processes

Supplementary Materials

Scaling-up and long-term operation of a full-scale two-stage partial nitritation-anammox system treating landfill leachate

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Description and Operation of the Industrial Treatment Plant

The values measured in the raw leachate for ammonium (TAN) and alkalinity (ALK) should be introduced manually into the supervisory control and data acquisition (SCADA) system. This information allows defining which are the conditions to be applied in the pre-treatment tank (bicarbonate or acid dosage to adjust ALK/TAN molar ratio). Next, targeted nitrogen loading rate (NLR), number of cycles per day, and minimum working volume in both sequencing batch reactors (SBRs) are defined by plant operator. According to these criteria, the SCADA system calculates the daily flowrate to be pumped in each SBR. The recirculation pumps should be operating for the on-line monitoring of the bioreactors (available probes: pH, dissolved oxygen (DO), redox potential (ORP), temperature, water level, and ammonium (this last probe only used temporarily)). In A-SBR, the nitrogen gas (N_2) produced is accumulated in the headspace of the reactor and released to the atmosphere when the overpressure exceeds 620 mbar.

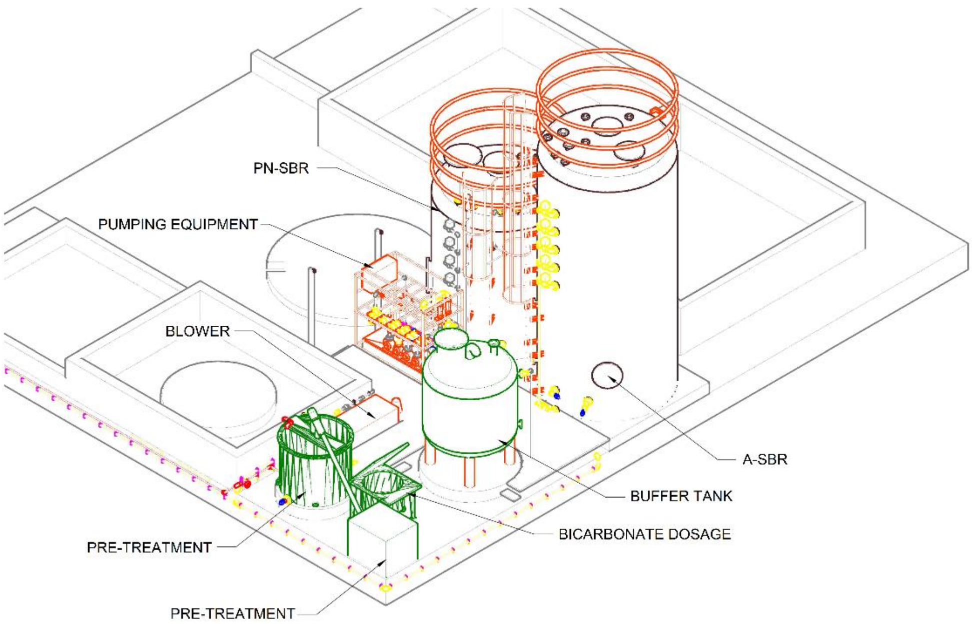


Figure S1. Layout for the industrial PANAMMOX® treatment plant running at the CORSA landfill site.

