The Photochemical Degradation of Lampricides

Wednesday, April 15, 2015
Noon – 1 PM
Engineering Hall, Room 236

Abstract:
Since the mid 1950’s lampricides have been purposely added to tributaries of the Great Lakes to target the invasive parasitic sea lamprey (Petromyzon marinus). Despite their widespread use, the environmental fate of the two lampricides, 3-trifluoromethyl-4-nitrophenol (TFM) and 5-chlor-N-[2-chloro-4-nitrophenyl]-2-hydroxibenzamide (niclosamide), has not been fully characterized. Combining lab based experiments with samples collected in the field, this study presents a proposed mechanism for the photodegradation of the two compounds and characterizes the impact of photodegradation on lampricide loss. In the laboratory, the influence of direct and indirect photodegradation on the environmental fate of TFM and niclosamide was studied. TFM degraded rapidly during direct degradation experiments, while niclosamide photodegradation was approximately an order of magnitude slower (e.g., TFM t1/2 = 0.98 hours and niclosamide t1/2 = 9.43 hours at pH 7). Additional experiments were conducted in a series of river water samples collected from five tributaries to Lake Michigan to study the influence of indirect photodegradation. These experiments indicated that the degradation of TFM is inhibited by increasing dissolved organic matter (DOM) concentrations, while the degradation of niclosamide is enhanced. For example, 63% of the observed photodegradation of niclosamide in Manistique River water (pH 7.09, 14.7 mg C/L) was attributable to indirect photolysis. Using probe and quencher experiments, we quantified the contribution of specific reactive oxidants, including hydroxyl radical, carbonate radical, triplet dissolved organic matter and singlet oxygen, to the indirect photodegradation of niclosamide. Finally, samples were collected from the Manistique River, located in the southeastern portion of Michigan’s Upper Peninsula during a combined dosing of TFM and niclosamide in September 2014. Field samples showed evidence of photoproduction formation during lampricide application. This finding confirms the importance of photodegradation to lampricide fate in tributaries of the Great Lakes.

Short Bio
Assistant Professor Christy Remucal (née Christina Renée Keenan) leads the Aquatic Chemistry group at the University of Wisconsin, Madison. She is a faculty member in the Department of Civil & Environmental Engineering, the Environmental Chemistry & Technology Program, and the Limnology & Marine Science Program. She holds an MS (2004) and a PhD (2009) in Civil & Environmental Engineering from the University of California, Berkeley, and a BS (2003) in Environmental Engineering Science from Massachusetts Institute of Technology. Before joining the UW faculty, Christy completed a post-doc in the Institute for Biogeochemistry and Pollutant Dynamics at the Swiss Federal Institute of Technology.