

ENVIRONMENTAL ENGINEER

VOLUME 44 NUMBER 1 — WINTER 2008

13

The Class of 2007

27

**A MULTI-PLANT STUDY TO
UNDERSTAND THE CHEMICALS AND
PROCESS PARAMETERS ASSOCIATED
WITH BIOSOLIDS ODORS**

Volume 5, Winter 2008

**Environmental Engineer:
Applied Research and Practice**

A MULTI-PLANT STUDY TO UNDERSTAND THE CHEMICALS AND
PROCESS PARAMETERS ASSOCIATED WITH BIOSOLIDS ODORS
Matthew J. Higgins, Yen-Chih Chen, John Novak, Dietmar Glindemann, Robert Forbes,
Zeynep Erki, Jay Witherspoon, David McEwen, Sudhir Murthy, J. Ronald Hargreaves and
Gregory Adams

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ENVIRONMENTAL ENGINEER



13 FEATURE:

CLASS OF 2007

Compiled by J. Sammi Olmo

25

ENVIRONMENTAL ENGINEER: APPLIED RESEARCH AND PRACTICE

AAEE's professional journal.

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Murthy, J. Ronald Hargreaves and Gregory Adams 27



AUDITING RECERTIFICATION REQUIREMENTS

8

DAN OKUN: 1917-2007

11

2009 OFFICER NOMINEES

12

2008 KAPPE LECTURER:
JEANETTE A. BROWN

20

TOP EMPLOYERS OF 2007

22

PRESIDENT'S PAGE	4
ACADEMY NEWS	5
EXECUTIVE DIRECTOR'S PAGE	6
MEMBER NEWS.....	7
PROFESSIONAL SERVICES	23

BY WILLIAM P. DEE, PE., BCEE

AAEE AND THE FUTURE

Regardless of your feelings about global warming and the science behind these discussions, the fact remains that important changes are occurring in our world.

IT IS AN AMAZING WORLD WE LIVE IN THESE DAYS. The demands on engineering in general, and environmental engineering specifically, are increasing constantly. The world environment is in trouble and it will take the concerted efforts of our greatest minds to find our path to sustainability. This is the dawn of a new era for our profession, and for the Academy. In order to take advantage of this opportunity, we spent a good portion of the last two years working on a new Strategic Plan for AAEE. This document was developed to chart the future of the Academy, map our path for creating a more vibrant organization, and outline strategies that will better position the Academy as a leader in addressing global environmental issues.

AAEE was founded more than 50 years ago to help differentiate true environmental professionals from the many who claimed the title of environmental engineer. Clients who use our services, regulators who develop policy and guidelines by which the effectiveness of our solutions are judged, and even our colleagues in other engineering fields, needed to appreciate the special skills and talents required to address our pressing environmental problems. While the challenges we address have evolved and grown more complex over the last half century, our


charge has not changed. As stated in our mission, the AAEE is dedicated to excellence in the practice of environmental engineering to ensure the public health, safety, and welfare to enable humankind to co-exist in harmony with nature. Never has achieving this mission been more critical.

Regardless of your feelings about global warming and the science behind these discussions, the fact remains that important changes are occurring in our world. The world is becoming smaller and environmental "cause and effect" is not constrained by geographical bounds. My belief is that the future will be determined by policy, technology and engineering centered around our water and energy resources. Water, in the natural and built environment, will be viewed with the same fervor as the current emphasis on oil in the world geopolitical economy.

As Board Certified Environmental Engineers and Members, those in the Academy are recognized as environmental leaders with the knowledge and skills to be in the forefront of the dialogue and debate surrounding these issues, and in the development of solutions.

Our unique perspective already revolves naturally around sustainability as we strive to produce and develop safe, reliable sources of drinking water; develop effective waste treatment and

disposal approaches; and protect the air and land which are essential for our existence.

As we approach this challenging future of change and opportunity, we need to continue to reinforce the role of the Academy and its members in environmental leadership. Our Strategic Plan has targeted significant growth in membership here in the US and also internationally. We need to inspire young students to be enthusiastic about careers in engineering, and the rewards of entering the environmental engineering profession. The younger workforce generations are looking for ways to have an impact on the world in a very beneficial and meaningful way. What better path is there to accomplish that dream than to be involved with identifying and solving some of the most significant environmental challenges in the world... and what better manner to be recognized for these accomplishments than to become a Board Certified Environmental Engineer or Member of the American Academy of Environmental Engineers. This is truly an exciting time to be involved with the Academy and I look forward to working with all of you to move us toward the vision of becoming acknowledged leaders in improving practice, evaluating standards, and advancing the cause of environmental engineering and science. 

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2008 EXCELLENCE IN ENVIRONMENTAL ENGINEERING COMPETITION

Twenty-six entries were received for the 2008 Excellence in Environmental Engineering Competition. Entries were submitted in the following categories:

Research - 3
Planning - 6
Design - 10
Operations/Management - 3
University Research - 1
Small Projects - 3

This was the second year that the submittal process was done completely electronically. Feedback on the new submittal process has been overwhelmingly positive. Entrants have noted that it has proven to be less time consuming and less expensive. Winners will be announced at the AAEE Awards Luncheon.

THE AAEE AWARDS LUNCHEON

The Academy's award luncheon will be held Wednesday, April 30, 2008, at the National Press Club in Washington, D.C. In addition to the announcement of the 2008 Excellence in Environmental Engineering Competition winners, the Academy will honor four distinguished environmental engineers:

R. Tim Haug, Ph.D., P.E., BCEE
Gordon Maskew Fair Award

Brian P. Flynn, P.E., BCEE
Stanley E. Kappe Award

Jeanette A. Brown, P.E., BCEE
Edward J. Cleary Award

A. Sekarajasekaran, KMN, DIC, FIEM, MICE, MASCE, MIWES, PEng, CEng, MACEM
Honorary Board Certified Environmental Engineer

Tickets for the Luncheon are \$60 and can now be ordered from Academy Headquarters. All members are encouraged to attend.

THE AAEE CAREER CENTER

The AAEE Career Center was launched in September 2006 and continues to grow. At press time, the AAEE Career Center had more than 100 registered employers and 76 searchable resumes. Due to its continued expansion, the AAEE Career Center will be implementing additional services. The AAEE Career Center is located at <http://careers.aaee.net>.

ENVIRONMENTAL ENGINEER: APPLIED RESEARCH AND PRACTICE

The *Environmental Engineer* continues to receive positive feedback on the journal section, *Applied Research and Practice*. If you have a journal that you are interested in having published in our publication, you may submit them to C. Robert Baillod, Ph.D., P.E., BCEE (baillod@mtu.edu). Submittal guidelines are detailed on page 26.



BY LAWRENCE C. PENCAK

YEAR OF THE UPGRADE

Their very generous support will move the Academy forward to the benefit of all members. We all owe them our thanks and appreciation.


THE OFTEN SEEN ROAD CONSTRUCTION SIGN, A TEMPORARY INCONVENIENCE FOR A PERMANENT IMPROVEMENT. Thank You for Your Patience, will be applicable this year to the Academy office. The office server, other hardware peripherals, operating software, and software programs will be replaced and upgraded. The present server dates to 1997 and has limited capacity and speed. In preparation for the improvements, the office network was entirely re-wired with new high-speed cable in January.

Members have often been frustrated when they have requested data, statistics, and information only to hear from the office that, "We are unable to do that." Member frustration is eclipsed by the AAEE staff's frustration when they are not able to quickly or adequately respond to your request or need. We are all looking forward with anticipation to the upgrades.

The upgrades will by year's end allow you entirely online to renew your membership, access and update your member information file, pay dues and make purchases, and increase your ease of access to AAEE services and information. During the past year the Academy has opened an online Career Center, added the ability to e-blast members with

notices and information, and electronically submit entries to the Excellence in Environmental Engineering Competition. These services are currently maintained by outside vendors. While some old and new electronic services will still be outsourced, many will now be maintained in-house for easier access and better coordination.

These upgrades and improvements are made possible by the Academy members who have contributed to Campaign 4000 during 2006 and 2007. Their very generous support will move the Academy forward to the benefit of all members. We all owe them our thanks and appreciation.

However, just as with the anticipation of those much needed road improvements, there is also accompanying inconvenience... lane and road closures, and night work crews still working during the morning rush hour. The office upgrade process will be no different, and we sincerely thank you in advance for your patience and support as we work to greatly improve our ability to serve you. 

WILLIAM DEE, P.E., BCEE, has joined the Board of Directors of the Water Environmental Research Foundation (WERF). Mr. Dee is currently President and CEO of Malcolm Pirnie, Inc. He has been certified in Water Supply and Wastewater Engineering since 1988 and is currently AAEE President.

TAPAS K. DAS, PH.D., P.E., BCEE, was recognized by the Indian Institute of Chemical Engineers as the DOST Professor S.K. Sharma Medal and CHEMCON Distinguished Speaker Award for 2007. Dr. Das is currently Project Engineer with Parametric. He has been certified in Air Pollution Control since 2002.

HERBERT I. HOLLANDER, P.E., BCEE, QEP, was presented with the ASME and IT3 Pioneer Award. Mr. Hollander is a Consultant with Hollander Associates. He is a Life Member and has been certified in Solid Waste Management since 1974.

ALAN H. PLUMMER, JR., P.E., BCEE, was inducted into the Academy of Distinguished Alumni in the Department of Civil, Architectural, and Environmental Engineering at the University of Texas at Austin. Mr. Plummer is the Chairman of the Board of Directors at Alan Plummer and Associates, Inc. He has been certified in Water Supply and Wastewater Engineering since 1995.

NIKOLAY S. VOUTCHKOV, P.E., BCEE, was selected by *Public Works Magazine* as 2007 Trendsetter. Mr. Voutchkov is currently Corporate Technical Director for Poseidon Resources. He has been certified in Water Supply and Wastewater Engineering since 1996.


IN MEMORIAM

GEORGE A. BRINSKO, P.E., BCEE, of Arizona has passed away. Mr. Brinsko was a Life Member. He had been certified in

Water Supply & Wastewater Engineering since 1975.

JAMES J. CORBALIS, JR., P.E., BCEE, of Virginia has passed away. Mr. Corbalis had served on numerous AAEE committees and served as President in 1984. He had been certified in Sanitary Engineering since 1958.

OTTO MILGRAM, P.E., BCEE, of New Jersey passed away in October 2007. He was a Life Member and had been certified in Water Supply and Wastewater Engineering since 1979.

DANIEL A. OKUN, SC.D., P.E., BCEE, of North Carolina passed away in December 2007. Dr. Okun had served the AAEE in many capacities, including as President in 1970. See page 11 for a profile on Dr. Okun. 

2008 APPLICATION CYCLE ENDS MARCH 31, 2008

Don't let your colleagues miss their chance to be part of the Academy's next class to become a **Board Certified Environmental Engineer or Board Certified Environmental Engineering Member**.

Encourage them to apply for Specialty Certification, showing the rest of the world that they are among the **Best of the Best**.

Completed applications must be submitted to the Academy offices no later than March 31, 2008. Call Academy Headquarters at 410-266-3311 for an application package.

*Looking for a qualified employee?
Seeking a position?*

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AAEE launched its AAEE Career Center in September 2006. There is no charge for job seekers to post their resume, and recruiters can post available positions for a fee of \$250/position for a 30-day listing. Check our website at <http://careers.aace.net> for more details.



REPRINT FROM JANUARY 2004

AUDITING RECERTIFICATION REQUIREMENTS

By Alan H. Vicory, Jr., P.E., BCEE and William C. Anderson, P.E., BCEE

BACKGROUND

Mandatory continuing professional development as a condition of certification became effective in 1999. This requirement was enacted by the Academy's Board of Trustees in 1995 to comply with the requirements of the Council of Engineering Specialty Boards (CESB) and thereby maintain accreditation of the Academy's certification program. However, CESB requirements notwithstanding, this requirement is instrumental to maintaining the credibility of Academy certification in the eyes of the public and peer organizations. Except for engineers, most license and certification programs mandate continuing professional development or periodic reexamination as a condition for maintaining their credential. It is the credibility of the Academy's certification, as perceived by others (other than Diplomates), that motivated the Academy's Board of Trustees to enact this requirement.

The Academy's continuing professional development program requires all Diplomates to accumulate a minimum of 40 Professional Development Hours (PDHs) in the two calendar years preceding the year of recertification. PDHs can be obtained in a variety of ways, including service on technical and professional association committees, attendance at technical conferences, seminars and workshops, teaching or receiving instruction in an educational institution, preparation of a professional/technical paper, or even by reading technical journals. Credit is also provided for ongoing employment that directly involves environmental engineering.

Each Diplomate certifies, as part of the application for recertification, that he or she has fulfilled the continuing professional development requirements. Diplomates are not required to submit any proof that they have obtained the necessary PDHs as part of the recertification process.

