LIFE DeNTreat

THE DEMONSTRATION PLANT

SBR

In the reactor the contact between wastewater and bacterial granules takes place. Being a batch-type process, it is structured in phases, whose complete cycles consist of loading, reaction, sedimentation, unloading and stand-by. The tank has a recirculation system for in-line measurement of chemical parameters and a nitrogen gas recirculation system for mixing. The tank is equipped with electric tracing and insulation to maintain the temperature, and with pressure, level and temperature gauges.

SAMPLING

During the loading and unloading phases, the wastewater is sampled in order to carry out further analyses of the chemical parameters in the laboratory.

PLC

The plant is equipped with automation and remote control system

TREATED WASTEWATER

The treated wastewater is discharged into two tanks arranged in sequence whose function is to avoid the accidental uncontrolled loss of biological sludge.

NOT TREATED WASTEWATER

The wastewater treated by the pilot plant comes from the equalization tank already existing end-of-pipe of the company discharges and is pre-treated through a basket filter to prevent the entry of any threads into the storage tank.

FEEDING TANK

The tank is used to store and homogenize the wastewater to be treated, through a dedicated recirculation pump, and to regulate the temperature. This parameter is kept in the range 35°-38°C thanks to a cooling/heating system, consisting of a coil fed with service water for cooling, and a steam jet for heating.

REAGENTS

In the reactor recirculation system, reagent dosing points for pH and foam control are installed. In the feeding tank there is a phosphoric acid dosing point to satisfy the phosphorus request.

ON-LINE ANALYSIS

The chemical parameters are continuously monitored thanks to in-line measurements given by pH, dissolved oxygen, RedOx, ammonia and nitrates probes installed on reactor recirculation.

GASOMETER

The gasometer is connected to the reactor by the nitrogen recirculation and is used as a volumetric compensation of the gas phase. It is equipped with a fan and a hydraulic guard to maintain the pressure in the reactor between 20 and 25 mbar.

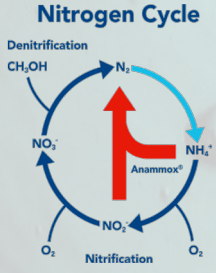
General design data

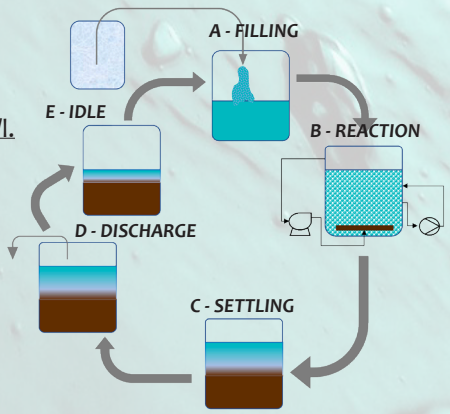
Design flow rate: 40 m3/d

Operating flow rate: 10 – 40 m3/d

Influent concentration: 130 – 260 mgNtot/l; avg ± st. dev.: 176 ± 44

Target effluent concentration: < 50 mgNtot/l (5%-ile = 100 mgN/l); < 0,6 mgN-NO2/l.





PHASE	DESCRIPTION
A	FILLING – Filling of Reactor SBR Anammox.
B	REACTION – Reaction between bacteria and wastewater.
C	SETTLE – Sedimentation of bacterial granules.
D	DISCHARGE – discharge of the treated effluent.
E	IDLE – Reactor in standby.

LABORATORY PILOT PLANT TESTS

The lab-scale reactor (Figure 1, 2-L volume) started its operation and confirmed the importance of an acclimation period for reaching steady state conditions. In the first period of operation, the reactor was fed with 100% synthetic influent made of a mixture of ammonium chloride and micronutrients and reached a Nitrogen Loading Rate (NLR) up to about 0.7 g/d.

After the start-up period, real wastewater was gradually added in place of the synthetic wastewater to achieve gradual adaptation. At day 60 the feed was entirely made by industrial wastewater and the removal efficiency gradually increased up to 70%.
Results are promising (Figure 2), in spite of the variability of the characteristics of wastewater treated. The installation has shown N-removal efficiency up to 60%, averaging at 44.8% (±12) However, there are important process settings which need to be strictly controlled, e.g. DO levels are crucial to avoid the development of nitrite oxidizing bacteria and the growth of a heterotrophic layer on the granular biomass, which may prevent ammonia oxidation by ammonium oxidizing bacteria. In addition to this, pH control is also essential as the decomposition of urea into ammonium nitrogen releases alkalinity and causes pH increase to above 8.5.

