Degradation of neonicotinoids by advanced oxidation process in water by O_3/UV

González, T. (1), Domínguez, J. R. (1), Correia, S. (1)

(1) Department of Chemical Engineering and Physical Chemistry, University of Extremadura, Avda. de Elvas, s/n. Faculty of Sciences, 06071 Badajoz, Spain.
Tel.: +34-924-289300, Ext. 86948. E-mail: teresaglez@unex.es

1. Introduction

Neonicotinoids are pesticides have reached an enormous economic value and represent one of the most important insecticides in the current market of plant protection products [1]. However, the presence of neonicotinoids in aquatic ecosystems has been tested. This is due to they have long average lives in soil and water, where they are resistant to hydrolysis at neutral or acidic pH in anaerobic conditions [2] and transport of them to aquatic ecosystems generally driven by runoff from heavy rains, soluble or insoluble fractions carried by melted ice, contaminated dust and leaching of groundwater [3]. In this article different advanced oxidation processes; ozone (OZ) and ultraviolet radiation (UV), will be used for the elimination of the selected neonicotinoids; neonicotinoids with nitro-substituted compounds (thiamethoxam (TMX) and imidacloprid (ICP)) and neonicotinoids with cian-substituted (acetamiprid (ACP) and thiacloprid (TCP)).

2. Experimental

The installation consists of a cylindrical glass column (ozone reactor) connected to an ozone generator. The ozone is introduced by the lower part through a porous glass plate that acts as diffuser. Also, the ozone reactor is equipped with a low-pressure mercury vapour lamp located axially into a quartz sleeve. The aqueous solution of the four neonicotenoids (5 ppm of each) is introduced into the rector, making it circulate through all the circulation through a peristaltic pump. The samples are taken out at different time intervals.

3. Results and Discussion

Table 1 lists elimination percentage of TMX, ICP, ACP and TCP, as well as, average elimination percentage attained at 60 min for OZ, UV and OZ-UV experiments.

Table 1. Elimination percentage of TMX, ICP, ACP and TCP.

System	E_{TMX} (%)	E_{ICP} (%)	E_{ACP} (%)	E_{TCP} (%)	E_m (%)
OZ	74	30	12	22	34
UV	90	53	11	34	47
OZ-UV	97	87	56	71	78

4. Conclusions

The single oxidation processes performed in ultrapure water allow high degradation rates for TMX, and significant for ICP and TCP. However, ACP elimination percentage is very low. UV single process reaches higher results with greater efficacy. The combination of two advanced oxidation processes has allowed to significantly improve the degradation rate of neonicotinoids, mostly for ACP. The degradation of the four neonicotinoids followed pseudo-first order kinetics for all the experiments performed.

5. References

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