Thesis proposal

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Scientific domain :	**chemical engineering, environmental engineering**		

Two major publications in the field proposed for the PhD :

1-Removal of bisphenol A by a nanofiltration membrane in view of drinking water production
Water Research, 40 (2006) 3793–3799.
Y. Zhang, C. Causserand, P. Aimar, J.P. Cravedi

2-A comparison of electrochemical degradation of phenol on boron doped diamond and lead dioxide anodes, Weiss, E., Groenen-Serrano, K., Savall, A. 2008 Journal of Applied Electrochemistry 38 (3), pp. 329-337

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Description of the research work proposed for a PhD

Title : **Eradicating micro-pollutants from waters by Hybrid Membrane Processes**

Subject (short description):

Surface waters suffer from pollution by micro-pollutants (oestrogens, endocrine disruptors, pesticides, etc…) in an increasing number of places all over the world, as sequels of domestic, industrial and even agricultural usages of water. Most of these pollutions are nowadays very efficiently taken over by advanced treatment processes, such as biological or membrane processes. However, a number of contaminants are not, today, efficiently removed from waters because of their resistance to biological degradation, their small size or their extreme dilution, though such substances are harmful especially to infants, pregnant women or elderly people.
Many strategies have so far been developed to address this increasingly important problem, however, with unfortunately a limited success from a practical point of view due to the extreme dilution of the contaminants, and their relatively small size.
Even though membrane processes are well designed to remove such micro pollutants from waters, these options do not eliminate the contaminants themselves, which remain a potential source of downstream contamination. On the other hand, advanced oxidation processes, such as Fenton based processes or photo catalytic processes have some efficiency but also suffer from the high dilution of the contaminants which requires the processing of enormous amounts of water, and therefore oversized systems. Another great disadvantage of many of the

advanced oxidation processes is that they are meant to produce by-products which may eventually be more harmful than the initial ones.
The present project is an attempt to combine the advantages of two well known technologies, which are reverse osmosis or nanofiltration on one side, to electro oxidation using diamond doped carbon electrodes. The concept is based on a pre concentration of micro pollutants by reverse osmosis, which produces extremely clean water, with yield expected as high as 99.9 %. Concentrate can then be processed by electro oxidation, with kinetics potentially accelerated by two to three orders of magnitude as compared to standard processes, thanks to the higher concentration. Electro oxidation on diamond doped electrodes is well known for its extremely high efficiency, straightforwardly turning organic components into CO2 and H20, the production of by-products being negligible, especially in a continuous mode, as proposed here, where the residence time is properly controlled. In any case, in the present proposal, by-products if any, do not mix with the produced water, which makes it a very safe option. Such processes may however be very sensitive to the presence of substances which may interfere with the oxidation process and the membrane separation, namely organic matters and bio contaminants. Therefore, we have planned to introduce into the process a first separation stage, which will reject organic matter, colloid and particles and let the micro-pollutants through, in such a way that the RO membrane and the oxidation can operate in a continuous mode, with stand-by periods as rare as possible and an optimised efficiency. Our experience in ageing of polymer membranes will be very useful at monitoring the potential degradation of membranes by oxidising agents which might be produced at the electrode.
The PhD student will have a degree in chemical engineering, environmental engineering or other area relevant to the subject. The work plan contains an experimental part, so as to acquire the process parameters (oxidation kinetics versus pollutant concentration, membrane rejection coefficients, test of various membrane materials) as well as a modelling part, which will be the ground basis for an optimisation of the whole process (UF/RO Electrochemistry). Finally a breadboard of the complete process will be built and tested in lab and field conditions.

Keywords (5) :	Micro pollutants	Membrane processes	Electro-oxidation	Water treatment	

Expected collaborations (if present)

If a cosupervision is possible, please give the possible name and institution & lab:

This document will be on line on the Doctoral College's website (http://www.univ-toulouse.fr/college-doctoral).