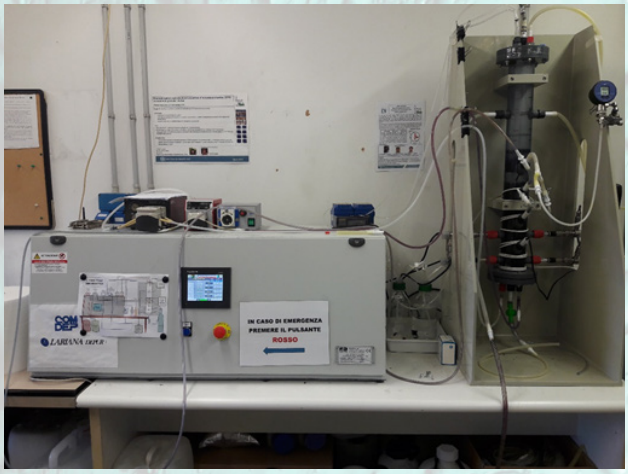


Figure 1 – Lab-scale plant (on the right) and control unit (on the left)

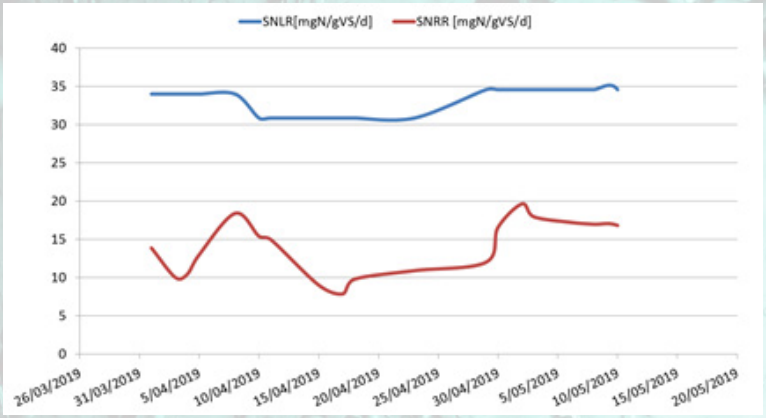
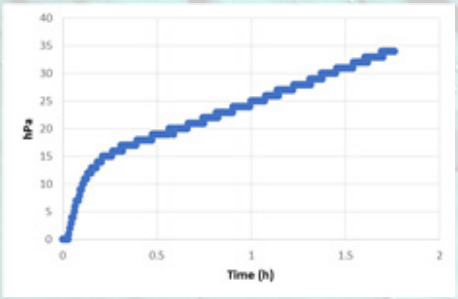


Figure 2 –Loading and removal rates of the bioreactor with 100% industrial wastewater

ACTIVITY TESTS

Activity tests on Anammox biomass were carried out following an in-house standardized method adjusted from van Loosdrecht (2016). This method evaluates the capability and the speed with which the Anammox granules are removing NH_4 and NO_2 from the solution by measuring the pressure increase due to the production of N_2. Providing a sufficient concentration of NH_4 and NO_2 at the beginning of the test, the granular Anammox biomass starts producing N_2 gas and increasing the pressure inside the test bottle (Figure 3).
Testing the activity in presence of a particular wastewater, the ability of Anammox biomass to operate in presence of that specific substrate can be assessed. The steepest part of the curve is known to be addressable to the activity of Anammox, while the less steep part can be addressed to the denitrification activity. Thus, at the net of the contribution of denitrifiers it is possible to assess the sole activity of Anammox biomass in controlled conditions.

Figure 3 – Particular of the activity test bottle equipped with the OxiTop® head (on the left) and a typical pressure profile (on the right).



PROJECT REFERENCES:

LIFE16 ENV/IT/000345

Locations:
- Como, Italy (Demonstrator installation site)
- Braga, Portugal
- Brussels, Belgium

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