WATER TECHNOLOGY NEWS

A BCC, Inc. Publication • 25 Van Zant St., Norwalk, CT 06855-1781
• 203/853-4266 • FAX: 203/853-0348

Volume 3, Number 5 August 1995

In This Issue...

Editor: Richard Barnett, 713/437-8319
Asst. Editor:
Karen Lindsey, 409/778/3924

Production Editor: Cynthia Del Vaglio

Editorial Office:
10101 Fondren, Suite 227
Houston, TX 77096
Managing Director: Anna Crull,
713/774-3942

BCC Newsletter Group
Editorial Director: Alan Hall
Director of Operations: Robert Butler
President: Louis Naturman

ISSN: 1070-3705

PHYSICAL TREATMENTS

Virus Disinfection By Ultrafiltration

Australian engineers have evaluated the efficiency of ultrafiltration and low-pressure microfiltration membranes for removing viruses from drinking water supplies.

Tony Fane led a group in Sydney (UNESCO Centre for Membrane Science & Technology, School of Chemical Engineering & Industrial Chemistry, University of New South Wales, Sydney, NSW 2052, Australia) that conducted tests on Millepore hydrophobic microfiltration (MF) membrane (GVHP) with 0.22 micron pores and Amicon polysulfone PM30 ultrafiltration (UF) membranes with a molecular weight cut-off of 30kD.

They chose cultures of human polio virus and *Escherichia coli* as their test species, and used secondary effluents from a sewage treatment plant to study the effects of turbidity on virus removal. Their 110 ml batch cells had a membrane area of 15.2 cm^2. They pressurized the cells with nitrogen to operating pressures of 25, 50, 100, and 200 kPa. After filtration, the investigators examined the membranes by scanning electron microscopy (SEC).

S.S. Madaeni reports in *Journal of Membrane Science* [**102**, 65-75, 1995] that rejection of polio virus by GVHP MF membrane was time-dependent. It was initially 100% , fell to 91-93%, and returned to 99-99.5%. Madaeni attributes the initial complete rejection to absorption of the virus on and in the membranes. Some virus particles pass after the most accessible absorption sites are filled, but the subsequent increase in rejection may be due to changes in the permeability of the membrane as the result of deposition. Virus rejection was better with higher the turbidity or *E. coli* levels.

In UF experiments with 10^4/ml polio virus with and without *E. coli*, rejection of the virus by PM30 UF membrane was complete.

MF membrane flux was unaffected by stirring but affected by deposition on and within the membrane. Absorptive deposition of polio virus on and within the membrane increased membrane resistance. Fouling increased with pressure.

Stirring improved UF membrane flux, with or without *E. coli*, but UF fluxes were consistently lower than MF membrane fluxes. Madaeni concludes that ultrafiltration membranes are capable of complete removal of viruses

test underestimates actual wastewater strength by 20-40%. Albertson finds no support for nitrification as a significant factor in the large differences in $CBOD_5$ and BOD_5 test values, and he concludes that suppression of the BOD_5 in the suspended solids fraction by TCMP is the primary reason for the differences.

Albertson concludes in *Journal of Environmental Engineering* [121-7, 515-520, 1995] that COD measurements are more useful and reliable than either BOD_5 or $CBOD_5$ for quantifying the strength of wastewater and therefore more reliable for design purposes or the control of plant operations. Neither BOD_5 or $CBOD_5$ are adequate for advanced wastewater treatment plants where 96-98% of influent organics are either oxidized or converted to biomass.

Detecting Selenium in Groundwater

Although selenium (Se) is an essential element, excessive selenium is toxic to animals and humans. The mandated limit in drinking water is 0.01 mg/l. University of Wyoming researchers have discovered that copper oxide selectively absorbs dissolved selenium, and have used this property to devise a new quantitative test for SeO_3^{2-} and SeO_4^{2-} in alkaline groundwater.

Groundwater in parts of Wyoming has Se concentrations as high as 0.033 mg/l. Katta J. Reddy (Water Resources Center, P.O. Box 3067, University of Wyoming, Laramie, WY 82701; Fax: 307/766-3785), Zhingua Zhang, Michael J. Blaylock, and George F. Vance note that the detection of selenium in groundwater is complicated by its number of oxidation states (II, IV, and VI), its variety of ionic species of different toxicity, and the masking effects of other ions such as magnesium and sulfate. Hydride generation atomic absorption spectrometry (HGAAS), the standard method of Se analysis, cannot distinguish between the ionic species of selenium.

Katta's group tested three groundwater samples with high selenium levels and high concentrations of magnesium and sulfate ions. They spiked their samples with 2 mg/l standard SeO_3^{2-} and SeO_4^{2-} and acidified them to pH 5.5 with HCl. The concentrations of Se(IV), Se(VI), and organic Se in spiked and unspiked samples by HGAAS were determined.

Aliquots of spiked and unspiked samples were transferred to centrifuge tubes containing 0.6 g of powdered CuO. They allowed the tubes to stand for 4 hrs. before centrifuging and decanting the supernatant. NaOH which was added to each tube to desorb Se.

Katta reports in *Environmental Science & Technology* [29-7, 1754-1759, 1995] that CuO absorbed 100% of SeO_3^{2-} at pH 9.5 and 100% of SeO_4^{2-} at pH 6.0. As pH increased, the selenium in solution increased, showing that absorption by CuO is reversible. Analyses of unspiked samples showed that CuO absorbed 97% of SeO_3^{2-} but only 80% of SeO_4^{2-}.

Results for spiked samples were similar, suggesting that Se(IV) concentrations are dominated by SeO_3^{2-} while Se(VI) concentrations consist of SeO_4^{2-} and metal SeO_4^{2-} solution species. Katta's group calculated the relative proportions of selenium species and their contribution to toxicity. Katta concludes that the CuO method followed by HGAAS is simple, effective, and able to extract SeO_3^{2-} and SeO_4^{2-} at levels as low as 7 micrograms/l from alkaline groundwaters.

RaPID Assay Kits from Ohmicron

The RPA-I System package from Ohmicron Environmental Diagnostics (375 Pheasant Run, Newtown, PA 18940; Tel: 800/544-8881, Fax: 215/860-5213) includes equipment and supplies for quantitative or qualitative testing of water samples with Ohmicron's series of RaPID Assay immunoassay test kits for 19 specific pesticides from alachlor to triclopyr and 6 toxic organics. The portable kits enable researchers to carry out low-cost herbicide analyses in the field and detect specific pesticides at very low concentrations.

The RaPID Assay kits are a form of enzyme-linked immunoabsorbent assay which feature the use of microscopic magnetic particles that bond covalently to antibodies. The magnetic particles keep antibodies from coating the surfaces of test tubes and plates so that they react much more quickly with target contaminants. The RPA-1 package includes a microprocessor-controlled spectrophotometer which delivers calculations of sample concentrations, printouts of assays, and quality control information. Pamela Greenwood of Ohmicron reports that lab and field studies confirm that RaPID Assay kits give results that correlate highly with gas spectrography/mass chromatography.

Single Molecules in Ultradilute Samples

The ability to detect single molecules in ultradilute environmental samples or in very small samples is a goal that sensitive new tests are closer to achieving. Michael D. Barnes, William B. Whitten, and J. Michael Ramsey (Oak Ridge National Lab, P.O. Box 2008, Oak Ridge, TN 37831-2008)