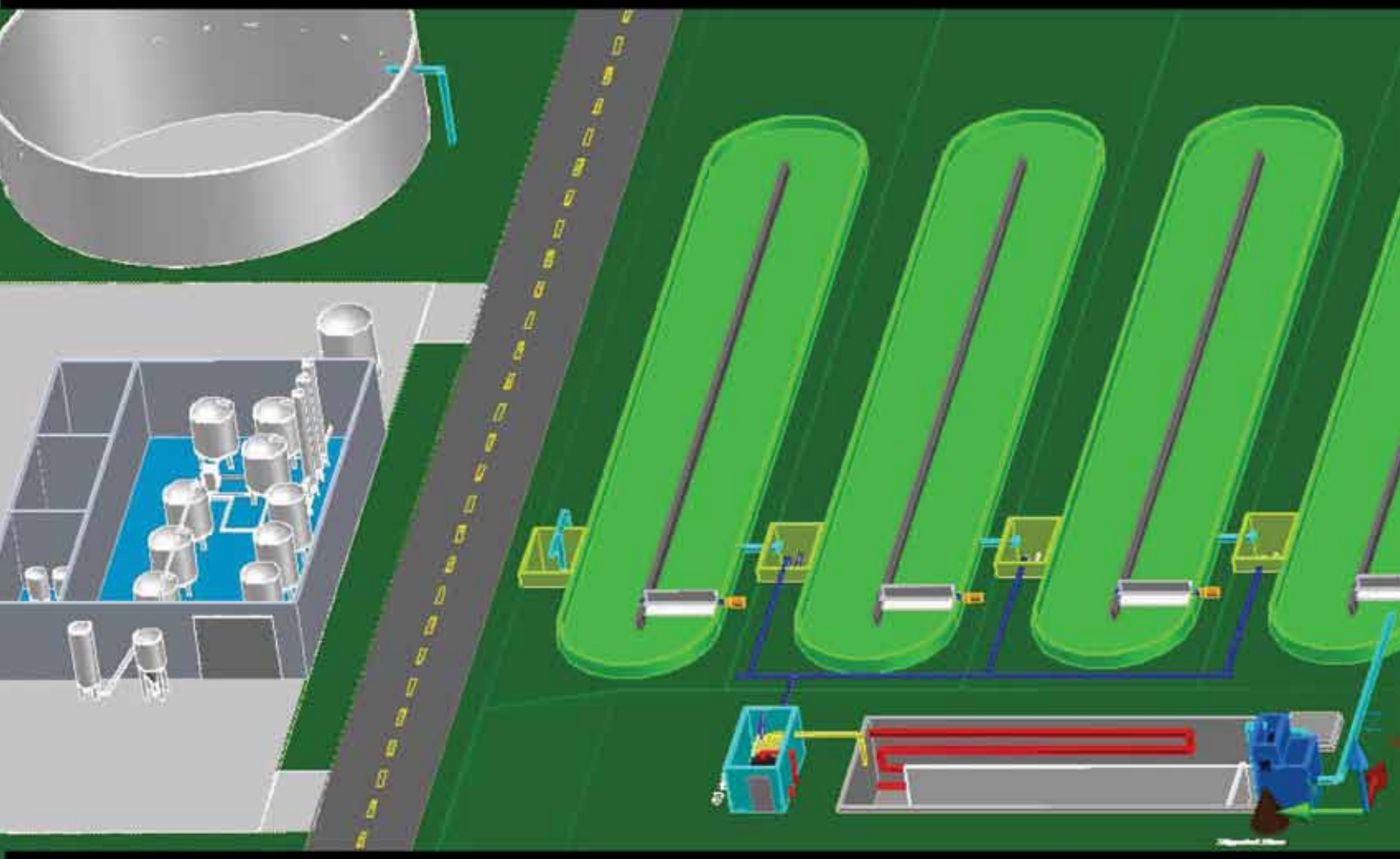
Fall 2009

BAE Bulletin

The Department of Biosystems and Agricultural Engineering

Food Quality, Safety & Biosecurity
Sustainable Ecosystems
Renewable Bioenergy Systems

Integrating Engineering and Biology Since 1906



Anaerobic Digestion-Based Algae Production System

MICHIGAN STATE UNIVERSITY

Advancing Knowledge. Transforming Lives.

From the Chair

BAE Bulletin

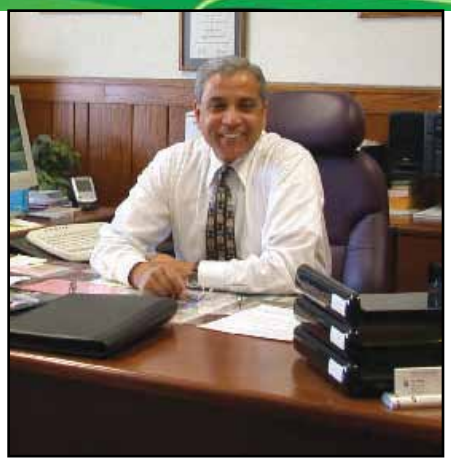
Since 1906, the Department of Biosystems and Agricultural Engineering has responded to the changing needs of society by integrating and applying principles of engineering and biology in a systems context. Today, biosystems engineers at MSU solve complex, rapidly-changing problems related to food quality and safety, ecosystems sustainability, homeland security and health protection, biomass utilization and renewable energy development.

Biosystems & Agricultural Engineering
Ajit Srivastava
Chair

Michigan State University
216 Farrall Hall
East Lansing, MI 48824
(517) 355-4720
Fax: (517) 432-2892
www.egr.msu.edu/age

College of Agriculture and Natural Resources

College of Engineering



Last year was one of the best years for our department. The enrollment in the Biosystems Engineering undergraduate program grew by 9 percent; and it is up by another 18 percent for the Fall 2009 semester. We have 140 students in Biosystems Engineering. More importantly, students continue to get jobs with competitive salaries, even in these difficult economic times, and continue to win recognitions and prestigious awards, as you will read within this newsletter. Graduate enrollment grew by 12 percent, while faculty grants increased by a whopping 300 percent. You might ask what is the secret behind these successes. I believe it is in focusing and aligning our priorities, hiring the best faculty, and building partnerships. As you are well aware, we completed a strategic planning process and identified three major themes for our department: **food safety, quality and biosecurity, sustainable ecosystems, and renewable bioenergy systems.** It is fair to ask why these three areas. To answer this question we must first look at our mission statement which states, "...to combine engineering with biology…and … taking a systems approach to solve critical issues facing our society." More than ever these issues are some of the most pressing issues facing our society and it takes a sound engineering approach coupled with an understanding of biological systems to solve these problems. As the associate dean of engineering, Dr. Leo Kempel recently said that we were at the "sweet spot." He must be right as we saw growth in all areas of the department. This clearly is the result of aligning our strategic directions with regional, national and global priorities thus being in the "sweet spot."

As we prepare for the reaccreditation review next year of our B.S. in Biosystems Engineering program under the new biological engineering criteria, we have made significant changes in our curriculum by adding more biological science course requirements and have formalized "cognates" to concentrations that are transcriptable. These are food engineering, ecosystems engineering, bioenergy engineering, and biomedical engineering. We have developed three core courses in bioenergy in collaboration with Chemical Engineering, Crop and Soil Sciences, and Forestry. We have partnered with the biomedical laboratory science program to offer a biomedical engineering concentration which emphasizes medical diagnostics. Partnerships and collaboration with other units and programs on campus is a key to our successes.

We have recently hired several new faculty members and many have joint appointments in other departments. Problems of the future are increasingly more complex and require multidisciplinary approaches to find sustainable solutions. These faculty members, working closely with the more established faculty, are already making their mark on the department and setting the department on the path of excellence.

