Water and Environmental Technology (WET) Center

Temple University, Rominder Suri, Director, 215.204.2378, rsuri@temple.edu

University of Arizona, Ian Pepper, Director, 520.626.3328, ipepper@ag.arizona.edu

Arizona State University, Morteza Abbaszadegan, 480.965.3868,
morteza.abbaszadegan@asu.edu

Center website: http://wet.temple.edu/

Advanced Oxidation Processes (AOPs) for Water and Wastewater Treatment

Advanced Oxidation Processes (AOPs) generate highly reactive species (e.g., hydroxyl radicals) for the oxidative destruction of target pollutants in water and wastewater. The WET Center has been researching a number of technologies that can be used to generate hydroxyl radicals. The Center AOPs (ozone, UV, ultrasound, hydrogen peroxide and their combinations) have been successfully applied for the removal of wide range of environmental contaminants including: steroid hormones, pesticide, pharmaceuticals, 1,4-dioxane, and BPA. Comparative life cycle analysis (LCA) and life cost analysis (LCC) is used to evaluate, optimize, and determine the environmental impacts of AOP technology. The best AOP is selected for a given application according to the efficiency of ECs removal, technical feasibility, energy consumption and costs.

This unit is equipped with inline ozone monitors to measure ozone in air, water and atmospheric phase, a UV sensor, a degassing unit and a catalytic ozone destructor.

A pilot-scale, skid mounted water treatment system has been acquired for testing at several global locations. This highly automated AOP pilot plant supplied by ITT (a Center member company) consists of an oxygen generator, ozone generator, low intensity UV lamps, and peroxide feed pump. This unit is also equipped with inline ozone monitors to measure ozone in air, water, and atmospheric phase, UV sensor, degassing unit, and catalytic ozone destructor. This system uses three proven treatment technologies (Ozone, UV, and hydrogen peroxide) in six different ways to eliminate organic pollutants. It has a capacity to treat 2,500 to 25,000 gallons per day of water and wastewater.

Economic Impact: The AOPs are gaining attention in the market and have tremendous application potential for drinking water, municipal wastewater, industrial wastewater, and groundwater treatment. A member company estimates revenue generation of $30 million in five years, as well as the creation of new jobs from the application of this technology. The global water industry is estimated to be about $500 billion.

For more information, contact Rominder Suri, 215.204.6937, rominder.suri@temple.edu.

Real-time Detection of Contaminants in Potable Water Distribution Systems

For 24-7 monitoring, Smart water distribution systems require a centrally located computerized data base.

The WET Center has developed a Real-Time Sensor Laboratory at the Water Village within the University of Arizona. Sensors in parallel allow for instantaneous detection of both chemical and microbial contaminants. Viable microbial contaminants can be detected via fluorescence from NADP and riboflavin. Chemical contamination can be detected through the use of multiple total organic carbon inline sensors. For continuous monitoring of distribution systems, multiple sensors must be employed as part of a supervisory control and data acquisition (SCADA) system. For 24-7 monitoring, management of simultaneously generated large data sets becomes critical. Smart water distribution systems require a centrally located computerized data base and appropriate software to integrate and correlate data with realistic alarm thresholds to protect consumers from drinking contaminated potable water.

Economic Impact: Since water is delivered to consumers via distribution systems in every town and city within the US, the economic impact of this proof of concept for the nation could involve billions of dollars annually.

For more information, contact Ian Pepper, 520.626.3328, ipepper@ag.arizona.edu.

Survival of Infectious Prions during Wastewater Treatment

Prions are malformed proteins that can enter healthy organisms, affect their neural tissue, and result in untreatable disease that is usually if not universally fatal. Recently published research documented that prions can survive wastewater treatment.

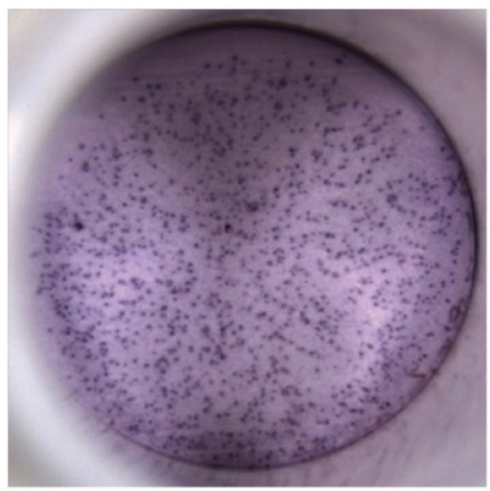
Transmissible spongiform encephalopathies (TSE) are a group of neurological prion diseases of mammals. In humans these include Kuru, Creutzfeldt-Jakob disease (CJd), sporadic Creutzfeldt-Jakob disease (spCJd), and variant Creutzfeldt-Jakob disease (vCJd). In animals, TSE includes scrapie in sheep and goats, bone spongiform encephalopathy (BSE) in cattle, and chronic wasting disease (CWD) affecting deer, elk, and moose.

Normal prions found within humans have a tertiary structure involving the alpha helix. In contrast, infectious prions have a beta sheet structure. Of interest is the fact that when an infectious prion encounters a normal prion it converts the normal prion to the infectious mode, ultimately resulting in disease. One route of exposure to infectious prions is through raw, contaminated wastewater via animal rendering and meat processing operations due to prion-infected cattle or sheep. However, Western blot technology was used in this study which only looks at the amino acid sequence and does not distinguish between infectious and normal prions.

Researchers at WET developed a new assay that only detects infectious prions. They used this assay to study of the fate of prions during wastewater treatment. Data showed that prions are actually inactivated during mesophilic or thermophilic anaerobic digestion negating the possibility of prions surviving wastewater treatment. This is significant in that if prions had survived wastewater treatment, they could have been found in biosolids and subsequently land applied with a potential for infecting cattle.

Economic Impact: The outbreak of "mad cow disease" in Britain in the 1990s resulted in the slaughter of hundreds of thousands of animals and many millions of dollars in damage. The toll on human life is incalculable. This breakthrough assay is making it possible for wastewater treatment plants to help to avoid or at least substantially reduce such losses in the future.

For more information, contact Ian Pepper, 520.626.3328, ipepper@ag.arizona.edu.



Because one route of exposure to infectious prions is through contaminated wastewater via animal rendering and meat processing of prion-infected cattle and sheep, the risks to local and national economies can be substantial.