52nd Conference on Senior Engineering Design

College of Engineering and Applied Sciences
52nd Conference on Senior Engineering Design

College of Engineering and Applied Sciences

Tuesday April 16, 2013
8:00 a.m. - 4:00 p.m.
---Directions---

From I-94
At exit #74, turn north onto U.S. 131. Go 2.8 miles, follow the directions listed below for U.S. 131.

From U.S. 131
At exit #36A, turn east onto Stadium Drive. Turn right at first light which is Drake Rd. Continue on Drake Rd. through the next light (at Parkview Ave.) into the WMU Parkview Campus. You will now be on Campus Drive.

From WMU Main Campus
From the corner of Stadium Dr. and Howard, go west on Stadium Dr. until you come to Drake Rd. Turn left onto Drake and continue south through the next light (at Parkview Ave.) and into the WMU Parkview Campus. You will now be on Campus Drive.
Conference on Senior Engineering Design Project

You are invited to attend the fifty second Conference on Senior Engineering Design Projects. The conference will be held from 8:00 a.m. to 4:00 p.m., Tuesday, April 16 at the College of Engineering and Applied Sciences on the Parkview Campus of Western Michigan University. The College of Engineering and Applied Sciences sponsors the conference to showcase the work of its graduating seniors, who are required to complete a capstone project that puts into practice what they have learned. Many of the projects are sponsored by business and industry. The conference is free and open to the public. You are welcome to attend all or part of the day's events. Reservations are not necessary.

High school and community college teachers are encouraged to bring students to the conference. Buses can drop off passengers in the College Circle in front of the building and then park in lot P-2. (See map)

Parking is available in the ramps behind the College of Engineering and Applied Sciences (See Map: Lots P3 and P4). There is no charge for parking for those attending the Conference.

Presentations begin on the hour and half hour. Please do not enter a room after a presentation has begun.

Session locations, times, and page number for project descriptions:

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A lunch break is scheduled from 12 p.m. to 1 p.m. There is a café available on site.

For more information about the conference, call Tamara Bergman at (269) 276-3248.

Brochure available electronically at:
http://www.wmich.edu/engineer/senior-design-conference.htm
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Calibration Device for a Surgical Navigation Camera  
Fast Wheel Alignment System  
Dry Ice Cooling System  
Autonomous Unmanned Aerial System with Ground Control  
Phosphorous Removal Process Comparison |
| 11:30 | D-115 CCE | Western View Phase II  
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THANK YOU

The College of Engineering and Applied Sciences is grateful to these sponsors that have provided or cooperated in Senior Engineering Design Projects being presented in April 2013. If you have a project for our students or if you would like more information, please call Tamara Bergman at (269) 276-3248.

Abonmarche
American Axle & Manufacturing
Amway
Applied Aerodynamics Research Group (WMU)
AVB Construction
Bronson Methodist Hospital
Byce Consulting Engineers
Cartek
City of Kalamazoo Department of Public Services
Denso Foundation
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Eaton Corporation
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TechCare-TronLabs
The Kohler Company
Whirlpool Corporation
WMU Office of Sustainability
WMU Sunseeker Solar Car Team
800 BARREL FERMENTATION ADDITION  
by: Matt Moran, Phil Tartaglia, and Bryce Wegner  
Sponsor: Bryan Webster, Byce Consulting Engineers  
Faculty Advisor: Xiaoyun Shao  
8:00 a.m. to 8:25 a.m., D-115

Today Bell’s Brewery is looking into the expansion of their current facility by adding a 110’ by 69’ framed structure. The addition includes the construction of a framed structure to support (24) 800 barrel fermentation tanks. This structure will be modeled in Robot Structural Analysis. The scope of work includes the design of the structures beams and columns, a cost comparison of steel vs. concrete option, as well as scheduling and sequencing of construction for this structure.

EAST SOUTH STREET IMPROVEMENTS  
by: Amos Kamp, Clint Richmond, and Samuel Sheets  
Sponsor: Mr. Todd Richter, Fleis & Vandenbrink Engineering, Inc.  
Faculty Advisor: Valerian Kwizgile  
8:30 a.m. to 8:55 a.m., D-115

East South Street in Sturgis, Michigan, was in need of various improvements and updating. The desired upgrades initially included an assessment of the water main, sanitary sewer, and storm water collection. In addition, sidewalk ramps were upgraded per federal/state regulations and new pavement options were evaluated using life cycle cost analysis. The components of the design are in compliance with respective standards. The completed analysis and design provide a feasible, cost effective, and sustainable solution for the city of Sturgis.
GRAND HAVEN HARBOR DRIVE REDESIGN
by: Chris Cooper, Josh Minger, and Matt Proffitt
Sponsor: Brian Vilmont, Fishbeck, Thompson, Carr & Huber
Faculty Advisor: Valerian Kwigizile
9:00 a.m. to 9:25 a.m., D-115

Harbor Drive redesigning consisted of the replacement of local utilities and placement of a 30” raw water transmission main. An analysis was completed for the sizing and inputs of the sanitary sewer. Also, an analysis for the 30” raw water transmission main was completed in order to select the most economical route for the raw water transmission main. A support system was designed in order to allow the new 30” water main to pass beneath an existing 30” raw water main. A construction sequencing schedule was created in order to help maintain traffic flow and ensure a successful construction.

I-94 DEEP CULVERT REPLACEMENT
by: Alexander Fattal, Evan Mann, and Peter Oudsema
Sponsor: Rick Jenkins, MDOT
Faculty Advisor: Mr. John S. Polasek
9:30 a.m. to 9:55 a.m., D-115

A culvert, located 25’ below I-94 near the Parma Road Interchange in Jackson County, is in need of replacement or rehabilitation. Multiple design alternatives were analyzed to consider the nearby interchange, as well as traffic restrictions over I-94. The evaluation of these analyses was based on current flow demand, cost, construction impact, and maintenance of traffic. A design evaluation report as well as a final recommendation was created, providing thorough comparison of the alternatives and a selection of the alternative best suited for this project.

I-94 EB/WB BRIDGE REPLACEMENT OVER HICKORY CREEK
by: Marino Esteban Calderon Diaz, Alexander D. Plair II, and John J. Sendor
Sponsor: Dina Tarazi, MDOT
Faculty Advisor: Haluk Aktan
10:00 a.m. to 10:25 a.m., D-115

Two highway bridges over Hickory Creek carrying I-94 east and west bound are nearing the end of their service life. The Michigan Department of Transportation is planning for their replacement. Project team is charged for overall design of the replacement project. A hydraulic analysis using HEC-RAS and scour modeling determines the required bridge span, foundation depth, geometry and placement. A structural study compares the two girder options: pre-stressed concrete and steel, designed using AASHTO LRFD Bridge Design Specifications. Traffic study of vehicular movement through the construction phases of the project was determined utilizing Highway Capacity Software and Synchro. Complete study report and design details are prepared based on the study findings and sponsor input.
Gymnasiums are not only used for a school curriculum but also extracurricular activities, assemblies and community events. By implementing advanced structural analysis and design, a gymnasium was designed for Portage Central High School to meet these needs in the most efficient way possible. Several design alternatives were analyzed for roofing, wall, and foundation systems. A final design was determined based on economics, ease of construction, sustainability, durability, and aesthetics.