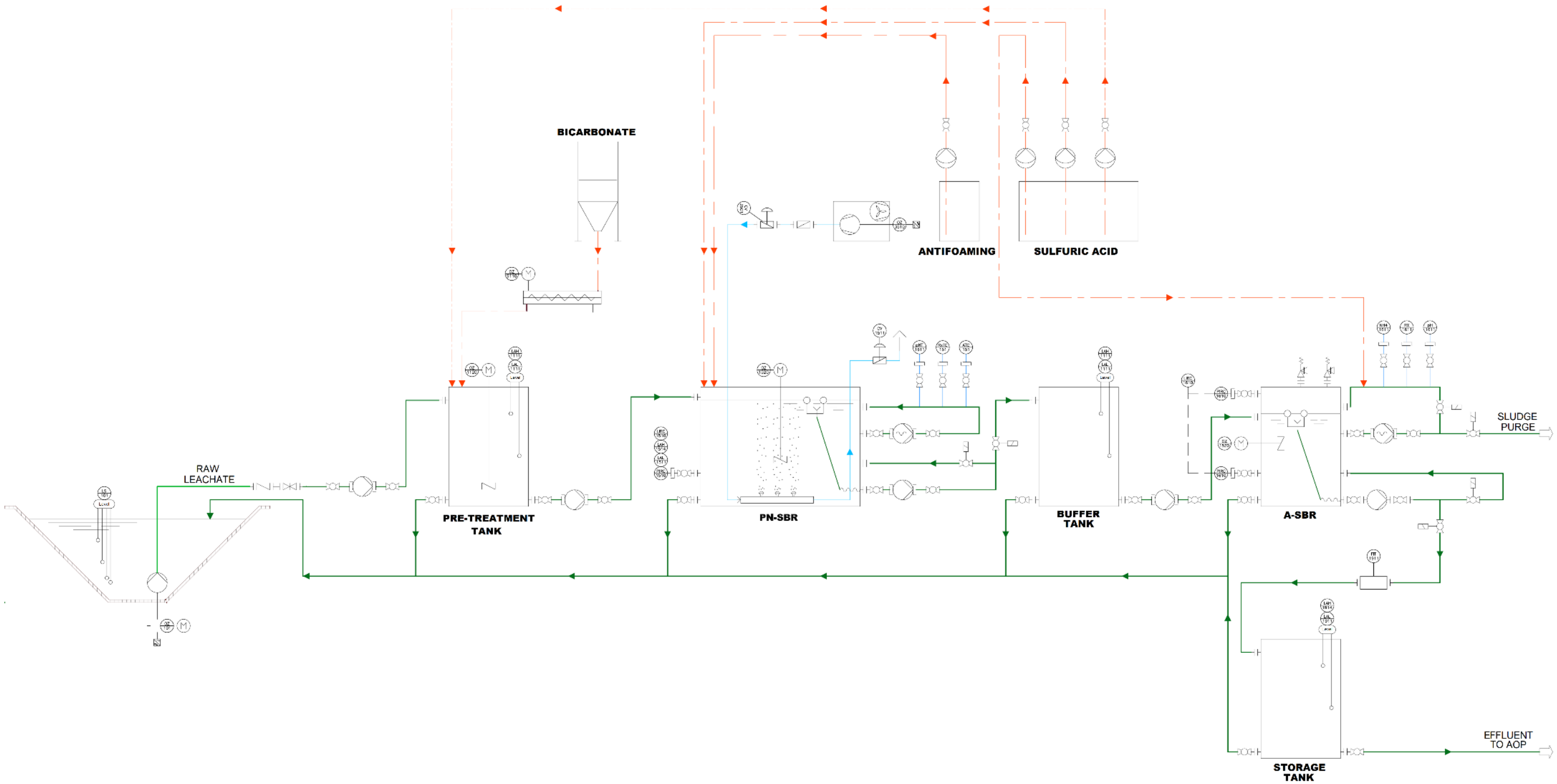
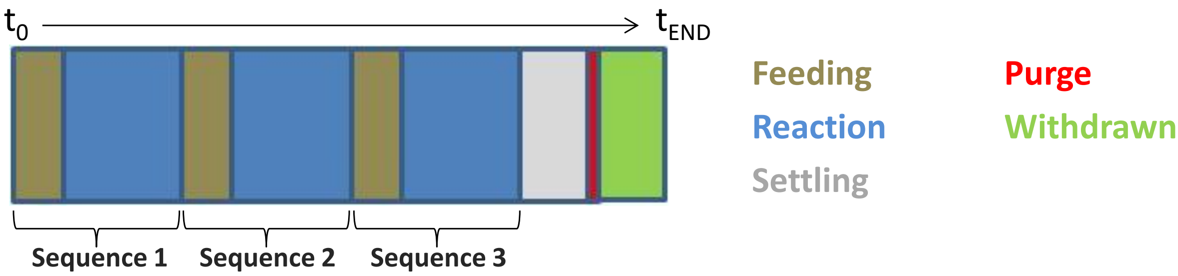


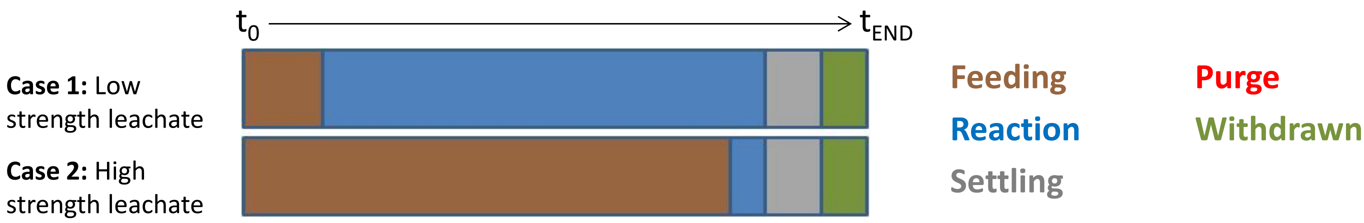
Figure S2. Piping and instrumentation diagram (P&ID) for the industrial PANAMMOX® treatment plant running at the CORSA landfill site.

