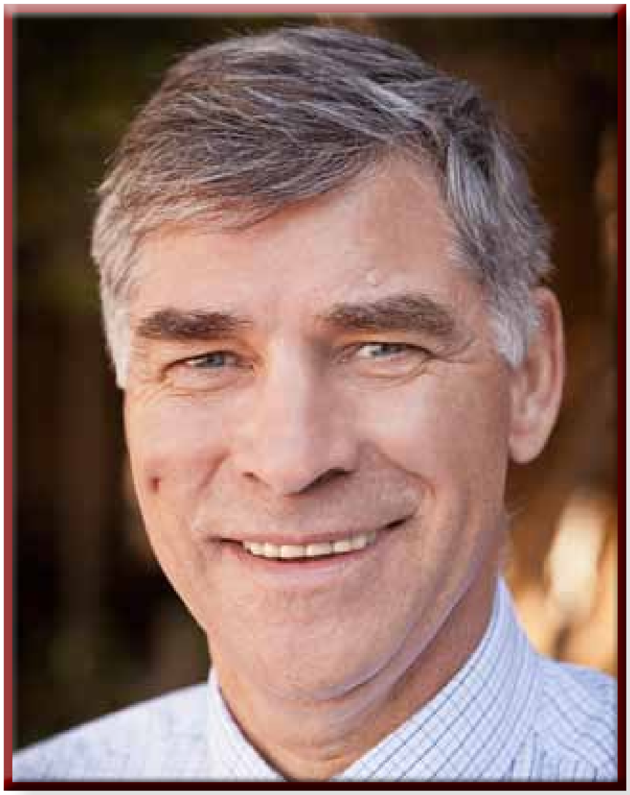
The Kappe Lecture Series

American Academy of Environmental Engineers & Scientists™

2014

Sharing the knowledge of today's practitioners with tomorrow's engineers.

The 2014 Kappe Lecturer



JB Neethling, Ph.D., P.E., BCEE

Technical Director for Wastewater
HDR Engineering, Inc.
Folsom, California

Education

- Hons-B. Eng., Civil Engineering (Cum Laude), University of Stellenbosch, South Africa, 1977
- M.S., Sanitary Engineering, University of California, Berkeley, 1980
- Ph.D., Sanitary Engineering, University of California, Berkeley, 1983

Professional Associations

- American Academy of Environmental Engineers and Scientists
- Association of Environmental Engineering and Science Professors
- Water Environment Federation
- International Association on Water Quality
- Professional Engineer, California and Nevada

Dr. Neethling is a Senior Vice President with HDR Engineering, Inc. As the Technical Director for Wastewater Treatment, he is responsible for evaluating technical solutions to environmental problems, drawing from his academic and research experience to find practical solutions for current challenges.

He started his engineering career in South Africa in 1978 at a time when nutrient removal from wastewater emerged as an important issue. His Ph.D. studies on control of filamentous bulking using chlorine led to an interest in solving operational problems at wastewater treatment plants. While teaching at UCLA, Dr. Neethling conducted research in anaerobic digestion, biological fluidized beds, and water quality for reuse. In his 24 years at HDR, he has engaged in a wide range of design and planning projects for both water and wastewater treatment facilities.

Dr. Neethling's primary focus has been on nutrient removal design and operations, having been involved in more than 75 biological nutrient removal (BNR) projects. He is currently the principal investigator for the WERF Nutrient Removal Challenge. This program engages researchers and collaborators across the globe to develop scientific information about the fate of nutrients (both nitrogen and phosphorus), their characteristics, treatability, and bioavailability in aquatic environments. The goal is to translate the research findings into practical solutions to protect water quality, allowing treatment facility operators to select sustainable, cost-effective methods, and technologies to meet permit limits.

Dr. Neethling has contributed to the *Manual of Practices* and served as associate editor for the American Society of Civil Engineers (ASCE) and Water Environment Federation (WEF), organized conferences for International Water Association (IWA) and WEF, and served on committees for several professional organizations. He has published technical papers in ASCE, WEF, and IWA journals, and presented at numerous state, national, and international conferences.