Parks attract people and help revive the economy, especially in small towns like New Troy, Michigan. A site analysis and design, including foundation design, cost estimating and structural analysis of the observation deck was performed. Preliminary plans and construction drawings were prepared to be used for the application of a grant. The location being in a place close to personal properties and marshlands; land easements, the soil profile and high ground water table were some of the issues encountered. With the completion of these facilities, Weesaw Park Trail will become a destination for nature lovers from the entire area.

Western View Phase II, a continuation of on-campus student housing for upper class students, is a construction project aimed at competing with similar off-campus housing. A comprehensive RS Means based budget and thorough Microsoft Project schedule were developed to meet Western Michigan University requirements. A sustainability analysis was also performed to meet the university requirement of LEED certification. In addition to the apartments, a structural steel design and 3D model of a clubhouse were developed using SAP 2000 and Revit. This information was then used to compile a bid package for the owner.
The intersection of Rambling Road and Winchell Drive has been identified for improvement due to potential conflicts involving vehicular traffic and speeds as well as pedestrian safety. Data collection necessary for speed studies and signal warrants, geometric analysis of the intersection, and analysis using traffic simulation software resulted in three potential solutions. Designs were made for pavement, site grading, intersection geometry, and project staging where applicable. The recommended solution, complete with a cost estimate, presented to the City of Kalamazoo Department of Public Services will facilitate potential safety improvements to the intersection.
INVERTED CLASSROOM WEBCAST WORKFLOW AND DISTRIBUTION
by: Justin Hill, Matt Layher, and Eric Leese
Sponsor: John Kapenga
Faculty Advisor: John Kapenga
9:00 a.m. to 9:25 a.m., D-202

The inverted classroom learning model proposes having students view lecture material outside of class. When students enter the classroom, they are given hands-on projects to work on and are assisted by the instructor. A workflow provides guidelines for using several recommended tools and software packages to both create the tutorials and make them accessible for students to view. An online quiz system was also put into place to provide the instructor with feedback about which topics might need to be covered in more depth.

AUDIENCE RESPONSE CLICKER PROJECT
by: Taylor Keenan and Joseph Meyer
Sponsor: John Kapenga
Faculty Advisor: John Kapenga
9:30 a.m. to 9:55 a.m., D-202

Active learning has become increasingly popular in universities in the United States. A cross-browser compatible web application was created to allow faculty and staff of Western Michigan University to implement active learning through an audience polling system. The application facilitates the construction of surveys and records individual audience member responses as they are received from any device with a web connection.

TEMPERATURE EXTERNAL SURVEILLANCE TRACKING SYSTEM
by: Andrew Wagner and Daniel Yap
Sponsor: John Kapenga and Eric Johnson
Faculty Advisors: John Kapenga and Eric Johnson
10:00 a.m. to 10:25 a.m., D-202

Server cooling failures are an extremely costly emergency situation if they are allowed to go unnoticed. A TEMPEST system was designed to communicate with the temperature sensors on site at WMU, in order to track the individual temperatures of each sensor. It would allow an easy interface to check all the current sensor data, as well as offer graphical representations. Furthermore, the TEMPEST system would notify WMU staff should any sensors fail to communicate its status. The TEMPEST system would be able to scale with WMU’s future sensor needs and will act as an extra line of defense against cooling failures.
SENIOR DESIGN HUB
by: Michael Grondin and Jason Levanna
Faculty Advisor: Ala Al-Fuqaha
10:30 a.m. to 10:55 a.m., D-202

There are many sponsors that could benefit from contributions from engineering students and senior design projects. Senior Design Project Hub is a web service that helps connect Western Michigan University engineering and applied science students to sponsors with projects. The service provides students with a greater selection of projects. It also gives potential sponsors an opportunity to discover the senior design students. Senior design faculty can use tools to control the flow of projects by granting permissions and approving projects if they choose. Senior Design Project Hub streamlines the project selection process for students, faculty, and sponsors.

HOCKEY DAEMON: STAT TRACKING SOFTWARE
by: Brian Blake and Jonathan Siterlet
Sponsor: Teresa Quiggle, Eagles Ice Center
11:00 a.m. to 11:25 a.m., D-202

You may be surprised to learn that ice arenas are typically one of the slowest adopters of technology. Besides missing things like wifi and a website, the extent of their stat keeping usually ends at a piece of paper tacked onto the bulletin board at the front of the rink. Hockey Daemon solves this issue. It is a stat tracking technology built specifically for hockey. It can run on any type of device with a browser and makes scorekeeping and league administration a breeze. For a relatively low cost, rinks can now host their stats and leagues online, hassle free.

SUNSEEKER CAN BUS UTILITY
by: Geroge Barry, James Dilts, and Kyle Noll
Sponsor: Brad Bazuin
Faculty Advisor: Brad Bazuin
11:30 a.m. to 11:55 a.m., D-202

It is extremely difficult to make a useful analysis of a car’s systems using CAN messages, especially when there are several thousand messages being transmitted every second. A utility was created to monitor, log, filter, interpret, and send CAN messages using the CANUSB hardware. The utility is compatible with Linux and Windows operating systems utilizing the D2XX driver from FTDI. The software utility and its many tools empower a user to more easily isolate and interpret the pertinent CAN messages and make a proper and immediate systems analysis.
As an international company with multi-departmental endeavors, The Kohler Company requires a sophisticated project management and reporting software. In order to replace an out-of-date and functionally decrepit time reporting system, a new system was put in place to allow for integration with current systems and extensibility for future needs. The new solution utilizes ColdFusion to meet Kohler’s needs for employees to track hours worked across multiple projects of various scales. This solution provides a simplified work flow that allows managers and employees alike to track their productivity, and accomplish their tasks.
STANDARD CURRENT MEASUREMENT DEVICE
by: Obaid Aldosari, Jonathan Christman, and Joseph Mutschler
Sponsor: Johnson Controls, Inc
Faculty Advisor: Ikhlas Abdel-Qader
9:00 a.m. to 9:25 a.m., D-204/205

Johnson Controls, Inc. needs to measure currents within the range of 0 to 20 amps, with an accuracy of 1%. The current design is both labor and time intensive, requiring the swapping out of different shunt resistors in order to acquire the most accurate measurement. To reduce time and labor costs a standard current measurement device has been designed that will measure current with great accuracy with no need to swap resistors. The output current measurement is interpreted by an Arduino microcontroller which sends the information to a tester program controlled by a user interface.

