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Conference On Senior Engineering Design Projects

Tuesday, April 12, 1994 Bernhard Center 9 a.m. to 4:30 p.m.

College of Engineering and Applied Sciences Western Michigan University



Conference on Senior Engineering Design Projects

You are invited to attend the fourteenth Conference on Senior Engineering Design Projects. The conference will be held from 9 a.m. to 4:30 p.m. Tuesday, April 12, at the Bernhard Center on the 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 circular drive in front of the Bernhard Center and then park in the lot at Read Fieldhouse. School groups traveling in cars are invited to call Linda Hager at (616) 387-4017 least one week before the conference to arrange for a parking permit. Teachers who cannot accompany their students to the conference may ask their students to sign in and out at the information table in the lobby on the second floor of the Bernhard Center. Sign-in sheets will be mailed to teachers the day after the conference.

Metered parking is available in the ramp near the Bernhard Center, in the lot behind the Center, and in the lot to the west of the center, off Michigan Avenue. Meters are checked regularly.

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

Session locations, starting times, and page numbers for project descriptions:

Electrical and Computer Systems Engineering	210	9 to 2:30	p. 5
Engineering Technology - A	209	9 to 2:30	p. 8
Engineering Technology - B	208	9 to 1	p. 10
Industrial Engineering	204	9:30 - 2:30	p. 13
Mechanical and Aeronautical Engineering - A	213	9 to 2:30	p. 16
Mechanical and Aeronautical Engineering - B	211	9 to 2:30	p. 19
Mechanical and Aeronautical Engineering - C	212	9 to 2:30	p. 22
Paper Science and Engineering - A	215-16	9 to 4:30	p. 25
Paper Science and Engineering - B	Brown & G	old 9 to 10	p. 29

Coffee will be available in the Faculty Lounge (across from 211) from 8:30 to 10:30.

A lunch break is scheduled from noon to 1 p.m.

For more information, call Linda Hager at (616) 387-4017.

- EE = Electrical and Computer Systems Engineering ET = Engineering Technology IE = Industrial Engineering MAE = Mechanical and Aeronautical Engineering PSE = Paper Science and Engineering

Time 9	Room 210 209 208 213	Dept. EE ET ET MAE	Topic Smart Digital Display Module Glueline Shear Strength in the Mortise and Tenon Joint Computer-Aided Design and Computer-Aided Manufacturing Fixture for Measurement of Spindle/Hub Assembly
	211 212 215 B&G	MAE MAE PSE PSE	Fast-Drying Household Clothes Dryer Submarine Modeling Using the Actuator Disk Theory The Effect of Fiber on Flotation Deinking Kinetics The Removal of White Pitch by Flotation
9:30	210 209	EE ET	Signal Processor for Control System of an HEV Investigation of Color Drift in Injection-Molded ABS Parts
	208	ET	Computer Animation Applied to Understanding a
	204 213 211 212 215	IE MAE MAE MAE PSE	Improvement of Bulk and Pre-Sort Mail Rooms Toaster Oven Door-to-Shelf Linkage Remote-Controlled Bypass Valve for a Transfer Pump Aerodynamic Analysis of Aircraft Wings Linear Optimization in the Selection of Filler Components
	B&G	PSE	The Effect of Corn, Wheat, and Potato Starch on Coatings and Coated Paper Properties
10	210 209 208	EE ET ET	Computer Interface for a Stamping Press Modification of an Extruder for Compounding Graphical Simulation Package for Programming the Prab Command RTX Robot
	204 213 211 212 215	IE MAE MAE MAE PSE	Re-Design of a Shop Floor to Expand Storage Capacity Sheet Metal Flanger for Auto Body Repair Electronic Weighing System to Measure Body Fat Spray Applicator for Tissue Adhesive Replacement of Silicate in Hydrogen Peroxide Bleaching
10:30	210 209 208 204 213 211 212 215	EE ET IE MAE MAE MAE PSE	Tester for a Fuel/Water Separator Support Stand for Automotive Technicians Optimal Design of an Engineered Hunter's Tree Stand Plant Layout for a Manufacturer of Guitar String Re-Design of a Stretcher Fixture for Stretching a Hydraulic Servocylinder Determination of Energy Consumption for Spas Use of Kenaf in Corrugating Medium for Strength Improvement

