fast breaking papers - 2010

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Despo Fatta-Kassinos talks with *ScienceWatch.com* and answers a few questions about this month's Fast Breaking Paper Paper in the field of Environment/Ecology. The author has also sent along an image of her work.

Article Title: Removal of residual pharmaceuticals from aqueous systems by advanced oxidation processes
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SW: Why do you think your paper is highly cited?

Over the past several years, pharmaceuticals are considered as an emerging environmental problem due to their continuous input and persistence into the aquatic ecosystem even at low concentrations (Fig. 1). This continuous release into the environment may constitute a long-term potential risk for aquatic and terrestrial organisms.

In addition, due to water scarcity, treated wastewater reuse schemes for irrigation or aquifer replenishment are widely implemented nowadays, contributing to the release of such compounds into the environment. The wastewater/water conventional treatment systems are not capable of completely removing xenobiotic compounds and therefore, more advanced systems are required.

Advanced oxidation processes (AOPs) are technologies based on the intermediacy of hydroxyl and other radicals to oxidize recalcitrant, toxic, and non-biodegradable compounds to various byproducts and eventually to inert end-products.

Although the environmental applications of AOPs are numerous, including water and wastewater treatment (i.e., removal of organic and inorganic pollutants and pathogens), air pollution abatement and soil remediation, they have only recently been employed for the abatement of pollution caused by the

presence of residual pharmaceuticals in waters.

Our paper reviews and assesses the effectiveness of various AOPs for the removal of pharmaceuticals from aqueous systems, thereby providing researchers with a quick overview of what has been achieved thus far in this regard.

SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

It is a synthesis of knowledge on what is currently known and what has been achieved so far with regards to the application of AOPs towards the removal of pharmaceuticals from aqueous matrices.

[+] enlarge

Figure 1:

Description: Sources and fate of pharmaceutical compounds in the environment.

SW: Would you summarize the significance of your paper in layman's terms?

Pharmaceuticals, which are designed to be biologically active substances, are usually lipophilic and resistant to biodegradation, thus having the potential for accumulation and persistence in the environment. Although they appear at relatively low concentrations ranging between ng/L and µg/L levels, they may have the potential to impose serious effects on the environment. Searching for suitable technologies to destroy these types of xenobiotics, this paper presents and assesses the capability of AOPs to treat such substances.

SW: How did you become involved in this research, and were there any problems along the way?

For much of the last 30 years, research on the effects of chemical pollution in the environment has focused almost exclusively on conventional "priority" pollutants. However, during the last several years, there has been a growing level of concern related to the hypothesis that various chemicals may exhibit endocrine-disrupting effects. This is due to increased incidences of endocrine-related diseases in humans, including declining male fertility, and more significantly, to adverse physiological effects observed in wildlife where cause and effect relationships are more evident.

In addition to this, thousands of tons of pharmacologically active substances are used annually, but surprisingly little is known about the ultimate fate of most drugs after their intended use. As the use of cosmetics and antibiotics grows, increasing quantities of their active organic ingredients are released into the environment through wastewater systems.

Triggered by the important recent findings of various research groups in Europe and the US concerning the removal efficiencies of such compounds in both drinking water and urban sewage treatment works, our work embraced this research direction. Studying this field, we have found advanced chemical oxidation processes (AOPs) quite fascinating since they employ chemical, photochemical, and sonochemical techniques to bring about chemical degradation/mineralization of such pollutants. This paper constitutes the platform for taking this research field a few steps forward and, because of the international interest in this particular field, our work is well-funded so far.

SW: Where do you see your research leading in the future?

Our research will further explore the mechanisms and kinetics of the oxidation of xenobiotic compounds through the application of advanced chemical treatment systems, either as stand-alone processes, or in

combination with other conventional treatment trains. Toxicity and other types of evaluation of the potency of oxidation byproducts will continue to constitute one of our main objectives as well.

SW: Do you foresee any social or political implications for your research?

Exploring and understanding the capability of such systems to treat water and wastewater so as to produce water free from xenobiotics will potentially provide a guideline for people to help prevent the release of these byproducts into the environment. This effort is currently being undertaken by a number of research groups throughout the world.

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