BATTERY CHARGING SYSTEM
by: Marcus Jennings, Rana Alshammasi, and DeMario Petrie
Sponsor: Bradley J. Bazuin
Faculty Advisor: Bradley J. Bazuin
9:30 a.m. to 9:55 a.m., D-204/205

Rechargeable Lithium-Ion batteries are rapidly replacing older technologies due to their small size and high energy density. A small battery recharging system with a “gas gauge” shows remaining battery life that can be built in to hand-held devices and plugged in overnight as needed. After much research, analysis, and testing with several different Lithium-Ion chargers with a “gas gauge” that shows remaining battery life a final design has been defined and demonstrated. The new circuitry has the best performance and efficiency of all Lithium-Ion battery chargers studied. This final design provides a working prototype for future senior projects and research applications at Western Michigan University.

NEODYMIUM ROTOR RE-MAGNETIZER
by: Trevor Atkinson, Jessie Buchholz, and Chad Martel
Sponsor: Jeff Schroeder, Fantom Racing
Faculty Advisor: Dean Johnson
10:00 a.m. to 10:25 a.m., D-204/205

A portable neodymium rotor magnetizer was constructed. The device exposes the two pole rotors to a magnetic field with a flux density high enough to saturate the neodymium material. This is achieved by the discharge of a high voltage capacitor bank, which induces a large impulse current through a solenoid coil. The excitation induced in the coil during this discharge creates the necessary magnetic field to re-magnetize the rotor, which is placed inside the core during discharge.
DC MOTOR TESTING SYSTEM
by: Naif Alkhammash, Andrew Larson, and Kiran Sandhu
Sponsor: Jeff Schroeder, Fantom Racing
Faculty Advisor: Johnson Asumadu
10:30 a.m. to 10:55 a.m., D-204/205

A DC motor testing system was developed that will allow a user to analyze the performance of brushless DC motor very popular among radio-controlled (RC) car hobbyists. The system comprises hardware and software modules. The hardware module measures and record parameters (speed, torque, efficiency, etc), while the software module includes a graphical user interface (GUI) to view and analyze the data in real-time. This completes and improves the work of previous groups making the system more robust and user-friendly.

CALIBRATION DEVICE FOR A SURGICAL NAVIGATION CAMERA
by: Alex Kingma, Shannon Kloha, and Matthew Wolfe
Sponsor: Stryker
Faculty Advisor: Bradley Bazuin
11:00 a.m. to 11:25 a.m., D-204/205

Precise motion and tracking of medical equipment during surgical procedures is a fundamental concern for Stryker navigational camera systems. Before shipment and delivery, every system must be tested and calibrated for performance and accuracy. The current method uses one of the few available coordinate measuring machines that are very costly and take significant time to sequentially move to appropriate locations enabling accurate measurements. The new calibration system developed uses an alternate method. A three-dimensional array of precisely positioned infrared LEDs are excited one at a time by the calibration system in coordination with the camera system so that accurate location and distance calibration can be performed quickly and efficiently.

PLUG-IN HYBRID ELECTRIC VEHICLE COMPONENT PRE-HEATER
by: Nick Munyan, Ria Pereira, and Mikhail Sokolov
Sponsor: John Patten, Denso Foundation
Faculty Advisor: Massood Atashbar
11:30 a.m. to 11:55 a.m., D-204/205

In order to increase the gas mileage of a plug-in hybrid electric vehicle and improve comfort for users during the winter months, this system preheats the vehicle using grid power while plugged in. This system is designed for use in a 2012 Toyota Prius. The system uses the built in coolant system and installed heaters, controlled by a microcontroller. Using digital temperature sensors and user input, the system preheats the cabin and other components to optimum temperatures. An Android application allows the user to preset temperatures and schedule start times according to their needs.
PROVISION OF DUAL POWER SOURCES FOR RESIDENTIAL LOW LOADS APPARATUSES
by: Mohammed Alkharashi, Abdullah Alkhder, and Louai Alqudaihi
Faculty Advisor: John Stahl
1:00 p.m. to 1:25 p.m., D-204/205

For the low wattage loads it is feasible to implement a solar power source at the residential units, while the usual power utility source powers all high wattage loads. Thus, two electrical power schemes are being implemented where one of the schemes is powered by the utility source and the other one from solar power. The low wattage design shall include the means to switch to the utility in case of loss of solar power for any reason. The solar power scheme will feed special low wattage wall receptacles leaving a few to be powered from the utility.

BICYCLE GENERATOR MONITORING SYSTEM
by: Salem Batiyah, Mohammed Binjalalah, and Mike Kennedy
Sponsor: Harold Glasser, Office of Sustainability of WMU
Faculty Advisor: Ralph Tanner
1:30 p.m. to 1:55 p.m., D-204/205

Western Michigan University needs a demonstrative aid device that would monitor the energy a person created and used while pedaling a stationary bike. The system built includes a stationary bike coupled to a DC generator. The energy is then transferred to a 12V lead acid battery. A load can be connected to the circuit through a 1500 W inverter. The microcontroller is programmed for the LCD to display the various outputs the user in generating. This device will bring awareness to the public about the amount of electricity consumed by small devices.

INDUSTRIAL WIRELESS COMMUNICATION SYSTEM FOR NOTIFICATION
by: Jumana Abukabbos, Jolica Dias, and Devin Semrau
Sponsor: Bradley Bazuin
Faculty Advisor: Bradley Bazuin
2:00 p.m. to 2:25 p.m., D-204/205

An industrial wireless communication system for short structured message communications is needed to support lean manufacturing. While a first generation prototype was previously constructed, it lacked the range, robustness and battery operation desired. The new system incorporates multiple small, rechargeable user modules that communicate with and through one or more higher power fixed location message router stations. This configuration insures that wireless signal integrity is maintained throughout an industrial or manufacturing facility and that the messages are successfully sent and received. The rechargeable lithium-ion battery powered portable user modules employ low-cost Digi XBee wireless transceivers for user-to-router communications. The router stations use higher power ISM band Digi’s Xtend RF modems for router-to-router station communications. Embedded software in the user modules and router stations insure robust communications in the presence of high power transient RF noise often found in manufacturing environments by repeating message transmission until a successful response is received.
THREE WHEEL ELECTRICAL TRICYCLE
by: Frank Brito, Ruddy Mateo, and Tomas Then
Sponsor: Pavel Ikonomov
Faculty Advisor: Rashrendra Liejji
2:30 p.m. to 2:55 p.m., D-204/205

The design concept for the three wheel electrical tricycle consists of several components. Two electric hub motors will be attached to the front wheels and this will be controlled by the same throttle. A motor controller will be controlling electronically the process of the motor so it can run. A microcontroller will be controlling the differential effect of the two front wheels so it does not turn over. Finally, a digital display is responsible to track performance during cycling. Therefore, this display will be displaying the battery power, speed, length, and level of assistance.

