

ELIMINATION OF IBUPROFEN BY TREATMENT WITH OZONE

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Abstract

This study investigates the oxidation of pharmaceuticals during conventional ozonation applied in drinking water treatment. Recent research has shown that traces of pharmaceutical may be present in water used for drinking water production. The choice of ibuprofen as the composite of study was due to the significant consumption of this compound by the population and their presence in the aquatic environment (rivers and groundwater) from the treatment plant effluent wastewater. The pilot plant where the test of degradation has been made has a column and a maze of reaction, an ozone generator and a sensor of dissolved ozone in water. The ozone generator produces an amount of ozone gas ranging between 2–4 g/h of ozone. In this plant was circulated water flow of 1,300 l/h with a concentration ranging between 0.1 and 10 mg/l ibuprofen. The compound has been identified using high performance liquid chromatography (HPLC) and detection by UV at 220nm. Prior to using the HPLC, samples were subjected to a process of concentration through extraction cartridges (SPE) and a 0,22 micron filtration to remove a significant amount of impurities. The results indicated operating conditions, show reductions of ibuprofen in water between 60% and 98% depending on operating conditions.

Introduction

It is known that both the waters of rivers and the lakes and seas contain high diversity of polluting compounds that can go to spot the drinking water supplied to citizens if the haven't received adequate treatment for their total elimination.

One family of compounds that are covering the interest of research are drug: analgesic, anti-inflammatory, contraceptives, antibiotics and various products that fill our medicine cabinets and they finish, ultimately in the environment to be introduced into the wastewater through excretion, elaboration process and uncontrolled discharge of expired drugs.(J.L. Santos Morcillo, 2006). This problem is that it isn't possible to eliminate these pharmaceutical residues when these wastes are faced with the conventional treatments of wastewater treatment plants, travelling, much of these ingredients into rivers, lakes, oceans, aquifers and finally, even in very small quantities, it ends up in

different households. (C. Zwiener et al, 2000). For these reasons, we have decided to study this field, in order to achieve the elimination of a number of drugs that they're in face water (ibuprofen, azithromicina and clofibric acid) by ozone treatment and optimize all process variables.

Methods

Ibuprofen, in solid form, was obtained from Sigma Life Science with a purity higher than 98%. The other compounds used for adjusting pH, SPE and HPLC reagents were purchased from Merck.

The aqueous sample (20 liters of MiliQ water) was introduced into the reactor. The top of the reactor the contaminant, previously diluted in a volume of 0.3 ml of a solution 70A/30B of methanol (A) and MiliQ water (B), was added. When the sample had been homogenized we took a sample. Then the solution was subjected to treatment with ozone. When the treatment had finished we took other sample. The aqueous sample (200ml) from the oxidation experiments was acidified to a pH of 2 and passed through the preconditioned SPE cartridge by means of a gentle vacuum with a flow rate of 10 ml/min. Conditioning was performed successively with 8 ml methanol, 8 ml acetone and 15 ml MiliQ water. After drying the cartridge with nitrogen, the analytes were eluted with four portions of 2 ml methanol. The solvent was evaporated by a gentle stream of nitrogen and the residue immediately dissolved in 1000 ml methanol/MiliQ water (70/30). The sample had been kept at a temperature of 80 degrees. The recoveries for the ibuprofen were in the range of 80% to 90% (DE 5%).

The identification of ibuprofen (IBP) was carried out according to the method publishes by Mendez Arriaga , F. 2009 and Zwiener et al , 1999. We used a liquid chromatograph (HPLC) which had a UV detector at 220nm.

A pilot plant scheme in which they're carrying out test is shown in Figure 1. The system consist of a column and a maze of reaction, an ozone generator and a sensor or dissolved ozone in water. The ozone generator produces an amount of ozone gas ranking between 2-4g/h of ozone. Ozone is generated by electric discharge lamps with high voltage. The concentration of gaseous ozone generated is measured continuous mode whit the help of ozone gas meter. In this plant are working with a MiliQ water flow of 1.300l/h and a concentration of IBP of 1mg/l.

