54th Conference on Senior Engineering Design

College of Engineering and Applied Sciences
--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.
You are invited to attend the fifty-third Conference on Senior Engineering Design Projects. The conference will be held from 8:00 a.m. to 4:00 p.m., Thursday, April 15th 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: 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:

| Civil and Construction Engineering | D-115 | 9:00 a.m. to 2:00 p.m. | p.6 |
| Computer Science | D-202 | 9:00 a.m. to 2:00 p.m. | p.9 |
| Electrical and Computer Engineering | D-204 | 9:00 a.m. to 3:00 p.m. | p.13 |
| Engineering Design, Manufacturing and Management Systems | D-201 | 8:00 a.m. to 12:00 p.m. | p.17 |
| Industrial and Entrepreneurial Engineering & Engineering Management | D-210 | 9:00 a.m. to 10:00 a.m. | p.20 |
| Mechanical and Aerospace Engineering | D-109 | 9:00 a.m. to 3:30 p.m. | p.21 |
| Mechanical and Aerospace Engineering | D-212 | 9:00 a.m. to 2:30 p.m. | p.26 |
| Chemical and Paper Engineering | D-208 | 8:30 a.m. to 4:00 p.m. | p.29 |

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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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 2014. If you have a project for our students or if you would like more information, please call Tamara Bergman at (269) 276-3248.

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United Soybean Board
USG Otsego Paper Inc.
Whirlpool Corporation

WMU Department of Military Science and Leadership
X-Treme Clean Carpet and Upholstery
LEADERSHIP REACTION COURSE AT WMU  
by: Talal Almaghlouth, Anthony Foresta, and Benjamin Ochoa  
Sponsor: LTC Decker B. Hains and MAJ Ken Gaylor  
WMU Department of Military Science and Leadership  
Faculty Advisor: LTC Decker B. Hains  
9:00 a.m. to 9:25 a.m.

A Leadership Reaction Course (LRC) on Western Michigan University’s campus will provide an important opportunity to the students of the Department of Military Science as well as other WMU students and the surrounding community to develop leadership skills. This LRC was designed based on the obstacles that make up Ft. Custer’s leadership reaction course in Augusta, MI. Eight obstacles were incorporated in the design to demonstrate mental as well as physical abilities. Construction documents including, site plan, floor plan, structural design documents as well as a cost estimate are considered.

CHARLES STREET RECONSTRUCTION PROJECT  
by: James Burlison, David Innes, and Anna Keehn  
Sponsor: Jeffrey S. Wingard, P.E  
Fleis and VandenBrink Engineering, Inc.  
Faculty Advisor: Valerian Kwizigile, Ph.D.  
9:30 a.m. to 9:55 a.m.

Charles Street is a local residential road in Hillsdale, Michigan that provides seventeen residencies with access to homes and a connection to Hallet and Sharp Street. Due to the degenerated condition and need for upgrades, Charles Street was selected by the city for repair. Reconstruction includes water main updating, storm sewer consolidation, pavement design, widening of pavement for on street parking, new concrete curb and gutter, and regenerated ADA compliant sidewalks. Design plans included cross sections, standard details, removals plan, plan and profile drawings, specifications, easement, and communication for residents. An engineer’s estimate of cost will be provided to the client.
SITE AND CIVIL ENGINEERING FOR NEW RESIDENCE HALLS
by: Zachary Boerema and Zachary Miller
Sponsor: Ryan D. Musch, P.E., LEED AP BD +C
Fishbeck, Thompson, Carr & Huber, Inc.
Faculty Advisor: Yufeng Hu, Ph.D.
10:00 a.m. to 10:25 a.m.

Bigelow and Hoejke residence halls are a part of the on-going update of Western Michigan University’s older buildings. The old buildings are being replaced by two new residence halls designed to encourage student interaction and recreation within a more open green space behind the dorms. The project required placing the new buildings’ innovative footprints, storm sewer system design, structural footing design, and existing parking lot restriping. The placement maximized student green space while minimizing grading changes and material needed for pedestrian paths between buildings. Attention was focused on limiting the use of materials and construction efforts with the site, as well as finding ways to make the site more sustainable. Sustainability was constantly considered, making the site ideal for LEED building and low impact site use.

LASALLE PLAT IMPROVEMENT
by: Isa Alawadhi and Hamza Srour
Sponsor: Jeffery Van Belle
Kalamazoo County Drain Commission
Faculty Advisor: LTC Decker B. Hains
10:30 a.m. to 10:55 a.m.

Ponds and wetlands play a major role in collecting and controlling the precipitation from storm events. Since the past few years the LaSalle Plat was facing some flooding problems because the pond wasn’t functioning properly. Two solutions have been combined together to overcome the problem. The first part of the solution was done by connecting a new outflow to a wetland that reduced the amount of precipitation going into the pond. The second part was by installing a pump in the pond that helped in transferring water from the pond to a ravine close by.
The sanitary sewer pipe along Ransom Street located in downtown Kalamazoo, MI had to be redesigned due to the current flow conditions exceeding the original design capacity. The new sanitary sewer pipe needs to be constructed while keeping the existing pipe operational. The proposed location was determined based on the area layout and existing underground utilities. A traffic analysis and construction staging was prepared to limit the effects of construction on the surrounding area. Sustainable and cost effective alternatives were considered throughout the project design. A cost estimate was developed in order to determine the most cost effective and efficient design.

The interchange of I-196 at Blue Star Highway, originally constructed in 1962, did not conform to current Michigan Department of Transportation (MDOT) design standards. Reconstruction considerations for the 0.95 miles of southbound I-196 included the analysis and re-design of the existing roadway, adjacent interchange ramps, and pavement types. Design decisions were based on current design standards and life cycle cost analyses. The final project plan set included interchange drawings, a maintaining of traffic scheme, and a total cost estimate. The reconstruction of this interchange will improve traffic safety and comfort in the future.

