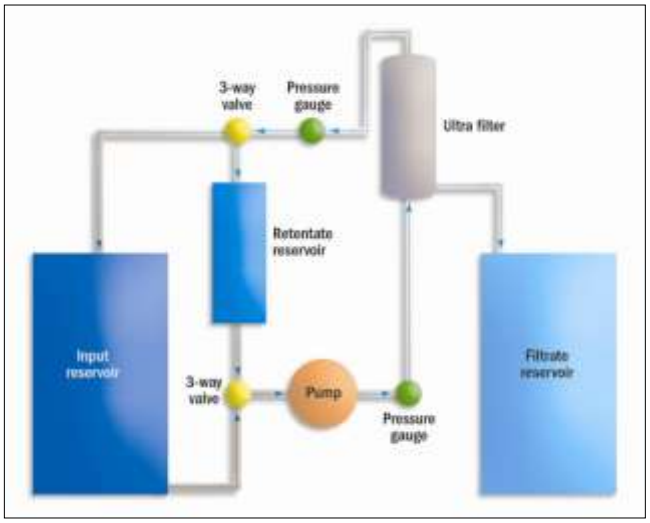
OFFICE OF RESEARCH AND DEVELOPMENT
National Homeland Security Research Center

TECHNICAL BRIEF

U.S. EPA Researchers Develop Ultrafiltration Concentration Methodology and Device for Drinking Water Samples

Background

The U.S. EPA's National Homeland Security Research Center, with the support of a steering committee composed of experts in the field of microbiology and analytical chemistry, has developed and is distributing protocols for the detection of biological agents in water. Included in the protocol under development is a method for the filtration of water samples that will enhance the capability of laboratories to concentrate biological pollutants in large volumes of drinking water samples. NHSRC researchers have developed a bench-scale ultrafiltration concentration device as a component of a larger project for developing analytical methods for detection of biological agents in drinking water. This device concentrates potential biological contaminants in drinking water samples, enhancing the ability to detect their presence in laboratory analyses. A project is currently underway for the development of a field-prototype for this device.



Ultrafiltration Apparatus: This diagram illustrates how an ultrafiltration concentration device can accumulate potential biological contaminants in concentrated amounts, making test results simpler and more accurate.

The Ultrafiltration Device and Methodology

The methodology recommended as well as the device created in the study involves a reservoir to collect the sample, a pump, a fiber membrane cartridge, a reservoir for the captured biological contaminants ("retentate"), and a filtrate reservoir (See Illustration). Certain filters with non-reactive membranes (polysulfone or low protein binding membranes) are preferred for filtering because they provide optimum protection while suffering minimal performance degradation from extensive use. The system operates at a 5-10 PSI difference between the input and retentate pressure to force water through the hollow fiber membrane, concentrating particles and microorganisms in the retentate. Recirculating concentrates the sample further, improving the likelihood of accurate test results.

Under an Idaho National Laboratory (INL) and NHSRC joint venture, researchers will develop the design, prototype engineering, and manufacturing expertise to design and manufacture a field-prototype device. The field-prototype will meet the need of a field rugged, transportable device, and will ensure safe operation from a remote unit. Design considerations are for a two-part quick-connect system composed of high-cost components and of less costly disposable components to meet decontamination needs.

Ultrafiltration Method Project Objective

The ultrafiltration study is one of several ongoing research projects intended to answer a call by the Homeland Security Presidential Directive 9 to develop a robust, comprehensive, and fully coordinated surveillance and monitoring system that would provide early detection and awareness of disease, pest,

(more)

or poisonous agents. In effect, researchers have developed a procedure and necessary equipment for drinking water sample filtration using an “off-the-shelf” design device. The contaminants that can be concentrated from water samples using this device include biological spores, vegetative spores, viruses and protozoa, and the samples can range from 10 to 1,000 liters. When concentrated, the hazards involved in handling and transport are minimized, providing a greater level of safety to those administering the tests.

The project at NHSRC had two objectives. The first was to use an existing ultrafiltration unit in the testing of the draft interim protocol. Criteria considered in the evaluation included volume reduction, percent sample recovery, filtration time, ease of operation, operator safety, and waste minimization. The second objective was to select the ultrafiltration unit for evaluation by a laboratory in testing a draft interim protocol. Commercially available devices used in the NHSRC testing included units under development by the Los Angeles Metropolitan Water District (MWD), the Centers for Disease Control (CDC), and the Army Joint Service Agent Water Management Program (JSAWM). Research was required to determine what filters were appropriate and the required platform and accessories (e.g., tubing, valves, etc.) needed to support the ultrafiltration devices when in use.

Users and Benefactors of the Ultrafiltration Method Technology

The expected users are water utilities, emergency responders, contract samplers, laboratories, and other individuals responsible for planning for analytical responses to contamination threats to the nation’s drinking water supply. The ultimate benefactor is the end user or consumer of the water supply.

For more information, visit the NHSRC Web site at www.epa.gov/nhsrc.

Technical Contact: Kathy Nickel (513) 569-7955, nickel.kathy@epa.gov

March 9, 2005
EPA/600/S-06/030