WIRELESS CHARGING STATION
by: Nasir Alfaraj, Ahmed Alorayfij, and Yaser Alqatari
Sponsor: Bill Forshey, TechCare-TronLabs
Faculty Advisor: Damon Miller
3:00 p.m. to 3:25 p.m., D-204/205

A wireless charging station for a single-cell lithium-ion batteries has been designed and built for use in the Computer-Integrated Manufacturing and Robotics Center, which is directed by Dr. Tarun Gupta. This near-field wireless power transmission system utilizes wireless power transfer evaluation kits manufactured by Texas Instruments as based on its bqTESLA integrated circuits. The station is capable of delivering up to 5 watts of power through inductively-coupled coils over a maximum distance of 4 cm with up to 75% efficiency.
3D LIGHT CURED MOLDS FOR CAST METAL PROTOTYPES
by: Nicholas Dixon and Nicholas Miskovich
Faculty Advisors: Sam Ramrattan and Pavel Ikonomov
9:00 a.m. to 9:25 a.m., D-201

Start-up costs associated with the implementation of a new part can be very expensive causing hesitation to change. A new rapid prototyping process using a machinable sand was qualified and tested here at WMU. The machinable sand specifications were determined using newly designed sand tests, including a thermal cure rate test and a peel back test. The mold cavity was developed using G-code programs for CNC machining. Parts produced were then evaluated for surface roughness and tolerance. The new rapid prototyping technique could potentially improve upon existing technologies with a higher throughput.

ELECTRIC-ASSIST URBAN TRANSPORTATION RECUMBENT TRIKE
by: Adam Hill and Michael Robinson
Sponsor: Matthew Hollander, WMU Office for Sustainability
Faculty Advisors: Pavel Ikonomov and David Middleton
9:30 a.m. to 9:55 a.m., D-201

The demand for green transportation alternatives is at an all-time high as CO₂ emissions continue to rise. Because bicycling is a very efficient means of transportation, a prototype recumbent tricycle was created to explore alternative transportation options. A design was formed to fit specific needs in everyday campus travel. A model was designed in CATIA; Finite Element Analysis was performed to ensure structural stability; and a functional prototype was constructed. The construction plans will be made available to WMU students via an open source platform online. This will provide a viable means of campus commute, while decreasing vehicle emissions.

ORTHOTIC LUMBAR SUPPORT BELT
by: Kenneth Brown, Kyle Martin, and Tommie Walls
Sponsors: John Dillworth and Jon Isley
Goodwill Industries
Faculty Advisor: Jorge Rodriguez
10:00 a.m. to 10:25 a.m., D-201

Many individuals suffer from lower back pain that medication and/or surgical procedures cannot always cure. A prototype orthotic lumbar support apparatus was built based off a design that is being patented. The design focuses on applying abdominal pressure to restrict harmful anterior movements of the patient’s lower back vertebrae. Various anthropometric statistics were researched and analyzed to help determine the final shape and dimensions of the prototype. Materials and fabrication options were evaluated and specified. The final design was modeled in a 3D CAD system. If successful, this apparatus will provide an alternative for individuals suffering lower back disorder.
DEVELOPING RICH INFORMATION SUPPORT FOR EMPATHIC DESIGN

by: Travis Bakeman, Christa Forbes, Mike Higgs, and Estreberto Marin
Sponsors: Kevin Kryszak and Ariel Piatek
Faculty Advisors: David Lyth and Larry Mallak
10:30 a.m. to 10:55 a.m., D-201

Empathic design is a user-centered approach that relies on rich information to gain an understanding of customer needs for a product. Currently, Stryker does not have a method to organize their rich information gathered through interviews and observations in support of empathic design. This project developed and tested a support tool that searches rich information files to organize and retrieve relevant pieces of information to help discover the user’s current unarticulated needs. To assist designers throughout the innovation process, ethnographic interviews, database structures, data flow diagrams, and the engineering design process were used to develop the rich information support tool.

FAST WHEEL ALIGNMENT SYSTEM

by: Reuben Burnside, Luke Robinson, and Thomas Strobl
Sponsors: Zak Ford, Oscar Ferreyra, and Emilio Banchs
Cartek
Faculty Advisor: Jorge Rodriguez
11:00 a.m. to 11:25 a.m., D-201

The fast-paced automotive service industry demands a quick and efficient way to perform a wheel alignment. Currently there is no automated process for performing the wheel run-out procedure. Applying the engineering design process, computer aided design (CAD) tools, and cost analysis concepts, a fully automated wheel run-out device was designed. A prototype was then fabricated and tested using real world conditions, ensuring the feasibility and safety of the design. The device automated the wheel run-out procedure, reducing the time required to perform a wheel alignment.

A HOSPITAL PHARMACY SEMI-AUTOMATION AND WORK STUDY

by: Robert Anderson, Jordan Bartow, Erik Bengston, and Sean Swistara
Sponsor: Louis Kynard, Bronson Methodist Hospital
Faculty Advisor: David Lyth
11:30 a.m. to 11:55 a.m., D-201

Bronson Methodist Hospital purchased automated medication carousels to minimize time and variation required to fill medication prescriptions, with a goal of reducing time spent manually picking drugs. To install the carousels in the pharmacy, existing, transitional, and new facility-equipment layouts were developed. The layout design process utilized activity-relationship charts, nodal diagrams, six sigma / lean manufacturing techniques, and AutoCAD. Workflows and work standards for the new filling process were established through observations, flow diagrams, time studies, and work analyses. Implementing new medication carousels and workflows allows pharmacists more time to educate patients on their medication use and reduces the number of returning patients, which will satisfy recent healthcare legislation.
REDESIGNED HYDRAULIC BIKE FOR THE CHAINLESS CHALLENGE  
by: Kevin Galeher, Dave Jensen, and Trevor Williams  
Sponsor: Matt Simon, Parker Hannifin Corporation  
Faculty Advisors: Alamgir Choudhury and Jorge Rodriguez  
1:00 p.m. to 1:25 p.m., D-201

Due to demand for energy efficient and environmentally friendly transportation, Parker Hannifin Corporation sponsors a national competition for the design of a Human-assisted Green Energy Vehicle, known as Chainless Challenge. The previous design of WMU’s hydraulic bicycle was improved by redesigning the hydraulic circuit and drive train for increased energy utilization and regeneration. The overall control of the hydraulic system was enhanced with the use of servo valves. A test bench was developed to obtain performance characteristics of all major components, and to validate the efficiency in simulated competition conditions. This new bike will serve as a concept for future human-powered transportation vehicles.