11	209 208 204 213 211 212 215	ET ET IE MAE MAE MAE PSE	Development of a Quick-Connect Engine Dynamometer Ergonomically Designed Workstation Project Analysis for Spectator Seating Effects of Combustor Hot Streaks on Turbine Blades A Fluid-Drive Conveyor System Use of Exhaust Gas in a Turbogenerator System Optimum Pulping Conditions of Flexographic Printed News for Flotation Deinking
11:30	210 209 208 204 213 211 212 215	EE ET IE MAE MAE PSE	Control System for Unattended Testing of a Pump Effect of Processing Parameters on Properties of a Cast Metal Matrix Composite Shock-Absorbing Seat Post for Bicycles Capital and Labor Scheduling for Furniture-Testing Labs Using Superposition to Reduce Gear Pump Ripple Optimization of a Supercharger Control System Mounting Fixture for Use in Endoscope Evaluation Improvement of Strength Properties for Currency Paper
LUNCH BREAK	(12 T	0 1	
1	210 209 208 204 213 211 212 215	EE ET IE MAE MAE MAE PSE	Optimization of a Geophysical Well-Logger Solidification of Aluminum: Theoretical vs. Actual Ergonomically Correct Input Device Modifying the Finishing Processes of Wood Furnishings Throttle Assembly for V-12 Racing Engine Control System for a Hybrid Electric Vehicle Four-Parameter Teaching Aid for Design of Experiments Depth-Specific Sampling of Bailers in a Water Column
1:30	210 208 204 213 211 212 215	EE ET IE MAE MAE MAE PSE	Energy Management System for a Hybrid Electric Vehicle Revising Temperature Control Systems A Road Map to Successful Product Development Improvement of a Surgical Instrument Design of an "Instant-On" Engine Cooling System Control Unit for an Interior Automatic Door The Effects of pH and Soaking Time on the Repulping of OCC
2	210 208 204 213 211 212 215	EE ET IE MAE MAE MAE	Test Head for the Command II Power Board Two-Chamber Raku Kiln Process Improvement of Absorption Ring Manufacturing Multi-Functional Stand for a V-12 Racing Engine Instrumentation of a Flight Test Aircraft Automated Assembly of an Automobile Sun Visor Starch Application with a Pod Coater

2:30	210 208 204 213	EE ET IE MAE	Interface Unit for a Proton Magnetometer Total Quick Die Change Analysis and Improvement of an Assembly Area Design of a Tennis Racket Handle to Reduce Arm Injuries
	211 212 215	MAE MAE PSE	Ultrasound Measurement of Ice on an Airplane Wing Improvement of the Rear Suspension for a Mountain Bike The Measurement of Sizing in Paper
3	215	PSE	Optimization of Recycled Paperboard Coating Properties
3:30	215	PSE	Application of Electrokinetics to Improve Sludge Dewatering
4	215	PSE	Rheological Behavior of Starches Used in Paper Pigment Coatings
4:30	215	PSE	The Effect of Moisture and Temperature on AKD Sizing

ELECTRICAL AND COMPUTER SYSTEMS ENGINEERING

Session Chair - John Gesink Room 210

SMART DIGITAL DISPLAY MODULE by <u>Alireza Bigdelou, Rodney Shafer, and Philip Story</u> Sponsor: Jeff Carpenter Faculty Advisor: S. Hossein Mousavinezhad 9 to 9:25 a.m., Room 210

A microprocessor-based digital display module and simulator were designed, built, and tested as an aid to operators of heavy trucks. The module provides visual feedback to the operator, indicating which gear the transmission is in and whether to increase or decrease the engine speed of the vehicle to obtain synchronization with the transmission. Synchronization results in improved performance, reduced wear, and increased fuel efficiency.