THE NEED FOR AUDITS

Given that Diplomates self-certify their compliance with the continuing professional development requirements, the Academy must have some means of verifying these claims. Auditing a randomly selected sample has been accepted by CESB as an acceptable means of ensuring compliance. It is noted that most engineering licensing programs that now require continuing professional development employ the same procedure.

The Academy randomly selects 2% of its Diplomates (about 50) each year to audit for continuing professional development compliance. Those selected for auditing who satisfactorily complete the audit are exempted from future audits for ten years following the audit, e.g., a person who satisfactorily completed the audit in 2000 will not be included in the group of Diplomates from which the random sample is selected until 2011.

The audit process determines compliance by having those audited providing a listing of the continuing professional development activities they have completed in the two-year period being audited and documentation to prove those claims. The types of proof accepted vary according to the PDHs claimed. For example, for a published paper – a copy of the paper from the publication or for attendance at conferences – a copy of the individual's expense account request. If the instructions provided with the audit are not sufficiently clear, the person audited can contact the Recertification Committee chair or Academy staff for additional assistance.

The audit is conducted by the Academy's Recertification Committee, comprised of six Diplomates, with the assistance of one of the Academy's administrative assistants operating under the supervision of the Academy's Executive Director. The decision by the Recertification Committee is final; there is no appeal. The typical annual audit schedule follows:

- **May** – Diplomates to be audited are randomly selected
- **June** – Auditees are informed by letter of their selection with a request for a description of the PDHs obtained during the prior two-year period and related documentation
- **July to September** – Submitted information is reviewed by the Recertification Committee
- **August to December** – Auditees are notified of their compliance, other decision by the Committee, or requested to provide additional information

During the Recertification Committee's review, the Committee Chair or the Administrative Assistant may contact the people being audited to obtain additional clarification. The Committee's goal is to ensure that the audit is properly performed even where the information initially provided is unclear. It does not revoke a Diplomate's certification unless such action is definitely warranted.

AUDITING EXPERIENCE

Generally, the results of the auditing process have been positive. 8 of 10 Diplomates audited in 2001 and 2002 were responsive to the request for submittal of a PDH report and supporting documentation, with over



Auditing a randomly selected sample has been accepted by CESB as an acceptable means of ensuring compliance.

90% confirmed as having achieved compliance with minimum requirements.

In several instances, auditees have affirmatively refused to respond or have indicated they have not achieved minimum requirements. In these cases, certification has been relinquished or changed to Inactive status. In addition, in an appreciable number of cases, the initially submitted information has been judged by the Recertification Committee to be either inappropriate

or inadequate, requiring a dialogue with the Diplomate to obtain proper documentation. The experience to date with the program seems to indicate that most Diplomates do pursue continuing professional development. That is not surprising, given the type of individual who voluntarily undergoes the Academy's rigorous process to obtain specialty certification. Those whose certification has been placed in Inactive status or who have relinquished their certification, voluntarily or involuntarily, as a result of the audit, demonstrate the Academy's commitment to maintain the integrity of its certification.

Experience also indicates that the Academy has work to do to better educate Diplomates on its continuing professional development requirements and the reporting/audit process. While the audit program is effective, we have found that many of the initial submittals are inadequate because they are not appropriate and/or lacking in complete documentation. It is important to note that the Committee is looking for minimum documentation regarding each continuing professional development activity, that is, when it occurred and independent testimonial records that the Diplomate participated.

HELPFUL HINTS

The most important recommendation is for all Diplomates to be aware of the



Academy's requirement for obtaining continuing professional development and to understand they must supply documentation to demonstrate compliance if requested. In so doing, there will be less tendency to skip a readily-available opportunity to attend a local seminar or other professional/technical continuing education opportunity. Given the wide range of types of continuing professional development activities accepted by the Academy, opportunities are sufficiently abundant for most Diplomates. However, there are circumstances requiring special consideration, such as where Diplomates work in remote areas with limited or no practically-available continuing professional development opportunities. In such cases, the Recertification Committee works with the Diplomate to develop a mutually acceptable accommodation.

Secondly, Diplomates should create and maintain a file for their continuing professional development activities. In this file the Diplomate should maintain a list of their continuing professional development activities and copies of appropriate

The Academy randomly selects 2% of its Diplomates (about 50) each year to audit for continuing professional development compliance.

documentation that demonstrates their involvement in each continuing professional development activity as the activities occur. The Academy's website contains copies of the necessary forms and guidance documents that can be downloaded and used for maintaining these records. For those who also have engineering licenses in states that require continuing professional development, this file will also assist in supplying such information to the state(s). Then, if the Diplomate is selected for audit, the necessary documentation is readily at hand. As audits are conducted only for the prior two-year periods, the file only need maintain records for the most recent past two years.

ABOUT THE AUTHORS

Alan H. Vicory, Jr., P.E., DEE is past-chair of the Recertification Committee and an Academy Past President Academy.

William C. Anderson, P.E., DEE served as the Academy's Executive Director from 1985 to 2003.





DAN OKUN

1917 TO 2007

Daniel A. Okun, Sc.D., P.E., BCEE, the world renowned Kenan Professor of Environmental Engineering at the University of North Carolina at Chapel Hill, passed away on December 10, 2007. He was 90.

The Winter 1987 (Volume 22, Number 4) edition of this magazine dubbed Dr. Okun “The Missionary” due to his active role in spreading the word about environmental engineering, and particularly regarding protection of drinking water resources, appropriate technology in developing countries, water reuse, and wastewater treatment.

Dr. Okun became certified with AAEE in 1956 in Sanitary Engineering and continued to be a dedicated supporter of the association. In addition to being a contributing writer to *Environmental Engineer*, he served as AAEE President in 1969-1970 and as the 1995 Kappe Lecturer.

He was also a member of American Public Works Association, American Society of Civil Engineers, American Water Works Association, Association of Environmental Engineering and Science Professors, and Water Environment Federation.

Dr. Okun was the first engineer from North Carolina to be elected into the National Academy of Engineering. Among his many other honors and recognitions, he has received the Eddy Medal from the Water Environment Federation, the Allen Award from the New York Water Pollution Control Association, The Fuller Award from the American Water Works Association, the Freese Environmental Engineering Award from the American Society of Civil Engineers, the Billard Award for Research from the New York Academy of Sciences as

well as lifetime achievement awards from the Orange Water and Sewer Authority (Orange County, NC), the Environmental and Water Resources Institute and the International Water Association. Of special significance to Dr. Okun were the Gordon Maskew Fair Award from the AAEE and the Gordon Maskew Fair Award Medal from the Water Environment Federation which are both named for his mentor.

The University of North Carolina, which served as Dr. Okun’s home base since 1952, honored him with their highest recognitions, including induction into the Order of the Golden Fleece and the Thomas Jefferson Award.

Through his knowledge and contributions, Dr. Okun has left a positive legacy within both the Academy and the environmental engineering profession. ▣

2009 Officer Nominees

Full profiles and voting ballots will be available in the Spring issue of *Environmental Engineer*.

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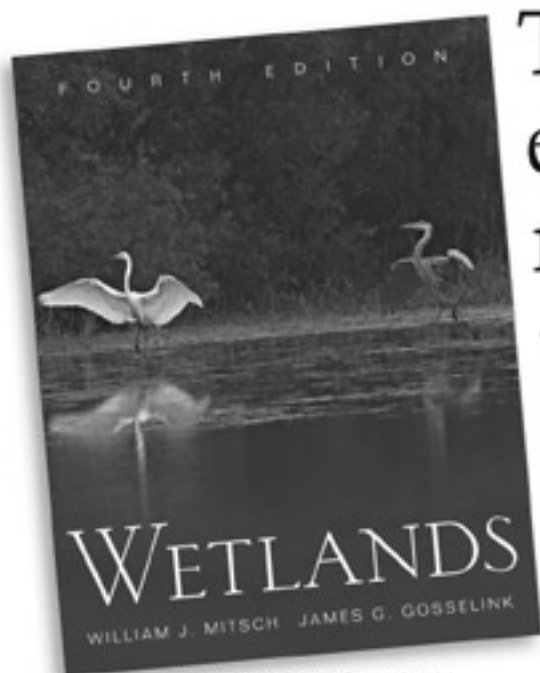
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The Class of 2007

THESE INDIVIDUALS were Board Certified in November 2007.

From the first applicants in 1956 to the 116 Board Certified Environmental Engineers and Board Certified Environmental Engineering Members listed on the following pages, the Academy has undergone growth and changes, but has never wavered from its core objective to “identify and credential persons with special capabilities in environmental engineering.”

Today, there are over 2,400 Board Certified Environmental Engineers and Board Certified Environmental Engineering Members in the Academy and interest continues to grow on an annual basis.

A brief description of the specialty certification process follows: To be included in an annual class, the application for specialty certification must be submitted to the Academy by March 31. Any application received after that date is held over to the next class. The applications received by March 31 are then reviewed by the Admissions Committee for adequacy of education and qualifying experience in April and May. Examinations are administered to the qualified applicants during July and August at convenient locations throughout the country. The examination results are reviewed by the Admissions Committee in September and recommendations for each candidate are presented to the Board of Trustees. Each person's history is reviewed by the Board members at the Academy's Annual Meeting and decisions made to certify or not.

THE ACADEMY announces the issuance of specialty certificates and Board Certified Environmental Engineers and Board Certified Environmental Engineering Members status to those individuals portrayed in this special section of the *Environmental Engineer*®. These persons have demonstrated to their peers that they possess the requisite formal education and environmental engineering practical experience and have successfully completed the Academy's examinations to be board-certified environmental engineering specialists. The special capability of each person is shown after their name using the following codes:

AP	Air Pollution Control,	HW	Hazardous Waste Management,	SW	Solid Waste Management,
GE	General Environmental	IH	Industrial Hygiene,	WW	Water Supply and Wastewater
	Engineering,	RP	Radiation Protection,		Engineering.

The Class of



Ernesto Marco Aieta, Ph.D., P.E., BCEE GE

Partner
Carollo Engineers
390 Interlocken Crescent
#800

Broomfield, CO 80021

Dr. Aieta received his Ph.D. in Environmental Engineering from Stanford University. He is a licensed P.E. in Colorado with more than 33 years experience.



Timothy D. Aultman, P.E., BCEE HW

Branch Manager
MDEQ
2380 Highway 80W
Jackson, MS 39204

Mr. Aultman received his B.S. in Mechanical Engineering from Mississippi State University and MS in Environmental Engineering from the University of Mississippi. He is a licensed P.E. in Mississippi with more than 14 years experience.



Charles B. Bott, Ph.D., P.E., BCEE WW

Research Assistant
Virginia Military Institute
619 Nichols
Engineering Hall
Lexington, VA 24450

Dr. Bott received his B.S. and Ph.D. degrees in Civil Engineering from VMI and M.S. in Environmental Engineering from Johns Hopkins University. He is a licensed P.E. in Virginia with more than 9 years experience.



Godofredo Canino-Rolon, P.E., BCEE WW

Pre-Construction Manager
CDM
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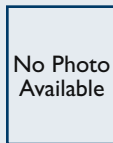
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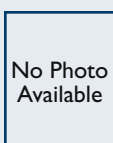
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**Edward L. Storrs, Jr.,
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THE 2008 KAPPE LECTURER

Jeanette A. Brown, P.E., BCEE

Executive Director, Stamford Water Pollution Control Authority



Jeanette Brown has worked as an environmental engineer for over 30 years. She is responsible for the operation of a 24 million gallon per day advance wastewater treatment plant, 25 pumping stations and 300 miles of sanitary sewer systems. In addition, she is responsible for the implementation and compliance of the Phase 1 Stormwater Permit for the City of Stamford and has been a leader in the nitrogen program for Long Island Sound and serves on the Nitrogen Credit Advisory Committee. She is also responsible for all capital projects associated with the wastewater treatment plant and collection system, including the recently complete \$105 million upgrade and expansion of the wastewater treatment plant. Her areas of expertise included biological nitrogen removal and biosolids management. In addition, she is an adjunct professor of Environmental Engineering at Manhattan College where she teaches wastewater treatment plant design. In March 2007, she had the opportunity to appear before the House Appropriations Subcommittee on Interior and Environment

to discuss the need for wastewater funding.

Jeanette has been involved in many research projects including developing operational modifications of existing activated sludge treatment plants to remove nitrogen with little or no capital investment and development of the "Stamford Baffle", which is used nationally and internationally to improve clarifier performance. Currently, she is Project Manager for a Department of Energy sponsored waste-to-energy research project and EPA sponsored river restoration project.

