Department of Biosystems & Agricultural Engineering BE 485/487

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About the Program

The Biosystems Engineering (BE) undergraduate program prepares graduates who will integrate and apply principles of engineering and biology to a wide variety of globally important problems. To achieve that purpose, the primary objectives of the BE program are to prepare graduates to:

- Identify and solve problems at the interface of biology and engineering, using modern engineering techniques and the systems approach, and
- Analyze, design, and control components, systems, and processes that involve critical biological components.

Additionally, the Biosystems Engineering program is designed to help graduates succeed in diverse careers by developing a professional foundation that includes vision, adaptability, creativity, a practical mindset, effective communication skills for technical and non-technical audiences, the ability to work in diverse, cross-disciplinary teams, and a commitment to sustainability, continuing professional growth, and ethical conduct.

BE 485 / BE 487 Courses

Biosystems Engineering student teams, enrolled in the two-semester biosystems design capstone experience, BE 485/487, develop, evaluate, and select design alternatives in order to solve real world problems. Projects are diverse, but each reflects systems thinking by integrating interconnected issues affecting the problem, including critical biological constraints. The engineering design process is documented in a detailed technical report. Teams present project designs to engineering faculty and a review panel of professional engineers for evaluation. Each BE 485/487 capstone design team prepares and presents a design solution in report, poster and oral formats to industry, faculty, peers and the public that:

- Requires engineering design
- Combines biology and engineering
- Solves a real problem
- Uses a holistic approach
- Interprets data
- Evaluates economic feasibility

Industry Advisory Board & Project Evaluators

The purpose of the Industry Advisory Board is to facilitate the exchange of ideas between Board members, faculty, and students of the BE program. Its function is to improve continuously the BE program quality by keeping it current and relevant to industry needs. Regular and adjunct board members also serve as external project evaluators.

Board

Mr. Kevin Blue - Meijer
Ms. Lisa Buchholz - Dow AgroSciences
Ms. Michelle F. Crook, PE - MDNR
Ms. Cassaundra Edwards - Bimbo Bakeries, USA
Mr. Bryce Feighner, PE - MDEQ
Mr. Gene Ford - Nestlé Nutrition
Mr. Andrew Granskog, PE - USDA-Rural Development
Ms. Ashley Julien, EIT - MDARD
Mr. Andrew Knowles - JBT FoodTech
Mr. Jeffrey Mathews, PhD - PepsiCo Global Beverage R&D
Mr. Mitch Miller - General Mills-Yoplait
Mr. Steve Richey - Kellogg
Mr. Larry D. Stephens, PE - Stephens Consulting Serv., P.C.
Mr. Kirk Walter - Perrigo
Mr. Richard Woodford, PE - USDA-NRCS
Mr. Rob Yoder - BDI, Inc.

Project Evaluators

Dr. Marialuci Almeida - Kellogg
Ms. Diana Bach - Meijer
Mr. Shane Bennett, PE - Dow Chemical Company
Ms. Holly Bowers - Consumers Energy
Mr. Dylan Comer - JBT FoodTech
Mr. Thomas Cornish - Perrigo
Mr. Ben Darling - MSU Land Management
Ms. Danielle Habitz - Kellogg
Mr. Tim Krause, PE - Granger
Ms. Sara Linder - Dow AgroSciences
Dr. Erik Petrovskis, PE - Meijer
Mr. Chris Rivard - Perrigo
Mr. Keith Tinsey - Walther Farms
Mr. Nick Tipper, PE - Techmark
Dr. Jim Wallace, PE - McLanahan Corp.
Ms. Amy Yoder - Anuvia Plant Nutrients

Team Projects

Industrial Biosolids Digestion Project

The Dow Chemical Company operates an aerobic digester to reduce the mass of the biosolids removed from their secondary clarifiers. Due to the high cost of operation, Dow has asked the "WasteWater Warriors" to improve their biosolids digestion system. The team generated design alternatives with the goal of increasing system performance while simultaneously lowering operational costs. The final deliverable was an engineering design report describing and comparing the proposed solutions. An economic analysis, process flow diagram, and a summary of expected improvements was completed in order to select the optimal design.

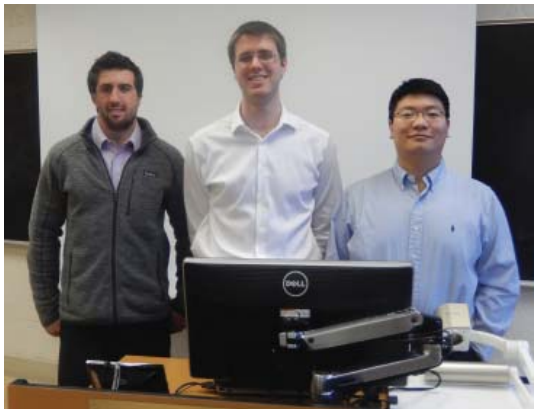
Team Members (L to R)
Christine Isaguirre
Michal Mulik
Alexander Bricco

Sponsor
Dow Chemical (under Non-disclosure)

Faculty Advisor
Steve Safferman, PE

Pilot-scale Compost Unit Design: Monitoring Chemical Degradation

Dow AgroSciences is a leader in the production of common herbicides used in both the public and private sector. Residuals of these chemicals in the environment can result in negative effects, including inadvertent plant injury and more. Understanding how these chemicals degrade in natural systems, such as composting, is important to ensure these residuals are non-threatening. An in-vessel composting system was designed, built, and tested in order to give Dow AgroSciences a method to perform future chemical life-cycle tracking tests. This in-vessel unit monitors important characteristics of compost through sensor technology, and serves as a base for process sampling. Samples can be analyzed to understand how herbicides degrade during a typical composting cycle.



