CHICKEN MANURE MANAGEMENT: ENERGY PRODUCTION AND NITROGEN REMOVAL

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Poultry industry raises fowls for the consumption of their meat or their eggs. Mainly this means chicken production, but turkeys, geese and ducks are also poultry. World poultry meat production soared from 9 to 120 million tonnes between 1961 and 2016 and egg production shot up from 15 to 81 million tonnes. At the year 2016, chicken represented the 91% of the world poultry population[1]. An increase in production also means an increased waste generation that carries several impacts on the environment and human health if is disposed inadequately due to air, water and soil pollution caused by released odors and gases or by its content of nitrogen and pathogens [2–4], then, waste management is an important industrial activity. The anaerobic digestion technology is an interesting choice to treat chicken manure since its high content of organic matter offers the possibility to reach high methane yields, allowing the valorization of this waste by the production of energy.

Nevertheless, this biological process is complex due to the different microorganisms involved which have different requirements and tolerances. The ammonia inhibition is the bottleneck for AD of CM, because of the high content of total ammonia nitrogen (TAN); then, operating at long hydraulic retention times (HRTs) or low substrate concentration is needed to achieve high methane yields, which implies high investment or and operation costs for AD plant. Some authors choose the co-digestion of CM with another organic waste [5–8], using additives [9,10] or even more, incorporating a stage for nitrogen removal [11].

The nitrogen removal from nitrogen-rich effluent can be carried out by physicochemical process: ammonia stripping or struvite precipitation; or by biological process: nitrification-denitrification, anammox (anaerobic ammonium oxidation), partial nitrification-anammox (CANON, completely autotrophic nitrogen removal) or SNAD (simultaneous nitrification, anammox and denitrification)[4]. The CANON process is carried out by autotrophic biomass and the removal of the 89% of ammonia is possible. Moreover, autotrophic processes like CANON or anammox are useful at low organic matter concentration, *i.e.* when the biodegradable chemical oxygen demand to nitrogen ratio (bCOD/N) is ≤ 3[12]. On the other hand, SNAD is a mixed process developed in presence of organic matter, where the growth of autotrophic and heterotrophic biomass allows a complete nitrogen removal, via nitrification, anammox and denitrification[13].

Since the AD effluent has a remnant of organic matter and high ammonia concentration, a good performance of a SNAD process is feasible to remove nitrogen content. Finally, a coupled AD and SNAD process is proposed to efficiently generate energy from CM. Then, the optimization of this process will be studied and the feasibility of SNAD effluent recycling will be evaluated, which decreases ammonia concentration and freshwater consumption.

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