SBRs Working Cycle Configuration



	Recirculation	Mixing	Pump IN	Pump OUT	Air	Temperature
Feeding	ON	ON	ON	OFF	ON	ON
Reaction	ON	ON	OFF	OFF	ON	ON
Settling	OFF	OFF	OFF	OFF	OFF	OFF
Purge	OFF	OFF	OFF	ON	OFF	OFF
Withdrawn	OFF	OFF	OFF	ON	OFF	OFF

Figure S3. Configuration of the working cycle for PN-SBR based on a step feed strategy. Each cycle includes multiple pairs of feeding plus reaction sequences (variable number of feeding events per cycle), which are followed by solids settling, solids purge, and finally, liquid effluent withdrawn (transferred to the buffer tank) until reaching the minimum working volume within PN-SBR.



	Recirculation	Mixing	Pump IN	Pump OUT	Temperature
Feeding	ON	ON	ON	OFF	ON
Reaction	ON	ON	OFF	OFF	ON
Purge	OFF	ON	OFF	ON	OFF
Settling	OFF	OFF	OFF	OFF	OFF
Withdrawn	OFF	OFF	OFF	ON	OFF

Figure S4. Configuration of the working cycle for A-SBR based on a fed batch strategy. Each cycle includes a long feeding phase (variable length depending on the strength of the influent stream, lasting up to 6 h) and a reaction phase (variable length, minimum 15 min), which are followed by solids purge (usually not considered), solids settling, and finally, liquid effluent withdrawn (transferred to a final storage tank) until reaching the minimum working volume within A-SBR.