SIGNAL PROCESSOR FOR THE CONTROL SYSTEM OF AN HEV

by <u>Rohit Bafna, Kevin C. Lee, and Chin Kooi Tan</u> Faculty Advisor: Garrison Greenwood 9:30 to 9:55 a.m., Room 210

Western Michigan University is designing a hybrid electric vehicle for the "HEV Challenge." The car needs a microcontroller-based control system to make it run at optimum efficiency. This project involved designing the interface circuits between the internal combustion engine, the electric motor, and the microcontroller. The interfacing required the design of circuits for conditioning, filtering, amplifying, analog-to-digital and digital-to-analog conversions of the signals passing between these components. The circuits were tested for reliability and efficiency. The finished interface circuitry was enclosed in a weatherproof container for protection against dust and harsh road conditions.

COMPUTER INTERFACE FOR A STAMPING PRESS

by <u>Jeff Hossink, Brian Ransler, and John Sczepanski</u> Sponsor: John Berish Faculty Advisor: Garrison Greenwood 10 to 10:25 a.m., Room 210

A stamping and die company needed a real-time monitoring system for their stamping press shop operations. The present manual system is slow and inefficient. A microprocessor-based monitoring system was developed to monitor, record, and display stamping press information. The system permits better management of resources and facilitates tracking of customer's orders. TESTER FOR A FUEL/WATER SEPARATOR

by <u>Maurice Fetterley, Daryl Kenney, and Chin Wee Wong</u> Sponsor: Kurt Rose Faculty Advisor: S. Hossein Mousavinezhad 10:30 to 10:55 a.m., Room 210

The fuel/water separator is a component used in tank engines. The separator senses the electrical resistance of the fuel to determine the presence of water. If water is detected, the separator opens a valve. The test unit ensures that a bad unit is not installed. The tester simulates different water/fuel mixtures and samples the resulting output of the separator. If the separator functions correctly, the test unit replies with a "go" response. If failure is determined, the unit gives a "no-go" response. Under "no-go" conditions, a cause of failure is indicated.

CONTROL SYSTEM FOR UNATTENDED TESTING OF A PUMP by <u>Kristine L. Bromberek, Scott M. Houser, and Terry A. Shook</u> Sponsors: Bill Goerss, Forrest Shook, and Steve Thomas Faculty Advisor: Frank Severance 11:30 to 11:55 a.m., Room 210

A control system that could operate unattended was needed to test two types of high-pressure water pumps. A control system was designed to monitor several variables of either a triplex or quintuplex water pump. When one of the variables out-steps its range, the control system initiates shut-down and turns on an indicator light. Because more than one type of pump and design will be tested, the control system is adaptable to various pump layouts. Test duration can range from 8 to 500 hours.

OPTIMIZATION OF A GEOPHYSICAL WELL-LOGGER

by <u>David Slater, Joseph R. Thompson Jr., and Jeffrey S. Wadell</u> Sponsor: William Sauck Faculty Advisor: Joseph A. Kelemen 1 to 1:25 p.m., Room 210

A geophysical well-logger which detects the presence of various ground materials by gamma radiation detection was optimized. The new design provides for discrete gamma particle counting and discrimination of energy levels vs. an averaged output of all particles detected with the original system. It also provides for manipulation of data by use of a laptop computer vs. hand picking points from a strip chart recording. Data errors associated with the analog system are not present in the new design. ENERGY MANAGEMENT SYSTEM FOR A HYBRID ELECTRIC VEHICLE

by <u>Sabri Abdullah, Rogelio Lemus, and Muath Zeidan</u> Faculty Advisor: John Mason 1:30 to 1:55 p.m., Room 210

A hybrid electric vehicle has two sources of motive energy, an electric battery and an internal combustion engine. Each is capable of powering the vehicle independently. An energy management system for a hybrid electric vehicle was designed, built, and tested. The system determines the state of battery charge by monitoring its current flow and voltage. If the battery needs to be charged, the system will initiate a charging cycle. The internal combustion engine will drive a generator for this purpose.

