United States Environmental Protection Agency

RESEARCH PROJECT

National Risk Management Research Laboratory
Water Supply and Water Resources Division
Treatment Technology Evaluation Branch

INTEGRATED DISINFECTION BYPRODUCTS (DBPS) MIXTURES RESEARCH: DBP CONCENTRATION VIA REVERSE OSMOSIS MEMBRANE TECHNIQUES

IMPACT STATEMENT

The implications to the U.S. Environmental Protection Agency (EPA) from this project will be fully realized during the next review cycle for the disinfection byproduct (DBP) rule. Current phases of this project are working toward developing a library of freeze-dried natural organic matter (NOM) that will contribute a source of consistent drinking water relevant NOM to EPA and the drinking water research community. This consistent source of concentrated dried NOM will allow DBP, water reuse, and many other areas of research to commence in new directions that have never before been possible because of the lack of relevant NOM.

BACKGROUND:

Interest in the health effects of complex DBP mixtures has existed for some time; although, until recently they have remained largely uncharacterized. Pioneering work done primarily at EPA facilities, has opened the door to more environmentally realistic characterizations of natural organic matter and disinfection byproducts. EPA scientists and engineers recently completed a large scale evaluation of the health effects of complex DBP mixtures known as the 4-Lab project. A key component of this research was the concentration of NOM from natural waters by reverse osmosis membranes.

The current research aims to continue with the concentration aspect of the 4-lab project, and to further characterize NOM concentrates and the DBPs formed during chlorination. Furthermore, the effects of lyophilization (freeze-drying) on NOM concentrate are undergoing investigation. Researchers have historically taken for granted that lyophilization does not fundamentally alter the character of NOM. This research attempts to provide a factual basis for this assumption.

DESCRIPTION:

With the completion of the 4-lab project, the NOM concentration aspect of 4-lab is being continued with renewed focus on creating drinking water relevant freeze-dried NOM isolates that can be used for many drinking water research efforts from DBP investigations to water reuse investigations. The first phase of the project involved developing a new freeze-drying technique to remove the remaining water from the reverse osmosis NOM concentrates. This new technique was optimized to minimize total organic carbon losses through the process.

The second phase of the project, currently in progress, involves comparing the freeze-dried and reconstituted NOM to the NOM prior to freeze-drying and concentration in order to demonstrate that the final product is representative of the original natural water. The first recently completed demonstration of this comparison was based on DBP comparisons

before and after concentration and freeze-drying. Follow-up work will include other well documented methods for characterizing NOM, such as NMR, elemental analysis, and molecular weight fractionation.

The third phase of this project, being conducted concurrently to the second phase, is aimed at concentrating a natural surface water source on a monthly basis for at least a year to build a library representing the NOM from a single water source capturing temporal variations. The concentrated and dried NOM from this source represents a consistent source of NOM that can then be used to research various changes in drinking water treatment and the effects upon DBPs formed.

The fourth phase of this project includes moving the NOM concentration equipment to various drinking water relevant water sources and creating a freeze-dried NOM library that can be used for a multitude of drinking water research projects requiring more than one water source to demonstrate the effects of treatment implements.

EPA GOAL: Goal #2 - Clean & Safe Water; Objective 2.1.1 - *Water Safe to Drink*
ORD MULTI YEAR PLAN: (DW) Long Term Goal - DW-2 *Control, Manage, and Mitigate Health Risks*

RESEARCH PARTNERS:
Contractors: Pegasus Technical Services, Inc.; Shaw Group, Inc.

Expected Outcomes and Impacts:

Outcomes of this research include new methods for concentrating and freeze-drying NOM that preserve the organic character and DBP formation characteristics of the original source, a full year of NOM collected monthly from a single source to capture temporal variations in NOM for further DBP treatment studies, and a novel library of dried NOM from various water sources that can be used by EPA and the drinking water research community for DBP and related research.

Outputs:

Current and future outputs:

- Integrated Disinfection By-Products Mixtures Research: Toxicology and Chemical Evaluation of Alternative Disinfection Treatment Scenarios. Journal of Toxicology and Environmental Health, Part A Current Issues, Volume 71 Issue 17 2008. (http://www.informaworld.com/smpp/title~db=all~content=g795055525)
- Project Report (APM 222) -(Submitted: 9/1/2009)
- Peer Reviewed Journal Article in Preparation for ES&T : *U.S. EPA's Four Lab Study: Concentration, Chlorination, and Chemical Analysis of Drinking Water Disinfection By-Product Mixtures for Health Effects Research*.

Resources:

NRMRL Treatment Technology Evaluation Branch: http://www.epa.gov/ORD/NRMRL/wswrd/tteb.htm

Integrated Disinfection By-Products Mixtures Research: Toxicology and Chemical Evaluation of Alternative Disinfection Treatment Scenarios. Journal of Toxicology and Environmental Health, Part A Current Issues, Volume 71 Issue 17 2008. (http://www.informaworld.com/smpp/title~db=all~content=g795055525)

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