The Kappe Lecture Series

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2018

The 2018 Kappe Lecturer

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Education

- B.S., Environmental Engineering, Illinois Institute of Technology, 1978
- M.S., Environmental Engineering, University of Washington, 1982
- Ph.D., Environmental Engineering, University of Washington, 1985

Professional Associations

- American Academy of Environmental Engineers and Scientists (AAEES)
- American Association of Environmental Engineering and Science Professors (AEESP)
- Air and Waste Management Association (A&WMA)

Mark J. Rood is the Ivan Racheff Professor of Environmental Engineering, at University of Illinois at Urbana-Champaign (UIUC), Illinois. Mark has over 35 years of research experience pertaining to gas separation and aerosol characterization.

He studied at Illinois Institute of Technology, Chicago, University of Washington, Seattle, and Stockholm University, Sweden prior to becoming a professor at UIUC.

Mark has published at least 130 peer-reviewed journal papers, co-authored one ASTM method, and six patents pertaining to gas separation techniques and ambient plume characterization. Mark is co-chief editor for *Environmental Technology & Innovation*, member of the Advisory Board for *Particuology*, was chief editor for ASCE's *Journal of Environmental Engineering*, and was an associate editor for *Journal of the Air and Waste Management Association*.

He is a Board Certified Environmental Engineering Member with American Academy of Environmental Engineers and Scientists. He is a Fellow and was a director for the Association of Environmental Engineering and Science Professors and Air and Waste Management Association.

Abstracts of Lectures Offered

Gas Separation with Activated Carbon Fiber Cloth for Reuse or More Effective Disposal of Organic Compounds

Development and evaluation of an activated carbon fiber cloth (ACFC) adsorption system using either electothermal swing adsorption (ESA) and microwave swing adsorption (MSA) will be described to selectively separate organic compounds from gas streams with bench-scale laboratory, pilot-scale field, and full-scale field tests. This research is important to reduce emissions of organic compounds to the atmosphere because they can adversely affect human health and contribute to the formation of secondary air pollutants. This research began by evaluating ACFC to adsorb environmentally relevant compounds at environmentally relevant concentrations. Consideration of multiple component adsorption for organic compounds and water vapor or other organic compounds then occurred to make results more relevant. Tests became more complicated to evaluate continuous treatment of laboratory generated gas streams while evaluating ESA and MSA. Extension of this research to organic gases with lower boiling points required treatment with cryogenic cooling and or compression for recovery and potential reuse. Experimental and modeled results from energy and material balances were used to evaluate these experimental and modeled results.

ESA was then improved to allow for in-vessel condensation of the organic compounds and eliminate cryogenic condensation to make the system more economically competitive. ESA was then evaluated for three different activated carbon morphologies (i.e., fibers, monolith, and beads) to better assess the appropriate morphology for activated carbons for an ESA system.

Our research group then modified the ACFC-ESA/MSA systems to allow for concomitant adsorption and regeneration to pretreat gas streams allowing for stable organic gas concentrations as inlet gas streams at appropriate concentrations for thermal oxidation or biofiltration. A life cycle assessment comparing ACFC-ESA, granular activated carbon-steam and regeneration, and thermal oxidation systems to better understand future research directions will also be discussed.

We have since successfully developed a technique to control ESA while using measurement of ACFC's electrical resistance without using temperature and hydrocarbon sensors. Such improvements simplifies the system and reduces cost.

Challenges to complete full-scale field tests will be discussed. Also challenges to publish high-quality peer-reviewed manuscripts, graduating students, and intellectual property while obtaining funding from National Science Foundation, Department of Defense, USEPA and the private sector to achieve these accomplishments will also be discussed.

Optical Remote Sensing of Particulate Matter to Quantify Plume Opacity and Mass Emission Factors

Development and field evaluation of optical remote sensing (ORS) techniques to quantify: 1) atmospheric plume opacity generated by point and fugitive sources and 2) particulate matter (PM) mass emission factors (EFs) from fugitive sources will be discussed. The abilities of these techniques to quantify the emissions of primary PM into the atmosphere are important because PM adversely affects human health and contributes to climate forcing.

"Visual Determination of the Opacity of Emissions for Stationary Sources" (Method 9) is a USEPA Reference Method to quantify plume opacity. However, Method 9 relies on observations from humans, which introduces subjectivity and is expensive due to certification requirements. The "Digital Optical Method (DOM)," was developed using digital still cameras and software as an alternative to human observations, reduce costs, provide archival records, and provide more objective measurements. DOM and its field evaluations will be described to evaluate DOM's performance. International ASTM developed D7520 Method based on field testing of the digital still cameras to determine plume opacity and such approval assisted USEPA to develop and approve USEPA ALT-82 allowing for the use of digital still cameras as an Alternative to using human observations.

The development and implementation of another ORS method using vertical-scanning **LI**ght **D**etection **A**nd **R**anging (LIDAR) and ancillary measurements will also be discussed. This method quantifies mass EFs for fugitive PM. In-situ range-resolved extinction coefficients measured by LIDAR and concurrent point measurements of PM mass concentrations were used to quantify two-dimensional PM mass concentration profiles of these fugitive plumes. Integration of these profiles with wind data, event duration, and source type provided fugitive PM EFs. Results quantifying EFs from vehicles travelling on unpaved roads, helicopters, open burning, and open detonation will be described and compared to other results. Field evaluation of this method demonstrates that it is well suited to improve quantification of PM EFs from fugitive sources when compared to similar emissions that were measured in controlled laboratory enclosures.

ORS has been used on a more limited basis compared to point measurements in the field of air quality to measure emissions to the atmosphere. Both techniques have their strengths and weaknesses. ORS has potential to more broadly impact not only air quality but also the field of Environmental Engineering.

"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 and scientists.

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 WEF Arthur Sidney Bedell Award, the WPCAP Ted Moses and Ted Haseltine Awards, and the AAEES 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 (now the American Academy of Environmental Engineers and Scientists) from 1971 to 1981.

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