TEST HEAD FOR THE COMMAND II POWER BOARD by <u>Martin Boonzaayer, Brian Welsh, and Teresa Yake</u> Sponsors: Michael Casey and Jerry Culp Faculty Advisor: Raghvendra Gejji 2 to 2:25 p.m., Room 210

A quick and efficient way to test the Command II Power Board was needed. The power board is a variable input/output power supply. A test head was designed and built that incorporates an electronic load designed to simulate variable operating loads typically placed on the power board. Safety features and automated operation were designed and built into the test head. The test head is controlled and monitored by a computer. Software written to control the testing procedure allows operators without technical training to carry out testing of the power board.

INTERFACE UNIT FOR A PROTON MAGNETOMETER by <u>Azreen Ariff, Louis Baiz, and Hock Guan Teh</u> Sponsor: William A. Sauck Faculty Advisor: Frank L. Severance 2:30 to 2:55 p.m., Room 210

A proton magnetometer is used to measure the intensity of the earth's magnetic field. For this project, a magnetometer was upgraded to perform automatic data logging, a feature lacking in the old model. An interface unit consisting of a microcontroller and storage elements was built to store data acquired from the magnetometer when conducting field surveys. The stored data can be downloaded into the computer at the convenience of the user.

ENGINEERING TECHNOLOGY - SESSION A Session Chair - Sam Ramrattan

Room 209

GLUELINE SHEAR STRENGTH IN THE MORTISE AND TENON JOINT by <u>Scott Drobot, Derik Reichhart, and David Williams</u> Faculty Advisor: Roman Rabiej 9 to 9:25 a.m., Room 209

Joints are the weakest structural nodes of furniture. The mortise and tenon joints commonly found in chairs and tables are glued. The glueline is one of the factors responsible for their strength. Three factors that affect the glueline shear strength in the mortise and tenon joint were investigated: orthotropic sections and grain arrangement of the wood, varying the percentage of solid content in the adhesives, and different methods of glue application. Statistical computer software was used to analyze and graph the data.

INVESTIGATION OF COLOR DRIFT IN INJECTION-MOLDED ABS PARTS

by <u>Dana Elkins, Dennis McKenzie, and Katie McParlan</u> Sponsors: Phil Marshall, Tim Parks, Mike Quinn, Jim Russel Faculty Advisor: Vladimir Tsukruk 9:30 to 9:55 a.m., Room 209

The problem of color drift, which often occurs when injection molding plastic parts from a mixture of natural (clear) acrylonitrile butadiene styrene (ABS) and color concentrate, results in increased scrap and low productivity. This group performed a study of the effects of process parameters on color uniformity. They explored the relationship between pigment distribution in natural resin on the molecular level, and the resulting color properties.

MODIFICATION OF AN EXTRUDER FOR COMPOUNDING by <u>Kurt F. Hayden, Tim E. McLain, and Michael E. Wilson</u> Sponsor: Robert Morgan Faculty Advisor: Paul V. Engelmann 10 to 10:25 a.m., Room 209

A two-inch extruder was retro-fitted with a vented barrel, compounding screw, and additive feeder. The new equipment makes it possible to compound resins with fillers and reinforcements. Compounding is used to improve the properties of plastics. The new barrel and screw can be interchanged rapidly with the current barrel configuration. Wall-mounted storage racks assist in the handling of the barrels during exchanges and provide for barrel storage, holding floor space requirements to a minimum. New instrumentation was added to control the additional barrel length and feeder. SUPPORT STAND FOR AUTOMOTIVE TECHNICIANS by <u>Horatius Dorval, Andrew Ostrowski, and Mike Peterson</u> Faculty Advisor: James VanDePolder 10:30 to 10:55 a.m., Room 209

Lower back strain is a major problem for automotive technicians because they spend many hours bending over to perform repairs under the hood. A support stand was designed and constructed that transfers onto the stand the weight usually placed on the lower back. Padding is provided for knees, thighs, and chest. The stand is placed near the vehicle, with the chest support protruding into the engine compartment to allow the technician to be supported above the engine without any contact with the vehicle itself.