The project is the full replacement with associated road work of the I-94 EB/WB bridges over Hickory Creek in Berrien County, Michigan. I-94 is on a corridor of national significance. Following the analysis of scoping inspection data, the bridge was slated for full replacement. The full replacement decision was primarily based on the scour critical rating of the bridge. Project tasks include traffic maintenance, bridge removal, shoulder widening, full bridge design with increased span and width (superstructure and substructure), construction cost estimate, and construction schedule.
Sprinkle Road between East Michigan Avenue and East Main Avenue was on the 5% Transparency List on 2011 by the Michigan Department of Transportation. The 5% Transparency List contains locations in Michigan that are most critically in need of safety repairs. In order to improve safety while being cost efficient, accident history and site conditions were investigated and analyzed on the two Sprinkle Road intersections as well as the stretch of roadway between them. Alternatives were proposed and compared in order to mitigate crash patterns. A final alternative was agreed upon and project plans and estimations were designed and calculated.
**COMPUTER SCIENCE WEB PORTAL**
by: Talivaldis Strautkalns and Christopher White  
Faculty Advisor: John Kapenga, Ph.D.  
9:00 a.m. to 9:25 a.m.

Web portals are a great way to provide users with access to a variety of services and tools. A web portal was developed using Laravel 4, a PHP framework for web developers, to help students and administrators manage databases, user preferences, and to provide a web-interface for the upcoming CS virtual machines. Communications between the web portal and back-end servers was accomplished through secure LDAP authentication, MySQL queries and stub script files. Coding standards and security in PHP, MySQL, and JavaScript were prioritized to ensure maintenance and upgrades can be applied in the future.

**A FAMILY DANCE**
by: Douglas Losey and William Naylor  
Sponsor: Michael Liepman, Ph.D.  
Elizabeth Upjohn Community Healing Center  
Faculty Advisor: John Kapenga, Ph.D.  
9:30 a.m. to 9:55 a.m.

When trying to understand a problem it is often helpful to draw a picture. We created this picture using a JavaScript canvas library called kinetic. At its core, among other features the library allows for simple and complex shapes to be drawn, resized, and moved around on an HTML canvas to create a custom picture and help understand the path that led them to their problematic destination. After the model is made, it can be saved for later use and exported to a PDF to be taken home by the person for whom it was made.

**THE DEPOT WEBSITE**
by: Patrick Coady, Yousef Joseph, and Matthew Stiles  
Sponsor: The Depot  
Faculty Advisor: John Kapenga, Ph.D.  
10:00 a.m. to 10:25 a.m.

Recent changes in the sale of alcohol and the acquisition of liquor licenses have allowed many new businesses to start selling alcoholic products. This huge influx of new competition means that businesses need to innovate in order to remain ahead of the curve. A website that allows for the purchase and delivery of wine not only stands out from the competition but greatly broadens the client base. This website allows sale of wine anywhere inside of Michigan, and also display all in store items, and upcoming events.
EMPLOYEE DATABASE MANAGEMENT SYSTEM
by: Christian Baird, Jonah Brandow, and Benjamin Styx
Sponsor: X-Treme Clean Carpet and Upholstery
Faculty Advisor: John Kapenga, Ph.D.
10:30 a.m. to 10:55 a.m.

One of the many issues a small company deals with is keeping track of employee time clocks and task lists. Without a proper method of documentation, employee data can be lost or misinterpreted. A web-based service with SQL database will allow off-site inputs of time punches, task lists, transfer of notes and task lists to be sent from manager to employee via web. This results in improved efficiency of company management by significantly decreasing the amount of lost data and reducing miscommunication between employees.

AUCTION HOUSE MANAGEMENT SYSTEM
by: Adam Kusey, Tracy Ondracek, and Cody Stidmon
Sponsor: James Givens
Dreamers Resale and Auction Center
Faculty Advisor: John Kapenga, Ph.D.
11:00 a.m. to 11:25 a.m.

Running a brick and mortar auction house entails organizing and tracking large amounts of data in a time sensitive environment. The Auction House Management System application was developed using Java, JSP, MySQL, SSL, CSS to alleviate this data management strain by providing a consolidated web interface for inventory tracking, sales reporting, receipt printing, and customer profiles. It also provides a dashboard for running live auctions, allowing transactions to be captured in seconds for a smooth flow on the action floor.

MATERIAL INNOVATION WEB APPLICATION
by: Seth Martin, Zach Ruppert, and Stuart Zeiger
Sponsor: David Moore
Steelcase Inc.
Faculty Advisor: John Kapenga, Ph.D.
11:30 a.m. to 11:55 a.m.

A web application for storing, curating, and presenting information visually of different materials was created with HTML, JavaScript, CSS, and PHP. The web application includes a visual representation of all materials providing users access to each material, along with a dynamic page on each material. The web application also includes a page allowing administrators to control the material and other user-facing data.
VIRTUAL MACHINE SERVICE
by: Kevin Kahovec
Sponsor: Jason Johnson
Computer Science Department
Faculty Advisor: John Kapenga
1:00 p.m. to 1:25 p.m.

A virtual machine is a software-based emulation of a computer. Virtual machines operate based on the computer architecture and functions of a real computer. The virtual machine service that was created provides an interface for students to implement their own personal virtual machine located on the computer science servers. These servers will be created using bash shell scripts. Students will be able to choose what operating system they want and create virtual machines along with destroying, snapshotting and re-using past vms. Students and faculty now have the flexibility to change platforms with ease for development and testing purposes.

EXPRESS AUTO REWARDS
by: Jason Hughes, Justin McNett, and Max Rowland
Sponsor: Cliff VanMeter
Express Auto
Faculty Advisor: John Kapenga, Ph.D.
1:30 p.m. to 1:55 p.m.

Half of Express Auto’s sales come from repeats and referrals. Developing Express Auto’s relationship with customers is vital to their success. A web application was created using a popular web framework, CakePHP. The application allows repeat customers to earn points and claim rewards. It gives management the ability to control the rewards program. Express Auto Rewards cultivates a relationship between the company and the customer in order to promote growth.

EMPLOYEE WEB PORTAL
by: Michael Moore, Justin Proxmire, and Erik Swan
Sponsor: Christopher Rand
Western Michigan University Computer Aided Engineering Center
Faculty Advisor: John Kapenga, Ph.D.
2:00 p.m. to 2:25 p.m.

Employees require an interface to manage their timesheets. The CAE Web Portal was created to deliver a fully functional and user friendly website using HTML5, JavaScript, and PHP web development tools. The website allows employees to clock in and out, and view employee’s schedules including their own. Employee and shift management tabs are also included, allowing administrators to add and remove employees, modify access rights, and update shifts. The completed web portal provides all the tools needed for successful timesheet and employee management.
NEXT GENERATION AIR HOCKEY TABLE
by: Abdulaziz Alqarni, Nicholas Schweiger, and Justin Ward
Faculty Advisor: Steven Durbin, Ph.D.
9:00 a.m. to 9:25 a.m.