DESIGN OF A BENCH-Top FILAMENT EXTRUDER FOR A DESIGN COMPETITION  
by: Jonathan Boyer, Michael Konkel, Timothy Molascon, Joshua Rotach, and Stephan Telenko  
Faculty Advisors: Paul Engelmann and Mitchel Keil  
1:30 p.m. to 1:55 p.m., D-201

Increasing use of three dimensional (3D) printing has driven a need for economical plastic filament. A bench-top filament extruder was designed and built under constraints set forth in the Desktop Factory Competition. Computer generated models and prints were produced using NX8 CAD modeling software. The plastic extrusion process was simulated with Autodesk Moldflow. A cost analysis was used to identify and select economical components used in building the machine. The result was a low cost machine design capable of producing the plastic filament used to print 3D parts.
ENGINEERING APPLICATIONS FOR TECHNICAL ENTREPRENEURSHIP  
by: Persefoni Lauhon, Daniel Panozzo, and Miguel Recio Lopez  
Faculty Advisors: Steven Butt and Tyco Fredericks  
10:30 a.m. to 10:55 a.m., D-210

Influencing the product design and development cycle are three separate business functions: 
engineering, finance, and marketing. Although there has been a recent push to combine these functions, 
the product development cycle could be further streamlined by concurrently merging traditional 
industrial engineering tools with creative marketing strategies in an entrepreneurial environment. To keep up with this trend, a proposal has been made to incorporate the business canvas ideologies into the Industrial and Entrepreneurial Engineering curriculum. Defending this proposal are three case studies involving student-designed products at various stages of development. By infusing this approach into its ABET-accredited curriculum, the Industrial and Entrepreneurial Engineering Program will continue to pivot its approach toward technical innovation.

DRY ICE COOLING SYSTEM  
by: Paul Fitzpatrick, Daniel Kellogg, Margaret Kelly, and Ty VanderWall  
Faculty Advisors: Steven Butt, Tyco Fredericks, and David Middleton  
11:00 a.m. to 11:25 a.m., D-210

The transportation of perishable goods, such as raw foods or refrigerated medications, has been an unfailing inconvenience for the modern traveler. Through market research, product experimentation, and feasibility studies, a solution for individuals who require mobile cold storage is presented by use of the key element: solid CO2. The result is a product that exceeds consumer expectations and competitive products on the market today. A business canvas was utilized as the foundation of this entrepreneurial concept. This product revolutionizes the notion of convenient travel by providing safe and simple means to transport perishable goods over extended periods of time.
American Axle has fluctuation in customer demand that has made for difficulties in production planning. A model of the current final linkage assembly department was developed using ProModel to analyze different customer demand scenarios without physically changing the department. Future customer demand was forecasted and used for the scenarios developed in the ProModel simulation. Facility layout and line balancing techniques were employed to improve production capability by altering the system parameters. These techniques were used to make a master production plan that details how to operate the department at varying levels of customer demand. This master production plan will reduce production costs by making more accurate builds during the week.
AN IMPROVED HIGH ALTITUDE TURBOFAN ENGINE
by: Jared Kukulies, Julian Standiford, and Jo Tokuda
Faculty Advisor: William Liou
8:00 a.m. to 8:25 a.m., D-109

Aerial surveillance has become a necessity in modern warfare allowing for more precise targeting of weapons and better protection of ground forces. In order to improve the efficiency of current surveillance aircraft improved engine designs are constantly sought after. A new conceptual engine design was developed and evaluated using Gas Turb 12, an engine design and performance software. This new design increased the service ceiling of the Northrop Grumman RQ4 Global Hawk from 60,000 to 70,000 feet. This lighter and smaller engine design reduces fuel consumption, extends the range, and increases the surveillance equipment capacity of the aircraft.

AIRCRAFT FLIGHT TESTING AND ANALYSIS (AFTA) BLACK BOX
by: Michael Billgren, and Kyle Nichols
Faculty Advisor: Tianshu Liu
8:30 a.m. to 8:55 a.m., D-109

Flight testing of experimental aircraft is a necessary risk in aeronautics; however, this risk can be reduced by referencing the flight characteristics of similar aircraft when proposing a design. A data analysis system was developed that monitors significant flight parameters and other aspects of the aircraft’s performance. The system employs the ArduPilot 2.5, a multi-function, open-source data measurement tool that works in conjunction with the other data acquisition components. This device, once installed in an aircraft, will provide necessary data to use as reference for a future design, or to offer insight into the current operations of the aircraft, highlighting any possible maintenance issues. The need to accurate flight test data is essential for the development of modern aircraft to ensure safe and reliable operation.
TORSIONAL ISOLATOR DESIGN FOR SUPERCHARGER APPLICATIONS
by: Kevin Davey, and Zach Tuyls
Sponsor: Chris Zuzelski, Eaton Corporation
Faculty Advisor: Judah Ari-Gur
9:00 a.m. to 9:25 a.m., D-109

A torsional isolator implemented by Eaton Corporation to address noise, vibration and harshness concerns on their supercharger applications was experiencing performance and endurance issues. A new isolator was designed replacing the original torsional spring with multiple linear coil springs in a newly designed body. The new isolator was designed and modeled using Solidworks. The model was analyzed using Ansys Finite Element Analysis (FEA) software. To validate the designed component, a prototype was built and tested in accordance to Eaton standards. The results of the design and validation were compared to the previous design and displayed significant improvements in all metrics.

DESIGN AND TESTING OF A WIND DRIVEN HELICOPTER
by: Eliana Altaira Germosen Medrano, and Jee Jong Tan
Faculty Advisor: Tianshu Liu
9:30 a.m. to 9:55 a.m., D-109

Wind turbines are mechanisms capable of extracting energy from the wind. A design model and a wing tunnel test of the design including analysis of the design parameters after testing was performed. The model would create lift with the least amount of drag. The model was constructed to experiment how lift can be generated from a wind turbine with a propeller mounted at the top. After being tested, MatLab and Excel codes were generated to obtain a detailed analysis of each structural parameter of the model. The completed model would introduce new forms of experimental lift generation.

THERMOELECTRIC GENERATION UTILIZING EXHAUST GASES
by: Andrew Lewis Sakala, and Brandon John Voelker
Faculty Advisor: Hosung Lee
10:00 a.m. to 10:25 a.m., D-109

The typical electrical power requirement for a motorcycle is roughly 200 to 500 watts. This is generated using a stator/rotor magnet system which hinders motorcycle performance. A waste heat recovery system is created utilizing thermoelectric generators and the thermal differential between the exhaust gas and ambient air to replace this system. Numerical computations are completed to find the optimum performance of the system. A prototype model is created to complete testing on a production motorcycle. This device will ultimately replace the stator/rotor system and will increase motorcycle performance.
WELD QUALITY ISSUE
by: Benjamin Deckert, Matthew McCoy, and Max Schrager
Sponsor: Erin Govier, Eaton Corporation
Faculty Advisor: Roman Rabiej
10:30 a.m. to 10:55 a.m., D-109

The weld quality of high stress transmission gears is a very important factor in the transmission life expectancy. Current weld quality was inspected, evaluated, and compared with the specifications and requirements provided. Weld quality and practices were then compared between three production facilities. Recommendations were given and weld quality improved. The updated weld quality increases overall customer satisfaction and reduces costs associated with warranty claims.