Jeanette is Past President of the American Academy of Environmental Engineers and is currently President of the Environmental and Water Resources Institute of the American Society of Civil Engineers. She is a member of the Water Environment Federation House of Delegates, has been nominated to the WEF Board of Trustees and is Chair of the ASCE National Water and Energy Policy Committee. In addition, she has been a principal contributing author on several WEF manuals of practice and has presented numerous papers at technical conferences in US and Europe.

EDUCATION

University of Maryland, BS

Manhattan College, MS

PROFESSIONAL CREDENTIALS

Registered Professional Engineer, Connecticut

Board Certified Environmental Engineer, AAEE

Fellow, American Society of Civil Engineers

PROFESSIONAL HONORS

Water Pollution Control Federation

Hatfield Award for outstanding contribution to the field of wastewater treatment

NEWPCA Operator of the Year, for excellence in operations

Governor's Environment 2000 Award for contributions to improving the water quality of Long Island Sound

Stamford Water Pollution Control Facility selected by EPA as the best large, advance wastewater treatment plant in the United States

ASCE State-of-Art award for Water Residuals manual

NEWEA Alfred E. Peloquin Award for significant contribution to the field 2000

Tau Chi Alpha, Environmental Engineering Honor Society

NEWEA Public Educators Award

Water Environment Federation Public Educators Award

EPA Region 1 Merit Award-Stamford WPCA

ABSTRACTS OF LECTURES OFFERED

LECTURE 1: NUTRIENT REMOVAL TO HELP RESTORE WATER QUALITY IN LONG ISLAND SOUND

During the early 1980's, the waters of Long Island Sound showed significant degradation, mostly in the form of low dissolved oxygen. This resulted in the death of lobsters and a decline in numbers and species of finfish in the southwestern portion of the Sound. Legislators in the States of New York and Connecticut supported monitoring and research programs and development of an action plan to preserve and protect the waters of Long Island Sound. Their support resulted in legislation and financial assistance from congress and the creation of the Comprehensive Conservation Management Plan (CCMP) which with the approval EPA, New York and Connecticut. The CCMP was an important document, which identified several problems associated with the degradation of water quality in Long Island Sound, including hypoxia, or low dissolved oxygen (DO), toxic contamination, pathogen contamination, floatable debris, habitat loss and its impact on living marine resources, and land use and development that degrades habitat and water quality. Of these problems, hypoxia was determined to be the most serious.

Hypoxia appears to be caused by large amounts of nitrogen discharged to Long Island Sound by wastewater treatment plants, surface runoff and atmospheric deposition. Nitrogen is typically the limiting nutrient for phytoplankton, a microscopic plant. When phytoplankton dies, it sinks to the bottom where the decaying phytoplankton use oxygen in the water column, thus reducing the dissolved oxygen in many cases to less than 2 mg/L. The CCMP concluded that the main objective for Long Island Sound corrective actions was to reduce the amount of nitrogen entering the Sound to increase the DO concentrations.

Located in the Western reach of Long Island Sound near New York City, the Stamford, CT, Water Pollution Control Authority (SWPCA) became pro-active in working to protect and improve the water

quality in the sound and was the first municipality in CT and the New York City metropolitan area to begin experimenting with nitrogen removal. In the early 1990's, SWPCA conducted a study funded by the U.S. Environmental Protection Agency (EPA) to demonstrate new nitrogen removal technology. This project was followed in the late 90's by plant improvements to further enhance nitrogen removal (50 to 60% nitrogen removal) and then a \$105 million upgrade and expansion of the treatment facility of which about \$50M was associated with nitrogen removal processes. Designed to achieve nitrogen removal on the order of 80 to 90% to levels of 4 mg/L Total nitrogen (TN) or less, the upgraded plant has been operating in the high level nitrogen removal mode since the spring of 2006.

This lecture will describe how SWPCA participated in the nitrogen reduction program on both a state and regional level and the various research and development projects and benefits. Furthermore, it will include a description of the upgrade and expansion project, complexities of funding and approval processes for the project, the Connecticut Nitrogen Credit Trading Program and current plant performance.



LECTURE 2: UNIQUE BIOSOLIDS MANAGEMENT PROGRAM

Stamford has a unique history in biosolids management. In the early 1970's until mid 1990's, Stamford dried waste solids using heat supplied from their refuse incinerator and then burned the dried sludge along with the refuse. This was a very economical process and the only drying system in the United States that used waste heat. In the 1990's, the City of Stamford decided to shut down the refuse incinerators because of the cost of upgrading to meet air emission standards. They choose to haul solid waste out of town where it was either landfilled or incinerated. The decision was a serious problem for the SWPCA which resulted in increased operating costs from about \$52 per dry ton to \$320 per

dry ton. Furthermore, it meant hauling dewatered sludge long distances to either a landfill or incinerator. From 1996 to 2005, the SWPCA tried to get approval to build a solids drying and pelletizing facility, however neither City officials nor Connecticut Department of Environmental Protection were willing to fund it. Since the drying process is a very sound environmental method of disposal, the SWPCA continued to pursue this option, but included the use of the dried pellets as a potential energy source rather than to be used on land.

Stamford is located in southwestern Connecticut which is the fastest growing area of Connecticut. Many corporations have chosen Stamford as the location for their corporate office. Increasing population has resulted in an increased need for housing and has placed demands on utilities. The power utility has been impacted the most and Stamford is in an electrical congestion area with residential, commercial and industrial users paying extremely high surcharges for electricity. Because of the demand and high cost of energy coupled with a concern about the dependence of the United States on foreign oil and non-renewable energy sources, the Stamford Water Pollution Control Authority (SWPCA) proposed a project to demonstrate that dried and pelletized wastewater residuals could be used as a renewable energy source to generate electrical power. This waste to energy project has received research and development funding from the Department of Energy and US EPA with the goal to determine the technology needed to convert pellets of dried wastewater residual into a renewable fuel and then design and construct that facility.

This lecture will describe the various aspects of biosolids management in Stamford including public acceptance, regulatory issues and permitting requirements. It will also describe the research and development program and project status. Furthermore, it will describe concepts of energy management districts and the positive impact on procuring funding and approval for electrical generation facilities. ▀

TOP EMPLOYERS

And Recruiters of Board Certified Environmental Engineers & Board Certified Environmental Engineering Members

in **2007**


OVER THE PAST YEAR, the Academy has seen a 3.4% growth in the number of new Board Certified Environmental Engineers and Board Certified Environmental Engineering Members. Last year, 101 men and women passed their exams and were certified by the Academy. The 2007 Class is profiled in this issue of *Environmental Engineer*®, on pages 13-29.

The vast majority of that new class came to us not on their own, but because they were encouraged to apply for specialty certification by someone else. In many cases, a Board Certified Environmental Engineer or Board Certified Environmental Engineering Member simply asked a qualified fellow environmental engineer, “have you considered becoming board certified?” In many other cases, an environmental engineer’s employer encouraged them to seek credentialing by the Academy.

In 1999, the Academy initiated the Professional Development Program (PDP) with environmental consulting firms to provide for the systemic professional development of environmental engineers from new graduates and extending through specialty certification and beyond. The PDP is customized by each participating firm according to its specific Human Resources needs and practices. As a part of this customization, the participating firms provide appropriate support and tangible incentives for program participants.

To date, eight firms have committed themselves as participants in the PDP. In 2002, the Academy further strengthened its recruiting efforts by kicking off the “More is Better” campaign. Together, these two efforts have gone a long way in rejuvenating interest in Academy membership and specialty certification.

Listed on this page are the Top Ten Employers of Board Certified Environmental Engineers and Board Certified Environmental Engineering Members in 2007 as well as the five organizations that recruited the most new Board Certified Environmental Engineers and Board Certified Environmental Engineering Members during the same period. The Academy would like to recognize and thank those employers for their continued support.

The Academy would also like to thank each and every member who has taken the time to recruit new Board Certified Environmental Engineers and Board Certified Environmental Engineering Members and continues to do so. Your efforts are greatly appreciated. Each new person that earns their specialty certification adds credibility to the BCEE and BCEEM designations by making it that much more recognizable as a distinguishing characteristic within the environmental engineering profession. 

Professional Development Program as of December 31, 2007

CDM
ERM – Environmental Resources Management
Hazen and Sawyer
HDR Engineering, Inc.
Malcolm Pirnie, Inc.
PBS&J
Stearns and Wheler
The Stover Group

Top 5 Recruiters

Organization	Number of New BCEEs & BCEEMs in 2007
CDM*	31
Mississippi DEQ	9
Malcolm Pirnie*	7
Stearns & Wheler*	7
LA Sanitation Districts	3
*denotes participating firm in PDP	

THE TOP TEN

Current Rank	Organization	Number of BCEEs/ BCEEMs	Rank in 2005	Current Rank	Organization	Number of BCEEs/ BCEEMs	Rank in 2005
1	CDM*	264	1	4	PBS&J	32	4
2	Malcolm Pirnie*	111	2	5 (tie)	Brown & Caldwell	30	8
3 (tie)	Mississippi DEQ	41	3	5 (tie)	LASan	30	0
3 (tie)	Stearns & Wheler, LLC*	41	5	6	MWH	28	5
3 (tie)	CH2M Hill	41	6	7	HDR	27	0

*denotes participating firm in PDP

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Instructions to Contributors

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A MULTI-PLANT STUDY TO UNDERSTAND THE CHEMICALS AND PROCESS PARAMETERS ASSOCIATED WITH BIOSOLIDS ODORS

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ABSTRACT

The main objectives of this research were to determine the compounds associated with odors during the digestion and handling of biosolids and understand the process operational factors which impact the production of these odor causing compounds. To accomplish these goals, a comprehensive sampling of 11 full-scale wastewater utilities with anaerobic digestion was performed in which samples were collected from most locations throughout the liquid and solids processing scheme. The samples were analyzed for a number of inorganic and organic constituents such as metal concentration, anions, pH, temperature, and the samples were placed in sealed headspace bottles for headspace analysis of possible odor causing compounds. The results indicated that biosolids odors after dewatering were generally much higher than odors produced from other sample locations in a plant. A direct correlation was found between the sulfur compound concentration, especially the volatile organic sulfur compounds, and the dilution thresholds measured by an odor panel, indicating that sulfur compounds were a main contributor to odors. The main sulfur compounds measured included hydrogen sulfide, methanethiol, dimethyl sulfide, and dimethyl disulfide. The odor descriptors most frequently cited by the odor panel were “offensive” “putrid” “chemical” and “garbage”. Few of the operational parameters were correlated with biosolids odorant production, such as influent wastewater characteristics, ratio of primary and secondary to digestion, and residual biosolids activity. Digester SRT was weakly, negatively correlated to the concentration

of VOSCs produced during storage and no correlation was found between the percent volatile solids reduction and VOSCs.

INTRODUCTION

Odors have been a long-standing concern for wastewater facilities. This includes odors emanating from the collection systems, wastewater treatment processes, solids treatment, and in the field with land application programs. Recently, odors in biosolids have become a greater issue for a number of utilities. For example, biosolids associated odors have been listed as a top area of concern according to recent surveys of wastewater utilities (Dixon and Field, 2004); however, research is limited related to the compounds associated with odors, the process factors that affect odors, and how treatment processes impacted odor production, especially during storage of biosolids.

The main odor causing compounds associated with biosolids are thought to include volatile organic sulfur compounds (VOSCs) mainly methanethiol (MT), dimethyl sulfide (DMS), and dimethyl disulfide, as well as inorganic sulfur compounds such as hydrogen sulfide, nitrogen based compounds such as trimethylamine (TMA), ammonia, indole, and skatole, and potentially volatile fatty acids. Many of these compounds have been found to be produced in similar odorous systems such as in collection systems, wastewaters, manures, anaerobic sediments and biosolids (WEF, 1995, Devai and DeLaune, 1999, Lomans et al., 1999, Rosenfeld et al., 2001). In addition, many of these compounds are detected at very low concentrations by the human

nose and can be considered offensive. Little research has been performed to determine the relationship between the different compounds produced by biosolids and odors, in other words to compare the odorous compounds and odors detection thresholds measured by odor panels. The lack of data related to odors is especially true for storage of biosolids since in many cases the biosolids are stored prior to land application. This research is needed to better identify the sources of odors to ultimately develop odor mitigation methods.