Dr. Neethling's lectures will provide valuable examples of converting fundamental engineering and scientific principles into practical large-scale solutions. Students will benefit from seeing research converted into full scale operating facilities.

Abstracts of Lectures Offered

Wastewater Process Development - from Theory to Practice

Each wastewater treatment challenge is unique because of permit requirements, wastewater characteristics, and the need to provide cost-effective, reliable solutions. While new technologies can provide unique approaches to meet treatment needs, the risk of implementing new approaches at full scale must be carefully weighed against the benefits of an emerging technology. Innovative solutions and creative thinking can push the envelope and provide economical solutions to practical problems.

This lecture presents examples of taking theory and research findings to identify practical, innovative solutions to practical problems. The risk associated with novel solutions must be assessed and may require pilot- or full-scale testing to control the risk exposure. The following case studies are presented:

- In 1990, the Clean Water Services' wastewater treatment plant in Tigard, Ore., faced the most restrictive phosphorus limit in the nation – 70 µg/L. The solution emerged following a classic approach – literature search, pilot studies to demonstrate the process, and full-scale evaluation. While meeting the original limits, it took another 10 years to optimize the process through improved biological phosphorus removal, developing a patented unified fermenter and thickening process, nutrient recovery, and other enhancements.
- Healdsburg, Calif., implemented an emerging technology for solids minimization. The risk of applying the technology in a new situation was mitigated with requiring contractual agreements to limit the financial exposure and provide a backstop to the implementation.
- Coeur d'Alene, Idaho, is facing a very restrictive phosphorus limit. Pilot tests were conducted to test the new understanding if surface complexation of metal hydroxides to reduce phosphorus to 36 µg TP/L. The tests proved the theory. In addition, the surprising discovery was made that the process can also remove ammonia, thereby eliminating the need for additional ammonia removal processes.
- Orange County (Ca.) Sanitation District produces water for reclamation. The existing biochemical oxygen demand (BOD) removal plant was converted to nitrification and denitrification within the same tankage while improving process stability. The special conditions at this location (warm water, flexible effluent goals) allowed a very aggressive design. The full-scale testing that followed showed deviations from the initial process analysis.
- The City of Bozeman, Mont., needed interim improvements to reduce nitrogen in its effluent. Based on principles to sequentially or simultaneously nitrify and denitrify, this plant implemented phased nitrification and denitrification with new aeration controls and meet the nitrogen limits. The process was further optimized based on the theoretical trends during follow-up testing.
- Other new emerging technologies.

Applying emerging and novel approaches to solve wastewater treatment challenges allows for economical solutions but does generate some risk of failure. These risks must be mitigated. Full-scale follow-up testing provides opportunities for correcting and improving the performance. Achieving a successful outcomes requires collaboration among the designer, operator, and owner of the wastewater facility.

Recalcitrant Nutrient Species Challenge Ability to Meet Low Nutrient Targets Reliably

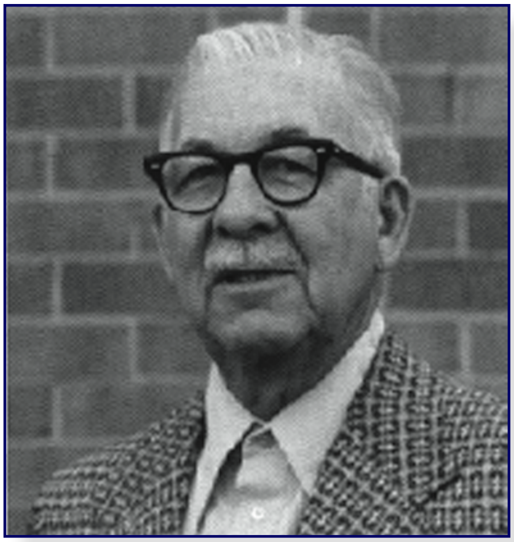
In-stream nutrient water quality criteria set by the United States Environmental Protection Agency (EPA) requires very low total nitrogen (TN) and total phosphorus (TP) concentration in all water bodies. Because the background nutrient concentrations in many streams, rivers, lakes, and estuaries already exceed the nutrient criteria, there is no option for dilution credits for treatment plant effluent, and the nutrient criteria are translated into very low permit limits – TN limits below 1 mg/L and TP below 10 µg/L. Meeting these low limits reliably and economically poses new challenges to technology capabilities, planners, designers, and operators.