The idea of this project was to take a basic air hockey table and upgrade it to an electronic version. An electric scoring system was added to the table, along with a working scoreboard. Multiple fans were also added to the table to give the user an opportunity to create random dead zones. Finally, there was an option added so the user can select between a score and time mode. The outcome with this air hockey table was to store it in the electrical and computer engineering department for future students to have a preview of what they would be doing in college.

WIRELESS SUSPENSION LOAD SENSING SYSTEM
by: Aaron Kelley, Luke Sorrelle, and Daniel Tippman
Sponsor: Richard Hathaway, Ph.D.
H&S Prototype and Design
Faculty Advisor: Dean Johnson, Ph.D.
9:30 a.m. to 9:55 a.m.

A Wireless Suspension Load Sensing System (WSLSS) for automotive racing has been created using system on chip wireless technology. The WSLSS consists of four distributed sensor modules that amplify, record, process, and transmit real time strain gage suspension loading data from each wheel of a race car to a central processing node. At the processing node, the race crew and driver have access to indicators and data which can be used to improve vehicle handling by identifying performance problems in the suspension setup or operation. Achieving superior suspension performance gives racing teams a competitive advantage over opponents.
SOFTWARE DEFINED RADIO DEMONSTRATION SYSTEM
by: Zachary Bohley, David Perreault, and Amy Valley
Faculty Advisor: Bradley Bazuin, Ph.D.
10:00 a.m. to 10:25 a.m.

Wireless communication systems and devices provide great technical challenges and tremendous career opportunities. At the core, many of these systems are software defined radios (SDR). Various forms of wireless signal transmission and reception were built and demonstrated by utilizing Universal Software Radio Peripheral devices combined with PC hosted GNU Radio SDR tools and development environment. The demonstration system graphically displays various signal properties and structures, including the local radio frequency spectrum and the baseband signal time waveform and spectrum. In addition, an impairment circuit was developed that models channel effects to support laboratory experiments and advanced receiver software algorithm development.

MINIATURE GOLF AUTOMATIC SCORING SYSTEM
by: Mohamed Alattar, Bryan Vanlent, and Joseph Schnock
Faculty Advisor: Steven Durbin, Ph.D.
10:30 a.m. to 10:55 a.m.

The miniature golf automatic scoring system automatically counts the players’ strokes, when each player scores, andwirelesslytransmits this information to a display board/user interface. Stroke counting will be accomplished using accelerometers, which indicate whenever the club is swung. A switch will be used in the hole to determinewhena player score. Microprocessors will tell the wireless transmitters to send this information to the display board, where the receiver and another microprocessor will use this information to display play scores on an LCD display.

RFID TRACKING SYSTEM
by: Jiles Cronkright, Steven Kirk, and Casey Timm
Faculty Advisor: Janos Grantner, Ph.D.
11:00 a.m. to 11:25 a.m.

Tracking objects in a manufacturing process can be a complicated setup. This problem can be solved using RFID (Radio Frequency Identification) technology. With RFID, a tag can be placed on the object to be tracked, and readers can be set up at various checkpoints. Information processed from this system can determine the location of the object, the time it arrived there, as well as other useful information. The system developed is a proof of concept for a manufacturing plant RFID application.
RADIO FREQUENCY CONTROLLED HELIUM BLIMP WITH ULTRASONIC COLLISION AVOIDANCE
by: Tory Robinson, Kyle Coplin, Andrew Baker, and Omar Aldossary
Faculty Advisor: Steven Durbin, Ph.D.
11:30 a.m. to 11:55 a.m.

Dr. Steven Durbin would like to have a radio frequency controlled blimp that has the ability to avoid collisions while being piloted indoors. Dr. Durbin plans on using the blimp as a tool to show prospective electrical and computer engineering students what they can learn at Western Michigan University. The Electrical & Computer Engineering Program at Western Michigan University is a nationally recognized and accredited program. This blimp must take off and land using RC controls and DC motors. The blimp must also be able to be steered by the user and be able to rotate freely 360 degrees without hitting any objects such as the wall or ceiling. Designing a blimp with a gondola, which uses DC motors, microcontrollers, ultrasonic sensors and fans, is the scope of the project design.

DIGITAL CONTROL TRAINING SIMULATION WITH A DC MOTOR
by: Alruwaile Ghaleb and Perry Brandon
Faculty Advisor: Gejji Raghvendra, Ph.D.
1:00 p.m. to 1:25 p.m.

A laboratory experiment to control motor speed using a microprocessor was developed. The microprocessor generates signals to be fed to the motor. We also used a D/A converter and a digital filter. An example application would be an elevator, taking an object from A to point B.

WIRELESS POWER TRANSMISSION
by: Terry Davison, Brendan Getz, and Aaron Lowell
Faculty Advisors: Damon Miller, Ph.D. and Tarun Gupta, Ph.D.
1:30 p.m. to 1:55 p.m.

The Robotics CIM Laboratory at Western Michigan University required a wireless charging system capable of transmitting electrical power through free space over a distance of approximately one centimeter. The design was tested using circuit simulation software. A prototype was subsequently constructed and tested for this application. The resulting device provides a solution to charging robot batteries by eliminating cords directly attached to the robot.
Global Positioning Systems (GPS) are not an accurate form of indoor position tracking because of obstructions to the signal. Therefore, a solution is needed to track indoor positions. A solution to this problem involves a low power signaling device that will be integrated into an intra-guilding tracking system using WiFi. A device was designed that includes a user interface allowing the user to send and receive messages through button presses and LEDs. Redpin, an existing open-source intra-building tracking system, was used to track the positions of the devices, and locations were relayed with the use of a central server.
INJECTION MOLDED SAND CORES
by: Robert Goetz
Faculty Advisors: Sam Ramrattan, Ph.D., Paul Engelmann, Ph.D., and Jay Shoemaker
8:00 a.m. to 8:25 a.m.