In addition, little research has been performed to examine how treatment plant process parameters such as activated sludge solids retention time (SRT), primary and secondary storage times, digestion SRT, and volatile solids destruction would impact the production of odorous compounds from biosolids. To address these research needs, the Water Environment Research Foundation (WERF) has funded a multi-phase project to better understand odors from biosolids as well as to develop management practices to minimize odors. The specific research objectives discussed in this paper include determining the:

1. different odorous compounds produced by biosolids and their relationship to odors;
2. effect of upstream parameters such as influent concentrations of different constituents, primary and secondary storage time, fraction of primary sludge added to the digestion, and activated sludge SRT on subsequent odor production;
3. effect of digestion parameters such as temperature, SRT, VS destruc-

tion, and residual biological activity, on odor production;

By achieving these objectives, the research will provide a better understanding of the causative agents of odors, how process parameters will impact odors, and ideally lead to strategies to reduce odors. The focus of the research was on utilities that employed anaerobic digestion and utilized centrifuge dewatering. This was done since the majority of solids in North America are digested anaerobically, and centrifuge dewatering processes had increased substantially in recent years and centrifuge cakes had been linked to greater odors (Murthy et al., 2002 and 2003).

METHODS AND MATERIALS

Overview

This study was based on an in-depth sampling and analysis of biosolids and headspace samples from 11 different wastewater treatment facilities across North America, all of them employing anaerobic digestion for biosolids stabilization, except one plant that utilized a lagoon for solids treatment. A comprehensive sampling of 11 different plants was performed in which nearly every location within the liquid and solids handling process was sampled, and these samples were analyzed for a number of different constituents. Although the process configuration varied from plant to plant, a general schematic of sampling locations is shown in Figure 1. The samples included influent to the liquid side (A) through the cake sample (G). The samples were collected, placed in appropriate sampling containers, and shipped to the Environmental Engineering Laboratories at Bucknell University and Virginia Tech for analysis. The analytical tests performed are summarized in Table 1. In addition, each plant collected results on several parameters that are also listed in Table 1. The analytical tests included a variety of organic and inorganic constituents as well as measurement of odorous compounds produced by the samples during their storage. A brief overview of the analytical methods is provided below, however, for a more detailed description, the reader is referred to Adams et al. (2004). In addition to the analytical tests, a detailed survey of operational parameters was also collected and a summary of these parameters are shown in Table 2.

Analytical Methods

Standard Tests of Water and Wastewater Analyses. Liquid samples were analyzed by the facilities participating in the program for VS, TS, temperature, pH, ORP, alkalinity, soluble TKN, and fecal coliforms. All tests in this section were completed under Standard Methods (1999) procedures, as referenced below. Examples of methods that were used by the facilities include the following:

- Volatile Solids: 2540D
- Total Solids: 2540E
- Oxidation-Reduction Potential: 2580B
- Temperature: 2550B
- pH: 4500-H+B
- Alkalinity: 2320B
- TKN (soluble): 4500-NorgB
- Fecal Coliforms: 9222B

Preparation of Headspace Samples. To assess the odors produced by the different liquid and solids samples, the headspace method was employed (Glindemann et al., 2006). In this method, the appropriate samples (either liquid or cake) are placed in a headspace container, and during specified intervals, the headspace is withdrawn with a syringe and analyzed for odor causing compounds by gas chromatography (GC) and for odors by an odor panel. The samples were placed in the headspace containers in the field during the sampling event. For each sample location, 142 g of sample were

placed in 710 mL polyethylene terephthalate ester (PETE) bottles. The liquid or cake samples were obtained from the sampling points and immediately weighed and poured into the sample bottles. The samples were then shipped in insulated containers at ambient (20 ± 5 °C) conditions with temperature data logging.

Once at the lab, the headspace sample containers were incubated in the laboratory at ambient temperature (22 °C), and headspace samples were withdrawn at regular intervals for GC and olfactometry analysis.

Odorant Analysis by Gas Chromatography. The extracted headspace sample was analyzed using a Hewlett Packard (HP 5890) GC with mass spec detector (MS 5971) with a 30 m x 0.32 mm ID x 0.25 mm HP 5 column. The carrier gas flow was 2 mL/min, with a sample size of 1 mL, and the temperature in the cryo-concentration unit of -130 °C for the first loop of the GC column. For quantification, standards were injected daily before measurements. The detection limit was on the order of 100 parts per billion by volume (ppbv), and the precision of repeated analysis was on the order of ± 5 percent. Analytes measured included hydrogen sulfide, methanethiol, dimethyl sulfide, dimethyl disulfide, carbon tetrachloride, isopropyl mercaptan, tert-butyl mercaptan, n-propyl mercaptan, ethyl methyl sulfide, trimethyl amine, acetone, acetic acid, propionic acid, and butyric acid.

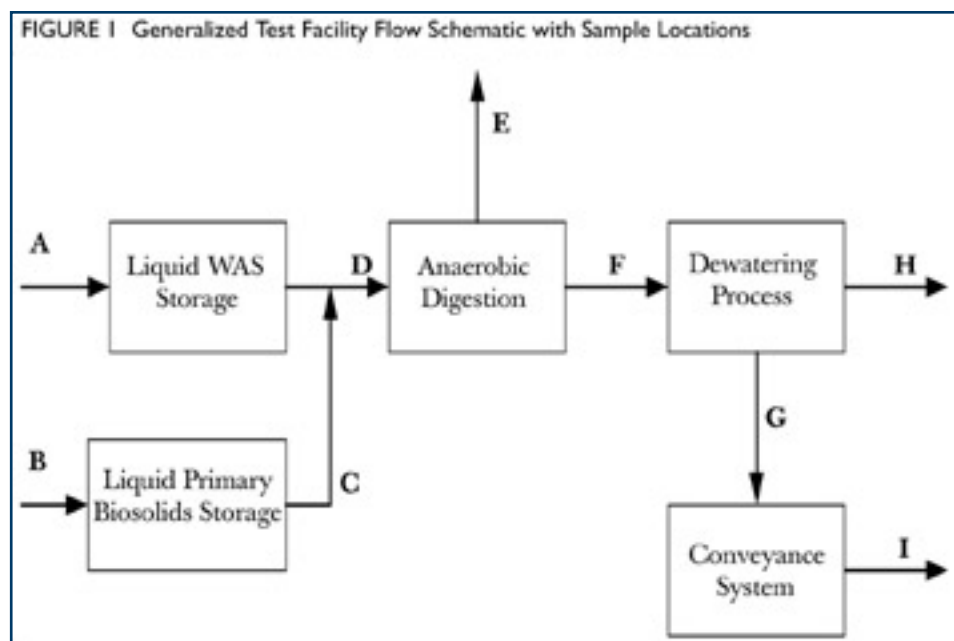


TABLE 1 Sampling and Analyses Matrix as a Function of Sample Location

Analysis	Sample Location									
	Influent	A	B	C	D	E	F	G	H	I
Sample Type	Liquid	Liquid	Liquid	Liquid	Liquid	Gas	Liquid	Cake	Liquid	Cake
Standard Tests (performed by facilities)₁										
Solids (VS & TS)	X	X	X	X	X		X	X	X	X
ORP/pH/temp	X	X	X	X	X		X	X	X	X
Alk/NH ₃ /TKN	X	X	X	X	X		X	X	X	X
VFA/Coliforms							X			X
VS Destruction					X	X	X			
Headspace Analysis for Odorants										
Reduced Sulfur	X	X	X	X	X		X	X	X	X
Amines	X	X	X	X	X		X	X	X	X
Ketones	X	X	X	X	X		X	X	X	X
Olfactometry ₅							X	X		X
Organics Analysis										
Proteins			S,T	S,T	S,B,T		S,B,T	B,T	S,T	B,T
Enzyme Assays					B		B	B		B
Amino Acids					T		S,B,T	B		B
VFA				S	S		S			B
Cations & Anions										
Fe/Al	T				T		T		T	
Ca/Mg/Na/K	S	S			S,T		S,B,T	B	S	B
Sulfate			S	S	S					
Residual Biological Activity										
Additional VS Destruction							X	X		X
Methane							X	X		X
Ammonia							B	B		B

Notes:
 1. X = Sampling and analysis point at that location
 2. Employ analysis of fractions: S = soluble, B = bound (or labile), T = total
 3. Incubation time analysis: every day for 1 week for samples from locations F, G, and I
 4. Measurement of analytes that require longer GC times were conducted at 48-hrs after sampling and onwards for samples obtained from locations F, G, and I only
 5. Sampling by St. Croix Sensory Labs on Day 7 after incubation at VPI during Days 1 through 6

Olfactometric Analysis. In addition to the odorant analysis by GC/MS, split headspace samples were also sent to an odor panel for olfactometry. A known volume of the headspace sample was placed in a Tedlar bag filled with a known volume of nitrogen and shipped to St. Croix Sensory for olfactometry analysis. Olfactometric analysis was conducted in accordance with ASTM Standard Practices (ASTM, 1991; ASTM, 1999), using a trained odor panel and producing the following results:

- Odor Thresholds: Defined as Detection Threshold (DT) and Recognition Threshold (RT), were determined using the “triangular forced-choice dynamic dilution”

presentation method, as prescribed by ASTM E679-91.

- Odor Descriptors: The odor panelists described specific odor characteristics of the samples, such as sour, earthy, ammonia, fishy, etc.

Volatile Fatty Acids. Volatile fatty acids (VFAs) were measured on the soluble fraction of samples from Locations C, D, and F and the bound fraction from samples taken from Locations G and I (Figure 1). The C-2 through C-7 VFAs were measured using an HP 6890 GC with an FID detector. The column was a 0.53 mm ID, 30 m, Nukol capillary column (from Supelco). The injector and FID detector temperature were

both 200 °C. The column temperature was 110 °C for the first 5 minutes, followed by a temperature ramp of 10 °C/min to a final temperature of 150 °C. The carrier gas (nitrogen) flow rate was 20 mL/min.

Cations and Anions Analyses. Cations and anions were measured in the liquid-phase of the samples for the sampling points indicated in Table 2. Similar to the organics analyses, the cations and anions samples was divided into fractions, including soluble, bound or labile, and total amounts of the various constituents. The total metals content, including Fe, Al, Ca, Mg, Na, and K was determined for samples from locations Influent, D, F and H (Figure 1). The analysis

TABLE 2 Summary of Plant Operational Data

Plant Designation	Plant Flow (MGD)	Domestic Wastewater Contribution (%)	WAS Thickening Equipment	Percent WAS to Digestion (%)	Anaerobic Digestion Type	Digestion SRT (d)	Dewatering Equipment	Mean Dewatered Biosolids TS Content (%)	Chemical Addition Locations	
									Iron	Polymer
1	36	100	DAFT	54	Mesophilic	38	Low Solids Centrifuges	15.5		Thickening, Dewatering
2-MS 2-HS	200	90	DAFT	40	Mesophilic	20	Medium & High Solids Centrifuges	27.4 (Med) 35.1 (High)	Influent	Dewatering
3	68	90	DAFT	49	Mesophilic	27	Medium Solids Centrifuges	22.0	Dewatering	Thickening, Dewatering
4	30	60	Belt	55	Mesophilic	40	Lagoons	4.5	Grit Channel	Thickening, Secondary Clarifiers
5	20	90	Belt	65	Mesophilic	27	High Solids Centrifuges	23.9	Aeration Effluent	Thickening, Dewatering
6	60	90	Gravity Thickener	54	Mesophilic	28	Medium Solids Centrifuges	21.4		Thickening, Dewatering
7	17	95	Gravity Thickener	33	Mesophilic	14	Medium Solids Centrifuges and Drying Beds	26.8		Dewatering
8	350	85	Centrifuge	31	Thermophilic	16	High Solids Centrifuges	32.6	Primary Effluent	Headworks, Dewatering
9	13	91	DAFT	48	Mesophilic	21	Recessed Chamber	22.2	Communitor	Grit Removal, Secondary Clarifiers, Thickening Plate and Frame
10-N 10-S	350	80	DAFT	34 38	Mesophilic	19 22	Medium Solids Centrifuges	26.2 (North) 28.2 (South)	Primary Sludge	Thickening, Dewatering
11	200	93	DAFT	37	Mesophilic	22	High Solids Centrifuges	28.4	Pre-Primary	Thickening, Dewatering

Adapted from Higgins et al., 2007a

required nitric acid-heat digestion to dissolve the particulate bound metals followed by analysis using inductively coupled plasma (ICP). Method 3030 E in Standard Methods (1999) was used for the nitric acid digestion procedure. The digest was measured by ICP according to the Method 3500. The cations Ca, Mg, Na, and K were measured on the soluble and/or labile fraction from the influent and from sampling locations A, D, F, G, H and I, as shown in Figure 1 and described in Table 1. Filtered samples were analyzed for cation concentrations using a Dionex Ion Chromatograph with a CS12 column and conductivity detection, with self-generating suppression of the eluent. The eluent is 20 mM methane sulfonic acid, introduced at a flow rate of 1 mL/min.