DEVELOPMENT OF A QUICK-CONNECT ENGINE DYNAMOMETER

by <u>Stephen Harris, Von Pham, and Rick Spaman</u> Faculty Advisor: James VanDePolder 11 to 11:25 a.m., Room 209

Effective use of engine dynamometers is limited by the amount of time required to connect an engine to the unit. An engine cart was designed that allows mounting the engine and most instrument connections away from the dynamometer. The cart is then connected to the dynamometer to form one assembly. This system increases the amount of time an engine can be tested and reduces the set-up and preparation time of the engine.

EFFECT OF PROCESSING PARAMETERS ON PROPERTIES OF A CAST METAL MATRIX COMPOSITE

by <u>David Harrell and John Siemen</u> Faculty Advisor: Sam Ramrattan 11:30 to 11:55 a.m., Room 209

The mechanical and physical characteristics of aluminum were compared in a conventional cast alloy to a metal matrix composite (reinforced with silicon carbide). The cast aluminum samples were prepared using gravity sand casting techniques. An aluminum/silicon alloy and a metal matrix composite were processed using the optimal foundry technologies for each material. The cast samples were tested according to standardized testing procedures. The collected data from the samples were analyzed and documented.

SOLIDIFICATION OF ALUMINUM: THEORETICAL VS. ACTUAL

by <u>Jeff Jowett, Kevin Kruger, and David Kwierant</u> Faculty Advisor: Sam Ramrattan 1 to 1:25 p.m., Room 209

In industry today, much production time is spent changing a part's design to compensate for the shrinkage caused by solidification inside a mold. Fortunately there are software packages available that predict this shrinkage. The experimental and theoretical solidification patterns were compared in an aluminum casting. The theoretical solidification was performed using the AFS Solidification System, a 3-D software package available to the public. The experimental data were obtained through a data acquisition system and thermocouple instrumentation to monitor temperatures with a green sand mold. Theoretical and experimental data were compared.

ENGINEERING TECHNOLOGY - SESSION B

Session Chair - Ralph Tanner Room 208

COMPUTER-AIDED DESIGN AND COMPUTER-AIDED MANUFACTURING by <u>Erin Daly, Cheryl A. Mostek, and Scott L. Selesky</u> Faculty Advisors: Michael V. Atkins and Ralph Tanner 9 to 9:25 a.m., Room 208

A system was devised to produce milled and turned parts on computer numerically controlled (CNC) machines using direct CNC programming input from a computer-aided design/computer-aided manufacturing (CAD/CAM) system. This system will save time programming the CNC machines and reduce human error. A direct link was used to connect the computers to a CNC mill and lathe. A CAD system was implemented to design a final test product to ensure complete integration. From the displayed design, the CAD/CAM system generates a program for the MAZAK VQC-15/40 mill to cut a production part, and for the Clausing CNC 350 lathe to produce a mating part.

COMPUTER ANIMATION APPLIED TO UNDERSTANDING A RAVIGNEAUX PLANETARY GEARSET by <u>Corey A. Griewahn, Daniel Oldham, and Daniel Warnaar</u> Faculty Advisors: Michael Atkins, Ralph Tanner, and Jim VanDePolder 9:30 to 9:55 a.m., Room 208

Computer animation technology was used to develop an educational tool for the enhancement of understanding of the Ravigneaux planetary gearset in an automatic transmission. The planetary gearset is used primarily by American and Japanese manufacturers. Three-dimensional models were created and animated to illustrate the gearset's dynamic functions. An evaluation was performed by test groups of students, faculty, and alumni to determine the usefulness of animation compared to current and traditional training methods.

