IMPROVEMENT OF ANAMMOX GRANULE SIZE DISTRIBUTION IN A EGSB REACTOR FED WITH REAL EFFLUENT AT DIFFERENT NITROGEN LOADING RATE

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Biological processes are widely used for the removal of high nutrient loads, especially nitrogen, in wastewater treatment systems. Among these processes, Anammox stands out due to several operational and economic advantages over other technologies.
In this study, anammox granule size distribution was evaluated during reactor operation once sludge granulation is a key issue for success process performance. An EGSB (Expanded Granular Sludge Bed) reactor with a volume of 1L was inoculated with 300 mL of anammox sludge, coming from a pilot reactor operating for 250 days. The reactor was fed with 200 mgN.L-1 of total nitrogen (100 mg L-1 of NH4+-N from a UASB (Upflow Anaerobic Sludge Blanket) reactor fed with swine manure and 100 mg L-1 of NO2--N supplemented with NaNO2 solution). The reactor was operated for 130 days, and the hydraulic retention time (HRT) was adjusted from the feed flow rate (Qin), increasing the nitrogen loading rate (NLR). After reactor efficiency stabilization (NH4+-N and N-NO2--N concentrations below 30 mg.L-1). Reactor samples were collected daily from the influent and effluent. Kinetic tests of substrate consumption were performed at reactor inoculation and after 50 and 130 days of operation to determine the specific activity of bacteria through the consumption rate and the specific rate of substrate consumption (rs, mgNH4+-N.h-1) and (µs, mgNH4+-N.gVSS-1.h-1). All physicochemical determinations were performed according to Standard Methods (APHA, 2022). Sludge particle size distribution analysis was performed using sieves with nominal diameters of 2.4, 1.4, 0.7, 0.3 and 0.2 mm. Qin was gradually increased from 5.7 L.d-1 to 8 L.d-1, reducing the HRT from 4.2 h to 3 h. The range of NLR applied was 0.8 to 1.6 g.L.d-1. The µs data showed a significant improvement between days 0 and 50 of reactor operation, from 1.04 mgNH4+-N.gSSV-1.h-1 to 2.12 mgNH4+-N.gSSV-1.h-1 for ammonia and 1.19 mgNO2-.-N.gSSV-1.h-1 to 2.17 for - mgNO2-.-N.gSSV-1.h-1, respectively, indicating that the strategy of increasing the flow rate was efficient for better distribution of the substrate inside the reactor. The same occurred with the calculation of the stoichiometric coefficients for the two kinetics, from 0.58 for NO2--N on day 0 to 1.21 on day 50, and from 0.04 to 0.15 for NO3--N, respectively. During days 50 to 130, there was a reduction in µs, 1.01 mgNH4+-N.gSSV-1.h-1 and 0.76 mgNO2-.-N.gSSV-1.h-1, respectively; however, the stoichiometric coefficients remained close to those in the literature 1.18 and 0.31, respectively for NO2- and NO3-. The results of volatile suspended solids (VSS) obtained during the experimental period corroborate with the improvement of the granule size distribution inside the reactor. The system was inoculated with a VSS/STS ratio of 67%, and after 130 days achieved 80%. This increase can be related to the change of granules size distribution, which in their majority (57.7%) were smaller than 0.30 mm on day 0 (flocculent characteristic) and became 1.4 mm (57%) after 130 days of operation. It can be concluded that the anammox sludge granulation was improved whith the adopted operational conditions.