Editorial

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Editorial: The importance of advanced oxidation processes in degrading persistent pollutants

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The removal of organic contaminants (OCs) present in surface water, underground water and effluents of industrial or household origins has always been a challenge for environmental chemistry specialists [1]. The efficiency of the selected water treatment technology as well as its cost effectiveness are basically the main factors affecting the implementation of water cleaning processes on a large scale [2]. In a very complex medium such as waste water collected from urban zones [3], conventional waste water treatments plants (WWTPs) have demonstrated to be the universal reliable and cost effective process adopted since the nineteenth and early twentieth centuries. However, the presence of emerging contaminants (ECs) such as Pharmaceuticals and Personal Care Products (PPCPs) [4], as well as new elected molecules such as flame retardants and other OCs [5] showed significant resistance to the conventional biological treatment because of their chemical structure frequently containing halo-atoms e. g. Cl, Br making their assimilation by bacteria more challenging [6].

Accordingly, tertiary treatments have been introduced as an efficient solution in order to improve the removal of residual OCs and more specifically ECs from water allowing its multiple post-use as for agricultural purposes or more importantly for groundwater recharge. The most common tertiary treatments so far used to tackle recalcitrant water micro-contaminants are the Advanced Oxidation Processes (AOPs) based on the use of powerful oxidants such as ozone [7], hydrogen peroxide (HP) [8] and more recently persulfate (PS) [9].

AOPs are very popular within the scientific community since they are capable of destroying OCs rather than displacing contaminants on an adsorbant or into a membrane. The process can even reach, under well controlled conditions, partial to full mineralization of contaminants into carbon dioxide and water. However, the reaction stoichiometric efficiency (RSE) defined as the number of moles of contaminant degraded over the number of moles of oxidants consumed is highly affected by the presence of other interfering species [10]. Methods for optimization of the RSE in AOPs systems has always been a challenge. Accordingly, AOPs are in permanent need of additional investigations and remain among the most attractive contaminants' degradation techniques worldwide. This is well reflected in most of the international organized conferences, symposia and scientific meetings on water treatment technology where AOPs-related themes are always given special attention.

This special issue of the journal of advanced oxidation technologies contains 27 research articles investigating the use of AOPs and their application to a variety of OCs, ECs as well as some PPCPs. It also encloses a comprehensive review on the development and improvement of one of the most investigated AOPs in the literature e. g. the Fenton's process operating in either homogeneous or heterogeneous medium. Special attention is given to HP activation by micrometric and nanometric zero-valent iron particles playing not only the important role of Fe^{2+} generator but also the role of iron corrosion products (ICPs) generator in solutions such as nascent iron oxides [11]. ICPs are found to be mandatory for a sustainable and an efficient Fenton's based AOP [12].

Upon special activation, HP is able to produce hydroxyl radicals (HRs) of high redox potential having therefore high oxidative properties. For example, wet oxidation of an industrial high concentration pharmaceutical wastewater using HP as an oxidant has been shown very efficient in improving the biodegradability of the effluent. The degradation of dyes such as Acid Orange and Safranin T has been investigated using classical as well as new catalysts such as Molecular Imprinted Catalysts in a Fenton-like oxidation process improving thereby the reaction efficiency. More advanced catalysts such as Ti/SnO_2-Sb_2O_3/PbO_2 enhanced by carbon nanotubes (CNT) and Bi co-doped electrodes showed great potential in decolorizing methyl orange.

Photo-degradation of contaminants continue to be an excited topic especially with the development of new catalysts that can operate in the UV and/or in the visible region of the electromagnetic spectrum such as

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$Co/N/Er^{3+}$: $Y_3Al_5O_{12}/TiO_2$ Films, BiOCl and strontium titanate supported on HZSM-5 for the degradation of OCs and ECs e. g. acid orange 7, phenol, benzo[a]pyrene, meclofenamic acid, fragrance precursor (catechol) and pesticides.

The topics investigated in this special issue are so rich that ozonation has also been considered for the elimination of (i) 2-hydroxybenzothiazole from waters in a hybrid heterogeneous ozonation system in the presence of oxygen-containing functional surface groups of activated carbons and of (ii) dimethyl phthalate in water in a bubble column reactor. In addition, more energy-needed AOPs are also studied such as the use of gamma radiation for the degradation of aniline or the use of micro arc oxidation technology for the treatment of printing and textile dyeing industries simulated with Rhodamine B (RhB) dye. Moreover, a green chemistry concept has been developed and implemented for the direct oxidative synthesis of nitriles from amines in addition to the regeneration concept of biological activated carbon using microwave technology.

I wish to sincerely thank Dr. James Lee for his help in assigning the appropriate reviewers for evaluating all submitted manuscripts. I would like to thank and congratulate the authors for their timely and greatly appreciated contributions to this Special Issue. I am also very grateful to the many reviewers who evaluated the manuscripts and wrote constructive comments.

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