GRAPHICAL SIMULATION PACKAGE FOR PROGRAMMING THE PRAB COMMAND RTX ROBOT by Jean M. Kruley, Daniel D. Parcheta, and Matthew D. Schultz Faculty Advisors: Michael B. Atkins, Fred Z. Sitkins, and Ralph Tanner 10 to 10:25 a.m., Room 208

A CADKEY-based application was developed to assist in the graphical off-line programming of a PRAB robot to perform a work-cell routine. The user executes the package within CADKEY. The computer monitor displays a three-dimensional robot within its work cell. The user defines the work cell routine by choosing from a menu and answering simple questions. As the information is entered, the robot model moves accordingly. When the routine has been defined, it is executed and the high-level language program creates a database that is transferred to the robot, where the routine is carried out. OPTIMAL DESIGN OF AN ENGINEERED HUNTER'S TREE STAND

by <u>Brad M. Bauer, Keith J. Marenger, and Ray A. Peterson</u> Faculty Advisors: Fred Z. Sitkins and Charles Woodward 10:30 to 10:55 a.m., Room 208

Market research was used to design a hunter's tree stand. A prototype was constructed and tested.

ERGONOMICALLY DESIGNED WORKSTATION

by <u>Anne Hodge, Gregory R. Johnson, and Bruce H. Landheer</u> Faculty Advisor: Charles Woodward 11 to 11:25 a.m., Room 208

New technology and workstyles challenge designers to develop office equipment that meets needs specific to workers of today and tomorrow. A computer workstation was designed and developed that upholds current ergonomic standards and anticipates future user needs. The workstation also brings into one product features that are now treated separately.

SHOCK-ABSORBING SEAT POST FOR BICYCLES

by <u>Eric Burmeister, Mark Bussee, and Bryan Smylie</u> Faculty Advisor: Charles Woodward 11:30 to 11:55 a.m., Room 208

A prototype was designed and built of a shock-absorbing seat post for bicycles. The function was analyzed, and different methods of damping were evaluated. Components were fabricated, and the prototype was assembled and tested. Different damping settings and spring rates were tested. An instruction manual was produced that makes it easy to install and adjust the device.

ERGONOMICALLY CORRECT INPUT DEVICE

by <u>Mike Mearing, Tricia Rathbun, and Jenna Snyder</u> Faculty Advisor: Charles Woodward 1 to 1:25 p.m., Room 208

Most computer keyboards and office chairs produce stress in wrists, arms, shoulders, and neck. An office chair was designed with an integrated keyboard to reduce these stresses. A split-key, alpha-numeric keyboard increases productivity and reduces worker-related injuries. The ergonomically designed chair can be adjusted to fit any user and provide comfort for all parts of the body. REVISING TEMPERATURE CONTROL SYSTEMS

by <u>Marty Mrozinski, James Mulvihill, and Bill Osborn</u> Sponsor: Bill Cline Faculty Advisors: Mahesh Nallakatla and Charles Woodward 1:30 to 1:55 p.m., Room 208

A more user-friendly heat exchanger was designed, tested, and built. A heat exchanger is used for temperature control of liquid adhesives used in automobile construction. The heat exchanger controls the temperature of the liquid being applied. The steps involved included using computer-aided design and analysis software to create and test the prototype. The heat exchanger was transferred into a computer-aided manufacturing package for production of the unit.

TWO-CHAMBER RAKU KILN

by <u>Todd Osler and Daniel S. Sommerfeld</u> Sponsor: Bud Osler Faculty Advisor: Charles Woodward 2 to 2:25 p.m., Room 208

"Raku firing" involves heating a small piece of pottery in a kiln and then using tongs to lift the pottery from the kiln to a container filled with combustible material. The combustible material ignites upon contact with the heated pottery, causing the ceramic to turn black where unglazed and affecting the glaze color. The process is not usually used for large pottery because it cannot be lifted safely with tongs. A two-chamber kiln was designed and built to move pottery from the firing chamber to the smoking chamber. The smoking chamber is sealed so air cannot feed the fire. The system ensures more consistent glazing and allows Raku firing of larger pottery.

