Long term experience of an ANAMMOX system in an actual big city WWTP to improve nutrient removal rates.

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Introduction –Wastewater treatment first focused on reducing solids and organic matter before releasing processed water into water basins. Nevertheless, it has become necessary to include systems enabling nitrogen and phosphorous removal in Wastewater Treatment plants (WWTP) in recent years to accomplish with legal environmental requirements, especially for nitrogen removal, as phosphorus is removed by chemical processes. In this context, upgrading WWTPs in big cities is essential to carry out that goal. In those plants the main contribution of nitrogen comes from the anaerobic digester, so that nitrogen appears as high ammonia concentrations. This fact has improved the development and use of more and more specialized technologies, as the ANaerobic AMMonium OXidation (ANAMMOX) process [1], which can remove a high concentration of nitrogen. ANAMMOX is a biological process in which certain microorganisms, in anaerobic conditions, transform ammonium into nitrogen gas, defining a new way in the nitrogen cycle. This ANAMMOX process was developed in laboratory, and currently there are few full-scale applications. For this reason, in this work, the ANNAMOX process in a WWTP designed for 220 000 Inhabitant Equivalent (I. E.) and located in the Southwest of Spain has been evaluated for one year. This full-scale application has three phases, the first homogenizes the effluent of the anaerobic digester, the second oxidizes ammonia into nitrite and the last one removes nitrite and ammonia by releasing nitrogen gas. The most significant factors that promote ANAMMOX microorganisms were measured and correlations between them were studied by means of artificial intelligent tools with the aim of assessing the process performance and to identify the most significant parameters in operation and maintenance.

2. Experimental– Twelve parameters were measured every two weeks for one year: ammonia (NH_4^+-N), Mixed Liquor Suspended Solids (MLSS) and alkalinity in the homogenization influent tank, which receive the overflow of the anaerobic digester with a high load of nitrogen as ammonia; MLSS, NH_4^+-N, nitrate (NO_3^-N), nitrite (NO_2^-N) and alkalinity in the partial nitrification vessel; NH_4^+-N, NO_3^-N, NO_2^-N in the ANAMMOX vessel and, finally, the ammonia removing performance of the whole ANAMMOX process. A Self Organizing Map (SOM) was used to analyze the information, to assess relationships between variables and to evaluate the process.

3. Results and Conclusion - The results obtained from the SOM analysis showed that the performance of the ANAMMOX process is heavily dependent on MLSS in the homogenization vessel as values higher than 1.5 g L^{-1} produce a reduction of 60 % in the ammonium performance. MLSS in the homogenization vessel depends on the performance of the anaerobic digester. Therefore, problems related to overflow of the anaerobic digester produces a decrease in the ammonium removal in the ANAMMOX process.

4. References

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