Current high pressure blow methods of creating foundry sand cores have limitations when producing long thin cores. A new environmentally friendly binder system was tested to determine its properties for use in injection molding simulations using Autodesk MoldFlow software. This simulation was compared to lab data to ensure accuracy and determine processing parameters for curing, casting, and shakeout. This new method will allow for the creation of complex hollow sections in aluminum castings that would otherwise be impossible to create.

UTILIZING CONTRACTED WORKERS AND PRODUCTION PROCESSES
by: LeeShauna Brown, Juan Hernandez, Brian Schmidt, and Mark Urban
Faculty Advisor: Larry Mallak, Ph.D.
8:30 a.m. to 8:55 a.m.

A local manufacturer sought to improve the performance of its R&D food production processes. Root cause analysis, work sampling, and time study activities were used to identify and collect downtime and delays, and to evaluate contract resources to increase effectiveness. The analyses led to redesigned production processes that standardize assignment of duties and prescribe appropriate staffing levels required at selected production lines.

CAST CUTTER REIMPLEMENTATION
by: Kyle Fournier, Joshua Hadel, and Kevin Zmich
Sponsor: Chabu Kashito
Stryker Instruments
Faculty Advisor: David Lyth, Ph.D.
9:00 a.m. to 9:25 a.m.

Based on company-collected financial data, a hand-held medical device previously outsourced to vendors for assembly is likely to be brought in-house for production. Using direct observation, time studies, cost analysis, and line balancing tools, a new design to manufacture the device in-house has been created. The outcome of our work provides a manufacturing line capable of meeting demand while maintaining appropriate inventory levels and manufacturing footprint within the facility. A line layout and updated assembly instructions were developed and tested. An implementation plan provides the company with the necessary information to start manufacturing this device. This collected documentation will be maintained until the company determines an optimal time for the product to be brought back in-house.
INTEGRATED SAFETY LATCH STRIKE AND CATCH DESIGN
by: Christopher Ford, Shawn Jones, Nick Kruse, Gilles Nsengiyumva, and Lindsey Reeder
Sponsors: Jon Boyer and Mike Dalton
Whirlpool Corporation
Faculty Advisor: Mitchel Keil, Ph.D.
9:30 a.m. to 9:55 a.m.

A dryer’s locking mechanism was redesigned to improve customer perceived quality. Using Creo 2.0, a parametric solid modeling software package, a new model with an aesthetically pleasing design was created. Features include a safety lock and cut off switch. Finite Element Analysis and Failure Mode Analysis were completed to test the strength of the latch and improve any weak areas. This design will allow for the dryer to turn off when opened and lock when a specified internal temperature is reached. The completed model increases customer perceived quality, and creates a safer environment within the home.

DESIGN AND ANALYSIS OF A NEW STAMPING METHOD FOR EVAPORATORS
by: Douglas Bonnell, Kyle Bradford, Andrew Hazen, and Kennaht Martin
Sponsor: Mike Smith
Denso Corporation
Faculty Advisor: Jorge Rodriguez, Ph.D.
10:00 a.m. to 10:25 a.m.

An automotive parts manufacturer needed an updated way of stamping their evaporators to improve marking consistency and legibility. Following research, brainstorming, and analysis, a stamping method was chosen. A cost analysis was performed to compare the current method of stamping the evaporators to the proposed method. A fixture was then designed to hold the evaporator in place and to install the proposed equipment. The proposed system was modeled in 3D parametric CAD program, and a prototype was built. The proposed method is expected to increase the efficiency and production rate of their evaporator testing machines. The new stamp and fixture are under consideration by the company for implementation.
SPIDER CLAMP 2: REDESIGN OF WHEEL CLAMP FOR ALIGNMENT SYSTEM
by: Jordan Irey, Trent Pallagi, and Chris Teich
Sponsors: Zak Ford and Oscar Ferreyra
Kodiak Engineering-Cartek Group
Faculty Advisor: Jorge Rodriguez, Ph.D.
10:30 a.m. to 10:55 a.m.

Wheel alignment is crucial to the handling of a vehicle and the wear the tire will experience. The Spider Clamp “Generation 2” is a newly designed clamp that provides more accurate and reliable data during the alignment, easier mounting and dismounting, and an increase in efficiency throughout the process. This new design is a 4-legged device with the characteristics to accommodate a wide range of tire sizes. The new design was fully documented in 3D parametric CAD, and a prototype was built and tested. Results indicated a very accurate and consistent camber measurement, as well as an exact torque setting for mounting.

INNOVATION OF HYDRAULIC-POWERED VEHICLE FOR CHAINLESS CHALLENGE COMPETITION
by: Joseph Celano, Zachary Coggins, and Timothy Lewis
Sponsor: Matt Simon
Parker Hannifin
Faculty Advisors: Alamgir Choudhury, Ph.D. and Jorge Rodriguez, Ph.D.
11:00 a.m. to 11:25 a.m.

Due to rising fuel costs and environmental awareness, consumer interest in alternative modes of transportation has been steadily increasing. A bicycle powered by hydraulics, which placed in the Chainless Challenge competition in previous years, was modified with the goal of increasing available energy output while simplifying vehicle operation. Modifications to increase efficiency included simplifying gearing, enhancing the hydraulic circuit, adding a second energy storage device, and implementing electronic control valves. The redesigned bicycle will serve as a foundation for future competitors and for higher-efficiency vehicles.

OPTIMAL WATER MONITOR DESIGN
by: Ross Bollinger, Brandon DeRoo, Brandon Elliott, and Bryan Switalski
Sponsor: Kyle Stoops
Elkhart Brass Manufacturing
Faculty Advisor: Alamgir Choudhury, Ph.D.
11:30 a.m. to 11:55 a.m.

Water monitors are large water cannons used for fire suppression in a variety of settings. There is an increasing demand for larger and more efficient water monitors in order to protect valuable assets and lives. SolidWorks was used as well as Computational Fluid Dynamics (CFD) and Finite Element Analysis (FEA) to determine an optimal design to fulfill these market demands for a local manufacturer of firefighting equipment. The final design aims to minimize pressure loss while maintaining the largest output velocity possible.
CAPACITY ANALYSIS FOR AACOA ANODIZING FACILITY
by: Nate Johnson, Andrew Lindner, Mitch Panek, and Tunakan Kurt
Sponsor: David Whedon
AACOA, a division of Bonnell
Faculty Advisors: Laila Cure, Ph.D. and Azim Houshyar, Ph.D.
9:00 a.m. to 9:25 a.m.