TOTAL QUICK DIE CHANGE

by <u>Eric D. Szabo and Mark A VanVliet</u> Sponsor: Jimmy L. Johnson Faculty Advisor: Charles Woodward 2:30 to 2:55 p.m., Room 208

Die changes cause press down-time in the stamping industry. A quick die-change (QDC) system permits die changes in minutes rather than hours. Various types of QDC systems were studied, with an emphasis on loading and unloading dies into the press, locating and clamping dies into the press, and handling dies outside the press. The most appropriate QDC system for the sponsor was selected and implemented.

INDUSTRIAL ENGINEERING

Session Chairs - Liwana Bringelson and Larry Mallak Room 204

IMPROVEMENT OF BULK AND PRE-SORT MAIL ROOMS

by <u>Steven Laninga, Jason Matousek, and Karn Siriphatra</u> Sponsors: Fleurette Bowers, Sharon Jager, and Valerie Wood Faculty Advisors: Liwana Bringelson and Larry Mallak 9:30 to 9:55 a.m., Room 204

A nonprofit organization wanted to increase efficiency in their bulk mail room and double capacity of their pre-sort mail operation. The layout and mail handling processes were analyzed. Work flow analysis and plant layout software were used to develop several ways of optimizing the limited space. A plan was developed for implementation of the best alternative.

RE-DESIGN OF A SHOP FLOOR TO EXPAND STORAGE CAPACITY

by <u>Danny Hendarmin, Raul Garcia, and Gordon Reigle</u> Sponsors: Fleurette Bowers and Lee Wilcox Faculty Advisors: Liwana Bringelson and Larry Mallak 10 to 10:25 a.m., Room 204

A sheltered workshop that provides employment and training for the developmentally disabled was running out of storage space. The organization requested an assessment of its facility to find ways of storing its large inventory. A new layout of the shop floor was designed to use space more efficiently and create designated storage areas for raw, finished, and inprocess materials. Special attention was given to improving the flow of materials in the assembly and production operations.

PLANT LAYOUT FOR A MANUFACTURER OF GUITAR STRING

by <u>Frances Bruischart, Alireza Hosseinian, and Jason Liefer</u> Sponsors: Robert Haldy and Richard King Faculty Advisors: Liwana Bringelson and Larry Mallak 10:30 to 10:55 a.m., Room 204

A manufacturer of guitar string has limited space for shipping and receiving, and the layout does not allow sequential material flow. A design was developed that provides a detailed layout of machines and departments, allows more efficient material flow, and provides space for shipping and receiving.

PROJECT ANALYSIS FOR SPECTATOR SEATING by <u>Erich Baum, Tony Federighe, and Anthony Trapalis</u> Sponsor: Ken Baratta Faculty Advisors: Liwana Bringelson and Larry Mallak 11 to 11:25 a.m., Room 204

A manufacturer of spectator bleachers and stadium chairs decided to convert to a work-cell-based manufacturing process for the production of "horses," the understructure of spectator seating. Research and recommendations concentrated on efficient work cell organization with implications for the plant's layout, indirect labor, material handling, and overall work flow. CAPITAL AND LABOR SCHEDULING FOR FURNITURE-TESTING LABS by <u>Turk Alfaraj, Andy Bush, and Laura Schumacher</u> Sponsors: John Fuhs and Tom Rademaker Faculty Advisors: Liwana Bringelson and Larry Mallak 11:30 to 11:55 a.m., Room 204

A personnel and equipment scheduling system was developed to accommodate varying test times, personnel times, and machine downtimes. Historical data pertaining to the testing labs were collected. Different design alternatives were evaluated for user-friendliness, compatibility with the current computer network, and practicality. For the schedule to be useful, it must be flexible and meet design criteria; the alternative chosen satisfies the criteria and allows for daily changes. A proposal was written for implementation of the test-scheduling system.