Finally, I want to take a moment to thank Ms. Laura Moser, a freelance writer, for creating a totally new look and feel of our newsletter. I hope this newsletter gives you a glimpse of how the Department of Biosystems and Agricultural Engineering at Michigan State University is rising to the challenge in meeting the needs of our society.

Respectfully,
Ajit Srivastava
Chair

Table of Contents

BAE Bulletin

Dr. Wei Liao, BAE Professor at MSU, hosts Chinese students from Zhejiang University on a trip to Mackinac Island (article on page 17).

Faculty News

History Detectives

Producers of the PBS show *History Detectives* sought out expertise from Jon Althouse and others in the BAE Department to test an electrical artifact from the 1950s. The artifact was a NEAR (National Emergency Alarm Repeater) device. The premise of the device was that it plugged into a receptacle outlet in your home and an alarm would be activated by an electrical signal. The device was part of a $1.3 million research project that was conducted in the mid-Michigan area in 1957. It was tested as a possible mass warning system. Althouse, with assistance from others in the department, was able to sound the alarm. Their work with the *History Detectives* aired in August 2009.

BAE Faculty Member Receives FLC Award

Renfu Lu and his lab, along with two ARS research groups in Beltsville, MD and Athens, GA, were selected to receive the 2009 Federal Laboratory Consortium Technology Transfer Award for their work on development and transfer of "Hyperspectral Imaging for Food Quality and Safety Inspection" to the private and public sectors. They have been working on the technology for 10 years. The technology is now being used in industry and research institutes worldwide.

They received the prestigous award at the Federal Laboratory Consortium Technology Transfer at their National Meeting this past May.

New Faculty

David Hodge joined the Department of Chemical Engineering and Materials Science and the Department of Biosystems and Agricultural Engineering as an assistant professor. Originally from Alabama, Hodge has a BS ('99) in Chemical Engineering with a specialization in pulp and paper engineering from Auburn University and worked for a year in a paper mill in Alabama.

He received his M.S. ('02) and Ph.D. ('05) from Colorado State University in Chemical Engineering with projects focusing on ethanol fermentation of 5-carbon sugars, optimal control of ethanol fermentations, and enzymatic conversion of plant biomass to fermentable sugars. Hodge worked at the DOE National Renewable Energy Laboratory (NREL) in Golden, Colo., during the last years of his Ph.D. and continued there as a post-doc. For the last 2½ years he has been part of the research faculty in the Department of Biochemical and Chemical Process Engineering at Luleå University of Technology in Luleå, Sweden. His primary research interests revolve around converting plant (lignocellulosic) biomass to fuels and chemicals with a particular focus on biotechnology.

Dr. Ferhan Ozadali was appointed adjunct assistant professor in BE and FSHN in October, 2008. Dr. Ozadali has a B.S. in Food/Chemical Engineering from Turkey, and an M.S. and Ph.D. in Food Science from Iowa State University, with a minor in Chemical Engineering. Since graduating, he worked two years as a research scientist at The Ohio State University, six years at Hirzel Canning Company in Toledo, and four years at Nestle Gerber in Fremont, Michigan. His present position is Principal Scientist & Global Process Authority in New and Strategic Process Technologies. He is recognized as an expert in aseptic processing.

More new Faculty on page 22

Srivastava Named ASABE Fellow

Ajit K. Srivastava, chair of the Department of Biosystems and Agricultural Engineering, has been named a fellow of the American Society of Agricultural and Biological Engineers (ASABE). Honored for numerous outstanding contributions to research, teaching, academic leadership, and dedicated service to ASABE, he was one of 15 individuals inducted to the 2009 class of ASABE fellows on June 23, 2009, during the ASABE Annual International Meeting in Reno, Nevada.

Chair Ajit Srivastava, accompanied by his wife Barbara, accepts the ASABE Fellow honor at the ASABE Meeting in Reno.

For more than 30 years, Srivastava has applied his expertise to the understanding and the application of machinery systems to food production, harvest, post-harvest, and processing operations. He has developed and taught several undergraduate and graduate courses at Michigan State University including a course in dimensional analysis and scale modeling. He was the lead author of the major textbook entitled, *Engineering Principles of Agricultural Machines*, which currently is in its second edition. He has mentored and served on guidance committees of more than 40 M.S. and Ph. D. students. For his dedication to teaching he was awarded the Withrow Excellence-in-Teaching award by Michigan State University's College of Engineering.

His research has focused on machinery systems for improving the productivity and profitability of the American farmer. Most notably, his early research on rotary grain-straw separation has contributed to the development of rotary combines. Srivastava has authored or coauthored numerous journal articles, conference proceedings, and technical papers and has received an ASABE Paper award. He also received a USDA-CSREES Group Honor award for Excellence in Northeast Multistate Project NE 179. He has been awarded two patents.

Several family members and friends were in attendance to congratulate Ajit on his honor.

As department chair since 1997, Srivastava has exhibited exceptional academic leadership. He initiated a faculty-led strategic planning process that resulted in a significant redirection of the departmental mission, vision and strategic directions including changing the name from Agricultural Engineering to Biosystems and Agricultural Engineering. Navigating through administrative challenges, he provided invaluable foresight and vision that have resulted in a department that is now growing, dynamic, and focused on the mission toward integrating and applying principles of engineering and biology to systems involving food quality and safety, sustainable ecosystems, and bioenergy. He is a fellow of the Michigan State University Committee on Institutional Cooperation (CIC) Academic Leadership Program (ALP).

A 36-year member of ASABE, Srivastava has provided leadership to numerous committees within the Power and Machinery division and Food and Process Engineering Institute, as well as to the P-515 Textbook and Monograph, and ED-210 Department Administrators committees. He has also served on the Publications council, and as a trustee on the ASABE Foundation board.

In addition to the various awards and honors, Srivastava received the Dennis M. Fenton Distinguished Alumni award from Rutgers University's Cook College in 2003. He is a member of the American Institute of Medical and Biological Engineers (AIMBE); and Alpha Epsilon and Sigma Xi honor societies.

Ajit and his wife Barbara have been married for 35 years and have two sons, Shaun and Steven. Ajit enjoys traveling and golfing.

Faculty News

Alocilja's students receive top scholarships

Evangelyn C. Alocilja, associate professor of Biosystems Engineering (foreground, left) with two of her most recent star students. Michael Anderson (left), a Ph.D. student in Biosystems Engineering, received a SMART — Science, Mathematics, and Research for Transformation Program — fellowship, which will cover full tuition, books, health insurance, and other fees and includes a stipend of $38,000 per year, for up to five years. Anderson is Alocilja's third SMART fellow. Hanna Miller, a Biosystems Engineering sophomore and professorial student in Alocilja's lab, received a Department of Homeland Security (DHS) scholarship, effective her junior year and renewable for her senior year. This schol arship pays for full tuition and books and includes a stipend of $1,000 a month. Miller also received an MSU DuVall Award for 2009, which includes a stipend of $1,500. Miller is Alocilja's third DHS scholar. The two previous DHS scholars are Tracy Kamikawa, a Ph.D. student currently doing her research in an FDA lab in Washington, DC; and Michael Wiederoder, who graduated from MSU in Biosystems Engineering in May 2009, and is currently attending graduate school at the University of Maryland.

Dr. Bradley Marks received the MSU College of Engineering 2009 Withrow Teaching Excellence Award. This award was created to recognize faculty of the MSU College of Engineering who have demonstrated excellence in instructional and scholarly activities and rendered distinguished service to the university and the student body. This is the third time Dr. Marks has received this award.

Jon Althouse was awarded the Honorary American FFA Degree in recognition of outstanding contributions made to youth through agricultural education and FFA. Mr. Althouse was recognized for leadership in developing a 9-week hands-on electrification education program that was delivered to several Agriscience programs in Michigan.