The aluminum anodizing industry is extremely competitive. For this reason, manufacturing efficiencies play a key role in the success of a company. A top-down analysis of throughput throughout the facility was completed. Next, simulations of the manufacturing processes were developed. This analysis produced several metrics that allowed for accurate evaluations of overall capacity utilization for the company. In addition, different sequencing events for the facility were proposed and analyzed for performance. Ultimately, overall facility capacity was explored, and a more thorough understanding of manufacturing capabilities was determined for the company.

FBN COST ANALYSIS PROJECT
by: Alex Ancinec, Kyle Croes, and Alex Woodward
Sponsors: Mike Turley, Joe Stroup, and Brian Rosenbaum
FBN Sales Inc.
Faculty Advisors: Bob White, Ph.D. and Azim Houshyar, Ph.D.
9:30 a.m. to 9:55 a.m.

A company that produces pressure gravity filler valves and bottle cappers operates in a traditional job shop style, with constantly shifting priorities and job sequencing. The company is interested in identifying the cost of manufacturing their products so they are able to correctly price their products. This opportunity will use Industrial Engineering tools including engineering economy, work measurement, and facility design to identify and reduce costs.
PNEUMATIC BAR FEEDER
by: Daniel Byers, Brent Metzner, and Loren Sanders
Sponsors: Shawn Brown and Todd Johnson
Beckan Industries Precision Machining & Grinding
Faculty Advisor: Sam Ramrattan, Ph.D.
9:00 a.m. to 9:25 a.m.

In the competitive field of manufacturing, it is important to be as efficient and streamlined as possible. One of the key components that aids CNC turning is a bar feeder. Bar feeders are used to feed a continuous stream of material into the machining center; this improves efficiency by eliminating manual loading operations between parts. An air pneumatic bar feeder was redesigned, manufactured, and tested, improving key issues that occur during the turning process. Some of the components of the design include vibration dampening, length of pusher for feeding the material, and material storage.

SUPERCHARGED FORCED INDUCTION SYSTEM DESIGN FOR A FORMULA SAE ENGINE
by: Garrett Brand and Kurt Spriet
Sponsors: Brian Smith, Tim Ziemer, and Tara Petrusha
Eaton Corporation, Engine Technology, Inc., and Gamma Technologies, Inc.
Faculty Advisor: Claudia Fajardo-Hansford, Ph.D.
9:30 a.m. to 9:55 a.m.

The need to reduce fuel consumption has forced powertrain design trends toward smaller, lighter internal combustion engines. Formula SAE engines have followed similar trends. In an effort to increase the power-to-weight ratio of a downsized FSae engine, a supercharged induction system was designed. Pro/Engineer CAD software was used to ensure manufacturability and optimal packaging of the supercharged induction system. Abaqus finite element analysis (FEA) software was applied to determine the reliability of the designed components. The performance of the system was quantified using an experimentally validated GT-Power one-dimensional computational fluid dynamics (CFD) model. Results provide a useful baseline to guide current and future designs of engine packages for WMU Formula SAE vehicles.
HVAC DESIGN OF WMU’S EAST HALL ALUMNI CENTER
by: Clayton Butcher and Jesse Hendershot
Sponsors: Hans Korendyke and Jon Rumohr
TowerPinkster Architects/Engineers
Facultly Advisor: Javier Montefort, Ph.D.
10:00 a.m. to 10:25 a.m.

Heating, ventilating and air-conditioning systems account for a great portion of a building’s total energy consumption. Thorough research was done to choose the correct distribution system to be coupled with a geothermal heat exchanger. Heating and cooling loads were calculated for the building using Trane Trace 700, an energy modeling software. Systems were then designed using Autodesk Revit, a building information modeling software. Engineering calculations were also completed to size equipment, piping and ductwork. The completed design will be an energy efficient and sustainable solution for the new WMU East Hall Alumni Center.

AIRSHIP WITH CONVENTIONAL AIRCRAFT WINGS
by: Feras Aloufi, Daoshen Ong, and Shubram Subramanyam
Faculty Advisor: Tianshu Liu, Ph.D.
10:30 a.m. to 10:55 a.m.

Airships are considered a practical alternative to airplanes for long sustained flight that need more technological advancement. Hence, a hybrid airship with conventional aircraft wing is created to study the aerodynamics and the characteristics of the airship. The structure of the wings is modeled using SolidWorks. The wings are sized according to precise calculation by accounting the weight of the blimp and it’s made control free surface to generate sufficient lift for the blimp. The completed airship which is propelled by 2 motors and controlled by R/C also underwent flight testing to apprehend the behavior of the airship during flight.

HYDRAULIC SYSTEM FOR ANALYZING DAMPER VALVES
by: Michael Ericson, Aaron Hoskinson, and Kyle Kampenga
Sponsor: Mike Zebolski
Port City Racing
Faculty Advisor: James Kamman, Ph.D.
11:00 a.m. to 11:25 a.m.

Previous testing methods for damper valves used a shock dynamometer that was limited to a pressure of 1350 psi at a volumetric flow rate of 3.2 GPM. For better testing of damper valves, a hydraulic system was designed to measure and record the pressure difference across an isolated damper valve versus volumetric flow rate for pressures up to 3000 psi and volumetric flow rates up to 32 GPM. The long term goals with the development of the hydraulic system will allow for research and development of new products and improve current valve variations.
DYNAMIC MOTION OF THE FLAPPING FLAG IN WATER
by: Aaron Cohen and Ali Merat
Sponsor: Dave McAllister
Faculty Advisor: Tianshu Liu, Ph.D.
11:30 a.m. to 11:55 a.m.

The waving motion of a flag in water is an important motion for companies involving the washing process. The better this motion is understood the better their product can be. In order to help continue to be a leader in their market, a dynamic analysis of this motion was studied with techniques such as High Speed Videogrammetry and Particle Image Velocimetry.

CONTROLLED RETRIEVAL OF A SUBORBITAL WEATHER BALLOON INSTRUMENTATION
by: Samuel Cox, Genalou Cumpio, and John Potok
Faculty Advisor: Jennifer Hudson, Ph.D.
1:00 p.m. to 1:25 p.m.

