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A global analysis of five years management of slurry with natural treatment systems for wastewater (NTSW) in Gran Canaria using a pilot plant

C.A. Mendieta-Pino¹, S.O. Pérez-Báez², A. Ramos-Martín³, F. León-Zerpa⁴, A. Ruíz-García⁵

(1)(2) Institute for Environmental Studies and Natural Resources (i-UNAT), University of Las Palmas de Gran Canaria (ULPGC)

(4) Institute of Intelligent Systems and Numeric Applications in Engineering (SIANI), University of Las Palmas de Gran Canaria (ULPGC)

(3) Department of Process Engineering. University of Las Palmas de Gran Canaria (ULPGC)

(5) Department of Mechanical Engineering. University of Las Palmas de Gran Canaria (ULPGC)

Abstract

carlos.mendieta@ulpgc.es

The objective of this article is to describe the experience on wastewater management in a pig farm over a 5 years period. A pilot plant with a singular design of Natural Treatment Systems for Wastewater (NTSW) has been installed and it is composed of: rotary sieve, first generation multi-chamber biodigestor, two constructed wetlands (CW) with subsurface flow and a facultative pond between both CWs.

The pilot plant has operated for 5 years (2009-2015), after the first year of commissioning (2008). This plant, located in the Island of Gran Canaria, has allowed to verify the suitability of the solutions applied to livestock waste, adaptability to variations in concentration (incoming batches), organic load, flow and atmospheric conditions. Data, was collected through 30 variables distributed between dry and wet periods, and significant correlations have been found between them.

In general, NTSW have stable and cyclic elimination percentages according to the time of year. Noteworthy is the significant elimination of the total COD (91.84% on average), soluble COD (96.11% on average), total suspended solids (TSS) and fixed solids (FS) (more than 90%) and other micro-elements such as copper, iron, manganese, zinc, (above 80% reduction) or the virtual exhaustion of total nitrogen (93.77%) or phosphorus (98.80%). The process is delivered with minimum energy consumption, located in the rotary sieve system, as all movement is performed by gravity.









pond and

Wetlands

Constructed

The biodigester stands out for decreasing soluble COD. The particulated COD which was not eliminated in the biodigester, is converted in soluble COD in CW nº1. The CW nº2 is better in organic load removal than the CW n°1 because CW n°2 improves the yield with respect to CW due to good work done by facultative pond placed in between then. NTSW show outstanding capacity of COD removal (total, particulate and soluble) above 90% and conductivity 50%.

Globally, the NTSW system exhibits a stationary behavior during the entire study period, even when the system intake is given in batches, thus showing that the integration and combination of different equipment allows NTSW to obtain a remarkable elimination performance and stability to load and variations of flow. NTSW can be considered an alternative solution to the management of wastewater in livestock farms with similar sizes.

This research work has been carried out within the Livestock Industry Modernization Program of the Cabildo de Gran Canaria (Government of the island), and with the inestimable help of the farmers and the technical staff of the Agrarian Extension and Agricultural Development Service, Agrofood and Phytopathological Laboratory of the Cabildo de Gran Canaria and Analytical Control of Environmental Sources (CAFMA), Institute for Environmental Studies and Natural Resources (i- UNAT) of the University of Las Palmas de Gran Canaria.

Keywords: Natural systems, anaerobic digester, wastewater management, constructed wetlands, ponds, COD removal, low-cost treatment.

Materials and methods



120,00

100,00

80,00

60,00

40,00

20,00

0,00

-20,00

-40,00

-60,00

-80,00

Discussion

5 years of operation in steady state





Evolution of COD and conductivity removal (2009-2015) (%)



% Reduction of parameters according to stage of the process







- Stability to load / flow variations
- High COD removed rate (> 90%)
- Steady state operation

References

[1] S. Lopez-Ridaura, H. van der Werf, J. Marie Paillat, B. Le Bris, Environmental evaluation of transfer and treatment of excess pig slurry by life cycle assessment, Journal of Environmental Management 90 (2009) 1296-1304.