Changes in Biosystems Engineering B.S. Program

In the past year, several significant and exciting changes have been made to the Biosystems Engineering B.S. program, aimed at: (1) strengthening the core linkages between biology and engineering, and (2) enhancing opportunities for students to concentrate in important applications areas. Specifically, undergraduate BE students now are required to complete four courses in biological sciences (from the 100- to 400-level) plus two new BE courses in Microbial Systems Engineering (BE 360) and Engineering Design and Optimization for Biological Systems (BE 385). These changes enhance the students' background in basic biology and in the integration of that knowledge to engineering applications. Additionally, students now can choose among four concentrations that show up on their transcripts: bioenergy engineering (new!), biomedical engineering (new!), ecosystems engineering, and food engineering. For the new concentrations, new courses have been added in Biosensors for Medical Diagnostics (BE 445), Bioenergy Feedstock Production (CSS/FOR/BE 467), Biomass Conversion Engineering (ChE/BE 468), and Sustainable Bioenergy Systems (BE/ChE 469). All of the above changes were made as part of the continuous program improvement process, aimed at meeting the needs of our stakeholders, with input from our Industry Advisory Board. Overall, the program is designed to prepare our graduates to identify and solve a diverse set of problems at the interface of engineering and biology, and to succeed in a broad range of career paths.

Algae Cultivation for Bioenergy Production

The construction of the new Anaerobic Digestion Research and Education Center (ADREC) on the MSU campus is opening the doors to a variety of novel research projects exploring the production of bioenergy. MSU Department of Biosystems and Agricultural Engineering Professors Wei Liao and Susie Liu are investigating the use of algae in bioenergy production as an alternative to other terrestrial plants. When completed, the ADREC will house four pilot-scale open ponds for the culturing of algae.

The algae will utilize substances of phosphorus, ammonia and carbon dioxide that have potential environmental impacts to accumulate the algal biomass rich in value-added energy and chemical products such as starch, lipids and proteins, to name a few.

"Compared to terrestrial plants, algae have several major advantages for generating biomass," says Liao. "They use marginal land, have a faster uptake of nutrients from waste systems, offer year-round production and have a faster growth rate and higher photosynthetic efficiency."

BAE Professor Wei Liao

BAE Professor Susie Liu

Algal culture can be used as one of the post-AD processes to utilize the remaining nutrients and carbon dioxide from AD to reduce pollution and generate value-added products. These products range from omega-3 fatty acids, proteins as animal feed and starch and vegetable oil for biofuels.

Liao states that algae cultured on high concentrations of AD effluent tend to accumulate more carbohydrate and proteins than lipid, which generate another supplemental feedstock for bioethanol production.

The BAE algal research group has adopted a high-rate open pond system to conduct algal culture on anaerobic digestion effluent. The bench-scale studies demonstrate a significant removal of phosphorus and nitrogen with the algal cultivation. Rates of nearly 90 percent of the nitrogen and 88 percent of the phosphorus were removed from the effluent by the algal biomass.

Liu estimates that the use of an algal culture system with anaerobic digestion to treat 120 million dry ton of cattle manure could theoretically produce 2.66 million dry ton of algae biomass per year that could be used as fertilizer or nitrogen sources for biorefinery. The nutrient level in the effluent of algal culture is significantly reduced to total nitrogen less than 10 mg/L and the total phosphorus less than 0.5mg/L.

"The data clearly demonstrate that algal culture on anaerobic digestion effluent is a good solution to value-added chemical production and nutrient removal," Liu says.

Liao and Liu, and their associates, have been awarded a $1.5 million grant by the Michigan Public Service Commission to continue their research using a 200-cow dairy farm. The researchers will use the ADREC to conduct their studies.

MSU Anaerobic Digestion Research and Education Center

The multi-million dollar MSU Anaerobic Digestion Research and Education Center (ADREC), slated to open in 2010, is positioned to launch a new generation of research and education projects in the Department of Biosystems and Agricultural Engineering involving the conversion of waste to energy through anaerobic digestion.

The Anaerobic Digestion Research and Education Center (ADREC) will create a comprehensive research environment for projects involving analytical instrumentation and laboratory, bench and pilot-scale equipment. Currently this research is spread out at different locations across the MSU campus.

Dr. Steven Safferman

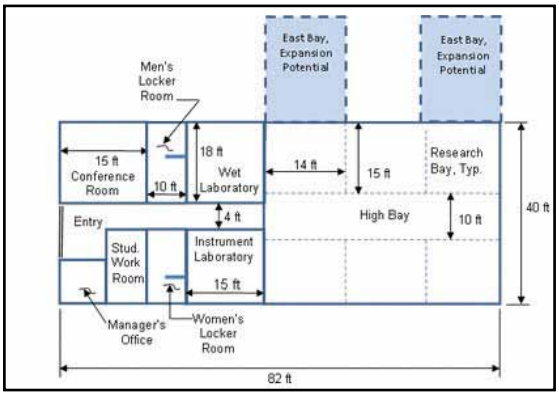
"The new center will create an umbrella for all the discovery work being done at the university from the pilot-scale in the laboratory to hands-on work at the dairy farm," says Dr. Steven Safferman, associate professor, Department of Biosystems and Agricultural Engineering at MSU. "In addition to the MSU dairy farm, we are also partnering with two other dairy operations to conduct field testing and evaluation."

The addition of the ADREC to the Animal Air Quality Research Center offers a one-of-a-kind complex for applied research on sustainability. This center reflects the growing interest in the use of anaerobic digesters to combat many environmental concerns including those associated with modern dairy farms and food processing.

Anaerobic digesters first became popular on farms in the United States in the 1970s in response to the energy crisis at the time, but early failure rates limited their longevity. Despite the slow acceptance rate, they have steadily increased since 1994. Today, there are approximately 114 operational farm-based digesters in the United States, with approximately 10 located in Michigan in various stages of planning and operation.

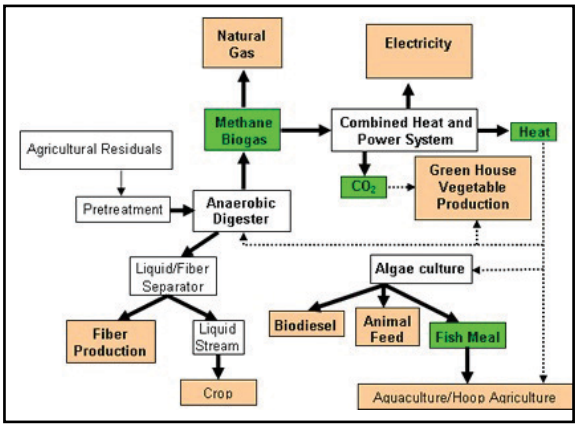
"The reason for their renaissance is their immense potential to provide an environmentally friendly solution to several farm-based problems with one technology," Safferman says. "That is why engineers in our department have made it a priority to ensure that anaerobic digesters become the cornerstone of a sustainable energy portfolio."

Green Meadow Farms, Inc, of Elsie, Mich. was the first newly constructed AD on a Michigan Farm in more than 20 years.



(left): The proposed floor plan of the new ADREC.

(right) The proposed flowchart of a sustainable waste management system.



Anaerobic Digesters

Anaerobic digesters (ADs) are enclosed tanks that decompose manure, food waste, or other organic material in an oxygen-free environment to produce and collect biogas. In the absence of oxygen, decomposing bacteria breaks down fats, proteins and carbohydrates into biogas, which is 50 to 70 percent methane and 30 to 40 percent carbon dioxide.

On farms, the ADs can help produce energy, control odor from livestock, improve air quality and reduce greenhouse emissions. In addition, the ADs provide high-value by products like irrigation water, nitrogen and phosphorus for fertilizer, and biofibers.