Weather balloons equipped with radiosondes for atmospheric data collection are launched every day without any means of a controlled retrieval. The instruments land miles away from the original launch site and approximately 80% remain uncollected. An instrument return vehicle was designed, based on an earlier preliminary design, and wind tunnel testing was performed. A control system was also developed to guide the vehicle to a specified launch site. Using aircraft design techniques, the initial design was created using MATLAB® and CAD software packages. The development of a controlled return vehicle reduces the number of uncollected instrumentation, making the process of atmospheric data collection more economical.

OPTIMIZATION OF GUIDE ROD ASSEMBLY FOR A BOTTLE FILLING MACHINE
by: Rob Cordes, Mike Kouskoulas, Doug Montgomery, and Brooke Solomon
Sponsors: Ryan Fritz, Joe Stroup, Mike Turley
FBN Sales, Inc.
Faculty Advisor: Parviz Merati, Ph.D.
1:30 p.m. to 1:55 p.m.

Virtually all members of the bottling industry use complex, high volume filling machines to produce their products. One such machine required a redesign due to downtime caused by the inability to interchange parts efficiently. The main issue was the high level of disassembly required to change the guide rod bushings. Additionally, the weight to generate the down-force needed to form a seal around the bottle during filling may require adjusting due to varying bottle styles. The task was to engineer a feasible solution to these problems while keeping cost low and minimizing the change to the original design of the system.
DESIGN AND ANALYSIS OF A COLD GAS PROPULSION SYSTEM FOR STABILIZATION AND MANEUVERABILITY OF A HIGH ALTITUDE RESEARCH BALLOON
by: Mitchell B. Brownell, Gregory A. Neff, and Ryan A. Savard
Sponsor: Office of the Vice President for Research and WMU Aerospace lab for plasma experiments
Western Michigan University
Faculty Advisor: Kristina Lemmer, Ph.D.
2:00 p.m. to 2:25 p.m.

High altitude research balloons allow for data acquisition of meteorological conditions through sensors and cameras. A cold gas propulsion system was designed for stabilization and maneuverability of the balloon through rotational positioning. The design included a finite-element analyzed frame, tank, and gas delivery components. The converging nozzle for the system, which utilized nitrogen as the process gas, provided a designed thrust and was validated using computational fluid dynamics. Through research grants awarded by the Office of the Vice President for Research, a prototype was constructed using preliminary components for the frame and tank to provide concept validation.

LOW-TORSION BUSHING FOR COMMERCIAL VEHICLE LEAF SPRING EYES
by: Steven Molesworth
Sponsor: Pat Lamm
Trelleborg Vibracoustic
Faculty Advisor: Koorosh Naghshineh, Ph.D.
2:30 p.m. to 2:55 p.m.

Leaf springs are commonly used in commercial vehicles. The mounting point of a leaf spring to the vehicle chassis is referred to as the spring eye. In order to allow rotational freedom as well as a load-bearing connection at the eye, bushings are used at this location. During the loading phase, these bushings must assist in maintaining suspension geometry, while also revolving about the global Y-axis (as defined by SAE standards). Current bushings require regular maintenance, such as greasing, in order to meet these requirements, leaving manufacturers with unnecessary costs. A new design, utilizing rubber for maintenance-free operation and low-torque rotation has been developed for Trelleborg Vibracoustic. Finite element analysis and physical testing were applied to standard automotive engineering procedures in the design and validation process of this component. The final design consists of two bottle-necked inner metals opposing each with a molded rubber layer and outer metal of the same profile. Additionally, while the final design was created for a particular suspension, the concept can be scaled to ensure its application in a wide range of other commercial vehicles.
WMU SAE has developed a full aerodynamics package for the 2014 competition car scheduled to compete at Michigan International Speedway. The aerodynamic components of the car were modeled using the 3-D modelling package SolidWorks and Computational Fluid Dynamics testing was performed using Star CCM+. The results of CFD were compared with full scale wind tunnel testing for verification. The development of the aerodynamics package will give the Bronco Racing team a competitive edge at their annual competition and the ground work for further aerodynamic development has been laid.
HYDROFOIL DESIGN TO BALANCE HEELING MOMENT ON MONOHULL SAILBOAT
by: Ryan Pohl and Nathan Davis
Faculty Advisor: Javier Montefort, Ph.D.
9:00 a.m. to 9:25 a.m.

When a sailboat leans over to one side it is known as heeling. To counteract this the sailor needs to move to the other side of the sailboard and, in some cases, almost completely lean his or her body over the edge of the sailboat to keep it from changing its direction of travel or capsizing. Our team solved this problem by experimentally analyzing the moment created by a sail and the force created by a hydrofoil, then designing hydrofoil that created a moment which was opposite and approximately equal to the moment created by heeling.

TURBOFAN ENGINE OPTIMIZATION
by: Daniel Darga, Brandon Stinson, and Laurence Timmerman
Faculty Advisor: William Liou, Ph.D.
9:30 a.m. to 9:55 a.m.

As international business increases, the need for fast transatlantic transport increases as well. A baseline turbofan engine model, designed for subsonic business jets, was redesigned and optimized for a new mission, a transatlantic flight at Mach 1.5 in a two-engine business jet, which was determined by the American Institute of Aeronautics and Astronautics. The optimization was completed with GasTurb 12 and AxSTREAM software programs, and focused on fuel efficiency to make the transport economically viable. The market entry date in 2025 and predictions of technological advancements were supported with documentation of current research in the field.

BOTTLE FILLING VALVE THREAD REMOVAL
by: Nicholas Crane, Phillip Swanson, and David Szpunar
Sponsor: Ryan Fritz
FBN Sales Inc.
Faculty Advisor: Parviz Merati, Ph.D.
10:00 a.m. to 10:25 a.m.

FBN Sales Inc. produces an after-market bottle filling valve for the beverage industry that will have different products running through it at different times. In order to maintain specific quality requirements the bottle filling equipment undergoes a five step cleaning process: a hot water wash, an acid wash, a hot water wash, an alkaline wash, and a final hot water wash. Results are still contaminated after the five step cleaning process. The purpose of this project was to eliminate the build-up of contaminants in the threaded connection. The modified design was then prototyped and tested for operational integrity and cleanliness.
FLOW CALIBRATION TEST BENCH
by: Scott Johnson, Isaac Romero, and Scott Zech
Sponsor: Humphrey Products Company
Faculty Advisor: Jennifer Hudson, Ph.D.
10:30 a.m. to 10:55 a.m.

