PT-6-3.

NH_4-N DEGRADATION WITH O_3-AC-TIO_2-UV

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NH_4-N and organic N are the predominant forms of N in urban wastewaters. NH_4-N contributes to eutrophication and degradation of natural water courses, thus it must be removed from treated effluents (Kadlec and Knight, 1996). Nitrification-denitrification is the selected process for NH_4-N elimination in most wastewater treatment facilities. However, this biological process requires large dissolved oxygen inputs, a well established specific bacterial biomass and large hydraulic residence times.

Additionally, Advanced Oxidation Technologies (AOTs), such as TiO_2-photocatalysis, O_3-UV and the photo-Fenton reaction, are able to degrade and mineralize many organic and inorganic compounds in relatively short times and at moderate economic cost (Pirkanniemi and Sillanpää, 2002).

In this work, NH_4-N degradation (from NH_4Cl in distilled water and a pond-wetland wastewater treatment pilot plant) was attempted by using different AOTs. Figure 2 illustrates the preliminary results from a 20 ppm N-NH_4 solution degradation under different experimental conditions.

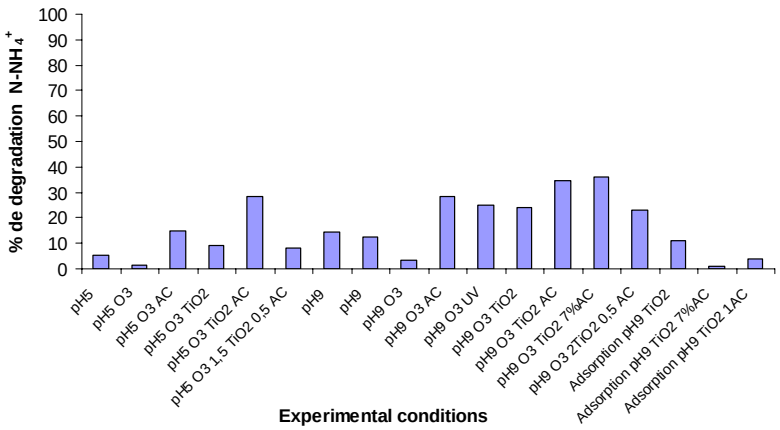

Figure 1. Preliminary results from a 20 ppm N-NH_4 solution degradation under different experimental conditions.

This preliminary data were statistically treated (MODDE 7.0, demo) to choose the best experimental conditions. Thus, the optimal parameters included UV light, ozonization, AC-TiO_2 (TiO_2 + 7 % w/w activated carbon) and high pH values (Figure 2).

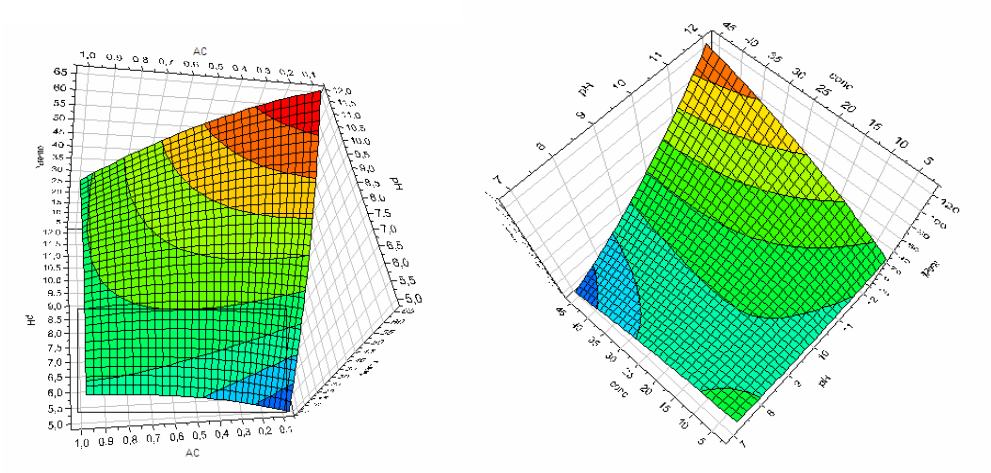

Figure 2. Activated carbon-pH (left) and initial N-NH_4 concentration-pH (right) effects on N-NH_4 removal. Red colour indicates highest degradation.

Table 1 shows the obtained N-NH_4 elimination at high pHs by degradation, volatilization and adsorption. The highest elimination (60 %) was achieved with a 45 ppm N-NH_4 solution, at pH 11. Volatilization was about 16 % and adsorption accounted for 4 %, approximately.

pH	Volatilization	O_3 + AC	UV + TiO_2	UV + TiO_2 7%AC	UV + O_3 TiO_2 7%AC	Adsorption
10	13,29	7,1	25,82	31,97	38,98	
11	16,97	28,96	35,15	39,21	62,73	4,11
12	20,83	35,98	45,46	54,53	56,99	

Table 1. NH_4-N elimination at high pH values

Degradation was also monitored by means of ionic chromatography. Nitrites (NO_2^-) were determined as unique products, but at much lower concentrations than the stequiometric ones. The possible production of gaseous N-compounds is tested and discussed.

References

Kadlec, R.H., Night R.L. (1996). Treatment wetlands. Lewis, Boca Raton, New York, London, Tokyo, p. 45.

Pirkanniemi K and Sillanpää M. (2002). Heterogeneous water phase catalysis as an environmental application: a review. Chemosphere, 48, 1047-1060.