NH₄-N and organic N are the predominant forms of N in urban wastewaters. NH₄-N contributes to eutrophication and degradation of natural watercourses, thus it must be removed from treated effluents (Kadlec and Knight, 1996). Nitrification-denitrification is the selected process for NH₄-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 TiO₂-photocatalysis, O₃-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, NH₄-N degradation (from NH₄Cl 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-NH₄ 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-TiO₂ (TiO₂ + 7 % w/w activated carbon) and high pH values (Figure 2).

**Figure 1.** Preliminary results from a 20 ppm N-NH₄ solution degradation under different experimental conditions.
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.

<table>
<thead>
<tr>
<th>pH</th>
<th>Volatilization</th>
<th>O$_3$ + AC</th>
<th>UV + TiO$_2$</th>
<th>UV + TiO$_2$ 7%AC</th>
<th>UV + O$_3$ TiO$_2$ 7%AC</th>
<th>Adsorption</th>
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<td>13,29</td>
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<td>35,98</td>
<td>45,46</td>
<td>54,53</td>
<td>56,99</td>
<td></td>
</tr>
</tbody>
</table>

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 stoechiometric ones. The possible production of gaseous N-compounds is tested and discussed.

References