Flow meters used by Humphrey Products are needed to precisely measure the flow through pneumatic valves and cylinders in the designing, testing, and manufacturing phases of development. Outsourcing flow meters is a slow and costly process. A flow calibration test bench is to be designed to reduce the need for external calibration sources. This design will also be quick to use and allows multiple users to easily operate the test bench without error.

SHRINK FIT ROTATING FACE ASSEMBLY
by: Nicholas Ball, Lee Gilbert, and Jonathan Spackman
Sponsors: William Dietzel and Matt Fox
Flowserve
Faculty Advisor: Judah Ari-Gur, Ph.D.
11:00 a.m. to 11:25 a.m.

Shrink fit method is used in many industries and is very difficult to analyze. A non-linear Finite Element Analysis program (ANSYS) was used to design a shrink fit rotating face assembly inside the MW-200 mixer seals. Stress and deflection results were used to optimize the shrink fit assembly. The main benefit of shrink fitting a hard metal around the outer diameter of the soft carbon face is an increase in strength.

SUBTALAR FUSION FIXTURE DESIGN AND EXPERIMENT
by: Andrew Campbell, Christopher Lucas, and Nathan Ortiz
Sponsors: James Jastifer, M.D.
Faculty Advisor: Peter Gustafson, Ph.D.
11:30 a.m. to 11:55 a.m.

Subtalar arthrodesis is performed when cartilage in the talo-calcaneal joint is degraded in a patient and there are multiple approaches to this surgery. Using synthetic bone material, fixtures were cast from aluminum, using the process of evaporation pattern casting, and epoxy. This casting was used to grip the calcaneus bone of the foot in order to load it mechanically, simulating different scenarios. The relative displacement of the ankle joint was measured using a three-dimensional digital image correlation (DIC) program that was modified for this experiment. The results of this study will aid surgeons in performing this type of surgery to expedite patient recovery.
WIND DRIVEN HELICOPTER
by: Steven LaBorn, Daniel Menck, and Ian Stoll
Faculty Advisor: Tianshu Liu, Ph.D.
1:00 p.m. to 1:25 p.m.

The Wind Driven Helicopter is a device that generates lift through a vertical axis turbine powered by the wind. This was a continuation from the project started in 2013. The helicopter is designed to operate in high wind environments to test weather and atmospheric conditions. A 3D model was designed using Solidworks, a prototype was built and was tested in the Applied Aerodynamics Lab wind tunnel. From the wind tunnel data lift generation and RPM were determined to analyze the performance of the helicopter.

PERFORMANCE IMPROVEMENTS OF A SURGICAL HELMET
by: Bryan Ulmer
Sponsors: Brian VanderWoude and Beau Kidman
Stryker Instruments
Faculty Advisors: William Liou, Ph.D. and Peter Gustafson Ph.D.
1:30 p.m. to 1:55 p.m.

Personal protective suits are used as a barrier between healthcare providers and patient during surgery. Prolonged use can cause uncomfortable temperature levels for the user. Fans are used to lower temperature, however cause unwanted noise. Competitive benchmarking showed varied levels of comfort and effectiveness. Experimental setups were constructed to identify problem areas; CAD software was used in conjunction with 3D printed prototypes to improve airflow performance. Extensive use of semi-anechoic chamber verified noise reduction. A complete prototype was developed and design recommendations established.

ANKLE LOADING DEVICE FOR CT SCANNING
by: Karen Haubert, Benjamin Parkhurst, and Benjamin VanDyken
Sponsor: James Jastifer, Ph.D.
Faculty Advisor: Peter Gustafson, Ph.D.
2:00 p.m. to 2:25 p.m.

The medical community desires the ability to apply a load within a CT scanner. A prototype of such a device has been constructed for research for the Strength and Materials Lab at Western Michigan University. The application was designed to apply a load to the lower leg in order to study the ankle, while constrained to requirements that include a completely radiolucent device and the implantation of a quick release of the load for patient safety.
RECYCLING PRINTED ELECTRONICS AND THE FATE OF SILVER IN WASTEWATER
by: Savanna J. Manchester
Sponsor: John Bergin
Managing Director of the Paper Technology Foundation
Faculty Advisors: Jan Pekarovic, Ph.D., Margaret Joyce, Ph.D., and Thomas Joyce, Ph.D.
8:30 a.m. to 8:55 a.m.

Printed electronics are a cost-effective way to create an electrically functional device by printing with conductive ink on various substrates. Printed electronics are expected to be very useful in the future for applications that require low-performance but also low-cost electronics. Depending on how the inks of these printed electronics act during the recycling process, will have a huge effect on whether they exit through rejects, become part of the product or dissolve and become part of the dissolved solids in the water. For this study, silver-based printed electronics were recycled, and it was determined if the silver from the ink ended up in the wastewater or another part of the process.

RECYCLE PAPERBOARD BALE MOISTURE CONTENT DETERMINATION
by: Brent Carter, Lindsay Fisher, Robert Heffernan, and Lauren Rockafellow
Faculty Advisors: Peter Parker, Ph.D. and Andrew Kline, Ph.D.
9:00 a.m. to 9:25 a.m.

Secondary fiber is the highest cost variable to the Kalamazoo Board Mill. The goal is to have all of the input fiber in stock preparation come off the machine as paper. High incoming bale moisture lowers fiber yield and increases fiber cost. Old corrugated container and old newspaper bales were suspect for the highest incoming moisture. For major suppliers, bale moisture was measured and quantified. A sustainable plan was then set in place for operators to easily measure bale moisture throughout their shift. Purchased fiber cost savings were then analyzed.
Outdated and inefficient lighting systems prompted the need for an energy efficient lighting analysis. A comprehensive energy assessment was completed with mapping to identify each facility area’s lighting quality, quantity, and operating costs. The energy assessment culminated in an installation strategy of newer lighting technology such as lamps, fixtures, and lighting control systems. Analysis of the proposed lighting solution included luminosity, coordinated color temperature, and energy use intensity which contributed toward significant energy savings. The most economically feasible options were recommended to replace existing lighting in the facility.

FUNGAL CHITOSAN FROM SOYBEAN MEAL FERMENTATION AS BIOBASED PAPER COATING
by: Amanda Goudreau, Teryn Mergen, and Shaun Shields
Sponsor: United Soybean Board and Semper Exeter Paper Co.
Faculty Advisors: Andro Mondala, Ph.D. and Brian Young, Ph.D.
10:00 a.m. to 10:25 a.m.