AUTONOMOUS UNMANNED AERIAL SYSTEM WITH GROUND CONTROL
by: Dustin Moyer, Jason Rancour, and Joseph Shaw
Sponsor: William Bradley
Faculty Advisor: Peter Gustafson
11:00 a.m. to 11:25 a.m., D-109

Unmanned aerial systems (UAS), which are prevalent in the aerospace industry, need to be integrated into the national airspace system and are a major focus. The American Institute of Aeronautics and Astronautics (AIAA) student section created a long term project to give WMU an advantage with design of these systems. A test-bed aircraft was used to design a complete autonomous system with a ground control station. Software was developed for target acquisition and fire control. A flight test schedule was used to validate the system components. This system will be a foundation for future AIAA improvements to the UAS project.

THERMOELECTRIC CELL PHONE BATTERY CHARGER
by: Matthew Gibson and Andrew Kohler
Faculty Advisor: Hosung Lee
11:30 a.m. to 11:55 a.m., D-109

The growing dependence on wireless communication calls for an increased need for energy sources. In an emergency without access to electricity, a means to charge a cellular phone may be crucial. A thermoelectric cell-phone charger was designed to be portable and supply enough power to charge a phone battery for emergency use. An opportunity to design for continuous charging throughout the day was an additional option. Various heat sources were analyzed and shown to be compatible with models developed in ANSYS and MathCAD. A prototype was also constructed to show good agreement with the model. Combined, the results show thermoelectricity to be a viable energy source especially for emergency or remote situations.
REAR SUSPENSION DESIGN FOR SUNSEEKER SOALR CAR
by: Brian Drinan, Matt Fraser, and Joe Nacci
Faculty Advisor: Judah Ari-Gur
1:00 p.m. to 1:25p.m., D-109

For years, Western Michigan University students have competed in the American Solar Challenge (ASC) where universities build and race solar power cars. A new car is being designed and built for the ASC competition in 2014. This project designed the rear suspension of the car using Autodesk Inventor and loads were analyzed using ANSYS. Some design flaws from the rear suspension of the 2012 solar car were fixed by building a simpler and lighter trailing arm as well as adjusting the stiffness and placement of the spring to prevent the car from bottoming out.

DRAG REDUCTION OF TRACTOR-TRAILER VEHICLES
by: Sai Kumar Kode, and Brandon Lewis
Sponsor: Applied Aerodynamics Research Group (WMU)
Faculty Advisors: Tianshu Liu and Sudesh Woodiga
1:30 p.m. to 1:55 p.m., D-109

With the wide usage of tractor-trailer trucks to transport large volumes of goods, it is advantageous to develop new techniques for drag reduction of these vehicles, directly resulting in higher fuel efficiency and lower greenhouse gas emissions. This is achieved through geometry altering ducts to reduce drag in the aft section of these rigs, where the majority of the aerodynamic drag through vortex shedding is imposed. Experimental, Computational Fluid Dynamics (CFD), and Particle Image Velocimetry (PIV) techniques have been implemented for model analysis.

NOISE AND VIBRATION REDUCTION OF A CLOTHES DRYER
by: Emily Cobbs, Benjamin Donoghue, and Daniel O’Hare
Sponsors: Steven Lentz and Mark Christensen, Whirlpool Corporation
Faculty Advisor: Koorosh Naghshineh
2:00 p.m. to 2:25 p.m., D-109

As placement of washers and dryers becomes common in homes and apartments, noise generated by the dryer becomes a nuisance to the inhabitants. Whirlpool Corporation is experiencing this issue first hand with their Horizon model dryers. A focus was placed on noise and vibrations caused by the dryer motor, because its vibrations are transferred throughout the structure of the dryer. Through sound and vibration measurements, structural and airborne noise contributions were compared, and problematic frequencies of the system were identified. Various sound and vibration reduction techniques were implemented and tested in order to reduce the overall sound level.
THERMAL DESIGN FOR BATTERY BOX OF 2014 SUNSEEKER SOLAR CAR
by: Johnathan Karakula, and Matt Paiva
Sponsor: Brad Bazuin
Faculty Advisor: Chris Cho
2:30 p.m. to 2:55 p.m., D-109

Overheating of the battery box is a common occurrence in solar cars which can lead to the destruction of the car. Several models of the lithium-ion battery boxes were made in SolidWorks, a solid modeling program, depicting different layouts. The various layout models were analyzed using ANSYS Fluent, an airflow and thermal analysis program, to check if they were sufficient. Using the two programs data the models were compared by weight, size, cost, center of gravity, air flow, and thermal efficiency. This data will allow the Sunseeker Solar Car group to choose the most appropriate design.

WMU SUNSEEKER SOLAR CAR 2014 FRAME & ROLL CAGE DESIGN BUILD
by: Pei Ling Chew, Andrew Day, and Man Wait Tammy Lui
Sponsor: WMU Sunseeker, DENSO International America Foundation, EATON Corporation, Plascore INC.
Faculty Advisors: Jorge Rodriquez and Daniel Kujawski
3:00 p.m. to 3:25 p.m., D-109

Improvements to the 2010 Solar Car’s frame and roll cage are necessary in order to fulfill safety requirements and to have a more competitive car for the 2014 Solar Car competition. The requirements are ability to withstand 5g collision, and a minimum weight. Solidworks was used to create a 3-D Computer model of these subsystems, and a prototype was fabricated in the machine shop. The 3D model was analyzed by using FEA and the prototype was tested in the lab. Additional testing was performed to acquire mechanical properties of the composite materials being used. Numerical and experimental results were compared to validate calculations, and to have a useful analysis tool for future design changes and new developments.

PLATFORM IMPROVEMENT FOR MATERIAL HANDLING MACHINE
by: David Meddaugh and J. Guadalupe Sanchez
Sponsor: Ben Gaegauf, Jerod Hayes, and Phil Lessard
System Logistics Corporation
Faculty Advisor: Daniel Kujawski
3:30 p.m. to 3:55 p.m., D-109

The existing platform design for a dynamic material storage machine has a greater weight than desired. The lifting beam platform has been improved by reducing this aspect of the component. A3-dimensional model of the platform has been created using AutoCAD, a software application for computer-aided design. The model was used to perform Finite Element Analysis to study deflections and stresses from various loading conditions occurring during operation. As a result of the reduction in weight, the lift platform will require a smaller drive motor, making it more cost effective, smaller in size, and more energy efficient.
BELLOWS SEAL LEVELING FIXTURE
by: Colin Haire, Ian Lincoln, and Erica Roberts
Sponsor: Corey Case, Flowserve Corporation
Faculty Advisor: James Kamman
9:00 a.m. to 9:25 a.m., D-212

To ensure the reliability of mechanical seals, accurate measurements of the geometric imperfections of their faces are important. Current systems do not provide sufficiently accurate measurements of these imperfections, indicating the need for a new system with higher precision. A new fixture was designed to provide precise measurements of non-flat seals. As part of this process, the fixture both centers and levels the seals relative to a fixed reference. Seals ranging in size from 0.25 to 6 inches in diameter are accommodated. The design of this fixture is crucial to the continued research and development of bellows seals.

