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AMMONIA NITRIFICATION IN THE NON-CLOGGING BIOLOGICAL PLATE TOWER

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In the air, ammonia is a corrosive and malodorous pollutant that must be removed before the contaminated streams are released in the environment. Biological reactors are an appropriate approach to promote the nitrification of ammonia. The first step is to transfer the pollutant to a liquid phase. The liquid must contain an enriched population of nitrifying bacteria that will oxidize

the pollutant in two steps: first ammonia in converted to nitrite (e.g., by *Nitrosomonas* sp.); finally, nitrite is oxidized to nitrate (e.g., by *Nitrobacter* sp.). The inoculum – a sample of activated sludge from a municipal wastewater treatment plant – was developed in batch.

For air pollution control, when odors and/or VOCs are the pollutants, there are three main classical biological solutions: biowashers (bioscrubbers), biotrickling filters and biofilters. The big mistake in the transposition from physical-chemical to biological reactors is to forget that the presence of biofilms completely changes the behavior and performance of the reactor. Biofilm growth is chaotic and spatially heterogeneous on a random packing. A good physical-chemical reactor is indeed a poor biological option in many situations (Sercu et al, 2006). Four phase reactors (liquid, gas, solid support and biofilm) always bring about hydrodynamic problems. Sloughing, channeling and clogging always occur. Good removal efficiency only makes it happen faster. Measures to deal with clogging are mostly oriented to limit the growth of the microorganisms, which are contradictory actions. To solve these problems and make the process easy to operate steadily for a long time, a new concept of reactor – BPT – was designed and tested with air polluted with VOCs, at first, and ammonia, now. The effluent simulation was achieved with the mixing chamber described in Peixoto and Mota (1997).

The BPT is a modular reactor. Each module contains a pile of parallel circular plates, with a single hole on the border. The plates are placed in such a way that the holes will alternate (180^{o}) from one to the next plate. A cascade of liquid flows downwards, changing direction from plate to plate. The gaseous stream follows the opposite direction. The bacteria attach to their top surface. When the biomass growth causes the limiting pressure drop then a fresh one replaces the saturated module. The performance is quite stable (the biofilm activity, surface-dependent, is kept approximately constant) and the constant surface contact area makes easy to model and scale up the process. The total surface area and the space between plates can be designed for the desired operating time and removal efficiency (Sercu et al, 2006).

Assays were done with five airflows, ranging from 20.6 dm^3/min to 42.4 dm^3/min, corresponding to residence times between 0.41 min and 0.87 min. Inlet varied between 7.3 µg/dm^3 and 136.6 µg/dm^3. In every situation, the percent mass removal was above 90 %, reaching above 99 % for the highest residence times. Normalized by plate surface area, removals ranged from 0.40 µg/(min m^2) to 7,51 µg/(min m^2). The biofilms on the plates were thin, below 1 mm thick. Total solids and volatile solids were 2.48 g/m^2 and 1.37 g/m^2, respectively, in the lower plates, diminishing upwards.

Nitrogen concentrations were measured with spectrophotometry and the Nessler reagent method, after bubbling the airflow in an alkaline solution.

Peixoto, J., Mota, M. (1997). Volatile organic compounds evaporation chamber for the simulation of gas effluents in laboratory research. *Biotechnology Techniques*, 11:1, 1-6.

Sercu, B., Peixoto, J., Demeestere, K., van Elst, T., Van Langenhove, H. (2006). Odors treatment: biological technologies. *Odors in the Food Industry* (Xavier Nicolay, Ed.), Springer, 125-158, (0-387-33510-2).