Livestock enclosures often have Heating Ventilation and Cooling (HVAC) systems utilizing corrugated paperboard pads partially submerged in water. As water wicks up the paperboard, evaporative cooling lowers the heat content of the air circulated through the paperboard pads. The permeability and structural integrity of the paperboard is currently enhanced using a barrier coating based on phenolic resins that are highly odorous and potentially toxic. The biopolymer chitosan may be a resin substitute, as it exhibits similar barrier properties in paper coatings but is biologically based, non-toxic, and environmentally friendly. This project investigates chitosan production through fungal solid-state fermentation of soybean meal to determine the optimum fermentation and processing conditions to maximize yield and economically produce chitosan with desirable properties for this specific end-use.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS (AIChE) STUDENT DESIGN COMPETITION PROBLEM
by: Forrest Carmer, Jordan Johnson, and Michael Kendziora
Faculty Advisor: Andrew Kline, Ph.D.
10:30 a.m. to 10:55 a.m.

The AIChE National Student Design Competition problem is a chemical engineering design problem developed by a team of chemical engineers from industry and academia. The design problem is made available to chemical engineering departments as one means of testing chemical engineering design skills. This presentation will showcase the design solution for the 2014 Student Design problem formulated by a team of WMU chemical engineering students.
CONVERSION TO CONTINUOUS DOUGH FERMENTATION
by: Marquavis Bryant, Wesley Exposito, Justin Sweatt, and Joe Vermeersch
Sponsors: Danielle Habitz, Gretchen Merkel, and Nicole Remily
The Kellogg Company
Faculty Advisor: Andrew Kline, Ph.D.
11:00 a.m. to 11:25 a.m.

Saltine crackers require a fermentation step in many small batches in order to create the proper flavor and flakiness. This system requires lots of space, time, labor, equipment, and it can create inconsistencies in the products. As an alternative, a few continuous systems were proposed, fit to the current production, economically analyzed and the benefits and cons of each system were weighed against the current production being run in the batch system. The best alternative continuous system provides a possible update to the older inefficient batch system that will save time and money.

EVALUATION OF BI-MODAL BAKING TECHNOLOGY FOR OVEN DESIGN
by: Michael Kovach, Michael Perez, Mohammad Farran, and Sara Pritchard
Sponsors: Terry Andren, John Guy, Louis Nelson, and Gary Garfield
The Kellogg Company
Faculty Advisor: Andrew Kline, Ph.D.
11:30 a.m. to 11:55 a.m.

Baking is a complex process of converting raw dough into a product with developed flavors and appealing color and texture at the right moisture content. Currently, two types of tunnel oven technologies are widely used in the food industry – ribbon burner ovens and recirculating air ovens. There is, however, a developing industry trend in which the two technologies are combined into a single “hybrid” oven. Benefits of the hybrid design are reduced energy use and improved product quality. There is currently a need to evaluate this technology for crackers, identify design options for future installations, and determine economics for options.

CONTINUOUS CAROTENOID PROCESSING
by: Jacob Heemstra, Jeremy Ruiz, Diane Simmons, and Xan En Voon
Sponsors: Chris Russell, Dave Gordon, John White, and Hershel Jude
Kalsec Inc.
Faculty Advisor: Andrew Kline, Ph.D.
1:30 p.m. to 1:55 p.m.

Carotenoids are organic pigments that are found in many foods including carrots. The carotenoids are extracted for use in the food and beverage industry. This is done by processing the carrots to remove the excess fats and other organic materials. The demand for natural ingredients used in today’s food and beverage industry has increased the demand for the carotenoid extract. The desire to expand capacity has called for a new continuous system to be designed to replace the current batch system. Process analysis as well as an economic analysis was conducted to determine if the project is feasible.
Having the storage capacity for process chemicals to keep up with production demand is an important aspect of manufacturing. Based on current capacities and a forecast for future production, a model was developed to increase the capacity for storage of sulfuric acid and potassium hydroxide. Additionally, a delivery schedule was developed to ensure that these raw materials can be on hand for production runs, and the potassium hydroxide dilution process was optimized for improved accuracy. The completed design will outline improvement in capacity, ordering schedule and the dilution process.

MODELING THE RECOVERY OF KEY COMPONENTS FROM HOP OIL USING BATCH DISTILLATION IN ASPEN PLUS
by: Samuel Dilworth
Sponsor: Chris Russell
Kalsec Inc.
Faculty Advisors: Peter Parker, Ph.D. and Andrew Kline, Ph.D.
2:30 p.m. to 2:55 p.m.

The cost effective recovery of key components from hop oil using batch distillation is difficult due to the propensity for some components to degrade during the distillation process. Aspen, a chemical process modeling software package, was used to model the recovery of critical components using reactive batch distillation. Reaction kinetics developed from previous work was used with the current batch distillation design parameters. The batch distillation model was optimized to maximize the desired separations while maintaining acceptable losses due to the degradation reaction. Product value and operating costs were considered.

RE-DISTILLATION OPTIMIZATION FOR THE MANUFACTURE OF MINT OILS
by: Brian Buelke, James Dexter, Andrew Hunter, and Stuart Surmann
Sponsors: Tim Chambers and Jesse Hochstedler
A.M. Todd
Faculty Advisor: Andrew Kline, Ph.D.
3:00 p.m. to 3:25 p.m.

Re-distillation is an integral part of the process in the manufacture of raw mint oils. It is necessary for the removal of specific components that affect the sensory profile of the finished product. To improve the distillation process, the current system was assessed in order to determine its capabilities and constraints. With the existing limitations of the system known, various optimization options were considered. A cost analysis was then performed to determine which still upgrade would provide the highest profitability.
The Amway oral care products cleaning project required the review of current formulas, manufacturing equipment, and current cleaning processes. Optimization of the proposed cleaning process was a two-step process. The first step was to identify the optimal cleaning agent by using standard test methods for evaluating the cleaning agent’s effectiveness. The second step was to optimize the cleaning procedure and perform engineering trials to verify the cleaning process effectiveness. An economic assessment and risk analysis is included and the outcome is an improved program with reduced cleaning times, increased efficiency, and continued high quality levels.
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