On-line Profiles from the Industrial Plant

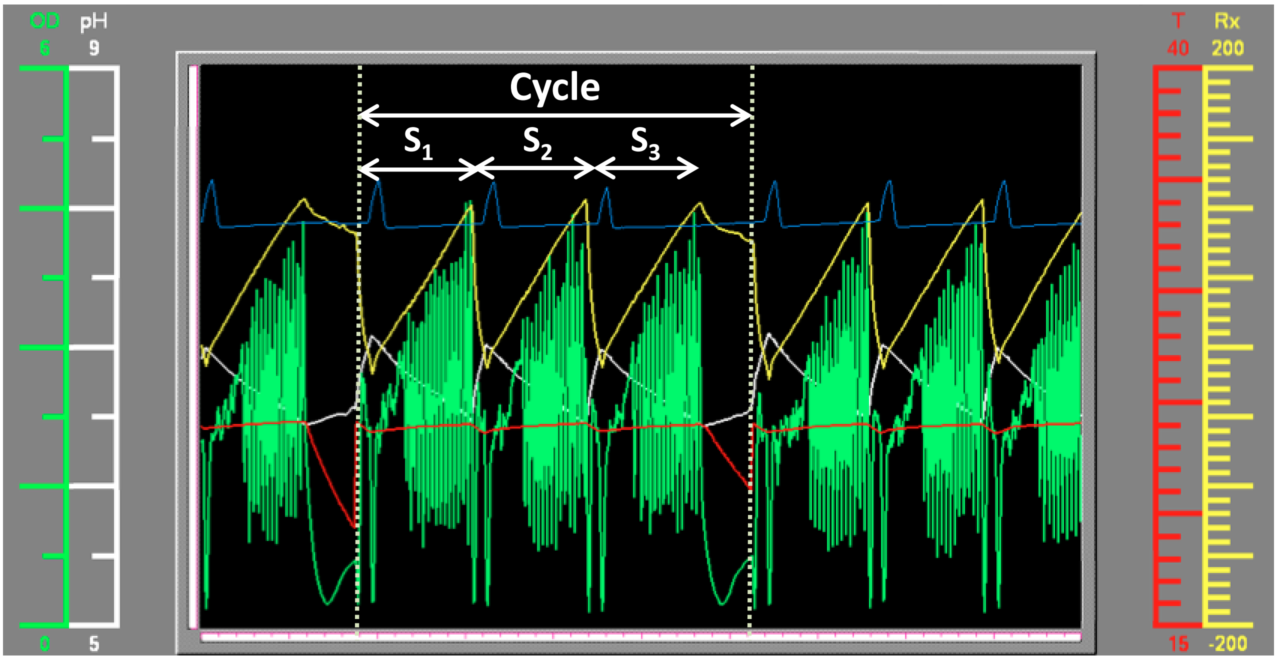


Figure S5. Example of an on-line monitoring profile during the start-up of PN-SBR. Evolution of the DO (mg O_2/L), pH, temperature (T, ºC), and ORP (Rx, mV) during one cycle. This cycle consisted of three feeding + reaction sequences (S_1-S_3). In each sequence, the pH rose due to leachate feed and decreased during reaction due to nitritation. The DO level became less stable by the end of the reaction phase due to a decrease in the oxygen uptake rate. A fast increase of the water temperature due to the re-activation of the recirculation pump was observed at the beginning of the cycle.

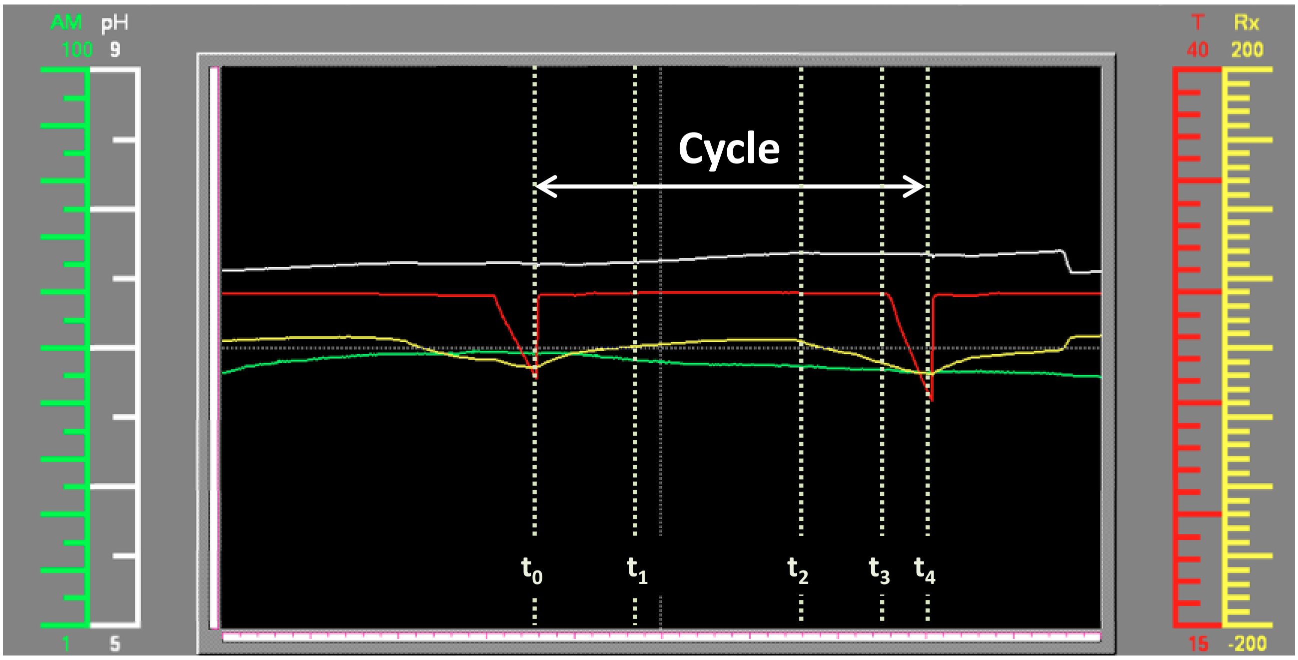


Figure S6. Example of an on-line monitoring profile during the start-up of A-SBR. Evolution of the ammonium (AM, mg N/L), pH, temperature (T, ºC), and ORP (Rx, mV) during one cycle. **(t_0)** Beginning of a new cycle (fast increase of the water temperature due to the re-activation of the recirculation pump); **(t_1)** End of the feeding phase (pH started to rise faster); **(t_2)** Nitrite depletion (ORP started to decrease while pH remained constant); **(t_3)** End of the reaction phase (temperature started to decrease); **(t_4)** End of the cycle.