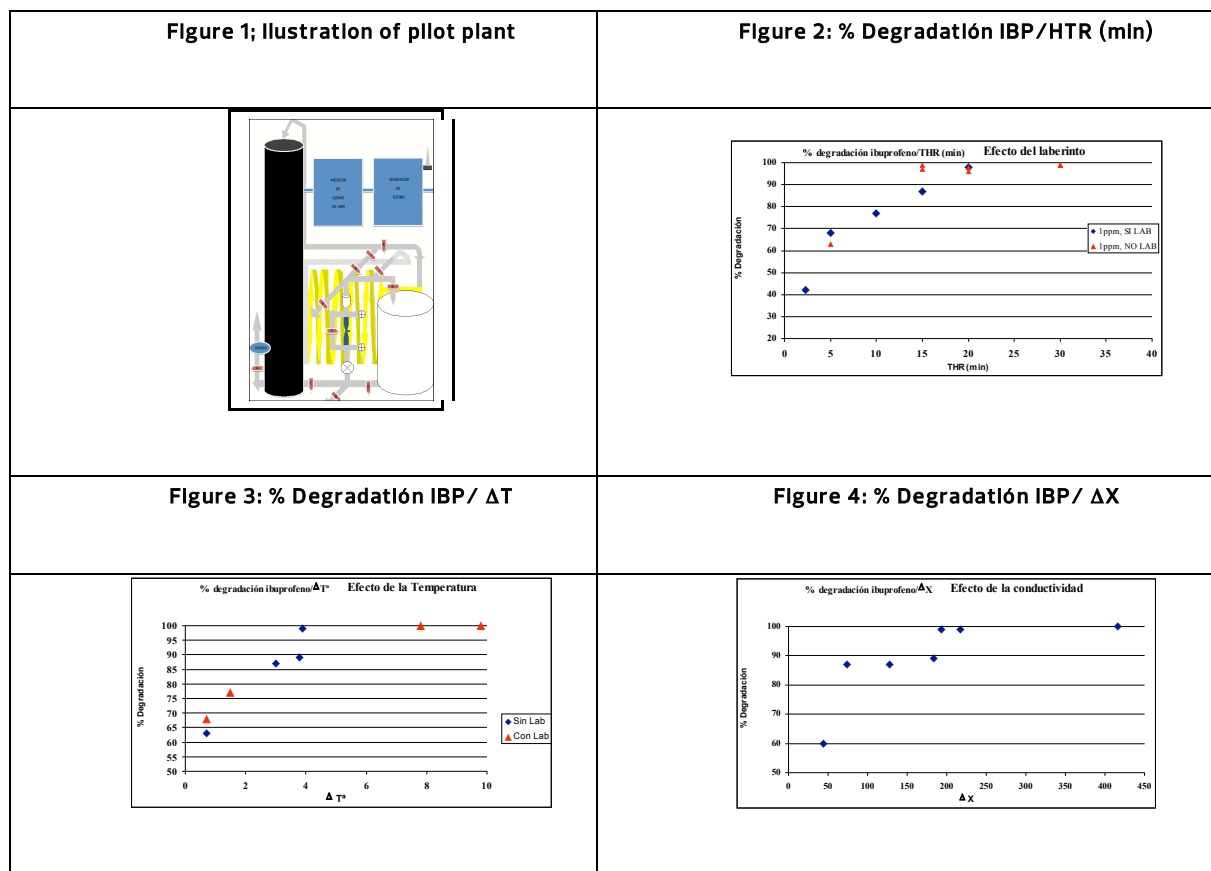
Results and discussion

This paper presents the results obtained in the optimization's phase of the operation's variables, hydraulic retention time (HRT), conductivity (X), temperature (T) and use of the labyrinth, working with solutions of ibuprofen of 1 mg/l.

Figure 2 shows the degradation's percentage of ibuprofen and hydraulic retention time, working with and without reaction labyrinth. It can be seen as working to HRT less than 10 minutes in the degradation the yields are higher when we use the labyrinth, while with HRT of 15 minutes the yields degradation are higher without we use the labyrinth. After 10 minutes of HRT the returns are independent of the use of the labyrinth.

After examining the optimal HRT in relation to use or no the reaction labyrinth, we studied, in both situations the effect of temperature. The conclusions can be seen in the figure 3. In this picture can be seen that small increases in temperature (below 4°C) in the reactor improve the degradation of ibuprofen, so when we work with labyrinth as when we don't work with labyrinth.

Finally, in Figure 4 can be seen that conductivity up to 200 $\mu\text{S}/\text{cm}$ are associated with consistent increases in the rates of degradation of ibuprofen to reach 99%, when we work with labyrinth in the optimal hydraulic retention times.



Conclusions

It is possible the elimination of ibuprofen as such from the water by ozone treatment. The use of the labyrinth in the system helps to achieve higher degradation's yields to low HRT (<10min). However for higher HRT the use of labyrinth doesn't improve the efficiency of oxidation. Small variations in temperature and conductivity during treatment predicted a higher rate of degradation.

References

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