Team Members (L to R)
Joshua Boucher
Benjamin Bailey
Yifeng Hu

Sponsor
Dow AgroSciences (under Non-disclosure)

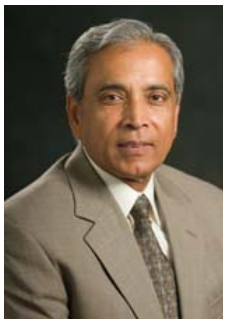
Faculty Advisor
Dawn Reinhold

Team Projects

Food Waste Management: Generating a Waste-to-Resources Product

Meijer is a regional supermarket chain interested in reducing their environmental impact. This project involves designing a food waste management system at one of Meijer's distribution centers capable of producing a waste-to-resource product. The Waste Watchers conducted an environmental and cost analysis to determine the current impact of the project sponsor's food waste disposal practices and recommended alternative systems. The team also designed a complete composting system to manage the company's food waste and generate a finished compost product. The final design included a feedstock recipe and end product quality, as well as a cost analysis.

Team Members (L to R)
Larry Buckner
Austin Wissler
Nathan Sobczak
Lauren Strange



Faculty Advisor
Ajit Srivastava, PE

Sponsor
Meijer (under Non-disclosure)

MICHIGAN STATE WASTE WATCHERS

Bio-oil Upgrading Through Continuous Electrocatalytic Hydrogenation

This project is coordinated with Tenneco, an automotive ride control and emissions products company. This project aims to electroreduce bio-oil produced through fast pyrolysis. Successful reduction of the bio-oil will increase energy content and decrease unwanted properties, such as reactivity. Electroreduction of bio-oils has primarily focused on neat model compounds and their mixtures in batch divided hydrogen fuel cells (H-cells). These cells are characterized by high voltages and unwanted molecular hydrogen production. Configuring a continuous hydrogen fuel cell, will minimize voltage and hydrogen production, improve efficiencies and reduce capital cost.

Team Members (L to R)
Stephen Wilson
Angela Hoang
Aubrey Proctor
Jack Stephan

Faculty Advisor
Christopher Saffron

Sponsor
Tenneco

R- Oil

Team Projects

Designing a Sustainable Conveyor System: A Frozen Food Application

JBT's SuperCONTACT freezer is designed to freeze a thin layer of tissue at the base of marinated poultry products prior to their discharge into a spiral freezer, which completes the freezing process. Currently, a disposable polyethylene film is used to convey products across the system's cold plates to the next freezing step, which creates unnecessary waste and downtime. Froz-hen was assembled to design a reusable solution that will improve economic efficiency, maintain the production and quality of the SuperCONTACT system, and promote sustainable operations by reducing landfill waste and the environmental costs associated with producing the polyethylene film.

Team Members (L to R)
David Olson
Austin Ebeling
Jacqueline Thelen
Nicholas Niedermaier

Faculty Advisor
Brad Marks, PE

Sponsor
JBT FoodTech (under Non-disclosure

Froz-hen

Ultrafiltration of Anaerobic Digestion Effluent for Sustainable Management

MSU Land Management operates an anaerobic digester. Effluent is drained from the digester daily and it is stored in a holding tank. A few times a year the holding tank is drained for application on agricultural lands. However, not all of this effluent can be land applied due to run off potential and odor. Remaining effluent must be exported at a high cost. The "Nutrient Moo-vers" team has designed a system to separate some of the liquid from the effluent so that it can be better managed The remaining nutrients can be land applied for plant growth.

Team Members (L to R)
Robert Munro
John Everett
Shane Peterson
Charlotte Thomas

Faculty Advisor
Wei Liao, PE

Faculty Advisor
Tim Harrigan

Sponsor
MSU Land Management

Nutrient Moo-vers

Team Projects

Optimizing Heat Transfer for Food Industry Application

The Efficientneers are working on creating a new design, for the shape and the material of a metal heating element that will yield a ten percent reduction in cooking time for a packaged food product while maintaining a more homogenous heat transfer across the heating element. This will be done on a computer model (COMSOL) that will show the optimization of the new design alternative compared with the original model. Project deliverables include these simulations on COMSOL, a sensitivity analysis on a range of material properties, and an economic analysis with an investment return rate of the final design.

Team Members (L to R)
Natsuki Ikeda
Brendan Cloonan
Christopher Walker
Michael Conklin

Faculty Advisor
Kirk Dolan

Faculty Advisor
Phil Hill

Sponsor
Major Food Manufacturer (under Non-disclosure)

Optimizing Purified Water Use for Pharmaceutical Tank Cleaning

Perrigo a leading global healthcare supplier is working to reduce plant-wide water use. The purpose of this project is to improve water efficiency while cleaning and sanitizing tanks used for pharmaceutical manufacturing. The team, Pharma Cleanse, is working to identify areas associated with tank cleaning that could be improved upon to save water. In doing so, the team will provide the client with a detailed analysis regarding economics, testing procedures, testing results, and a scaling plan. After testing and data analysis, the team will also provide the client with a set of recommendations going forward.

Team Members (L to R)
Joseph Commane
Sydney Preston
Jacob Vankeulen
Jason Petros

Faculty Advisor
Susie Liu

Faculty Advisor
Jade Mitchell

Sponsor
Perrigo (under Non-disclosure)