The captured biogas can be flared or used to generate heat, hot water, electricity or natural gas. Both the flaring and use of biogas for energy reduce methane emissions, allowing for the sale of carbon equivalents, which are tradable on the Chicago Climate Exchange.

ADs can be beneficial in a variety of processes. Any facility that processes animal manure, organic chemicals, milk, food, fiber, pharmaceuticals, municipal solid waste or wastewater has the potential to produce biogas from organic waste matter. Waste streams can also be blended to increase or optimize digester feed stocks and potentially increase methane production.

On Farm Compatibility

One newly constructed AD on a Michigan farm was constructed in 2006 at Green Meadow Farms, Inc, in Elsie, Mich. The field-scale AD was designed and constructed with the help of a $2 million grant from the Michigan Public Service Commission. Research on this field-scale AD includes demonstrating profitable energy production with implications for environmental protection, carbon sequestration and sustainable agriculture. The biogas generated at the farm is used to run an 800 kW generator set, which is connected to the grid.

"The combination of the on-campus center and the two field-scale ADs enable researchers to study cutting edge technologies in a commercial setting as well as research projects that rely on ADs," Safferman says.

The second on farm field-scale AD is located at Scenic View Dairy in Fennville, Mich. This 2,200-head dairy farm is the first to combine electricity generation with biogas upgrading to pipeline standards, providing a second option for revenue optimization by selling this energy to local power companies.

Long-term possibilities

BAE engineers use anaerobic respirometry to provide biogas potentials assays. They have developed tools to calculate how much methane can be produced from blending organic materials. These tools will help organizations determine the potential of a site-specific AD and its optimal placement of centralized digesters.

"Some of our biggest successes for other groups have been failures," Safferman says. "We can tell them what will and what won't work before they invest in the digester which can save them millions of dollars. Our clients are most thankful when we tell them it doesn't work at the bench level because we have saved them from investing in something that won't work."

Providing the pilot studies for other organizations is one way for the Center to remain sustainable. The other is to be more competitive for national grants.

"We see the MSU ADREC becoming a national center for research," Safferman says. "We are already receiving research grants for projects at the center. The research plus the education component will make us very competitive in research proposals."

Construction of the ADREC building is slated for the fall of 2009.

Researchers Improving Food Safety with Irradiation Technology

Reprinted with permission from *Resource* April/May 2009.

ASABE member Bradley Marks and Sanghyup Jeong are proving that X-rays can kill bacterial pathogens such as E. coli 0157:H7 and salmonella on the most delicate vegetables, extending shelf life in the bargain. Irradiation from other sources has been used for years to protect ground meat and other products, essentially pasteurizing food without cooking it.

"Our work to date has shown that X-ray technology is very effective in killing the bacterial pathogens without causing undesirable changes in product quality," Marks said.

A higher dose than is used for medical X-ray imaging is applied, yet less than is used by competing irradiation methods. That means less protective shielding is necessary, so the equipment is more compact and food companies can install it at their processing plants. Currently, food must be transported to specialty facilities, which eliminates irradiation as an option for much fresh produce.

Marks in the MSU food irradiation pilot lab.

Marks and Jeong work in the Michigan State University (MSU) Department of Biosystems and Agricultural Engineering and collaborate with Elliot Ryser, a microbiologist in the Department of Food Science and Human Nutrition.

They are using MSU's unique biosafety level-2 pilot processing facility to validate technology being commercialized by Rayfresh Foods, Inc., of Ann Arbor, Mich.

"The problem the leafy green industry faces is there is absolutely no kill step in the process of cleaning, rinsing, and bagging the product. There is nothing they can do," explained Peter Schoch, Rayfresh's CEO. The potential for widespread contamination is compounded by the mingling of greens from different sources in processing plants.

Food irradiation—which does not in any way render food radioactive—uses gamma rays from radioactive material or machine-generated electron beams, Schoch said, both of which tend to cause cellular damage and visually degrade food. X-rays promise a gentler, more scalable solution.

Rayfresh recently landed its first contract to build an X-ray machine to treat ground beef for Omaha Steaks, which inspected the prototype at MSU. The university's validation work was pivotal in winning that first order, Schoch said.

"We also have very significant interest from people who produce and use food service lettuce," he added, a product connected to a recent E. coli illness outbreak in Michigan and other states.

Before regulators and the market will accept such devices, however, their use for each food and target

Continued on page 11

Sanghyup Jeong, a visiting assistant professor in biosystems engineering, loads samples of lettuce into a prototype x-ray device to kill bacterial pathogens. (Photos by G.L. Kohuth)

Recent Advances and Future Directions in Nondestructive Quality Evaluation of Specialty Crops

Reprinted from New Zealand Institute for Plant and Food Research at Ruakura, New Zealand

Dr. Renfu Lu spent one week with the Applied Sensors Team, discussing progress on the 'Looking Into Fruit' FRST program. It was a marvelous opportunity for the team to get some direct feedback on progress from the world's leading researcher on non-destructive methods for fruit evaluation. Dr. Lu runs a very active research group with the USDA Agricultural Research Service, in East Lansing, and is also adjunct professor in the Department of Biosystems and Agricultural Engineering at Michigan State University. Dr. Lu had a full week of discussions with team members (particularly Andrew, Bob, Paul, Rod and Peter). He gave two formal seminars, one each at Ruakura and Mt Albert, as well as visiting and meeting with staff from Compac Sorting Equipment Ltd; our industry partner on the FRST program.

His feedback to us was very encouraging, commenting that we are

probably better placed and able than any other team in the world to really hit hard on the problems involved in making fast on-line measurement a commercial reality. In turn it was quite clear to us that our interests are very complementary to his, he being more focused on exploring the general capability of hyperspectral imaging. Hyperspectral imaging is rich in possibilities for a variety of useful fruit measurements but taking it online, to very high speeds in an affordable manner, is not straight forward at all.

The conclusion of the week was a promise to collaborate with Dr. Lu on developing a light scattering measurement method for fruit firmness prediction, using a variant or otherwise of his hyperspectral imaging system.

Irradiation Technology

Continued from page 10

bacteria must be scientifically validated.

That ensures a continuing role for the MSU testing facility and staff, who also are working on validating the technology to kill salmonella on almonds. Earlier this year, the U.S. Food and Drug Administration published a final rule allowing the use of irradiation for iceberg lettuce and fresh spinach, a move expected to open the doors to greater use of the technology for leafy greens (www.fda.gov/consumer/updates/irradiation082208. html).

Regulators have studied irradiation of food for 40 years and approved its use for red meat in 1997. Irradiation also now may be applied to other foods such as spices, poultry, and shellfish including oysters, clams, and scallops.

The world food irradiation market is predicted to exceed $2.3 billion by 2012, according to Global Industry Analysts Inc.

MSU Student Teams Place in the Environmental Challenge International

After a tough competition with 11 teams in the Environmental Challenge International at the 2009 Air and Waste Management Association (A&WMA) 102nd Annual Conference & Exhibition, MSU student teams were able to capture third and fourth place. The competition began early in 2009 with a real-life problem definition concerning Moochville, a theoretical town in Michigan's Upper Peninsula, facing a municipal solid waste (MSW) handling issue as the local area landfill was quickly running out of space. The objective of the competition was to design a MSW management plan that was able to treat and/or dispose of MSW adhering to specific environmental, economic, and social aspects in addition to production of renewable energy and sustainability as set forth by the local community, the college, and various role players.

To participate in the competition, teams were required to submit a technical paper prior to the A&WMA Annual Conference detailing their selected design and management plan. Judges reviewed the papers and then had the opportunity to ask probing questions and pose theoretical situations concerning the various design aspects during the poster session (where student teams were required to prepare a technical poster), and the final presentation. Their questions gave the judges insight into the students' knowledge and preparation.