ANALYSIS OF AUTOMOTIVE AXLE NOISE AND VIBRATION
by: Matthew DeYoung
Sponsor: Nick Derra, American Axle and Manufacturing
Faculty Advisor: Koorosh Naghshineh
9:30 a.m. to 9:55 a.m., D-212

As the quality of vehicles continues to increase, increasing emphasis is being placed on the noise and vibration of the vehicle components. One major component that is being tested for noise and vibration is the vehicle’s rear axle. Romax, a gearbox and drivetrain analysis software package, was used to develop a simulation model of the gear set of interest so that transmission error and pattern shifting could be replicated without building actual axles. Once the model was complete, it was compared to actual axle noise and vibration signatures. The outcome of the simulation program enabled a thorough analysis of transmission error and gear pattern shifting on axle noise and vibration and has increased the production quality of rear axles.
SIMULATION AND SYNTHESIS OF NANOPARTICLE BASED HYDROGELS
by: Brian Omondi Asimba, Atreya Biswas, and Charles Onsinyo Monari
Faculty Advisor: Muralidhar Ghantasala
10:00 a.m. to 10:25 a.m., D-212

With current technology advancements, nanoparticles and nanoparticle based composites such as ferrogels, hydrogels are investigated extensively due to their promising applications such as drug delivery, contact lenses, micro actuator and thermally-sensitive actuators to activate the gel particles to dispense medicine. In order for hydrogels to be used in the following applications, it is crucial to understand their physical and chemical characteristics. This research project involves both the simulation as well as experimentation using hydrogel. In the simulation part of the changes of hydrogel with changes in pH in the steady state and the change in hydrogel with time step in transient condition between pH 3-6 were studied using COMSOL 4.3. This has also been extended to arbitrary geometries too. In the experimentation part, the gelation time of hydrogels were studied with and without gold nanoparticles.

HOUSEHOLD ELECTRIC TANKLESS WATER HEATER
by: Benjamin Arseneau, Dustin Jennings, and Thomas Slager
Faculty Advisor: Christopher Cho
10:30 a.m. to 10:55 a.m., D-212

Every household has a need of hot water for many different uses. Current electric tankless water heater models are scarcely used because of their limited water flow and output temperatures or other installation inconveniences. The proposed household electric water heater addresses these problems and provides a better solution to a household’s hot water needs. Mathematic and heat transfer simulation software was used to produce an improved heat exchanger design. A prototype was also constructed to validate the heat exchanger concept. This innovative heat exchanger design provides a higher flow rate and temperature rise output using the same power input.
EFFECT OF PRE-COATING SUBSTRATE ON POLYETHYLENE EXTRUSION COATING FOR BARRIER TO MOISTURE
by: Jacob Henderson
Sponsor: Brad Fadden, Graphic Packaging International, Inc.
Faculty Advisor: Margaret Joyce
9:00 a.m. to 9:25 a.m., D-208

Moisture barrier in paper based packaging is necessary for many applications. Liquids packaging commonly uses laminated foil to reach the necessary moisture barrier in poly extrusion applications. Current research into nanoparticle liquid barriers gives potential to replace the foil lamination techniques for polyethylene extrusion coating. By compounding the two techniques, comparable barrier properties can be attained while increasing recyclability and reducing cost of production.

POLYESTER RELEASE LINER AGING WITH SILICONE AND FLUOROSILICONE COATINGS
by: Danielle Valdivia
Sponsors: Bob VanOss, Richard Schmidt, and Dan Thompson Loparex, LLC.
Faculty Advisor: Margaret Joyce
9:30 a.m. to 9:55 a.m., D-208

Silicone-based coatings are used on adhesive release liners. They are prepared from many formulations including those that use fluorosilicones as the primary polymer. Silicones and fluorosilicones can withstand high temperatures, but fluorosilicones have higher thermal stability which could mean they are more resistant to heat aging. For the study, a liner aging experiment was used to compare the performances of both a silicone coating and a fluorosilicone coating as well as identifying the complete failure of each. Each sample was tested by performing a rub test, a release test, and an abrasion test after being aged at three different temperatures and relative humidity.

PAPER DRAINAGE PROJECT
by: Kevin Lee
Sponsor: Dewei Qi
Faculty Advisor: Dewei Qi and Andrew Kline
10:00 a.m. to 10:25 a.m., D-208

Cationic chemical retention aids will be used to increase attraction forces between fines particles and long fibers to encourage coagulation. Relationship between the drainage rates and charge density will be explored in this project. The fibers will all be starches with different charge densities or degree of substitution.
FEASIBILITY OF A DISSOLVED AIR FLOTATION DEVICE
by: Eric Bock, Luis Hernandez, and Joseph Munsch
Sponsors: Mark Cline, Richard Couch, and Erin Zahnow
Faculty Advisor: Andrew Kline
10:30 a.m. to 10:55 a.m., D-208

Wastewater with a high amount of total suspended solids causes increased disposal costs. To reduce this cost the use of a dissolved air flotation unit (DAF) was suggested in order to remove solids that can’t be removed with a settling clarifier. Various set ups were explored to find how to best utilize both the DAF and the clarifier to decrease both operation cost and downtime of the paper mill due to malfunction in the primary wastewater treatment process.

PHOSPHOROUS REMOVAL PROCESS COMPARISON
by: Sean Clark, Megan Kaiser, and Mikkhael O’Dell
Sponsors: Larry Hill and Gary Roys, Otsego Paper Inc.
Faculty Advisor: Andrew Kline
11:00 a.m. to 11:30 a.m., D-208

The total maximum daily limit (TMDL) of phosphorous permitted to be discharge into the Kalamazoo River Watershed by point sources will need to be lowered in the future. Research was done to determine the chemical, biological, and mechanical methods available, their effectiveness, and costs that would be incurred if implemented. The completed comparison can be used to aid in future company decisions as well as provide comprehensive information on these removal processes.

