Biographical Sketch and Abstracts for 2010 AEESP Distinguished Lecturer

David Dzombak, Sr. Professor of Environmental Engineering

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Dave Dzombak is the Walter J. Blenko, Sr. Professor of Environmental Engineering in the Department of Civil and Environmental Engineering at Carnegie Mellon University. He is also Faculty Director of the Steinbrenner Institute for Environmental Education and Research.

Dr. Dzombak received his Ph.D. in Civil-Environmental Engineering from the Massachusetts Institute of Technology in 1986. He also holds an M.S. in Civil-Environmental Engineering (1981), a B.S. in Civil Engineering from Carnegie Mellon University (1980), and a B.A. in Mathematics from Saint Vincent College (1980). He is a registered Professional Engineer in Pennsylvania, a Diplomate of the American Academy of Environmental Engineers, a Fellow of the American Society of Civil Engineers, and a member of the National Academy of Engineering.

His reseach and professional interests include water chemistry, fate and transport of chemicals in surface and subsurface waters, wastewater treatment and reuse, contaminated soil and sediment remediation, abandoned mine drainage remediation, and public communication of environmental science. He has published numerous articles in leading environmental engineering and science journals; book chapters; articles for the popular press; and two books (*Surface Complexation Modeling: Hydrous Ferric Oxide*, Wiley-Interscience, 1990; *Cyanide in Water and Soil*, CRC/Taylor&Francis, 2006). He also has a wide range of consulting experience.

Dr. Dzombak's professional service has included the EPA Science Advisory Board (Environmental Engineering Committee, 2001-present); the EPA National Advisory Council for Environmental Policy and Technology, Environmental Technology Subcommittee (2004-2008); various National Research Council committees; Associate Editor of *Environmental Science & Technology* (2005-present); Editorial Board of *Water Environment Research* (1993-1998) and *Ground Water* (1991-1993); Board of Directors and Officer (Treasurer) of the Association of Environmental Engineering and Science Professors (1996-1999); chair of committees for the American Academy of Environmental Engineers, American Society of Civil Engineers, and Water Environment Federation; and advisory committees for Allegheny County and the Commonwealth of Pennsylvania.

The Need and Challenge of Alternative Sources of Water for Use in Electric Power Production

Increasing population and development in the U.S. will continue to increase demand for electric power in the years ahead. The U.S. Energy Information Administration projects a 1% average annual increase in electric energy consumption through 2035. Despite growth in renewable energy sources in the decades ahead, most of the electricity generating capacity in 2035 will still be from coal-fired and nuclear thermoelectric power plants.

In most thermoelectric power production, water is used for cooling. About half of the power plants in the U.S. employ once-through cooling, while recirculating systems with cooling towers are used for the rest. Thermoelectric power generation accounts for essentially as much freshwater withdrawal as agricultural irrigation in the U.S., with both at about 40% of total water withdrawal. Increasing demand for electric power will thus increase demand for water. Meeting this demand with freshwater will be very difficult in parts of the nation that already have limitations on available freshwater, in the western U.S. and other regions.

Waters of impaired quality can be used as alternative sources of makeup water for recirculating cooling systems in electric power plants. Some alternative sources include treated municipal wastewater, abandoned mine drainage, and industrial process wastewater.

This talk will provide an overview of the water-energy challenge facing the U.S., and will examine the need for and challenges of using alternatives to freshwater for power plant cooling. The availability of various alternative sources will be assessed, and regulatory and technical challenges governing the use of impaired waters for cooling in thermoelectric power generation will be examined.

Geologic Sequestration of CO_2: Evaluating and Monitoring Seal Rock Integrity

The leading technology under development for management of CO_2 separated and captured from large emission sources such as electric power plants is compression of the gas and storage in deep geologic formations. Only a few large scale tests have been conducted so far around the world. In the United States, the Department of Energy has established seven regional partnership programs for large-scale testing of CO_2 geologic sequestration. An important component of the testing will be evaluation of the rate of leakage from the storage reservoirs as this affects the success of carbon capture and geologic sequestration (CCS) technology for mitigating CO_2 emissions and related climate change. This talk will present an overview of CCS and the challenge of risk assessment in relation to deployment of the technology. Next, possible mechanisms for leakage from CO_2 storage reservoirs will be discussed, as well as performance objectives under consideration for storage reservoirs in terms of acceptable leakage. Results of collaborative research in which I have been engaged on seal rocks overlying saline reservoirs will then be presented. This work has involved study of the seal rocks overlying intended CO_2 storage reservoirs and of cements plugging abandoned wells that penetrate the seal rock at many candidate storage reservoirs. Available information on the physical and mineralogical characteristics of seal rocks in the regions of a number of candidate test sites will be discussed, including information on the lateral extent, thickness, porosity, and permeability of the seals. The types of possible interactions of supercritical CO_2-brine mixtures with common seal rock minerals and with well cements will be examined. Implications of results obtained in our studies and by others for assessment and monitoring of seal rock integrity in geologic sequestration of CO_2 will be discussed.