Υβριδικό
Μοντέλο Επεξεργασίας
στραγγισμάτων ΧΥΤΑ

NEWSLETTER

June
23

Υβριδικό μοντέλο επεξεργασίας στραγγισμάτων ΧΥΤΑ συνδυάζοντας τη χρήση Προχωρημένων Οξειδωτικών Διεργασιών Αντιρρύπανσης (ΠΟΔΑ) και την τεχνολογία των μεμβρανών

UV-LEACH

«ΕΡΕΥΝΩ – ΔΗΜΙΟΥΡΓΩ – ΚΑΙΝΟΤΟΜΩ»

Υβριδικό Μοντέλο Επεξεργασίας στραγγισμάτων ΧΥΤΑ

18TH INTERNATIONAL CONFERENCE ON CHEMISTRY AND THE ENVIRONMENT(Venice 11-15, June 2023)

ORAL PRESENATIONS

UV-LEACH

CONFERENCES

"HRMS Workflows Reveal Target and Suspect PFAS in Landfill Leachates: Identification and Evaluation of their Potential Risk to Environment"

L.-A. Koronaiou, S. Petromelidou, E. Evgenidou, D. A. Lambropoulou

"Landfill Leachates as a Prominent Source of OPFRs and their Transformation Products Based on HRMs Suspect Screening"

L.-A. Koronaiou, L. Daktylidi, E. Evgenidou, D. A. Lambropoulou

"Exploring Structure Database, Suspect and Non-Target HRMS Workflows for Comprehensive Screening of Unknown Transformation Products of Pharmaceuticals in Complex Environmental Matrices"

L.-A. Koronaiou, C. Nannou, E. Evgenidou, D. P. Abrahamsson, D. A. Lambropoulou

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CONFERENCES

18TH INTERNATIONAL CONFERENCE ON CHEMISTRY AND THE ENVIRONMENT(Venice 11-15, June 2023)

"Landfill Leachate Degradation Using UV/Fe^{2+}/H_2O_2 and UV/Fe^{2+}/$S_2O_8^{2-}$ Processes"

P. Parthenidis, E. Evgenidou,D. A. Lambropoulou

Landfill leachate degradation using UV/Fe^{2+}/H_2O_2 and UV/Fe^{2+}/$S_2O_8^{2-}$ processes

ICCE 2023

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Introduction

One of the great disadvantages of the dominant waste disposal method (landfilling) is the formation of landfill leachate. The production of these highly contaminated liquids is the result of synergistic processes that occur in the landfill, involving the percolation of rainwater through the wastes, leaching of substances and degradation processes. Consequently, a leachate sample can contain a variety of chemicals, with the main ones being organic matter (humic and fulvic acids), metals, inorganic species and xenobiotic organic substances (XOCs). Given the ecological risk, especially for aquatic ecosystems, treatment processes must be applied. Advanced oxidation processes (AOPs) constitute a particularly attractive option for treating wastewaters, like leachate, as one can see by looking at relevant studies and reviews [1]. Among AOPs, classical Fenton process (Fe^{2+}/H_2O_2) occupy a pivotal position due to its noteworthy characteristics such as high reaction rates, low environmental footprint and simple operation. The combination of Fenton reaction with UV radiation can lead to improved efficiencies as a consequence of regeneration of ferrous ions and photolysis of hydrogen peroxide. However, specific limitations of the process led scientific research in different directions, towards the development of other oxidation processes like SR-AOPs.

Methodology

- Different leachate samples were collected and used for the experiments (**Fig. 1A,B**). **Table 1** summarizes some of their physicochemical characteristics
- All photocatalytic treatment experiments took place in a glass reactor (1 L) at which a UV lamp (125 W) was vertically placed (**Fig. 1C**) The lamp was cooled using a reflux condenser while the reactor was covered with aluminum foil to enhance the effect of ultraviolet radiation
- The concentrations of reagents used were determined by the quantity of chemical oxygen demand (COD) of the samples
- A multi-parameter photometer (Hanna) and a TOC analyzer (Shimadzu) were utilized for assessing COD and TOC values

Table 1: Physicochemical characteristics

Parameter	L1	L2	L3
pH	8.2	8	8
COD (mg/L)	4320	3220	2870
TOC (mg/L)	1594	1191	1056
Color Index	2.06	2.27	2.59

Figure 1

Results & Discussion

Table 2: Results from (photo)catalytic experiments

Leachate sample	Experiment	Removal COD (%)	Removal TOC (%)
L1	UV/Fe^{2+}/H_2O_2	68.0	66.1
	Fe^{2+}/$S_2O_8^{2-}$	68.6	67.2
	UV/Fe^{2+}/$S_2O_8^{2-}$	79.3	71.4
L2	Fe^{2+}/$S_2O_8^{2-}$	72.4	70.5
	UV/Fe^{2+}/H_2O_2	69.8	67.1
	UV/Fe^{2+}/$S_2O_8^{2-}$	89.4	69.5

