Speaker Name: Arash Zamyadi

Affiliation: Polytechnique Montreal, University of Montreal

Coauthors:

Coauthor Affiliations:

Abstract Title: Development of a model to support the design and operation of ozonation against toxic cyanobacteria

Abstract: Toxic cyanobacteria cell lysis, toxin release and oxidation using ozone have been the focus of several research projects in recent years. However, the growing number of breakthrough incidents where toxic cells and dissolved toxins were detected in treated water with concentrations over safe drinking water thresholds, demonstrates the unsuccessful application of research results. The objective of this work is to provide water utilities and operators of treatment plants with a much-needed practical tool to implement the new research results into their routine operation and evaluate the performance of their ozonation barrier for efficient removal of cyanotoxins.

The loss of cell integrity (and by inference toxin release) and toxin degradation as a function of exposure to the oxidant agent (CT) can be described by first order processes and can be considered as consecutive reactions. In these reactions the cell-bound toxins are first released by the action of the oxidant on the cell and the dissolved toxins are then degraded by the oxidant. Hence, a novel successive reaction kinetics model was developed using the kinetics of the ozone reaction with cyanobacterial cells and cell-bound toxins. The performance of the model has been evaluated using the experimentally determined loss of cell integrity and toxin degradation rates for laboratory cultured toxic Microcystis aeruginosa and Anabaena circinalis and natural bloom samples. Furthermore genomic analyses were used to investigate the expression of toxic gene during and post ozonation (on going).

Using the release rate of cell-bound toxins and the degradation rate of dissolved toxins, the model determined the ozone exposure (CTmax) that would yield the maximum concentration of free dissolved toxins i.e. the worst case scenario for drinking water treatment. Treatment plant operators would need to ensure contact with oxidant exceeded CTmax to achieve adequate degradation of toxins. The model correctly describes the decrease of total microcystins from M. aeruginosa and the trends for dissolved toxins. Excellent predictions for the oxidation of total saxitoxin from A. circinalis were also observed. Data from ozonation of toxic natural bloom samples were used to further test the validity of the model. The close agreement of predicted and measured values after a minimum CT of 10 mg min/L shows the applicability of this approach to estimate operational boundaries for oxidation.