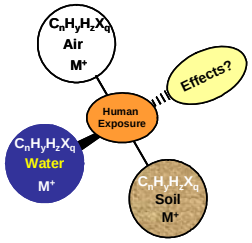


Superfund Research Program
University of California Davis

Dr. Bruce D. Hammock, Director

Research Update No. 2 **November 2009**

Introduction

This Research Update informs staff in State and Federal government involved in legislation and regulation of toxic substances in the environment about research results emanating from the UC Davis Superfund Program. The goal of these updates is to provide information about the National Institutes Environmental Health Sciences (NIEHS) funded Superfund Research Program (SRP)[1] that has been at UC Davis for the past 23 years. This national program was initiated to address human and environmental problems such as Love Canal, NY where improper disposal of chemical wastes occurred or Times Beach where oil containing chlorinated dioxins was sprayed as a dust suppressant. The mission of the SRP is stated below[2]

> "*Since its inception in 1987, the SRP has applied a multidisciplinary approach to basic research focused to provide a solid foundation which environmental managers and risk assessors can draw upon to make sound decisions related to Superfund and other hazardous waste sites. We believe that basic research plays a crucial role in addressing challenges posed by environmental contamination such as health risks, toxicity, exposure predictions, fate and transport, and the need for* cost-effective treatments for hazardous *waste sites found throughout the United States"*

The Superfund Program at UC Davis[3] has provided basic research information to address these needs. We continue to develop innovative, novel technology to investigate human exposures, environmental fate and transport of toxic substances, as well as cost-effective methods for the treatment and remediation these chemicals. The success of our program is due to the breadth of the multidisciplinary approach to these complex scientific issues of chemical exposure that continue to pose hazards to human and environmental health.

This program exports its findings beyond academic journals and publications to other venues and audiences. As required by the NIEHS, we have concerted efforts to effectively partner with government, transfer technology to commercial ventures, or communicate with broader public audiences for the purpose of improving human and environmental health. Research Translation of scientific results is important for society to understand the goals of the SRP in the mitigation of toxic substances in the environment.

Results

This newsletter highlights three relevant areas of research from the program: 1) a discussion of the impact of ethanol on degradation of persistent gasoline contaminants in ground water, 2) new methodology for rapid detection of polybrominated diphenyl ether flame retardants (PBDEs) and 3) multiple protein analysis: potential uses for analysis of toxic proteins in the food or domestic water supplies.

[1] Name changed from Superfund Basic Research Program to Superfund Research Program in 2008
[2] www.niehs.nih.gov/research/supported/sbrp/about/index.cfm
[3] www-sf.ucdavis.edu/

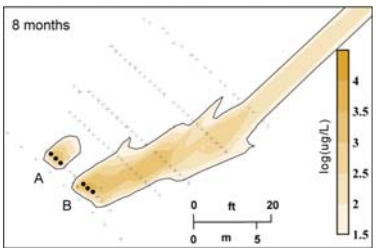
Ethanol in ground water prolongs the microbial degradation of persistent gasoline constituents

Background

The renewable energy policy in The Energy Policy Act of 2005 sets a path forward for the development and commercial introduction of ethanol made from cellulosic biomass, which promises to have a profound impact on our ability to manufacture and use renewable fuels in the future" as stated by Jeff Bingaman, U.S. Senate Energy Committee in 2005. The MTBE oxygenate experience has taught us that fuels that contain up to 10% of this oxygenate have resulted in widespread contamination of drinking water aquifers from leaking underground fuel tanks. In its place as stated above, there is a requirement to develop fuels that contain cellulosic ethanol and by 2012, 7.5 billion gallons of renewable fuels must be in commerce.

