Highlighting the Role of Sunlight in Minimizing the Impacts of Aquatic Pollutants

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Final Report: October 2015

BACKGROUND AND PROJECT DESCRIPTION

Pollutants such as pharmaceuticals, hormones, pesticides, and viruses can be highly detrimental to aquatic ecosystems and water re-use operations, and research into the fates of these chemicals is of current concern. Because wastewater treatment plants (WWTPs) are not 100% effective at removing such contaminants, these pollutants are often released to surface waters via WWTP effluent. Many downstream receiving waters have been negatively impacted by the WWTP effluent; the widespread feminization of wild male fish living in such receiving waters provides a stark example of the effects of aquatic pollutants contained in WWTP effluent. The purpose of this project was to write two book chapters reviewing aspects of the potential environmental fates of pollutants that enter surface waters via WWTP effluent. The major focus of these book chapters is to illustrate ways in which sunlight is involved in the breakdown of aquatic pollutants.

One of the chapters is to be included in a second edition of the 2004 book “Advanced Oxidation Processes for Water and Wastewater Treatment” published by IWA Publishing (IWA = International Water Association). To gain a better understanding on how and why solar produced reactive species transform aquatic pollutants, I was invited to write a chapter reviewing the photochemistry of micropollutants in natural waters. The target audience of this book will be mostly environmental engineers in academic and municipal settings, and the chapter is to serve as a broad overview of photochemical processes capable of transforming aquatic pollutants.

The other chapter is to be published in the book "Surface Water Photochemistry" published by the Royal Society of Chemistry as part of their Comprehensive Series in Photochemical and Photobiological Sciences. I was invited to write a chapter on the role of singlet oxygen in surface water photochemistry (singlet oxygen is a reactive species capable of transforming certain types of aquatic pollutants in sunlit waters). Because the target audience for this book has a high level of expertise in environmental science and/or photochemistry, this chapter will trade the breadth of the other chapter for more depth. The production, decay, and reactivity of singlet oxygen will be presented in detail. Examples of pollutants that are transformed by singlet oxygen will also be included.

CURRENT PROJECT STATUS

Significant progress has been made on this project, with both chapters having been submitted and reviewed. “The role of singlet oxygen in surface water photochemistry” has been accepted for publication by RSC Publishing and the book should be available shortly. I am currently in the revision stage of “The role of photochemistry in the transformation of pollutants in surface waters” for the Advanced Oxidation Processes for Water and Wastewater Treatment book, but I anticipate that it will be completed soon. The book is scheduled to be released in early 2016.