The anion analysis included a determination of sulfate and sulfide quantities at select locations in the soluble and/or bound forms. Soluble and bound fractions were determined the same way as performed for the organic analysis. Sulfate was measured on the soluble fraction of samples B, C, and D. Sulfate was analyzed by ion-chromatography using electronic self-regenerating suppression of eluent conductivity and conductimetric detection. The eluent was a mixture of 1.8 mM sodium carbonate and 1.7 mM sodium bicarbonate with a flow rate of 1.5 mL/min. The column is a Dionex Ion-Pac AS4A-SC with an AG4A guard column.

Residual Biological Activity (RBA). The residual biological activity, which is defined

and the additional VS destruction that occurs after 40 days of batch digestion at 35 °C, was measured for samples from the sampling points indicated in Table 1. Briefly, a 35 gram sample was batch digested in a 500 mL sample bottle for 40 days at 35 °C, as specified in the 503 Rule by Option No. 2 to evaluate RBA. VS destruction was evaluated by the approximate mass balance method (Appendix C of USEPA, 2003).

RESULTS AND DISCUSSION

Overview of Plant Processes

A summary of the plant processes is provided in Table 2. As shown in the table, 11 different facilities were sampled, one with two digestion trains. Ten of the plants utilized mesophilic anaerobic digestion, and

FIGURE 2 Example of Sulfur Species Concentrations Measured in Reactor Headspace of Samples Taken from Various Points in the Treatment Process After 1 Day of Equilibration in the Headspace Bottle (Data from Plant 3)

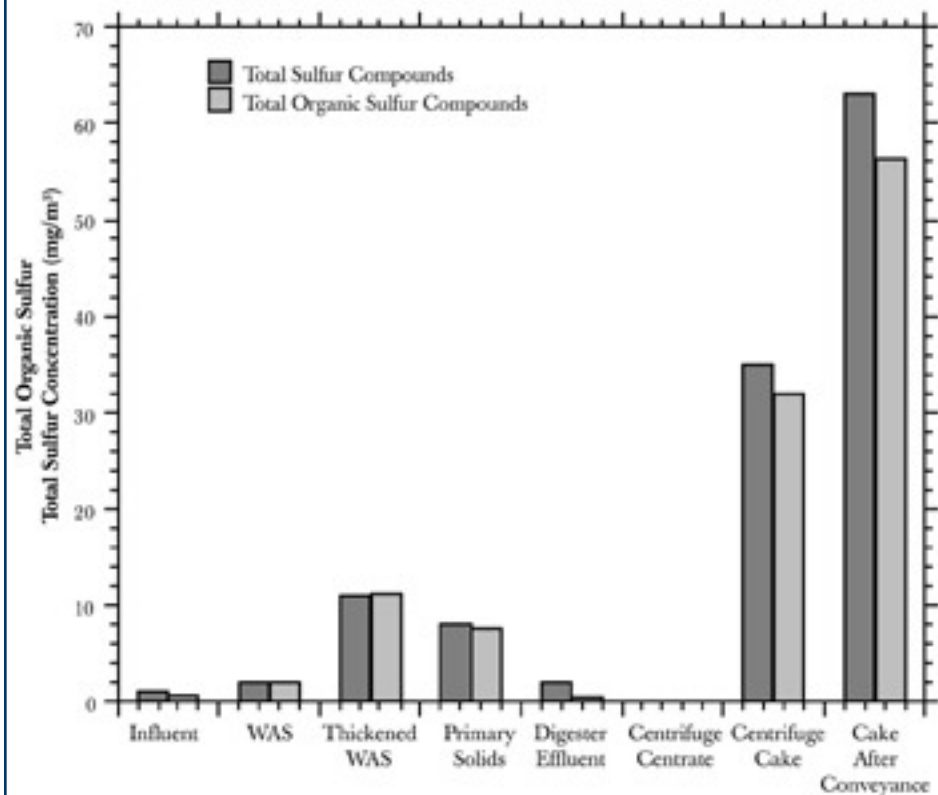
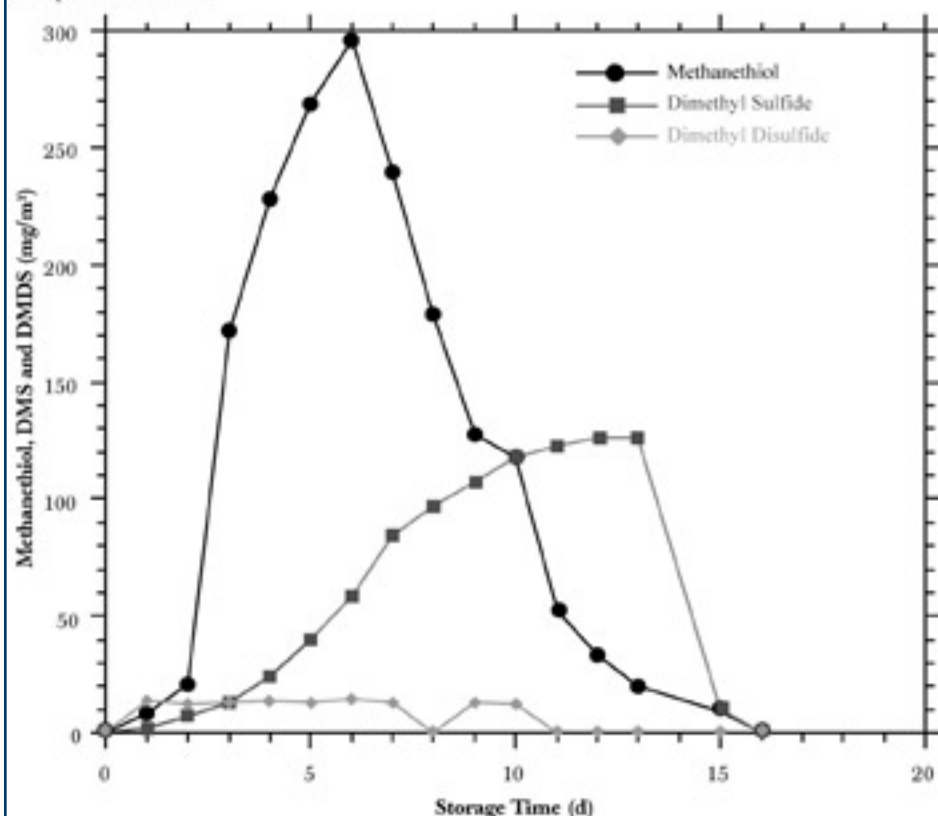


FIGURE 3 Headspace Organic Sulfur Compound Concentrations During Incubation of Cake Sample from Plant 3



one plant utilized thermophilic anaerobic digestion. In addition, nine of the plants utilized centrifuge dewatering, one plant utilized a plate and frame press, and one utilized a lagoon for dewatering. The cake solids varied from about 15 to 35 % solids from the different dewatering processes. The plant selection provides a useful data set for comparing how different processes affect the production of odor causing compounds since a number of the parameters such as SRTs, VS reduction, and cake solids content varied substantially.

Odors and Analytes

Production of Odorants Throughout the Plant.

A profile of the sulfur based odorants measured from the different processes at one of the plants (Plant 3) is shown in Figure 2. The data are from the headspace of the different samples after one day of storage in the headspace vials. The results only show the sulfur species concentrations because they were found to be the main odor causing compounds as discussed below. As shown in the graph, the samples taken after dewatering have much greater concentrations of odorous sulfur compounds compared to other locations in the treatment process. This is an indicator of the problems associated with odors from dewatered biosolids. It can also be seen that the H_2S concentration (the difference between the total sulfur compounds and the organic sulfur compounds) was small, indicating that most of the sulfur based odorants were organic sulfur compounds.

During cake storage, which was the focus of this research, the organic sulfur compound concentrations generally increased, reached a peak, and then decreased to below detectable limits within two or three weeks of storage. For example, Figure 3 shows the concentrations of the main organic sulfur compounds, methanethiol (MT), dimethyl sulfide (DMS), and dimethyl disulfide (DMDS), measured during cake storage for the Plant 3 sample. This pattern is fairly typical of cakes produced by centrifuge dewatering (Novak et al., 2006, Higgins et al., 2006). In most cases, the methanethiol reached the highest concentration, and peaks first, followed by DMS and DMDS. Also, the concentrations of H_2S remain fairly low in the cake headspace. The two exceptions in this research were Plant 1 and 7, which

had relatively high concentrations of H_2S in the cake headspace. The production of the organic sulfur compounds was found to be directly related to the amount of protein in the cake (Higgins et al., 2007a), and research has shown that microbial degradation of protein is an important pathway for production of these odor causing compounds (Higgins et al., 2006). For a full description of the odor production profiles associated with the different plants, see Novak et al. (2006). To account for the differences in the pattern for the production of these compounds, many of the comparisons below examine the peak total sulfur compounds which were found by summing the different sulfur compounds concentrations on each day, and determining the maximum concentration measured during storage of the cake samples.

Compounds and Odor Descriptors Associated with Biosolids. Headspace samples were collected on day 6 of the cake storage as well as the digester sample storage, and they were analyzed for the different analytes contributing to odors as well as the detection and recognition thresholds measured by an odor panel. For digested and dewatered biosolids, odor threshold concentrations in the biosolids headspace samples correlated well with the concentration of total reduced sulfur compounds in the sample headspace. For example, for dewatered cake results, a correlation was found between the total sulfur concentration and the detection threshold, as shown in Figure 4. In addition, the headspace odor detection threshold was correlated with the headspace organic sulfur as shown in Figure 5. The results show a good relationship, with two main outliers. Interestingly, these two outliers are from samples that had high H_2S concentrations (Plant 1 and 7), whereas for most plants the organic sulfur concentrations were greater than the H_2S concentrations. When omitting the results from Plant 1 and 7 which had the high H_2S concentrations, the correlation coefficient was 0.76. These results show that reduced sulfur compounds are the most prevalent odorants in dewatered biosolids that have been anaerobically digested, at least during the first week of storage. The results agree well with other research (Webster et al., 2006), and suggest that the sulfur compounds are

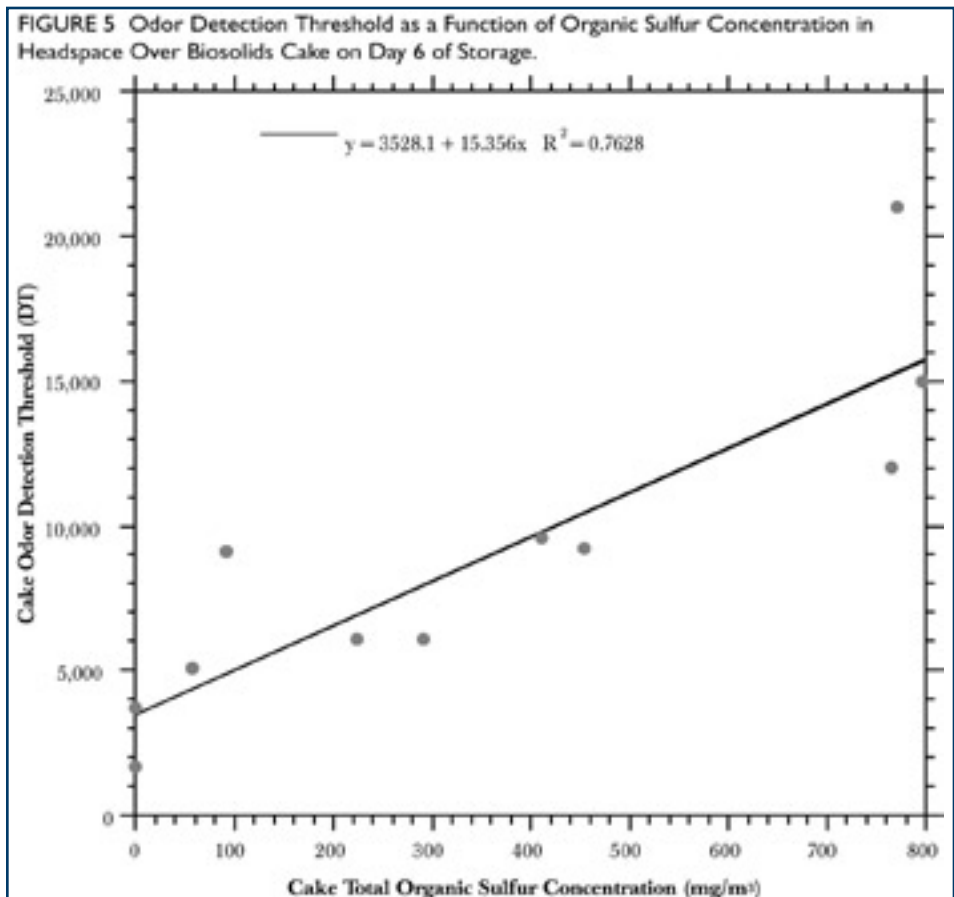
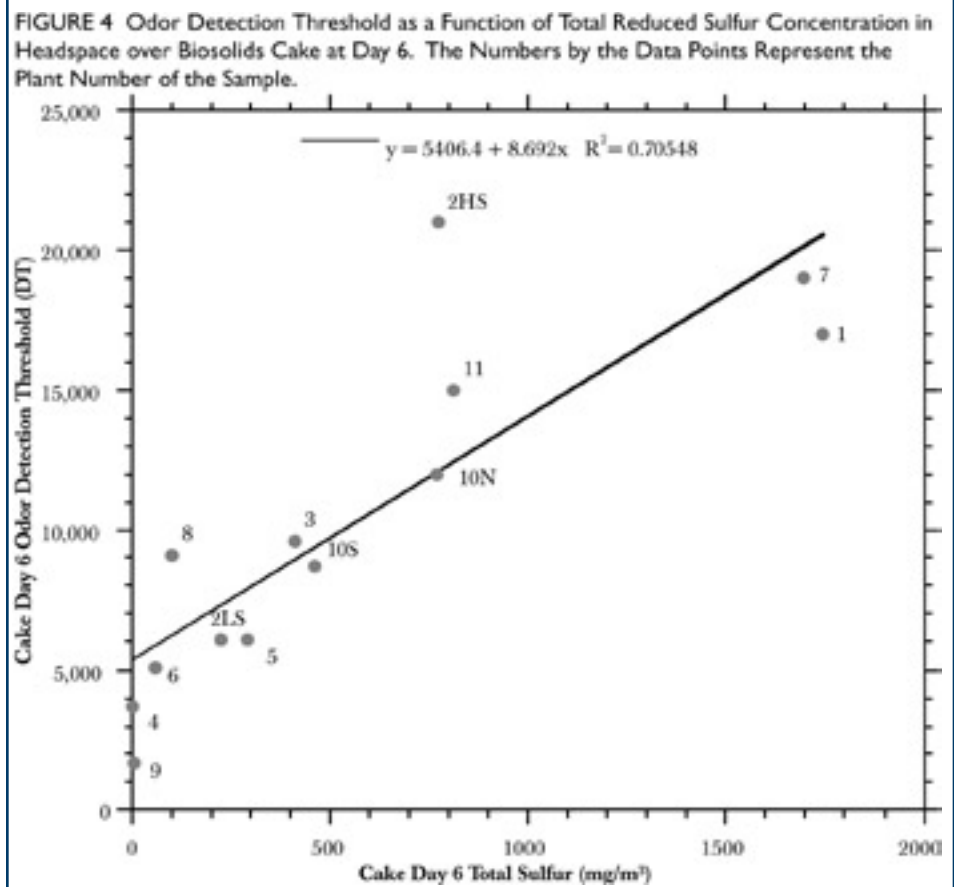


