass retention, positively affecting treatment process capacity. This research is leading towards the development of a more economical treatment system for swine wastewaters containing high ammonium.

Partial nitritation + anaerobic ammonium oxidation (anammox)



CONCEPT

- ✓ Totally autotrophic bioprocess for the removal of nitrogen

TARGET

- ✓ Treatment of wastewaters with high nitrogen and low organic contents targeting N-removal efficiencies close to 90%

ADVANTAGES (with respect to conventional nitrification-denitrification)

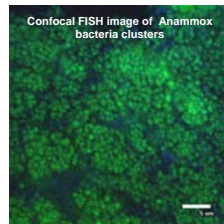
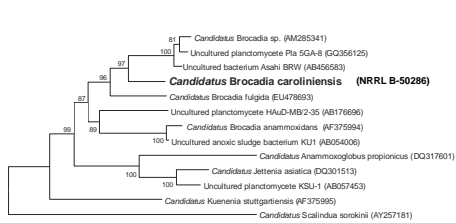
- ✓ Reduction of both oxygen needs (60% less than nitrification-denitrification) and sludge production
- ✓ Does not need organic carbon for denitrification, which is optimal for treatment of anaerobic digestion effluents
- ✓ Does not produce nitrous oxide, a powerful greenhouse gas
- ✓ The possibility of working with higher nitrogen loading rates

CHALLENGES

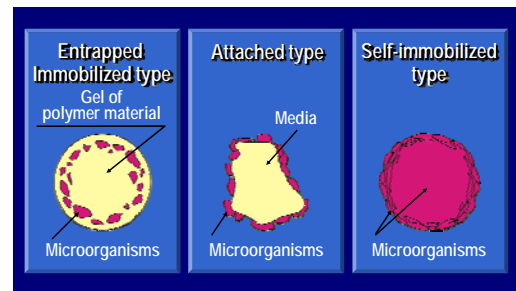
- ✓ Anammox biomass retention inside reactors is difficult due to the low growth rates of these bacteria

New anammox bacteria

- ✓ Novel microorganism *Candidatus "Brocadia caroliniensis"*
- ✓ Isolated from an animal waste treatment facility in North Carolina, USA



Anammox immobilization techniques



Entrapped biomass

- 1.4-L continuous stirred tank reactors (CSTR) packed with pellets (25% v/v)
- Use of polyvinyl alcohol (PVA) as gel carrier to make the pellets
- Preparation of gel pellets of about 3-5 mm
- Nitrogen loading rates (NLR) of 0.45 to 1.65 g N L⁻¹ d⁻¹ (40-d start-up)
- Synthetic feed (71 ± 14 mg NH₄-N L⁻¹, 90 ± 12 mg NO₂-N L⁻¹)
- Nitrogen removal rate of 0.05-0.55 g N L⁻¹ d⁻¹



Attached biomass



- 10-L continuous upflow reactor
- Use of polyester non-woven biomass carrier
- Flow rate of 60 L d⁻¹ and NLR = 1.74 g N L⁻¹ d⁻¹ (350-d)
- Synthetic feed (131 ± 13 mg NH₄-N L⁻¹, 152 ± 13 mg NO₂-N L⁻¹)
- Nitrogen removal rate of 1.48 g N L⁻¹ d⁻¹ with 85% efficiency

Self-immobilized biomass

- Bench-scale automated unit coupling partial nitritation (PN) and anammox processes
- Use of sequencing batch reactor (SBR) technology
- Biomass: nitrifying activated sludge and suspended-granular anammox sludge
- Treatment of swine wastewater with 1400 ± 36 mg NH₄-N L⁻¹ and low biodegradable organic-C (1625 ± 129 mg COD L⁻¹)
- PN stage produced a good quality effluent, with a NO₂-N:NH₄-N ratio of 1.4 ± 0.3 (70-d)
- Measured conversion rates in the anammox reactor of up to 1.34 g N L⁻¹ d⁻¹