Impact

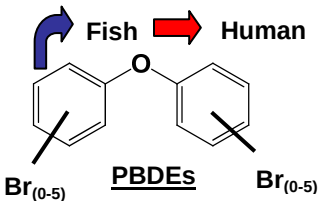
Researchers at UC Davis examined the biodegradation of gasoline contaminants, benzene, toluene, xylene (BTX) alone (A in figure) and in the presence of ethanol. What they found is that in the presence of ethanol there was in less degradation of BTX which resulted in greater mobility of BTX and enlargement of the plume (B in figure). This is not unexpected given that ethanol is more easily oxidized than BTX because of the hydroxyl group which can be oxidized eventually to carbon dioxide and water. Microorganisms preferentially degrade ethanol compared to BTX thus resulting in a longer half-life. This research has significant implications for newer oxygenates that contain an alcohol functionality or structure that can be metabolized to an alcohol in the environment.



PBDEs: Easier analyses of human and environmental samples by immunoassay techniques

Background

It is still a challenge to detect and quantitate persistent organic pollutants that reside in human and environmental matrices. Yet the data about the presence of such compounds is important to the risk assessment process. Polybrominated diphenyl ethers (PBDEs), one of the organic fire retardant replacements for polychlorinated biphenyls (PCBs), are now found in similar environmental compartments as the PCBs. This is not unexpected given similar properties (multiple bromine substitutents), which result in their partitioning from aqueous environments into the fat of organisms or onto sediment in streams, rivers or lakes. Toxicology results indicate that PBDEs have hormonal and reproductive effects. In California for more than 20 years there has been a requirement that furniture foam contain a fire retardant and the PBDEs have predominated. Human exposures occur occupationally (carpet installers for example), or non-occupationally, from ingestion of marine fish.



Impact

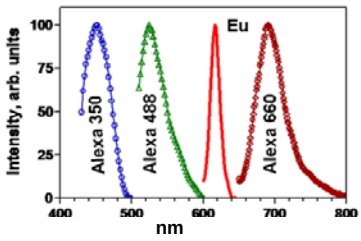
Reported methodologies to measure PBDE are either very time consuming (lengthy analysis time for each sample) or relatively non-specific (analysis for bromine, not individual congeners). Researchers in the the UC Davis Superfund Research Program have applied their immunoassay expertise to provide more rapid analysis of PBDEs. This methodology has been found useful for a wide range of sample sizes that include diverse matrices such as furniture foam, blood and house dust. The use of this analytical methodology will facilitate more rapid assessment of PBDEs that occur in matrices that may pose risks to humans or animals in the environment.

Superfund technology investigated for the rapid, simple detection of multiple analytes: potential application to toxic proteins

Background

The proteins very toxic to mammals such as botulinum toxin, ricin, and abrin, are some of the possible candidates that terrorists could use for the contamination of food and water supplies in the US or overseas. For the past 20 years, the Superfund Program at UC Davis has improved and extended uses of immunoassay technology for the analysis of small molecules and proteins in human, environmental and food samples. impact

With some funding from the USDA, the immunoassay technology was applied to the analysis of non-toxic proteins as prelude to the potential analysis of the toxic proteins named above that could be introduced into the food supply. The exciting aspect of this work is that researchers found they could analyze multiple proteins at one time. This is a significant improvement over analysis of each individual protein, one at a time. If toxic proteins were introduced into the food supply, their exact identity would not be known. An assay format allowing assessment of multiple proteins (blue, green, magenta peaks on left) that may be in the sample simultaneously would facilitate quarantine activities for drinking water or food for human or farm animal consumption. The partnering of the Superfund Research Program research expertise with the needs of the USDA for potential detection of toxic proteins introduced into the food or water supplies exemplifies the broader applicability of SRP immunoassay analytical methodology that has been developed for toxic small molecules normally found in Superfund Sites on the National Priorities List.



This newsletter is still in its formative stages. Therefore, we would appreciate some critique so that in the future it will improve and therefore better meet the needs of the recipients. Some areas on which we would like comment are content, effectiveness of communication and how it can build interactions and relationships with others outside the UC Davis Superfund Research Program. Please share this Research Update with your colleagues who may have an interest in the results of our research.

For more information about the UC Davis SRP, please contact: James R. Sanborn, Research Translation Coordinator, JRSanborn@ucdavis.edu or (530) 752-8465.