During the A&WMA Annual Meeting, attended by numerous professionals, students were given a theoretical addition/change to the problem, typical of real-life design situations. In this year's challenge, the added complication was the treatment/disposal of fly ash from the college's coal power plant. This addition assessed the ability of each team to use the conference resources to determine the most practical and efficient design change to meet the new demands.

Teams evaluated various engineering designs including landfills, mechanical biological treatment (MBT), incineration, and plasma arc technologies to name a few. Each team evaluated the specific technologies for the various objectives that they outlined and selected the most efficient design. In addition, reduction in waste, recycling and reuse, and social programs were integrated into designs.

Each of the two MSU teams developed an engineering design in combination with a social and holistic community management plan to present as a problem solution. Megan Massa, Adarsh Menon, Elizabeth Brown, and Jon Libby made up Garbage Gurus Inc., and won fourth place with their bioreactor landfill design. The novel features of their design included a landfill gas-to-energy plant, a geo-exchange system to utilize the heat generated by the biological processes in the landfill, and a leachate recirculation system to boost the gas generation capability. GeoGreen Solutions, comprised of Felix Yeboah, Indumathy Jayamani, Ziqiang Yin, Biao Chang, and Becky Larson, secured third place using a MBT technology paired with an intensive recycling, reuse, and waste reduction strategy.

The successes of both teams are a result of hard work, detailed research, and analysis of the design. Each of the teams spent many hours evaluating various technologies and every aspect of the management plan. The experience expanded the knowledge base of each participant about the difficulties in real-life design and the many aspects that come into play, particularly those outside of the technical realm. The teams would like to thank the East Michigan Chapter for their support in attending and participating in the competition, as well as Dr. Susan Masten, Scott McQuiston, and Ruthie Levy for their encouragement and support.

We would also like to acknowledge financial support from the Departments of Civil and Environmental Engineering, Chemical Engineering and Materials Science, Biosystems and Agricultural Engineering, and the Environmental Science and Policy Program.

GeoGreen Solutions (3rd Place)

From left to right: Biao Chang, Felix Yeboah, Becky Larson, Indumathy Jayamani, and Ziqiang Yin

Garbage Gurus Inc (4th Place)

From left to right: Adarsh Menon, Jonathan Libby, Elizabeth Brown, and Megan Massa

Graduate Student Completes Nestle Internship

Dharmendra Mishra, a Ph.D. student in Biosystems Engineering, under the mentorship of Dr. Kirk Dolan, recently completed a year-long graduate internship with Nestlé Nutrition Product Technology Center in Fremont, Michigan. During his internship, he worked with Dr. Ferhan Ozadali, Principal Scientist & Global Process Authority in New and Strategic Process Technologies at Nestlé and an adjunct faculty in the departments of BAE and FSHN. Dharmendra worked in the area of aseptic process development and product improvement of baby foods.

Dharmendra returned to MSU in August 2009 to complete his Ph.D. in the area of optimization and mathematical modeling of the food processing systems. His research work will continue to be funded by Nestlé PTC Fremont. This is an excellent example of how the department is collaborating with industry partners in providing highly focused, quality education to our students. The Department seeks similar collaborations with other industry partners. The BAE department thanks Dr. Ozadali and Nestlé for their mentorship and sponsorship.

Graduate Awards 2009

BAE Endowed Fellowship
Haiyan Cen
Rebecca Larson

Merle & Catherine Esmay Scholarship
Rabiha Sulaiman

Bill & Rita Stout Scholarship
Niroj Aryal

Student Awards

Undergraduate Scholarships 2009

F. W. Bakker-Arkema Endowed Scholarship
Juliana Henriques

A.W. Farrall Scholarship
Ellen Bornhorst
Brandon Coles
Catherine Dudgeon
Hanna Miller

Clarence & Thelma Hansen Scholarship
Joseph Ahlquist
Jennifer Jury
Nancy Maschke
Michael Schierbeek
David Sparks

Howard & Esther McColly Scholarship
Bradley Wardynski

George and Betty Merva Scholarship
Natalie Bouchard

Biosystems Engineering Merit Scholarship
Lauren Dietz
Jessica Emery

2009 University Undergraduate Research and Arts Forum

Congratulations to Michael Wiederoder, Kyle Anderson, Jackie Palmer, Thomas Skrocki, Hanna Miller, and Alyse Egner. These Biosystems Engineering students won all three engineering Student Projects Group awards at the 2009 University Undergraduate Research and Arts Forum (UURAF).

MSU BAE Senior Design Showcase

2009 Biosystems Engineering Design Project Class

Every year, teams of Biosystems Engineering students, enrolled in the two-semester senior design capstone expereince, BE 485/487, develop, evaluate and select design alternatives in order to solve real-world problems. The projects are diverse, but each reflects systems thinking by integrating interconnected issues impacting the problem, including critical biological constraints. The engineering design process is documented in a detailed technical report. The project designs are then presented to engineering faculty and a review panel of licensed professional engineers for evaluation.

Engineering and Technology for Detecting Medical Device Related Tampering

Team Members: (Pictured l-r) Chelsea Peterson (South Lyon, MI) Patrick Breen (New Lenox, IL) Trevor McLean (Okemos, MI) and Matthew Burtt (Charlevoix, MI)

Academic Advisors: Dr. Evangelyn Alocilja, MSU BAE
Industry Advisors: Dr. Paul Satoh, Neogen Corporation; Steve Steffes, Perrigo; Rebecca Leaper, Abbott.
Medical Packaging Supplies: Barger Packaging, Elkhart, IN

The epidemic level of infections following surgery has prompted the U.S. Center for Disease Control to urge hospitals to include biological indicators to identify defective medical packaging for both invasive and noninvasive devices. Incorporating a tamper detection method to current medical packaging is a major step in reducing surgical site infections.

Preliminary data prompted testing and design optimization of two oxygen indicator prototypes that are contained inside modified atmosphere packaging that is 99 percent oxygen free.

- Zinc-air battery, light emitting diode — two zinc air batteries connected in series to a light emitting diode (LED). The batteries provide power and light the LED only in the presence of oxygen.
- Colorimetric, ultra-violet (UV) light activated— a mixture of methylene blue (dye), anatase titania, triethanolamine (semi-electron donor), and hydroxylethyl cellulose is dried on a paper substrate and inserted into an oxygen free package. When exposed to UV light, the dye lightens in the oxygen free environment. When the package is opened or compromised, oxygen enters the package and the dye reverts to the original color.

These indicators provide hospitals a way to indicate compromised product package and verify instrument sanitation with a quality control checkpoint.

Process Design of an Anaerobic Digester for the Kellogg Biological Station

Team members: (Pictured l-r) Thomas Shedd (Tekonsha, MI), Andrew Hoyles (Okemos, MI) and Christopher Gancsos (Jackson, MI)

Client: Michigan State University Kellogg Biological Station Dairy Farm
Academic Advisors: Dr. Steven Safferman, MSU BAE
Industry Advisors: Michelle Crook, Michigan Dept. of Agriculture; Todd Forbush, Techmark, Inc.

Anaerobic digestion is a biochemical process by which microorganisms digest biomass in an environment lacking oxygen. Products include biogas, available to generate heat or electricity, and digestate. The digestate is a slurry that is either applied to the soil as an amendment or separated into solid and liquid components that are individually used as resources.

As an extension education facility aiming to showcase technological advances in sustainable agricultural practices, the Kellogg Biological Station dairy farm expressed interest in installing an anaerobic digester to effectively and sustainably treat manure.

