# ANAMMOX TREATMENT OF SWINE WASTEWATER USING IMMOBILIZED TECHNOLOGY

Albert Magrí[1], Matias Vanotti[2], Ariel Szogi[2]

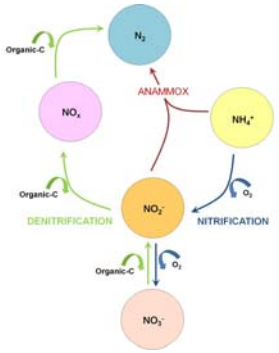
[1]GIRO Technological Center, Mollet del Vallès, Barcelona, SPAIN

[2]USDA-ARS, Florence, South Carolina, USA

RAMIRAN
13th - 15th September
Lisbon, Portugal

**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

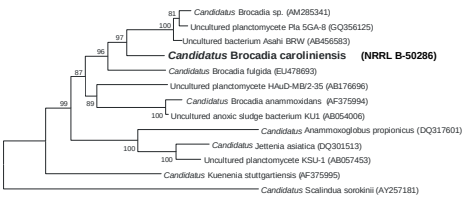
### CHALLENGES

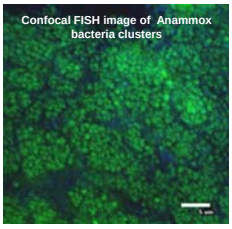
✓ Anammox biomass retention inside reactors is difficult due to the low growth rates of these bacteria

## New anammox bacteria

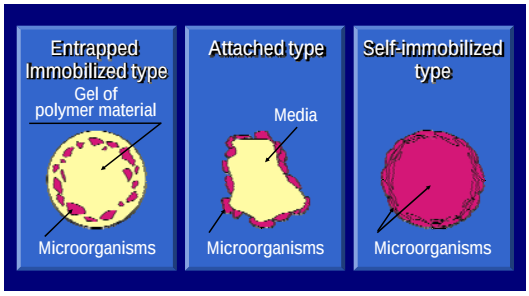
✓ Novel microorganism ***Candidatus*** **"Brocadia caroliniensis"**

✓ Isolated from an animal waste treatment facility in North Carolina, USA

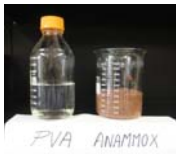


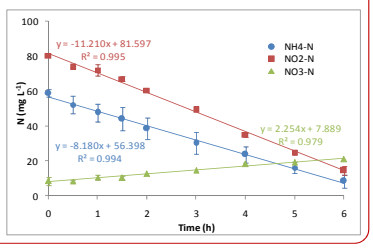




## Anammox immobilization techniques




### *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 $NH_4$-N $L^{-1}$, 90 ±12 mg $NO_2$-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 $NH_4$-N $L^{-1}$, 152 ±13 mg $NO_2$-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 $NH_4$-N $L^{-1}$ and low biodegradable organic-C (1625 ±129 mg COD $L^{-1}$)**
- **PN stage produced a good quality effluent, with a $NO_2$-N:$NH_4$-N ratio of 1.4 ±0.3 (70-d)**
- **Measured conversion rates in the anammox reactor of up to 1.34 g N $L^{-1}$ $d^{-1}$**