TABLE 3 Odor Descriptor Intensities Greater Than 25% (St. Croix S.)

Descriptor	Plant Number										
	1	2	3	4	5	6	7	8	9	10	11
Chemical				60	60	60	40		29		
Decay		79	40				60				
Earthy	40	60					60				
Fecal	60	40				60	40				
Fishy			40								
Garbage		40	60		40		60				48
Garlic				40							
Gasoline				60							
Manure	40										
Musty							40				
Offensive	100	100	100	79	100	100	100	48	48	38	48
Oil				40							
Putrid	60	60	79	60	100	40	60			29	
Rancid		60	79		40		79				
Raw Meat							40				
Rotten Eggs	40			60	40	40					
Septic	40					40					
Sewer	60		40			60					
Sour	40	40	60		40		40			29	29
Sulfur				40	40	40					
Vegetable		40	40	40							

TABLE 4 Statistical Evaluation for Linear Correlation Between Upstream Process Parameters and Cake Odors

	Parameter	Primary Sludge Holding Time (hr)	Activated Sludge SRT (d)	WAS VS (%)	WAS Thickening Time (hr)	Digester Feed Secondary (%)
Cake Odor Detection Threshold (DT)	Correlation Coefficient	0.20	-0.50	0.19	0.25	-0.43
	Significance (p-value)	0.52	0.09*	0.52	0.43	0.14
Cake Peak Total Sulfur (mg S/m ³)	Correlation Coefficient	-0.09	-0.29	0.39	0.29	-0.30
	Significance (p-value)	0.77	0.33	0.18	0.36	0.32
Cake Peak Total Organic Sulfur (mg S/m ³)	Correlation Coefficient	-0.30	-0.48	0.16	0.17	-0.68
	Significance (p-value)	0.32	0.09*	0.60	0.60	0.01*
Cake Peak H ₂ S (mg S/m ³)	Correlation Coefficient	0.06	-0.08	0.37	0.24	0.02
	Significance (p-value)	0.85	0.81	0.21	0.44	0.94

*Significant at the p<0.10 higher.

a good surrogate for odor. However, the data is limited to the storage period used in this study. Longer term storage of biosolids has shown that the organic sulfur compounds are degraded in the cake, and other compounds such as indole, skatole, p-cresol, and others can persist for longer periods (Higgins et al., 2006, Chen et al., 2006). No significant correlations between nitrogen based compounds or volatile fatty acids and odor were found (data not shown).

In addition to the dilution to threshold values, the odor panel also judged the cake odors based on their character or odor descriptors. The results from these tests are summarized in Table 3. All of the cakes were described as “offensive” by more than 25% of the odor panelists. Other characteristics that were described by most of the panelists included “putrid” “sour” and “chemical” showing that the panelist generally found the odors to be unpleasant.

Based on the results from the odor panel and the analytical results it is clear that biosolids produce offensive odors, and these odors are associated with organic sulfur compounds, especially during the first week of storage. Additional analysis and data collection was aimed at understanding the factors that may contribute to the production of these odor causing compounds, and several of these factors are investigated below.

Factors Affecting Biosolids Odor Production

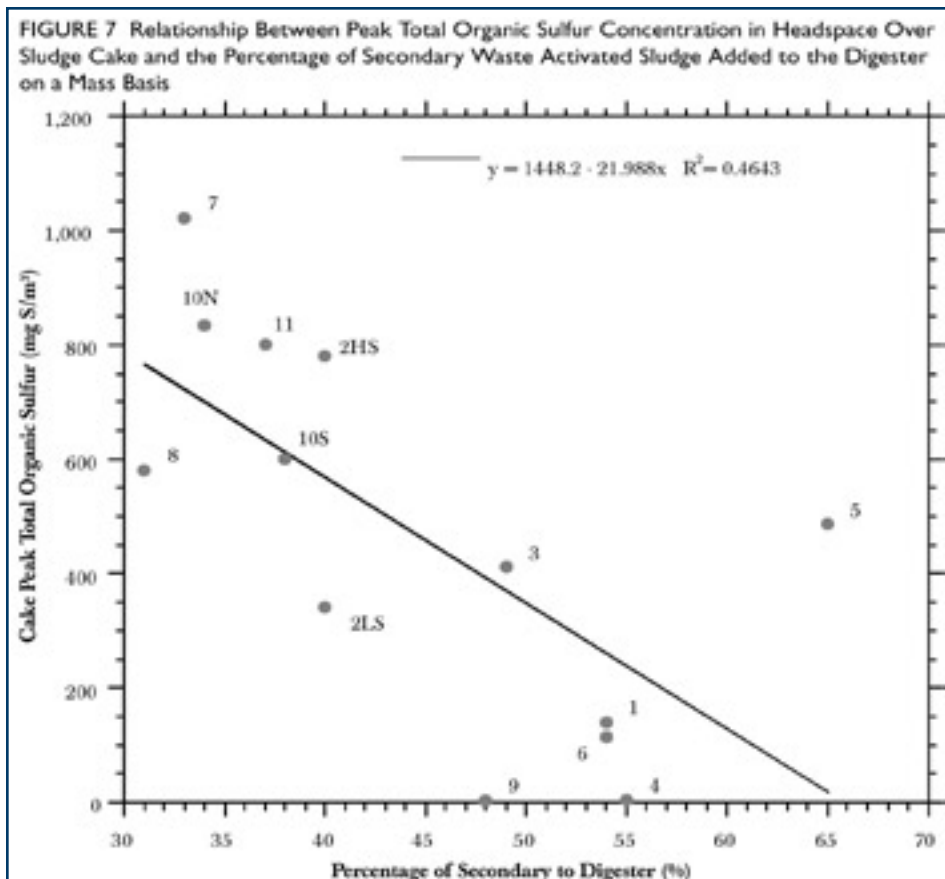
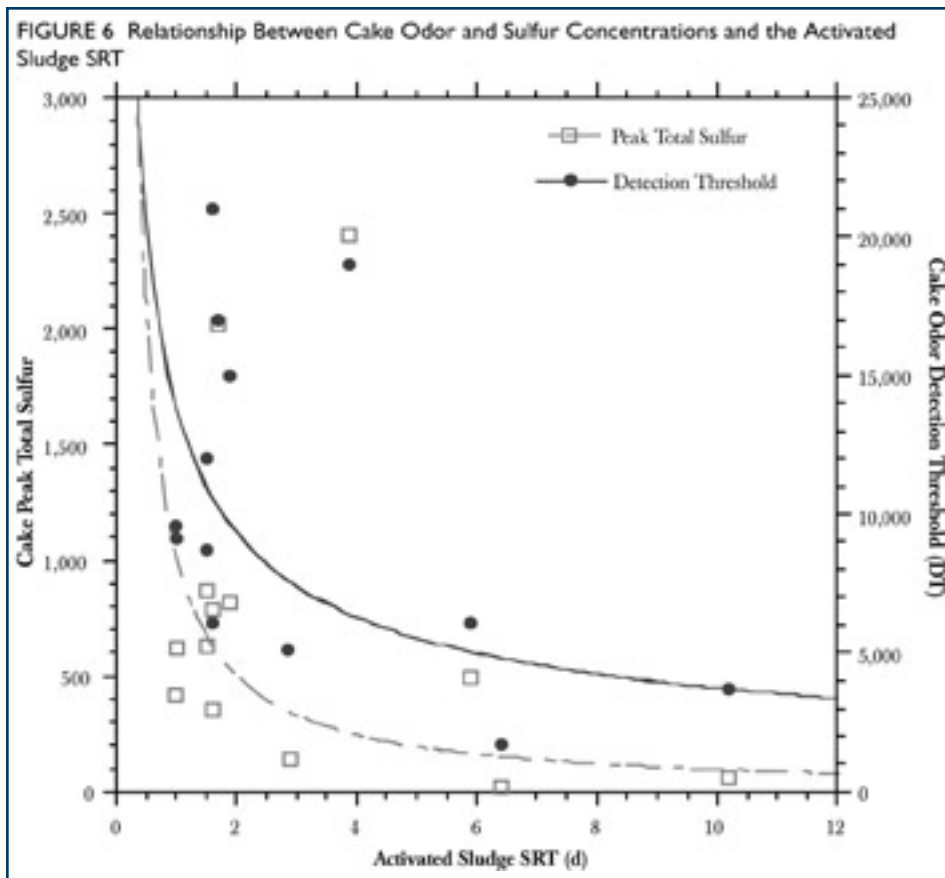
Effect of Upstream Parameters on Odorant Production. A number of upstream parameters were investigated to determine if they were correlated to biosolids odor production. Linear correlations were investigated using bivariate analysis to determine the correlation coefficient and the significance of the correlation. The first set of parameters examined was influent characteristics such as metal concentrations (Na, K, Mg, Ca, Al, and Fe), sulfate concentration, sulfide, ammonia, TKN, alkalinity and pH. None of these parameters showed any significant correlation (when using p<0.05 as the criteria) with any of the odor measures including peak total volatile organic sulfur compounds (TVOSC), peak total reduced sulfur (TRS) or the odor panel results. The influent Fe concentration was negatively correlated with the peak total organic sulfur concentration in the cake

with $p=0.10$. The influent ammonia, TKN, and alkalinity were also not correlated to cake odors (data not shown). However, iron was added during the process in 8 of the 11 plants either for nutrient or odor control (see Table 2). Iron was added to some of the plants in the headworks, to some in the primary influent, and to some in the secondary influent. In addition, two plants received iron in the digester feed and one added iron to the centrifuges. Therefore, it is difficult to determine the impact of iron on odors at these plants, since the addition point may affect its impact.

The effect of upstream operational parameters such as activated sludge solids retention time (SRT), WAS solids concentration, and ratio of WAS/primary solids into the digester on odors and sulfur compound concentration was also examined. The correlation coefficients along with the p-values for each parameter comparison are shown in Table 4. Interestingly, the SRT of the activated sludge process was negatively correlated with the cake odor detection threshold and the cake peak organic sulfur concentration for $p<0.10$. This indicates that greater SRTs were associated with lower production of odorous compounds for centrifuged cakes. Although the SRT correlations discussed above were treated as linear, an examination of the data indicated a non-linear trend as shown in Figure 6. Similarly, the peak organic sulfur concentration measured during cake storage was significantly ($p=0.01$) correlated with the percentage of the waste activated sludge added to the digester on a mass basis as shown in Figure 7. As the fraction of WAS increased compared to the primary sludge fed to the digester, the organic sulfur compound concentration decreased.