Experimental conditions: pH = 3, COD:Oxidant = 1:3, [Fe^{2+}](Oxidant) = 1:10, treatment time = 60 min

Figure 3: Effect of dosing mode (L1)

Removal (%)	One-step addition	Sequential addition
COD	68.0	68.1
TOC	66.1	66.0

Experimental conditions: pH = 3, COD:H_2O_2 = 1:1, [Fe^{2+}](H$_2$O$_2$) = 1:10, treatment time = 60 min

Figure 2: Reduction of COD of L1 during the treatment

Experimental conditions: pH = 3, COD:Oxidant = 1:3, [Fe^{2+}](Oxidant) = 1:10, treatment time = 60 min

Figure 4: Comparative evaluation of different processes (L1)

Experimental conditions: pH = 3, COD:Oxidant = 1:1, [Fe^{2+}](Oxidant) = 1:10, treatment time = 60 min

Conclusions

The results showed that both processes can be a useful tool for reducing basic pollution indicators like chemical oxygen demand and total organic carbon. However, UV/Fe^{2+}/H_2O_2 process can succeed to degrade leachate samples in a predictable and efficient manner, while the performance of UV/Fe^{2+}/$S_2O_8^{2-}$ was highly dependant on the composition of the sample. Additionally, UV light didn't have a a significant effect on the competency of catalytic reactions, probably due to the dark color of the samples and suspended solids generated in the processes.

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POSTER PRESENATIONS

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ΚΕΔΕΚ

ΕΠΑνΕΚ 2014-2020
ΕΣΠΑ 2014-2020

Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης

ΕΔΑΔΥΜ

ΔιαΔυμα

ΕΛΛΗΝΙΚΟ ΑΝΟΙΚΤΟ ΠΑΝΕΠΙΣΤΗΜΙΟ

Υβριδικό Μοντέλο Επεξεργασίας στραγγισμάτων ΧΥΤΑ

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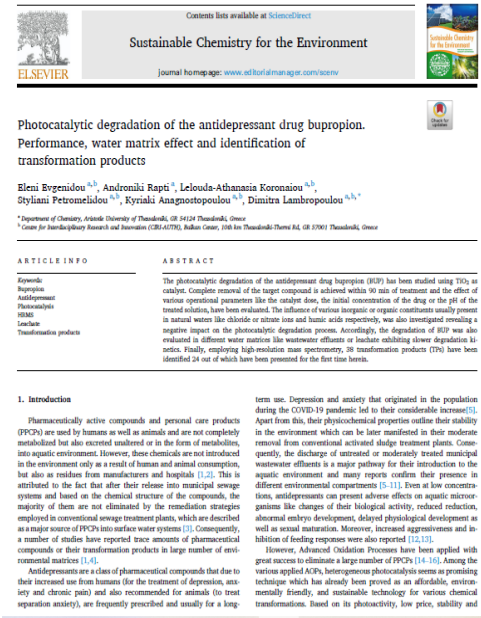

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Photocatalytic degradation of the antidepressant drug bupropion. Performance, water matrix effect and identification of transformation products

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ARTICLE INFO

Keywords:
Bupropion
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ABSTRACT

The photocatalytic degradation of the antidepressant drug bupropion (BUP) has been studied using TiO_2 as catalyst. Complete removal of the target compound is achieved within 90 min of treatment and the effect of various operational parameters like the catalyst dose, the initial concentration of the drug or the pH of the treated solution, have been evaluated. The influence of various inorganic or organic constituents usually present in natural waters like chloride or nitrate ions and humic acids respectively, was also investigated revealing a negative impact on the photocatalytic degradation process. Accordingly, the degradation of BUP was also evaluated in different water matrices like wastewater effluents or leachate exhibiting slower degradation kinetics. Finally, employing high-resolution mass spectrometry, 38 transformation products (TPs) have been identified 24 out of which have been presented for the first time herein.

1. Introduction

Pharmaceutically active compounds and personal care products (PPCPs) are used by humans as well as animals and are not completely metabolized but also excreted unaltered or in the form of metabolites, into aquatic environment. However, these chemicals are not introduced in the environment only as a result of human and animal consumption, but also as residues from manufacturers and hospitals [1,2]. This is attributed to the fact that after their release into municipal sewage systems and based on the chemical structure of the compounds, the majority of them are not eliminated by the remediation strategies employed in conventional sewage treatment plants, which are described as a major source of PPCPs into surface water systems [3]. Consequently, a number of studies have reported trace amounts of pharmaceutical compounds or their transformation products in large number of environmental matrices [1,4].