The understanding of biological and chemical process fundamentals for nitrogen and phosphorus removal has increased dramatically since the 1970s. Because readily degradable organic compounds – in particular volatile fatty acids – are required for enhanced biological phosphorus removal, fermentation can be used in treatment processes. Metal hydroxide chemistry and surface complexation lead to ways to reduce chemical usage for tertiary phosphorus removal. Alternative carbon sources are available for denitrification. These findings provide the theory that can be implemented to improve nutrient removal efficiency and reliability while reducing treatment costs.

The performance and reliability of nutrient removal treatment plants can be determined by considering the fate of individual nitrogen and phosphorus species during conventional and advanced treatment processes. Inorganic species are efficiently removed, but the recalcitrant species limits the ability to meet the restrictive water quality limits. Data from benchmark full-scale nutrient removal facilities, along with data from special nutrient species characterizations, are used to identify the limits of technology and the reliability of attaining these limits.

This lecture presents the fundamentals of nutrient removal and its application to attain reliable nutrient removal. The topics covered include:

- Nutrient removal principles and factors affecting performance and reliability
- Nutrient species and their role in treatment technologies
- Environmental water quality impacts of different nutrient species
- Sustainability impacts of increasingly lower nutrient removal requirements
- Strategies to improve performance and reliability



"A man's debt to his profession is to help those that follow."

STANLEY E. KAPPE, P.E., DEE, a successful environmental engineer, believed he owed a debt to the profession that rewarded him so well. During his life, he gave of himself to his university and to his profession through countless hours of volunteer activity. And, through this Lecture Series, he continues to share his good fortune with tomorrow's environmental engineers.

He graduated from Pennsylvania State University in 1930 with a bachelor's degree in sanitary engineering. He served with the Pennsylvania State Health Department and the U.S. Army Corps of Engineers before joining the Chicago Pump Company as its Eastern Regional Manager in 1935. In 1945, he founded Kappe Associates, Inc., a water supply and wastewater equipment company headquartered in Rockville, Maryland, and continued as its Chief Executive Officer until his death in 1986.

His peers recognized his contributions to the profession by numerous awards, including the AWWA Fuller Award, the WPCF Arthur Sidney Bedell Award, the WPCAP Ted Moses and Ted Haseltine Awards, and the AAEE Gordon Maskew Fair Award. In 1985, Pennsylvania State University named him Outstanding Engineer Alumnus.

Stanley E. Kappe was an activist member and leader in several national and Chesapeake region professional societies. He served as the Executive Director of the American Academy of Environmental Engineers from 1971 to 1981.

AMERICAN ACADEMY OF ENVIRONMENTAL ENGINEERS & SCIENTISTS™

SPONSORED BY

Air & Waste Management Association
American Institute of Chemical Engineers
American Public Health Association
American Public Works Association
American Society for Engineering Education
American Society of Civil Engineers
American Society of Mechanical Engineers
American Water Works Association
Association of Environmental Engineering and Science Professors
National Society of Professional Engineers
Solid Waste Association of North America
Water Environment Federation

147 Old Solomons Island Road, Suite 303, Annapolis, MD 21401 • (410) 266-3311

FAX: (410) 266-7653 • E-MAIL: info@aaees.org • WEBSITE: http://www.aaees.org