Centrifugation Versus Other Dewatering Processes

Nine of the plants dewatered using centrifuges. As noted by Novak, et al, (2006), high solids centrifuges (capable of operating at greater speeds) resulted in higher organic sulfur generation than low solids centrifuges. It was also found that sludges dewatered by processes other than centrifuges produced very low volatile sulfur, both organic sulfur and hydrogen sulfide. A comparison of the two plants without centrifuges, one used lagoon storage for dewatering and the other a recessed chamber, is shown in Fig-



ure 8. It should be noted that there are 11 centrifuge data points. One plant uses both a high and low solids centrifuge so both are represented and one plant has a train with primary sludge only and another with a mix of primary and secondary sludge so both are shown.

The data in Figure 8 suggest that more energy-intensive dewatering processes have greater potential to increase biosolids odors in the cake product, possibly because of their potential to impart higher levels of shear to the sludge, thereby releasing more bioavailable protein for odor-generating biological activity, which is a key odor precursor (Higgins et al., 2006 and 2007a). In addition, the resulting higher cake solids may lead to greater amounts of sulfur compounds being emitted from the sludge cake. Figure 9 shows a comparison of total volatile organic sulfur concentration in headspace samples of biosolids cake versus the cake solids concentration. Also shown are the two cakes from plant 2 which uses both older, low-solids centrifuges (2-L) and newer, high-solids centrifuges (2H). Headspace concentrations of total reduced sulfur from the high-solids cake are more than double the headspace concentration of reduced sulfur compounds from the lower-solids cakes. It appears that while the cakes solids might account for some of the increase in headspace TVOSC, the higher shear in the high solids centrifuge might also contribute to the release of more organic sulfur in the headspace.

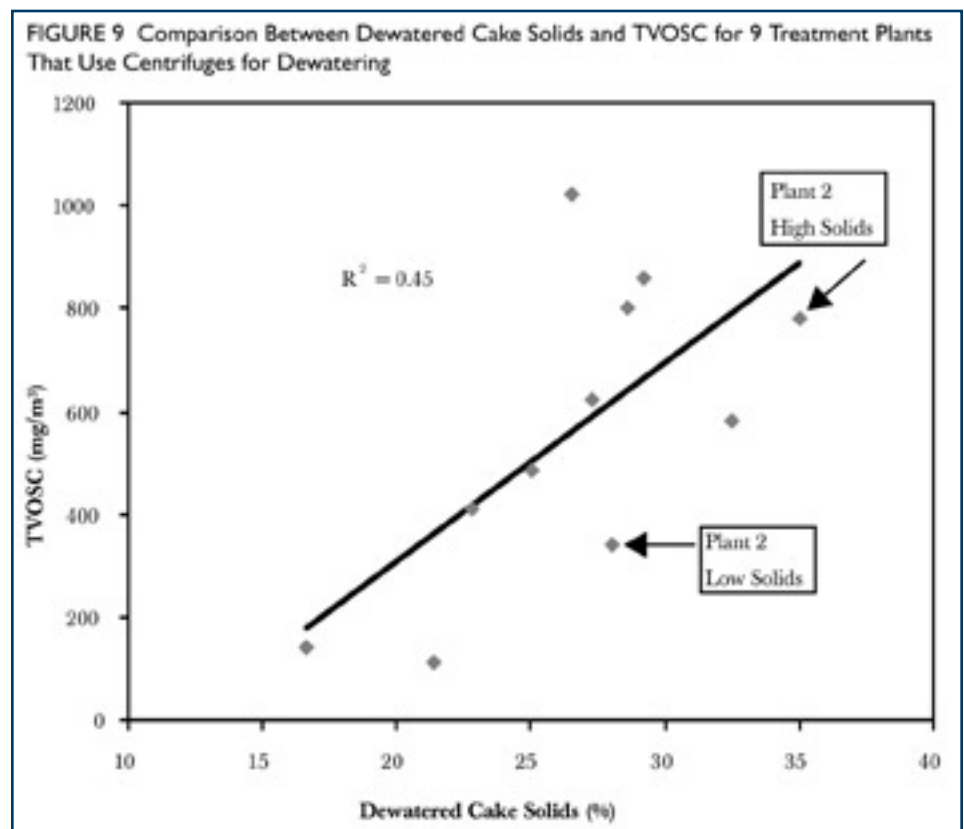
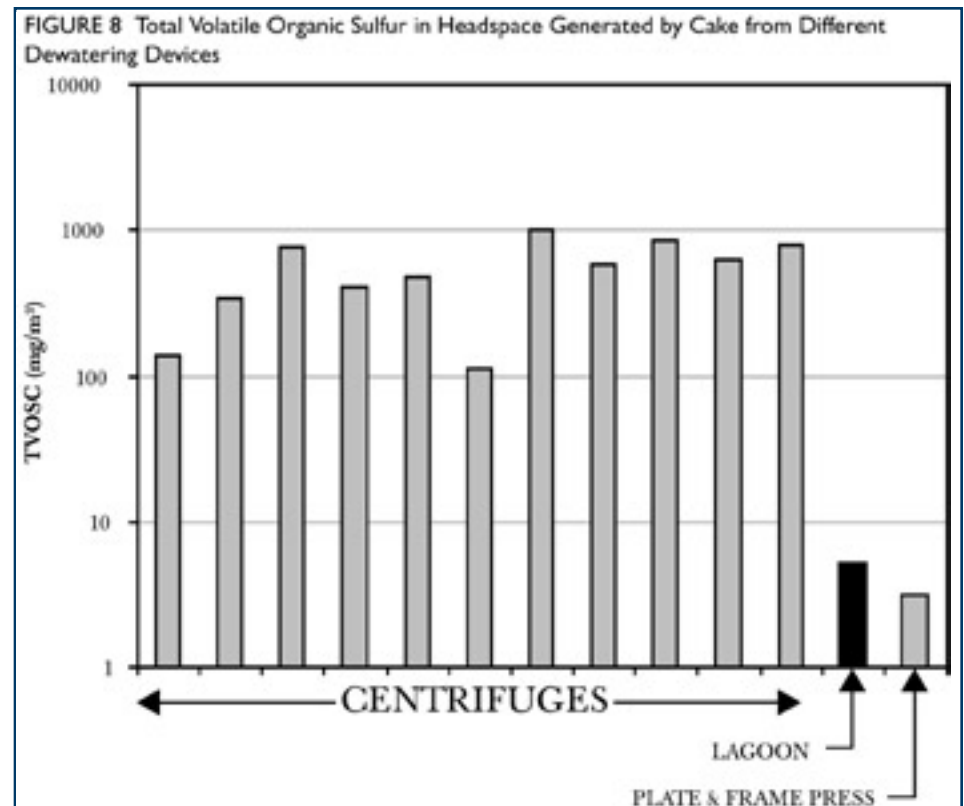
The data in Figure 8 suggest that a key factor affecting odors from biosolids is the dewatering process, with centrifuges producing cakes with greater odor. Similar results were found in other studies in which side-by-side centrifuges and belt filter presses dewatering the same anaerobically digested solids showed that the centrifuge cakes produced much greater odorants compared to the belt filter presses (Higgins et al., 2007b). It is hypothesized that the shear created in a centrifuge is the main cause of the release of volatile sulfur compounds. Therefore, most of the data evaluation that is made with regard to digestion effects is limited to the 9 plants that used centrifuges.

Digestion/RBA

The effect of digester SRT on the peak concentration of TVOSCs produced by the centrifuge cakes is shown in Figure 10. The

results suggest that as the SRT increases, the TVOSC decreases. It is interesting to note from Figure 10 that the data point for

the only thermophilic anaerobic digestion facility falls below the linear correlation of other facilities employing mesophilic anaero-



bic digestion, indicating that thermophilic digestion may be more effective at reducing biosolids odor precursors at shorter diges-

tion times. This suggests higher protein destruction may be occurring with thermophilic digestion. Other digestion-enhance-

ment techniques (such as pre-pasteurization, sonication, high-pressure cell lysis, etc.) might also be effective in destroying more solids during digestion and in reducing odor in the final biosolids product.

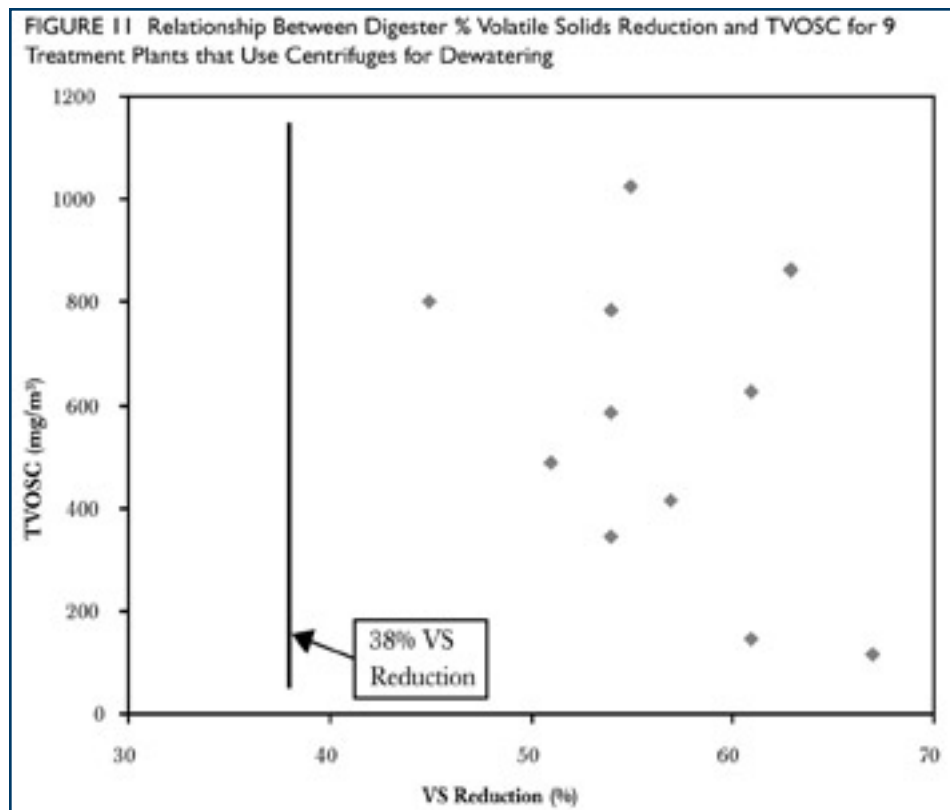
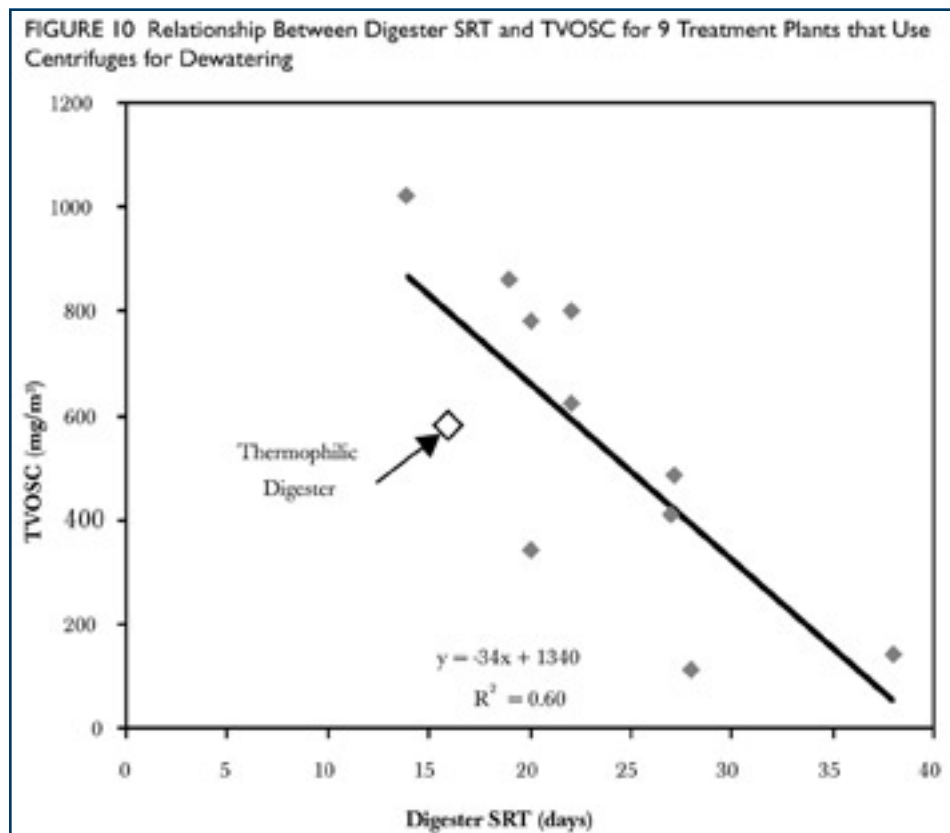
Among the 503 regulations that are used to indicate sludge stabilization, 38% volatile solids reduction and a residual biological activity (RBA) of less than 20% additional VS destruction after digestion are two parameters that relate digester performance to stability or vector attraction reduction (USEPA, 2003). Since odors are the primary attraction for vectors, the relationship between volatile organic sulfur from dewatered sludge cakes and these two stability parameters was investigated. In Figure 11, the relationship between volatile solids reduction and TVOSC is shown and in Figure 12, the relationship between RBA and TVOSC is presented.