DEVELOPMENT OF A PROOF OF CONCEPT GDR CYLINDER
by: Brandon Byrnes and Brandon Tracy
Faculty Advisor: Kalyana Pingali
11:30 a.m. to 11:55 a.m., D-208

Agglomeration and cohesion of granular materials has necessitated the pharmaceutical industry to explore new methods for assessing their flow properties. Electrostatic charge distribution during mixing of powder was found to be one of the main reasons that affect powder flow and mixing. To address this issue, a cylinder was modified to measure and remove static charge from powders generated during mixing. The model utilizes a wire which collects charge, pulling it away from the powder. A LabVIEW virtual instrument measures this charge through an oscilloscope. This cylinder will have many applications for pharmaceutical companies once a working model is developed.
ALTERNATIVE INDUSTRIAL CLEANING AND SANITIZATION PROCESS
by: Bret Nordland and Graham Roumell
Sponsor: Carolyn Wright, Amway
Faculty Advisor: Andrew Kline
1:00 p.m. to 1:25 p.m., D-208

The previously validated sanitization and cleaning programs may have been overly aggressive which resulted in changeovers taking longer than necessary. The project’s focus was on creating and validating cleaning and sanitizing programs which results in shorter changeovers. This project required the review of current formulas, manufacturing equipment, cleaning and sanitizing processes. Engineering studies were performed to confirm proper formula groupings, alternative cleansers, and optimized cleaning methods. An economic assessment and risk analysis was completed to demonstrate the benefits for each recommendation. The outcome is an improved program with reduced cleaning times, increased efficiency, and continued high quality levels.

DESIGN IMPROVEMENTS TO LARGE PORTABLE WASH SYSTEM
by: Justin Hubbard, Jeff Przekora, and Adam Schultz
Sponsors: Andy Litts and John Goodell
Riveer Environmental
Faculty Advisor: Andrew Kline
1:30 p.m. to 1:55 p.m., D-208

Large military and industrial vehicles must be cleaned of oil and other contaminants to prevent degradation. A large portable wash system can be used to clean the vehicle and then recycle the water after the oil and other contaminants have been removed. Oil and other contaminants are removed using oil coalescence filtration media. The flow pattern and filtration media properties of the wash system were studied and optimized to achieve maximum oil removal and water recovery.

OPTIMIZATION OF SEPARATION OF HOP OILS INTO USABLE COMPONENTS
by: Michael Dill, Joel Freimark, Derrick McKee, and Bradley Stalzer
Sponsors: Jim Barren and Charlie Reed
Kalsec, Inc.
Faculty Advisor: Peter Parker
2:00 p.m. to 2:25 p.m., D-208

Two hop oil products are separated from whole hop oil received from a third party. This whole hop oil is not separating the way it used to when produced onsite. The oil behaves erratically in the column when under vacuum conditions causing the separation to be problematic. The distillation column and the hop oils were both analyzed to obtain improved operating conditions for the production of desired products. Theoretical data from Aspen Tech simulation was used along with laboratory experiments to obtain these optimized conditions.
CONVERSION OF FERMENTATION WASTE-CAKE TO SOLID FUEL
by: Nathan Gardner, Vincent Krell, and William Rickert
Sponsors: Tom Fletcher and Laura Strylund
Pfizer, Inc.
Faculty Advisor: Andrew Kline
2:30 p.m. to 2:55 p.m., D-208

Large scale fermentation processes generate solid waste-cake that must be disposed of in a landfill. With production on the rise, this quantity is expected to increase in the upcoming years. Research was conducted to examine the feasibility of converting the waste-cake into a solid fuel. This fuel can be burned to generate heat for steam production. This process must support a variable waste-cake composition from various fermentation products. The waste-cake’s heating value could present a cost effective method of reducing waste-cake disposal costs, while generating steam for on-site usage.

ELIMINATION OF CONDENSATION IN COOLING TUNNEL
by: Andrew J. Biscupski, Tidasate Success, Nicolas J. Wolters, and Kayla M. Ziegler
Sponsors: Terry Andren, Mark Bergman, Gary Garfield, Nicole Remily, and Greg Stevens
Kellogg Company
Faculty Advisor: Andrew Kline
3:00 p.m. to 3:25 p.m., D-208

In bakery production at the Kellogg Company, products such as cookies, need to be cooled after baking in order to maintain their form and allow them to be packaged appropriately. The formation of condensation in cooling tunnels risks degradation of equipment life. An analysis of the mass and energy balances around the located problem areas associated with condensation was completed. Possible heat transfer and dehumidification processes were explored to formulate process modifications to eliminate the condensate. The completed project provides better solutions of optimizing cooling tunnel operations and preventing loss of equipment life.
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The Master of Science in Engineering is offered in computer, electrical, mechanical, and industrial engineering. The Master of Science is offered in chemical engineering, computer science, construction engineering, engineering management, manufacturing engineering, and paper and imaging science engineering. The Ph.D. is offered in chemical engineering, computer science, electrical and computer engineering, industrial engineering, mechanical engineering, and paper and imaging science and engineering.
Information about the College of Engineering and Applied Sciences at Western Michigan University

CEAS Mission
To educate our learning community for life-long excellence in responsible professional leadership. To increase knowledge through collaborative discovery, integration, application, and teaching. To serve as a resource and partner to our constituents. To prepare job-ready graduates for the global market.

CEAS Vision
A scholarly community dedicated to excellence through student-centered education and research emphasizing professional practices in engineering and applied sciences.

CEAS Four Cornerstones
- Engagement: Produce job ready graduates with the ability to grow in their profession and are life long learners
- Innovation: Move the profession and society forward by providing engineers, scientists, and technologists with new capabilities
- Leadership: To graduate engineers, technologists, and applied scientists who are and will continue to be leaders in their profession and community
- Globalization: Our graduates must be prepared to work in a global engineering and applied sciences industry

CEAS Administration
- Dean: Dr. Anthony J. Vizzini, Ph.D., PE
- Associate Dean of Undergraduate Studies: Dr. Edmund Tsang
- Associate Dean of Graduate Studies: Dr. Osama Abudayyeh
- Chair of Civil and Construction Engineering: Dr. Osama Abudayyeh
- Chair of Computer Science: Dr. Steven Carr
- Chair of Electrical and Computer Engineering: Dr. Jonas Grantner
- Chair of Industrial and Manufacturing Engineering: Dr. Steve Butt
- Chair of Manufacturing Engineering: Dr. John Patten
- Chair of Mechanical and Aeronautical Engineering: Dr. Parviz Merati
- Chair of Paper Engineering, Chemical Engineering, and Imaging: Dr. Said AbuBakr

CEAS Data (Fall 2012)
- Bachelor’s Enrollment: 2571
- Master’s Enrollment: 270
- Number of Faculty: 100
- Number of Staff: 26

CEAS Contact Information
- CEAS Advising Office: (269) 276-3270
- CEAS Dean’s Office: (269) 276-3253
- CEAS Student Outreach and Recruitment Coordinator: Scot Conant – (269) 276-3272
- CEAS Cooperative Education and Internships: Fred Sitkins – (269) 276-3261
- CEAS Website: www.wmich.edu/engineer