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Advanced oxidative treatment for wastewater contaminated by micropollutants

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Many micropollutant products are introduced into the environment by domestic, industrial or hospital waste waters. It has been observed that many of them are not well removed by traditional biological waste water treatment plants (WWTP). In this project, a physico-chemical process is elaborated and placed at the end of existing WWTP. Such processes already exist and are based on an ozone and UV radiation combination to oxidize organic compounds. Our study shows that higher degradations could be reached using heterogeneous photocatalysis in addition to ozone and UV radiation. At the laboratory scale, problematic micropollutants of the European Water Framework Directive have been chosen to model waste water (10 µg/L): pharmaceuticals (diclofenac, carbamazepin, sulfamethoxazol), PFOS, anti-corrosive (1H-Benzotriazol), phthalate (DEHP), alkylphenol (bisphenol A), pesticide (diuron, atrazine), flame retardant (PBDE). Their degradations were evaluated by LC-MS/MS and GC-MS/MS. Different photocatalysts have been synthesized by organic and aqueous sol-gel methods and deposited as thin films by dip-coating on glass substrate: pure titanium dioxide (TiO_2) and doped titanium dioxide (with Ag, Pt, Commercial Evonik P^{25}, MnO_2 - nanoparticles, and with Zn^{2+} ions). Characterizations were made by profilometry for films thickness and roughness by GIRXD for photoactive crystalline phase presence, by UV-Vis transmission for band-gap, by ICP-AES/MS for dopants percentages in films and in water (leaching concentration through delamination). The photo activity of all these catalysts was determined from the degradation on 10 micro pollutants (10 µg/L) under UV-C for 1 h. The best photocatalyst found was silver doped titanium dioxide. A film was then deposited inside a one-meter long alkaline free tube for pilot trials. Experiments were carried out with 150 L of our model water (10 micro pollutants with 10 µg/L) and with 150 L of waste water at the exit of a WWTP. Both experiments have confirmed laboratory results for efficient degradation of pharmaceutical products in water.

Biography

Stephanie D Lambert is a Professor and a FRS-FNRS Senior Research Associate in the Department of Chemical Engineering (DCE) of the University of Liege, Belgium since 2009. She obtained her PhD in Applied Sciences in 2003. After an Engineer position in a Belgian Chemical Company (Nanocyl) (2004-2005), and two Postdoctoral stays at the DCE of the University of Illinois at Chicago in 2006 and at the Institute Charles Gerhardt in Montpellier in 2007, she joined the team Nanomaterials, Catalysis, Electrochemistry of the University of Liege, in which she develops heterogeneous catalysts for sustainable chemistry (tars reforming, treatments of chlorinated compounds, photocatalysis). She is Vice-Chair of the DCE since early 2016. She has published over 75 publications, 12 book chapters, holds 1 patent and has an H-index of 20. She also received 15 invited lectures. She was Member of Local Organizing Committee of SOL-GEL 2017, 3-8 septembre 2017, Liege, Belgium.

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