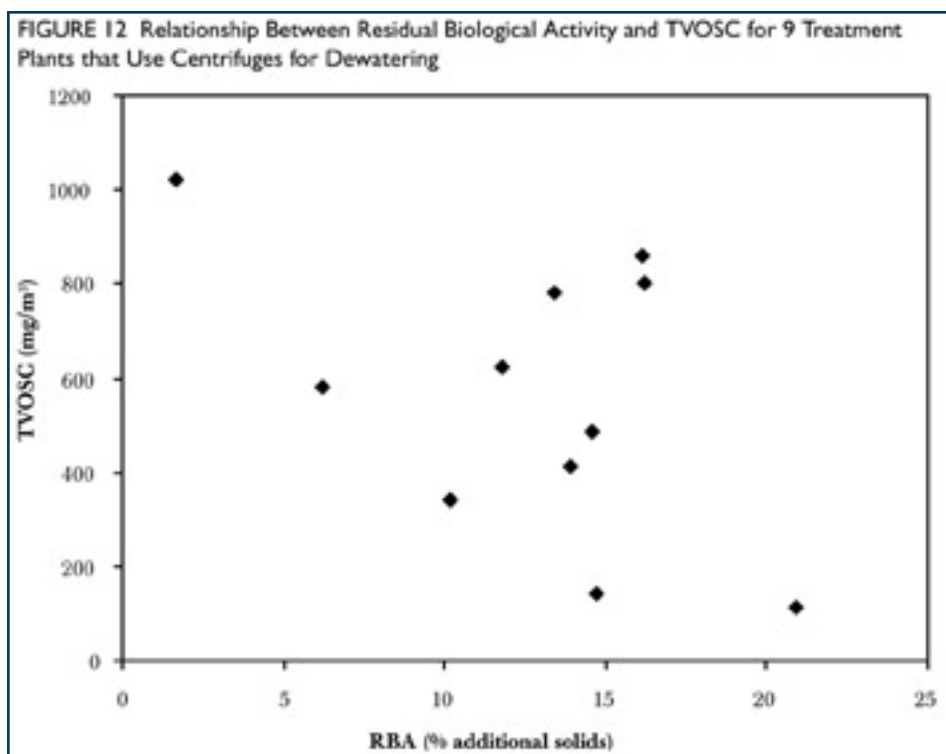
It can be seen from the data in Figures 11 and 12 that neither parameter is predictive of the odor potential from dewatered sludge cakes. Although the trend in VS reduction and TVOSC suggests that higher volatile solids reduction could lead to lower odors, the correlation is not statistically significant, and all digesters reduced the volatile solids more than the 38% specified in the EPA 503 regulations. For RBA, the expected trend (as RBA increases, TVOSC also increases) is the opposite of what was observed. Only one sludge had an RBA greater than 20% and this was a low odor sludge.

It can be seen in Figure 11 that for the 9 plants with centrifugally dewatered solids, the TVOSC ranged from 100 to 1000 mg/m³. Based on the threshold odor panel results and the observed odor at the plants, a low odor sludge is one with a cake odors less than 200 mg/m³ and a high odor sludge is considered to be one that exceeds a TVOSC of 700 mg/m³. Neither of the suggested EPA odor parameters (VS Destruction and RBA) were effective in predicting which of the sludges produced high odors and which produced low odors.

Engineering Implications

The results of this research demonstrate that odors produced from dewatered biosolids are generally much greater than the odors produced from other locations sampled throughout a typical plant. Volatile organic sulfur compounds are well correlated with





odors measured during the first six days of cake storage, and this provides compounds which can be targeted in developing odor control strategies. Of particular interest is research showing that organic sulfur compounds are associated with protein degradation, therefore, better degradation of protein throughout the process should lead to a reduction in odors produced by cakes. Interestingly, a key design parameter for digestion, SRT, was negatively correlated with the production of these odorants. This suggested that designing and operating digestion processes for better digestion of protein may result in a higher quality product in terms of odors and decreased vector attraction. The VSR requirement of the USEPA does not provide a guarantee that vector attraction reduction (or odors) will be eliminated, especially with centrifuge dewatering. The shear associated with centrifuge dewatering appears to release biodegradable materials that were not degraded during the digestion process. The result is a “destabilization” of the resulting cake, resumption of biological activity and production of odors. This finding is important for engineers in that the dewatering processes should be operated and designed to minimize shear and the destabilization of solids, or digestion processes should be aimed at more complete

digestion of the biologically available materials such that destabilization does not occur even with high shear dewatering.

SUMMARY AND CONCLUSIONS

This research incorporated a comprehensive survey of 11 treatment plants, all with anaerobic digestion, to determine the factors that lead to odor generation. Of the 11 plants, 9 used centrifuges for dewatering, one used thermophilic digestion and 8 added iron somewhere during the treatment process. In order to determine the odor potential, a methodology was developed for measuring odorous components and odor thresholds of headspace gases generated by sludges taken various points in the solids handling process. It was found that:

- The highest concentrations of headspace odorous gases were generated by samples taken after dewatering compared to other locations with a plant.
- The threshold odor concentration (dilution to threshold) correlated well with the total volatile sulfur concentration in the headspace of reactors in which dewatered cakes were incubated.
- The concentrations of reduced sulfur compounds in the headspace gas

released from incubated centrifuged cake solids were much higher than those from the two plants that did not use centrifuges. It is suspected that shear created by centrifugation may release biodegradable protein, providing substrate for odorant production. High solids centrifuges resulted in higher organic sulfur concentrations compared to low solids centrifuges. This appears to be related to higher cake solids and higher shear.

- High solids centrifuges produced sludge cakes that generated higher concentrations of organic sulfurous gas than did low solids centrifuges, and this appeared to be caused by higher cake solids and more shear in the process.
- It appears from this study that sludges that are considered to be well digested as evidenced by a high percentage of volatile solids destruction and low residual biological activity could still have centrifuge cakes with high odor potential.
- Neither residual biological activity nor volatile solids reduction appear to be good predictors of the odor potential from anaerobically digested, centrifugally dewatered biosolids.
- It appears that the EPA 503 regulations should be modified to include a more appropriate predictor for odor generation or stability.
- Higher digester SRTs was associated with lower cake odors from anaerobically digested sludges.

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REFERENCES

- Adams, G.M., J. Witherspoon, T. Card, Z. Erdal, B. Forbes, J. Geselbracht, D. Glindemann, R. Hargreaves, L. Hentz, M.J. Higgins, D. McEwen, S. Murthy. (2004) *Identifying and Controlling the Municipal Wastewater Odor Environment Phase 2: Impacts of In-Plant Operational Parameters on Biosolids Odor Quality*. Water Environment Research Foundation Report No. 00HHE5T, Alexandria, VA.
- ASTM Standard Practice E544-99. (1999) *Referencing Suprathreshold Odor Intensity American Society for Testing and Materials*. West Conshohocken, PA.
- ASTM Standard Practice E679-91. (1991) *Determination of Odor and Taste Thresholds by a Forced-Choice Ascending Concentration Series of Limits*. American Society for Testing and Materials. West Conshohocken, PA.
- Chen, Y., Higgins, M.J., Murthy, S.N., Maas, N.A., Covert, K.J. and Toffey, W.E. (2006) Production of odorous indole, skatole, p-cresol, toluene, styrene, and ethylbenzene in biosolids. *Journal of Residuals Science & Technology*. 3 (4): 193-202.
- Dixon, L. G.; Field, P. (2004) *Proceedings from the Biosolids Research Summit*. Water Environment Research Foundation Project Report 03-HHE-1; Water Environment Foundation Project Report: Alexandria, Virginia.
- Devai, I., and R.D. DeLaune. (1999) Emission of Reduced Malodorous Sulfur Gases from Wastewater Treatment Plants. *Wat. Environ. Res.*, 71, 203-208.
- Glindemann, D., S. N. Murthy, M.J. Higgins, Y.C. Chen, and J.T. Novak. (2006) Biosolids incubation method for odorous gas measurement from dewatered sludge cakes. *Journal of Residuals Science & Technology* 3(3): 153-160.
- Higgins, M.J., D.P. Yarosz, Y.C. Chen, S.N. Murthy, N. Maas, J. Cooney, D. Glindemann, J.T. Novak. (2006) Cycling of volatile organic sulfur compounds in anaerobically digested biosolids and its implications for odors. *Water Env. Research*. 78, 243-252.
- Higgins, M.J., G. Adams, T. Card, Y.C. Chen, Z. Erdal, R.H. Forbes, Jr., D. Glindemann, J.R. Hargreaves, D. McEwen, S.N. Murthy, J.T. Novak, and J. Witherspoon. (2007a) Role of protein, amino acids, and enzyme activity in odor production from anaerobically digested and dewatered biosolids. *Water Env. Research*. Accepted for Publication, June 2007.
- Higgins, M.J., Y.C. Chen, R.H. Forbes, G. Adams, J. Witherspoon, R. Hargreaves, J. Novak, M. Higgins, Z. Erdal, R. Morton, T. Shea, M. Abu-Orf. (2007b) WERF Odor Study Phase III: Impacts of Dewatering Processes and Operational Parameters on Production of Odor Causing Compounds *Proceed. of Wat. Env. Fed. Joint Residuals and Biosolids Management Conf.*, Denver, Colorado.
- Lomans, B. P.; Op Den Camp, H. J. M.; Pol, A.; Van Der Drift, C.; Vogels, G. D. (1999) Role of Methanogens and Other Bacteria in Degradation of Dimethyl Sulfide and Methanethiol in Anoxic Freshwater Sediments. *Appl. Environ. Microbiol.*, 65, 2116-2121.
- Murthy, S.N., Forbes, B., Burrows, P., Esqueda, T. Glindemann, D., Novak, J., Higgins, M., Mendenhall, T., Toffey, W., Peot, C. (2002) Impact of High Shear Solids Processing on Odor Production from Anaerobically Digested Biosolids. *Proceedings of Water Env. Fed. 75th Annual Conference*. Chicago, IL.
- Murthy, S., Higgins, M., Chen, Y., Toffey, W. and Golembeski, J. (2003) Influence of solids characteristics and dewatering process on volatile sulfur compound production from anaerobically digested biosolids. *Proceedings of Water Env. Federation and AWWA Annual Biosolids and Residuals Conference*. Baltimore, MD.
- Novak, J.T., G. Adams, T. Card, Y.C. Chen, Z. Erdal, R.H. Forbes, Jr., D. Glindemann, J.R. Hargreaves, L. Hentz, M.J. Higgins, D. McEwen, S.N. Murthy, J. Witherspoon. (2006) Odor generation patterns from anaerobically digested biosolids. *Water Env. Research*. 78, 821-827.
- Rosenfeld, P.E., C.L. Henry, and d. Bennett. (2001) Wastewater Dewatering Polymer Affect on Biosolids Odor Emissions and Microbial Activity. *Wat. Env. Res.*, 73, 363-367.
- Standard Methods for the Examination of Water and Wastewater*. (1999) 18th ed., Am. Public Health Assoc. Washington, D.C.
- U.S. Environmental Protection Agency. (2003) *Control of Pathogens and Vector Attraction in Sewage Sludges - Under 40 CFR Part 503*. EPA/625/R-92/013, Revised July, 2003. Washington, DC.
- Water Environment Federation (WEF). (1995) *Odor Control in Wastewater Treatment Plants*, WEF Manual of Practice No. 22. New York, USA.
- Webster, N.A.; Worley, S.; Robinson, N. and Govind, R. (2006) A Neutral pH Biotrickling Scrubber Replaces Thermal Oxidizer, Saving \$600,000 Annually. *Proceedings of WEF/AWWA Odors and Air Emissions Conference*.

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