Antidepressants are a class of pharmaceutical compounds that due to their increased use from humans (for the treatment of depression, anxiety and chronic pain) and also recommended for animals (to treat separation anxiety), are frequently prescribed and usually for a long-term use. Depression and anxiety that originated in the population during the COVID-19 pandemic led to their considerable increase[5]. Apart from this, their physicochemical properties outline their stability in the environment which can be later manifested in their moderate removal from conventional activated sludge treatment plants. Consequently, the discharge of untreated or moderately treated municipal wastewater effluents is a major pathway for their introduction to the aquatic environment and many reports confirm their presence in different environmental compartments [5-11]. Even at low concentrations, antidepressants can present adverse effects on aquatic microorganisms like changes of their biological activity, reduced reduction, abnormal embryo development, delayed physiological development as well as sexual maturation. Moreover, increased aggressiveness and inhibition of feeding responses were also reported [12,13].

However, Advanced Oxidation Processes have been applied with great success to eliminate a large number of PPCPs [14-16]. Among the various applied AOPs, heterogeneous photocatalysis seems as promising technique which has already been proved as an affordable, environmentally friendly, and sustainable technology for various chemical transformations. Based on its photoactivity, low price, stability and

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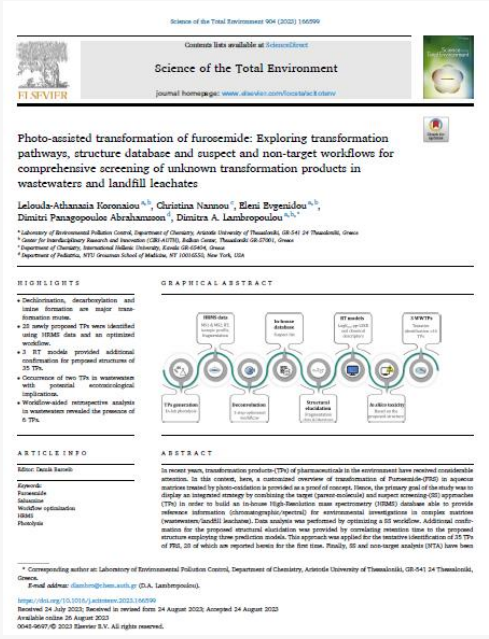

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Photo-assisted transformation of furosemide: Exploring transformation pathways, structure database and suspect and non-target workflows for comprehensive screening of unknown transformation products in wastewaters and landfill leachates

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HIGHLIGHTS

- Dechlorination, decarboxylation and imine formation are major transformation routes.
- 25 newly proposed TPs were identified using HRMS data and an optimized workflow.
- 3 BT models provided additional confirmation for proposed structures of 35 TPs.
- Occurrence of two TPs in wastewaters with potential ecotoxicological implications.
- Workflow-aided retrospective analysis in wastewaters revealed the presence of 6 TPs.

GRAPHICAL ABSTRACT

ARTICLE INFO

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ABSTRACT

In recent years, transformation products (TPs) of pharmaceuticals in the environment have received considerable attention. In this context, here, a customized overview of transformation of Furosemide (FSE) in aqueous matrices treated by photo-oxidation is provided as a proof of concept. Hence, the primary goal of the study was to display an integrated strategy by combining the target (parent-molecule) and suspect screening (SE) approaches (TPs) in order to build an in-house High-Resolution mass spectrometry (HRMS) database able to provide reference information (chromatographic/spectral) for environmental investigations in complex matrices (wastewaters/landfill leachates). Data analysis was performed by optimizing a SS workflow. Additional confirmation for the proposed structural elucidation was provided by correlating retention time to the proposed structure employing three prediction models. This approach was applied for the tentative identification of 35 TPs of FSE, 25 of which are reported herein for the first time. Finally, SS and non-target analysis (NTA) have been

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PUBLICATIONS

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Open Access Article

AOP-Based Transformation of Abacavir in Different Environments: Evolution Profile of Descyclopropyl-Abacavir and In Silico Toxicity Assessment of the Main Transformation Products

by Eleni Evgenidou [1,2], Konstantina Vasilopoulou [1], Lelouda-Athanasia Koronaiou [1,2], George Kyzas [3], Dimitrios Bikiaris [4] and Dimitra Lambropoulou [1,2,*]

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Abstract

This study explores the photocatalytic transformation of the antiviral drug abacavir employing different advanced oxidation processes (AOPs) such as UV/TiO_2, UV/MOF/H_2O_2, UV/MOF/$S_2O_8^{2-}$, UV/Fe^{2+}/H_2O_2, and UV/Fe^{2+}/$S^2O_8^{2-}$. All processes appear to be effective in eliminating abacavir within a few minutes, while the evolution profile of the basic transformation product, descyclopropyl-abacavir (TP-247) was also monitored.

Evgenidou E., Vasilopoulou K., Koronaiou L.-A., Kyzas G., Bikiaris D., Lambropoulou D.

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