Effect of water matrix on Vacuum UV process for the removal of organic micropollutants in surface water

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UV-based advanced oxidation processes (UV-AOPs) have been demonstrated as effective technologies for the removal of micropollutants in water. One promising UV-AOP is Vacuum UV (VUV), which relies on the formation of hydroxyl radicals ($HO^{\cdot}$) by the photolysis of water induced by VUV photons. TiO_2/UV photocatalysis is another promising AOP. Both VUV and UV photocatalysis are greatly affected by the water matrix, inorganic ions and natural organic matter (NOM).

Water constituents can absorb the UV and VUV radiations, they can act as $HO^{\cdot}$ radicals scavengers, and can produce radicals when photolyzed.

The main objective of this research was to study the effects of water matrix on the efficiency of VUV for the degradation of micropollutants (with atrazine as a model contaminant). First, the absorbance of radiation at 254 nm and 185 nm was measured in the presence of different ions and NOM. All the inorganic ions showed a molar absorption coefficient equal to zero at 254 nm except nitrate with a ε=3.51 M^{-1} cm^{-1}. On the other hand, at 185 nm all the ions absorbed 185 nm radiation, with chloride showing the highest absorption coefficient ε=2791 M^{-1} cm^{-1} .

NOM showed a high absorption coefficient at both 254 and 185 nm ranging from 116 to 638 M^{-1} cm^{-1} at 254 and from 1137 to 1537 M^{-1} cm^{-1} at 185 nm). Second, the HO scavenging effects of different components were evaluated; nitrate showed a detrimental effect both with UV/H_2O_2 and with VUV. The presence of 50 ppm of bicarbonate reduced the degradation rate of atrazine considerably. Sulfate seemed to photolyze at 185 nm to form HO radicals. NOM was found to be a strong HO scavenger: in the presence of 9 ppm NOM, less than 1% of the HO radicals were available to react with atrazine. The next component of this work involved developing a method for the measurement of quantum yield of atrazine at 185 nm. This allowed to measure the degradation of atrazine due to photolysis only. Finally, this research investigated the combination of VUV with TiO_2/UV. The results showed that incorporating photocatalysis cannot improve significantly the efficacy of VUV.