



WATER RESOURCES RESEARCH GRANT PROPOSAL

Title: Using Semi-Permeable Membrane Devices for Detecting and Assessing Risks of Exposure to Dioxins in Natural Waters

Focus categories: NPP, TS, HYDGEO

Key Words: Pollution control, pollutants, contaminant transport, membranes, organic compounds, model studies

Duration: 1 August 1998 - 31 September 2000

Federal Funds Requested: \$69,147

Non-Federal (Matching) Funds Pledged: \$ 160,458

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Congressional District: 2nd district

Statement of Critical Regional or State Water Problem:

Polychlorinated dibenzo-*p*-dioxins (PCDD) and dibenzo-*p*-furans (PCDF) are ubiquitous in the global environment, introduced from a variety of natural and anthropogenic sources and processes. Because of their well documented carcinogenic and reproductively toxic characteristics, PCDD/F emissions and bioaccumulation are the subject of intense public health debate and research. Dioxins are fat-soluble, and accumulate in organisms from dietary sources. Because these compounds persist in tissue, they bioaccumulate in the food chain to levels that are often thousands of times higher than in the surrounding environment. Thus, higher predators and older organisms contain the highest concentrations of dioxin. The bioaccumulation factor in fish is thought to be as much as 100,000 times ambient, depending on the species and the environmental conditions.

In Maine, a law enacted in 1997 will require paper mills and other dioxin sources to comply with the 'upstream-downstream' mandate by the year 2001. This simply means that fish downstream of the mill must have concentrations no higher than fish upstream. Unfortunately, the variability in fish age, distributions, and toxic accumulation means that establishing statistical significance is often not possible. More-over, this suffers from the

serious issue that fish move around in rivers. The upstream and downstream analysis has an uncontrolled statistical design. Tuesday's 'downstream' fish may have been Saturday's 'upstream' fish under some circumstances! The results of the proposed project herein will determine the effectiveness of Semi-Permeable Membrane Devices (SPMDs) under a range of environmental conditions to determine whether and when the devices are suitable (or not) as indicators of dioxin exposure. This proposed method will be useful worldwide for a host of purposes, including such goals as 'upstream-downstream' dioxin source testing.

Statement of Expected Results or Benefits:

Maine has one of the most intensive toxic screening programs underway in the country for metals, PCB's, dioxins/furans, and pesticides in rivers, streams and lakes. The Surface Water Ambient Toxics (SWAT) program is intended to help environmental managers and policy makers resolve problems regarding toxic contamination based on statewide analysis of the distribution and severity of toxic contamination in surface waters. The various Kraft mills in Maine have worked with the DEP on the Governors "upstream-downstream" Proposal; under this document, levels of dioxin in Maine rivers below a Kraft mill must not exceed the levels above that mill. Finding an accurate way to routinely monitor dioxin levels will help to implement this plan.

The cooperative agreement between CIA labs, the patent holder of the SPMD's , and the University of Maine is an opportunity to develop and fine tune a system which then could be utilized by other states nationwide. The SPMDs will provide a more accurate and less time consuming analytical tool for the determination of toxics at specific sites. The SPMDs are composed of low-density polyethylene tubing consisting of transport cavities ($<10A^{\circ}$) that contain triolein (an indigenous oil found in most organisms). The SPMDs eliminate the variability of fish size, species, and age that are present in the current methods. The use of SPMDs will also eliminate multiple stages of laborious and expensive sampling and analysis steps such as catching the fish at the sites and processing the fish tissue at the laboratory. The problems of inhomogeneity of the processed sample will also be eliminated. As the samples are stationary, their concentration is directly attributable to the levels passing that point and SPMDs, unlike fish, do not migrate into tributaries and other bodies of water.

Results from this study will provide the opportunity to utilize SPMDs for widescale monitoring of a variety of toxins. For example, with the results from the dioxin/furans we will apply similar methodologies and procedures to other dioxin-like compounds that have similar toxicity, such as PCBs. The ultimate goal is to provide a reliable monitoring tool for a variety of environmental toxic compounds from aqueous systems and to greatly lower costs of monitoring. The advantages and the applicability of techniques developed in this study will be well beyond the scope of this project. Results from this activity will educate policy makers and enhance pollution prevention efforts and influence local and federal policy issues in a constructive manner. The information dissemination to DEP and the public sector will provide a channel to make policies based on scientifically informed and sound data. This activity will also ensure that pollution prevention providers have

access to new technologies to develop pertinent programs. Lastly, fish caught in the various rivers under study are a food source for the Penobscot Indian Nation on the Penobscot River, the Passamaquoddy Nation on the St. Croix, and the Maliseet Nation on the Aroostook River. Improved risk assessment and subsequent reduction of fish consumption advisories is a major goal of these tribes.