To ensure a sustainable system, a process design for an anaerobic digester was developed to produce biogas at a rate adequate to satisfy the system heat requirements. The process design included feedstock source identification, system modeling, digester selection and the development of a byproducts management plan.

Silage Leachate and Runoff Mitigation using a Constructed Treatment Wetland

Team members: (Pictured l-r) Sean Woznicki (Warren, MI) Brandon Kovnat (West Bloomfield, MI), Abby Johnson (Lansing, MI) and Daniel Cycholl (Rochester Hills, MI)

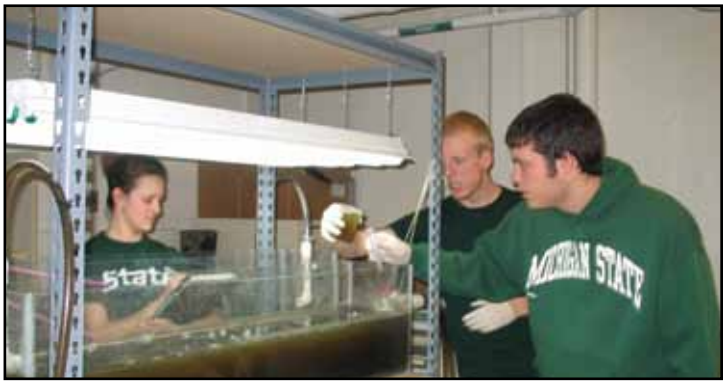
Client: Michigan State University Kellogg Biological Station
Academic Advisor: Dr. Dawn Reinhold, MSU BAE
Industry Advisors: Juanita McCann, US Dept. of Agriculture-Natural Resources Conservation Service; Larry Stephens, Stephens Consulting Services, and P.C.

The MSU Kellogg Biological Station (KBS) located in Hickory Corners, Mich., operates a small-scale dairy farm that serves as a teaching and research facility where new and common farming practices are displayed and implemented. KBS uses silage as cattle fodder, which consists of fermented, high-moisture corn. Silage, compacted and stored in bunker (horizontal) silos, leaches liquid that is high in nutrients. With improper management, silage leachate contaminates surface and ground water, causing eutrophication of ponds and lakes, fish kills, and vegetation burn. KBS requested the design of a constructed treatment wetland to manage this waste stream.

Constructed treatment wetlands are a low-cost sustainable solution to treating agricultural, industrial and municipal wastewater. Wetlands use an abundant supply of water to increase biological productivity, while overcoming shortages of other essential chemical elements such as oxygen. The relatively high rate of biological activity transforms wastewater pollutants into byproducts or essential nutrients that benefit the wetland system.

The wetland area and hydraulic loading rate required to reduce nitrogen, phosphorus and biochemical oxygen demand in the silage leachate to regulatory levels are calculated using empirical design equations. A vegetation tolerance study is performed as a preliminary assessment of the effects of silage leachate nutrient concentrations on the growth of duckweed, a plant species commonly used in constructed treatment wetlands.

Farm Nutrient Management Through Algae Production



Team: (Pictured l-r) Katie Borga (Norway, MI), Brad Love (Bancroft, MI) and Aaron Work (Farmington Hills, MI)

Client: Dr. Jan Stevenson, MSU Dept. of Zoology
Academic Advisor: Dr. Wei Liao, MSU BAE
Industry Advisors: Norma McDonald, Phase 3 Renewables; Paul Eisele, Private Consultant

The use of liquid digestate from anaerobic digestion as feed to benthic algae culture systems was explored. During growth, the algae sequester nutrients form the liquid digestate. The produced algae is then converted into products such as fertilizer amendments, animal feed supplements and biofuels. As a sustainable solution to manure management, the MSU dairy farm plans to construct an anaerobic digester and utilize the liquid digestate as a nutrient source in an onsite algae raceway reactor.

This project involves the construction and operation of three raceway reactor prototypes to simulate algae growth and nitrogen and phosphorus removal rates under varying flow velocities while temperature, light exposure and fluid depth are held constant. Data analysis will determine if flow velocity significantly effects biomass yield and nutrient removal rates at the 95 percent level of confidence.

Post-Processing Microbial Control on Shelled Chestnuts

Team: (Pictured l-r): Thomas Skrocki (Rochester Hills, MI) Kyle Anderson (Westland, MI) Jackie Palmer (Clinton Township, MI) and Michael Wiederoder (Midland, MI)

Client: Chestnut Growers, Inc.
Academic Advisors: Dr. Daniel Guyer and Dr. Bradley Marks, MSU BAE
Technical Advisor: Irwin Donis-Gonzalez, MSU BAE
Industry Advisors: Scott Millsap, JBT Food Tech; Steve Richey, Kellogg Company

During the processing of peeled chestnuts, a microbial build-up occurs on the surface of the product that creates a spoilage biofilm after a short period of refrigerated storage. A solution to reduce the microbial load must be devised to prevent an unsightly and unpalatable product from reaching consumers.

To achieve the objective, a two-log reduction in total microbial count is needed based on previously collected data. The project focused on steam treatment, a food grade chemical bath and ultra-violet light as processing methods to reduce the amount of biofilm.

Data from treated chestnuts is collected using standard microbiological measurement techniques and is statistically analyzed to evaluate the ability of each treatment method to reduce the microbial load. Sensory evaluations of treated chestnuts are used to assess changes to the overall product taste and texture. Proposed alterations to the existing process, which meet the client's needs, are based on bench-scale results, general observations, and published literature.

Chinese Students from Zhejiang University in Hangzhou, China, Spend Summer Research Internship in BAE

Dr. Jian Ping Wang, Chair of the Department of Biosystems Engineering of Zhejiang University and Dr. Ajit Srivastava, Chair of the Department of Biosystems & Ag Engineering of Michigan State University sign an agreement between the two universities.

MSU President Lou Anna Simon is committed to transforming MSU from a Land-grant university to a World-grant university. She launched a special initiative, Boldness by Design, in 2005 during the sesquicentennial year of the university which includes five imperatives: enhance the student experience; enrich community, economic, and family life; expand international reach; increase research opportunities; and strengthen stewardship.

In keeping with Boldness by Design global imperative, the department has signed a memorandum of agreement with the Zhejiang University College of Biosystems Engineering and Food Science. According to the 3+1+X agreement students will complete three years of the undergraduate degree in their home institution and will attend their senior year in Biosystems Engineering at MSU taking senior level courses including the capstone design sequence. These course credits will transfer to their home institution which will grant their bachelor's degree in Biosystems Engineering. Students will continue on for their MS degree in Biosystems Engineering at MSU. Students interested in taking advantage of this agreement have the opportunity to spend a five-week summer internship in the various labs of the department prior to entering the program. A group of eight students participated in summer internship during 2008 and a second cohort of nine students came during summer of 2009. Students were assigned to different faculty members depending on their interests, and in addition to gaining valuable lab experiences, they had excellent social interactions with other MSU students and went on several cultural tours within the state of Michigan.

MSU is committed to developing an in-depth relationship with China and has established an office of MSU China programs in Beijing.

Study Abroad – Impacts on the Mind?

By: Luke E. Reese

Study Abroad is a mind-broadening experience even in English-speaking destinations. Could the same content be learned in the US or in an MSU classroom? The answer to that question is likely yes, but the impacts are drastically different. When you personally see, feel, hear, smell or taste an issue or problem, there is a reality context to solutions. By taking students out of their comfort zones, senses are sharpened and observations become clearer. The simplest of things can have an impact such as all paper money in the world isn't green like the US, or you really can drive safely on the left side of the road. However, from a critical-thinking standpoint, study abroad students learn systematic approaches and to be careful with assumptions and perceptions.

