

Award-winning Ultrafiltration Device Used to Aid in the Detection of Microorganisms in Drinking Water

Portable Device Developed to Detect Microorganisms

The possibility of terrorists or criminals intentionally contaminating drinking water with pathogenic microorganisms is a significant public health concern. This concern has given rise to the need to rapidly and effectively sample water to detect small concentrations of potentially dangerous microorganisms.

Analysis of water for the presence of low levels of microorganisms requires that either a large volume sample be collected and transported to a laboratory where the sample is concentrated before analysis, or concentrated in the field with cumbersome, yet delicate laboratory equipment. Concentration of a sample is necessary because low levels of microbes can be more accurately detected in a concentrated sample than in a diluted one.

The transportation and handling of a large volume of potentially contaminated water is a safety concern for the transporters, laboratory personnel and the public. To improve upon this situation, EPA, in partnership with the Department of Energy's Idaho National Laboratory (INL), developed a rugged and automated field deployable sample concentration (ultrafiltration) device. The device significantly reduces the sample volume by concentrating the microorganisms contained in a large sample into a small volume of water. The device can concentrate the microbes contained in a 26-gallon sample into less than 2 cups of water, often in under an hour. Following concentration, the smaller, concentrated sample can be more easily and safely transported to a laboratory.

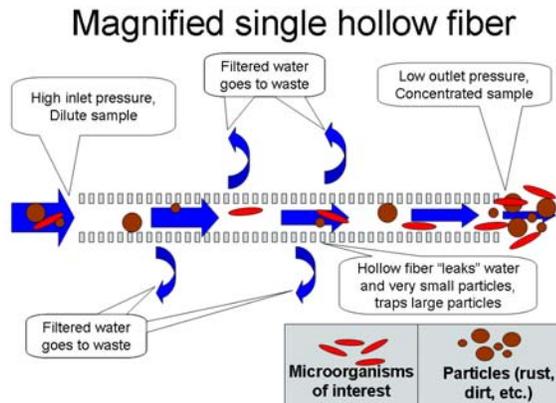
For the development of this filtration device, EPA and INL researchers received a 2009 R&D 100 Award from *R&D Magazine*, a magazine that provides news and information concerning the research and development community. Each year, the editors of *R&D Magazine* bestow the prestigious R&D 100 Award to help new products compete in the marketplace. As stated by *R&D Magazine*, "the winning of an R&D 100 Award provides a mark of excellence known to industry, government, and academia as proof that the product is one of the most innovative ideas of the year".

U.S. EPA's Homeland Security Research Program (HSRP) develops products based on scientific research and technology evaluations. Our products and expertise are widely used in preventing, preparing for, and recovering from public health and environmental emergencies that arise from terrorist attacks. Our research and products address biological, radiological, or chemical contaminants that could affect indoor areas, outdoor areas, or water infrastructure. HSRP provides these products, technical assistance, and expertise to support EPA's roles and responsibilities under the National Response Framework, statutory requirements, and Homeland Security Presidential Directives.



Ultrafiltration Device – Methodology and Advantages for Water Sampling

The approximate dimensions of the ultrafiltration device are 31 x 20 x 16 inches (795 x 518 x 393 millimeters), which allows it to fit into the trunk of a car. It consists of pump valves, sensors, electronic controls, a hollow fiber filter cartridge and a sample bottle. The device is controlled by software that can be installed on a personal computer. The device works by pumping water through a filter, while maintaining 10 to 25 pounds per square inch pressure difference between the filter inlet and outlet. This pressure difference forces the water to be discarded through a hollow fiber filter, while the microorganisms remain suspended in the sample (See diagram).



Using a computer controlled system, the ultrafiltration device automates the process of concentrating microorganisms. The system was also designed to reduce human exposure to potentially contaminated water and to generate samples that are appropriate for the analyses of several types of microorganisms. The underlying technology has been tested by several laboratories, with further testing being conducted by both EPA and Centers for Disease Control.

The ultrafiltration device:

- **Reduces sample collection and concentration time and cost** – Sample concentration processes are automated, which reduces the time it takes to determine pathogen content. Since only a concentrated sample is shipped, the cost of transport is less. One hundred liters of water sample can often be processed and concentrated in about an hour.
- **Improves accuracy and consistency** – By using a large sample volume, analytical sensitivities may be improved by as much as 200-fold over smaller volume assays. Concentrated samples help ensure that highly diluted microorganisms are accurately identified. The automation of processes that were previously performed manually in the laboratory should help improve the consistency of sample preparation.
- **Requires minimal setup and training** – Instrumentation and controls allow operation with minimal setup and training.
- **Allows for real-time monitoring** – The computer screen provides a virtual display of the filtration process, allowing operators to monitor the status and quickly respond to operational issues during sampling.
- **Eliminates cross-contamination** – All device parts that come in contact with the sample water (e.g., tubing, fittings, pressure transducer) are single use items. This ensures that there is no cross-contamination between samples. The device includes quick disconnects for sample removal.

- **Increased safety** – The shipment and handling of a small water sample, compared with a high volume sample, is less likely to result in spillage which decreases risk to the transporters, laboratory personnel and general public.

Additional Uses

The ultrafiltration device could be used by water utilities during their routine regulatory compliance sampling. This routine sampling includes testing for several different microorganisms in drinking water.

The ultrafiltration device may also be useful for sampling:

- Bilge water on shipping vessels
- Process control liquids from the brewing and pharmaceutical industries
- Surface water for environmental studies
- Decontamination water from cleanup areas.

Although not yet confirmed, the ultrafiltration device might be useful in concentrating samples for large molecular weight toxins such as ricin, as well as yeasts, fungi, viruses, protozoa and helminths, which are targeted pathogens in EPA's new water reuse guidelines.

Licensing

In early 2009, INL and Teledyne Isco signed a licensing agreement that provides exclusive rights to Teledyne Isco for further development and marketing of the device. Teledyne Isco, an operating unit of Teledyne Technologies, is a world leader for the design, manufacture and distribution of automatic collection devices used to sample water and wastewater for subsequent laboratory analysis.

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

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