Eric Richey, 2009 TSM graduate, and Kevin Koryto, BE Junior, respectively participated in the 2008 and 2009 Sustainable Food, Environment and Social Systems study abroad program in Australia earning credit for ISS 310: People and Environment. Eric was featured in a November 2008 Resources (p. 18) article where he stated, 'To be sustainable, there has to be a balance of three topics – environment, economy and social issues. You might ask, "What is this balance?" The answer I like is this: "It's different for every person on the planet, depending on what he or she deems important." However, when you balance

Continued on page 18

Donor Appreciation Luncheon 2008

The Biosystems & Agricultural Engineering Donor Appreciation Luncheon took place in November 2008 at the University Club at MSU.

We celebrated Clarence Hansen's 95th birthday (BAE Professor Emeritus) at the luncheon by presenting him with a surprise birthday cake.

Pictured: *left: Biosystems Engineering student John Roberts entertained us with his guitar-playing and singing of some original songs he had written.*
(top right) Clarence & Thelma Hansen listen to a lively rendition of Happy Birthday!
(bottom right) Bob Wilkinson (BAE Professor Emeritus) and wife Ellen, visit with Thelma Hansen.

Study Abroad

Continued from page 17

any two of the three topics, this remaining third topic is always negatively impacted.' Sustainability is often exemplified by a three legged stool where one leg is allocated to economic, environment and social issues. All three legs must be strong and in balance else the stool will topple.

Kevin studied Technologies and Practices for Sustainable Water Use during his 2009 trip. Reality and book learning merge when every toilet you flush has a dual flush water conservation mechanism, you visit Sydney Olympic Park where all water is collected on-site and recycled and you travel on the Murray River that no longer flows to the sea. The Murray River demise caused by human impact/management negatively impacts the economic sectors: agriculture and tourism, the environmental sectors: loss of wetlands, loss of biodiversity, salinity, bank slumping, and acid sulfate soils and not to be omitted the social sector: livability. Often engineering solutions are strong on economic and environmental goals but lack the necessary strength in social sustainability. Kevin states in his final research project report, "Seeing the current critical situation now it is evident that we must think about problems in future terms. Solving water shortages will only be attained through the fusion of changing attitudes towards water use and implementing effective technologies."

Study Abroad – Impacts on the Mind? Absolutely!

Kevin Koryto, Sydney Olympic Park Water Recycle Plant, Sydney, New South Wales, 2009. The Sydney Olympic Park Water Reclamation and Management Scheme (WRAMS) is designed to save more than 850 million litres of drinking water annually and was Australia's first large scale urban water recycling scheme. WRAMS supplies high quality recycled water with 40% used for toilet flushing and the remaining 60% is used for irrigation and operational wash-down activities.

Alumni Awards

MSU College of Engineering BAE 2009 Distinguished Alumni Award
R. Paul Singh

Dr. R. Paul Singh is a Distinguished Professor of Food Engineering, Department of Biological and Agricultural Engineering and Department of Food Science and Technology, University of California at Davis. He received his degrees in the area of agricultural engineering from Punjab Agricultural University (B.S. 1970), University of Wisconsin (M.S. 1972), and Michigan State University (Ph.D. 1974). His research involves transport phenomena in food processing and mathematical modeling to seek improvements in process efficiency. Dr. Singh is a Fellow of the Institute of Food Technologists, American Society of Agricultural and Biological Engineers, and the International Academy of Food Science and Technology.

He is an author or co-author of 3 U.S. patents, 15 books, and over 230 refereed papers. Dr. Singh received the Samuel Cate Award for Research in 1982 and International award in 1988 from the Institute of Food Technologists, and Distinguished Food Engineer Award in 1997 from the Dairy and Food Industry Suppliers Association. He received the Kishida International award in 2007 and A.W. Farrall Young Educator Award in 1986 from the American Society of Agricultural and Biological Engineers. He is currently serving as Editor-in-Chief of the Journal of Food Engineering. In 2008, Dr. Singh was elected to the National Academy of Engineering.

BAE 2009 Distinguished Alumni Award
David A. Hamilton

David A. Hamilton is chief of the Water Management Section, Land and Water Management Division, Michigan Department of Environmental Quality. He oversees all of the division's engineering functions, including the Hydrologic Studies, Dam Safety, Lake Level Engineering, Floodplain Management, and Transportation Project Review Programs. Dave previously managed the Surface Water Quality Division, which included NPDES permits and nonpoint source control; the Soil Erosion and Sedimentation Control Program; and the Inland Lakes Management Program. He has a B.S. degree in Agricultural Engineering from Michigan State University, with special emphasis in Soil Conservation and Water Management. He has a M.S. degree in Civil Engineering from the Massachusetts Institute of Technology, with emphasis in Hydrology and Water Resources. He has worked for the Department of Natural Resources, and the Department of Environmental Quality, since 1978. His work involved both surface and groundwater hydrology, and both water quantity and water quality issues. He has been a licensed professional engineer in Michigan since 1980.

Dave is one of the principal developers of Michigan's Water Withdrawal Assessment Tool. The Assessment Tool is designed to evaluate the likely impact of water withdrawals on stream fish populations. It is a unique combination of hydrologic, well hydraulics, and fish response models.

BAE 2009 Outstanding Alumni Award
Thomas W. Hefferan

Tom Hefferan is a Process Engineer working at Eli Lilly's biotech manufacturing plant supporting the manufacture of human insulin crystals in Carolina, Puerto Rico. He attended Coopersville High School in West Michigan, followed by five years at Michigan State University, earning his Bachelor of Science in Biosystems Engineering with a cognate in Food Engineering. This invaluable experience peaked interest in food production processes such as dairy foods, which opened up an opportunity to grow with Seiberling Associates in Roscoe, Illinois, after graduation in May of 2004. Following nearly two years of learning the food, dairy and pharmaceutical industries, he chose to follow personal and professional goals and move to Puerto Rico to support Lilly's biotech operation in April of 2006. At his current position within "Lilly del Caribe", he supports all technical aspects of the biotech plant's Clean-In-Place (CIP) operation.

Tom wishes to continue supporting the production team by providing technical expertise on process and manufacturing equipment, but seeks to expand on experience in process modeling and optimization by starting coursework for a Master's degree in Industrial Engineering starting in Fall of 2009.

~ Year in Review ~

Fall 2008 Meeting
Battle Creek, Mich.

The Fall meeting was held on September 26, 2008. The meeting started with the dedication of the ASABE Historical Landmark for the first flaked cereal at the Helen Warner Branch of the Willard Library in Battle Creek, Mich.

The general meeting was held prior to dinner at Clara's on the River. Approximately 20 members attended the meeting and orders of business included passing an updated set of bylaws and the election of officers for the coming year.

ASABE Historical Marker Dedication (l-r) Dale Marshall, Melissa Moore, Gerald Isaacs and Ajit Srivastava

Spring 2009 Meeting
East Lansing, Mich.

The Spring meeting was held on April 24, 2009, in Farrall Hall at Michigan State University. The general meeting was attended by approximately 20 members. Notable orders of business included awards and recognitions discussed below.

The general meeting was followed by ongoing research updates from the BAE department. The meeting was concluded with a dynamic presentation from North Carolina's Dr. Bill Hunt about Biorention Basins (Rain Gardens).

Dr. Bill Hunt's presentation on "Evolution of Bioretention Design in North Carolina as a result of Field Research."

Keith Tinsley and the rest of the MI ASABE Section recognized Paula Steiner, Michigan Section Chair, for her instrumental role in reinstating the Michigan ASABE Section. Prior to Paula's involvement the Section had been inactive for over 20 years. Thanks to Paula's hard work and vision, the Section is now thriving. May we all benefit from Paula's efforts for many years to come!

Biological Engineers (ASABE)

Awards and Recognition – Milestone Anniversaries

Dale Marshall receiving his 50-year Milestone Recognition from Paula Steiner at the spring meeting.

Congratulations to all of our Section members that are celebrating anniversaries this year!

Dean G. Baas	25 years
Mary E. Maley	25 years
Fred W. Bakker-Arkema	40 years
Harold A. Hughes	40 years
Russell H. Hahn	50 years
Cernyw K. Kline	50 years
Dale E. Marshall	50 years
Keith E. Robertson	50 years
Gene R. White	50 years
Floyd W. Reuter	60 years
Clarence M. Hansen	61 years
George D. Kreuzkamp	61 years
Jimmy L. Butt	63 years
Leland E. Morgan	64 years
Ernest H. Kidder	73 years

2009 ASABE Summer Social and Networking Event

This year's ASABE Summer Social and Networking Event was held at Oldmobile Park in Lansing, Mich., on August 25, 2009. The Lansing Lugnuts hosted their interstate rival and Detroit Tigers affiliate, the West Michigan White Caps. Approximately 20 people including ASABE members, friends, and family attended the event. Our group sat along the third baseline and was recognized on the scoreboard and welcomed over the public announcement system.

Upcoming Events

Fall 2009 Meeting – White Pigeon, MI
The 2009 Fall Meeting will be held at Fresh Solution Farms, a potato packing and storage facility in southwestern Michigan.The tentative date of the meeting is Friday, October 2, 2009. We will be receiving a tour from fellow Michigan Section member, Keith Tinsey. Also invited are the Southwest Michigan Society of Women Engineers (SWE) Chapter and Indiana ASABE members. This will be a great opportunity to network with your peers. For more information about this event please contact Paula Steiner at psteiner@nthconsultants.com.

Get Involved!

For more information about the Michigan Section of ASABE please contact Paula Steiner, MI Section Chair at psteiner@nthconsultants.com.

BAE Distinguished Lecture Series

Dr. William Hunt, Assistant Professor and Extension Specialist in North Carolina State University's Department of Biological and Agricultural Engineering department, presented his research on bioretention design to the members of the BAE Department this past April.

Bioretention, also known as Rain Gardens, has become one of the most popular stormwater management practices in the United States. However, the technology is relatively young and continues to be refined by research and demonstration. As part of North Carolina Cooperative Extension's mission, field faculty and campus faculty in Biological and Agricultural Engineering have conducted applied research on 22 different bioretention cells. The cells have been studied for periods exceeding 10 months and are located from coastal North Carolina to the state's western mountains. The purpose of the research has been to refine design standards from relatively coarse standards initially used in NC and other states. In part due to this research, the state of North Carolina now awards credit differently to bioretention, allows a wider range of vegetation to be used, encourages alternative under drainage configurations, and has a specific fill media specification. The research conducted by NC State faculty and students, and the changes in NC design standards from 2002 to 2009, was presented at this seminar.

Dr. David L. Sedlak, from the University of California, Berkeley, visited the MSU campus in March to discuss his work on Engineering Surface Waters to Facilitate the Removal of Trace Organic Compounds. A summary of his comments follows:

Since the first reports that steroid hormones in wastewater effluent cause feminization of fish, considerable effort has been directed at modification of wastewater treatment plants to enhance the removal of trace organic compounds. However, advanced treatment methods do not control all of the contaminants of concern and in some cases plant modification may not be practical. In addition, public concerns about wastewater-derived contaminants have led to considerable interest in the use of natural barriers as part of the treatment process. As a result, environmental engineers are attempting to engineer surface waters to remove organic contaminants. Among the different options for achieving these goals, engineered treatment wetlands hold great promise as passive treatment systems for contaminant removal because they are inexpensive and aesthetically appealing. Building reliable and effective treatment wetlands will require the development of a better understanding of the attenuation processes that occur in surface waters and methods for controlling naturally occurring processes. In many cases, the challenges associated with the engineering of surface waters will be similar (but more difficult) than those faced by the designers of conventional wastewater treatment plants and will require interdisciplinary research in chemistry, biology and fluid mechanics.

New Faculty

Continued from page 4

Joan Rose, a Homer Nolin Endowed Chair Professor, was appointed to the Department of Biosytems and Agricultural Engineering (BAE) effective July 1, 2009. She is a Co-Director for the Center of Water Sciences (CWS) and Center for Advancing Microbial Risk Assessment. Dr. Rose is also a professor in the departments of Fisheries and Wildlife (FW) and Crop and Soil Sciences (CSS). Joan's areas of expertise include microbial water quality and public health.

Alumni notes...

McIntyre Builders, Inc. (**Arn McIntyre**, 1986 graduate of Agricultural Engineering Technology), was a gold winner of the 2009 National Energy Value Housing Award presented by the NAHB Housing Research Center.

Adnan Degirmencioglu has been named chair of the Department of Agricultural Machinery, Ege Univeristy, Turkey.

Gift and Order Form

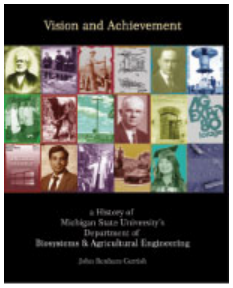
A gift to BAE is an investment in future generations, in the environment, in food safety, and in the planet.

In support of the MSU Department of Biosystems and Agricultural Engineering, I am enclosing $_____.
I designate this gift to be used for:

	Biosystems and Agricultural Engineering Discretionary Fund A104		Deborah and Timothy Spehar Endowed Scholarship Fund A10428
	Agricultural Engineering Laboratory Enhancement Endowment Fund A1047		Electrical Technology for Agriculture Fund A10402
	Agricultural Engineering Endowed Fellowship Fund A1043		F.W. Bakker-Arkema Endowed Scholarship Fund in Biosystems Engineering A10416
	Alfred and Mary Murray Endowed Scholarship Fund A10430		Galen K. Brown Endowment Fund A10424
	Arthur W. Farrall Endowed Scholarship Fund A10404		George E. and Betty L. Merva Endowed Scholarship Fund A10412
	Bill and Rita Stout Expendable Scholarship Fund A10422		Howard F. and Esther L. McColly Endowed Scholarship Fund A10411
	Biosystems Engineering Fund A10413		Katherine and Merle L. Esmay Endowed Fellowship Fund A10423
	Biosystems and Agricultural Engineering Centennial Endowment Fund A10426		Robert Gustafson Endowed Scholarship Fund A10427
	Clarence and Thelma Hansen Endowed Scholarship Fund A10401		Walter M. and Lillie M. Carleton Endowed Scholarship Fund A10429

Last Name _____ First Name _____ MI _____
Address _____ City _____ State _____ Zip _____
E-mail _____ Phone _____
o Alumni – Degree/Year _____ o Friend o Parent o Faculty/Staff o Business/Corporation

Make checks payable to: Michigan State University
Mail gift check to: Michigan State University Development Office
300 Spartan Way
East Lansing, MI 48824-1005



"Vision and Achievement" by John Gerrish
A History of MSU's Department of Biosystems and Agricultural Engineering
$125 donation

"Spring" Watercolor 13" x 20"
$250 donation

I would like to order the following:

	Donation	# of copies	Total
History Book	$125		
"Spring" 13" x 20" watercolor of Farrall Hall	$250		
"Morning Shadows" 11" x 14" watercolor of Farrall Hall	$100		

"Morning Shadows" Watercolor 11" x 14"
$100 donation

Mail merchandise check to: Biosystems & Agricultural Engineering
Michigan State University
216 Farrall Hall
East Lansing, MI 48824-1323

Thank you for supporting BAE!!

Michigan State University
216 Farrall Hall
East Lansing, MI 48824
517-355-4720

Presorted
Nonprofit
U.S. Postage
PAID
East Lansing,MI
Permit #21