MODIFYING THE FINISHING PROCESSES OF WOOD FURNISHINGS by <u>Parimalam Balasubramaniam, Brian Roberts, and Paul Szymanski</u> Sponsor: Todd Kienzle Faculty Advisors: Liwana Bringelson and Larry Mallak 1 to 1:25 p.m., Room 204

A manufacturer of fine wood furnishings was looking for an improved layout for the wood-finishing process. The hand-sand, finish, rub, and trim departments needed reorganization on a product basis. A layout was developed that allows multiple lines based on product families. The new layout reduces work-inprocess inventory by decreasing the time needed to finish the products, reduces material-handling cost and damage, and reduces customer delivery time.

A ROAD MAP TO SUCCESSFUL PRODUCT DEVELOPMENT by <u>Mark Czuk, Okwudiri Jideaku, and Joe Shaver</u> Sponsors: George Ignatiev and Mark Lindquist Faculty Advisors: Liwana Bringelson and Larry Mallak 1:30 to 1:55 p.m., Room 204

A metal-fabricating firm wants to find a standard product development process for the design and manufacturing of a product. The development process must reduce design time while improving quality and reliability of the new product. A "road map" was developed that incorporates the use of various engineering concepts such as concurrent engineering and quality function deployment. PROCESS IMPROVEMENT OF ABSORPTION RING MANUFACTURING by <u>Ahmed AlAwaji, Doug Hunt, and Jeff Szafranski</u> Sponsors: Tim Hanna, Perry A. Kuipers, and W. Douglas Lutes Faculty Advisors: Liwana Bringelson and Larry Mallak 2 to 2:25 p.m., Room 204

A company that manufactures tools and automotive components wishes to improve their operation for producing a vibration absorption ring used in alternators. Manufacturing cell layout, production scheduling, and work design concept applications were evaluated to offer recommendations for improving the manufacturing processes and product quality, as well as reducing lead times, inspection, and labor. Machine alteration and automation recommendations were also proposed.

ANALYSIS AND IMPROVEMENT OF AN ASSEMBLY AREA

by <u>Keith Hartung and Kenny Willson</u> Sponsors: Dale W. DeWeese, Larry M. Dowd, and Eric J. Giese Faculty Advisors: Liwana Bringelson and Larry Mallak 2:30 to 2:55 p.m., Room 204

An automotive parts manufacturer that produces instrument panel mounting carriers requires a flexible, variable-rate assembly area. The assembly process includes everything from the paint racks to packaging and requires manual attachment of parts to the assembly using various hand and air tools. Line balancing, forecasting, ergonomics, and process flow analysis were used to standardize the process and improve the assembly area.

MECHANICAL AND AERONAUTICAL ENGINEERING - SESSION A

Session Chair - Parviz Merati Room 213

FIXTURE FOR MEASUREMENT OF SPINDLE/HUB ASSEMBLY ENDPLAY

by <u>Tom Armbruster and Steve McKeeby</u> Sponsors: Dale Kwasniewski and Paul Mason Faculty Advisor: John Ward 9 to 9:25 a.m., Room 213

A truck components manufacturer instructs customers to adjust wheel bearings to a predetermined endplay reading. But there has been no reliable means of measuring endplay. A fixture was designed that attaches to the spindle/hub assembly and accurately determines the amount of endplay when installation is complete. The fixture measures endplay for any given load by means of strain gages, a linear variable differential transformer (LVDT), and data acquisition equipment.

TOASTER OVEN DOOR-TO-SHELF LINKAGE

by <u>Pamela J. Monroe and Joseph D. Wetzel</u> Sponsor: Timothy B. Sutton Faculty Advisor: John Ward 9:30 to 9:55 a.m., Room 213

The door-to-shelf linkage on a toaster oven had undesirable noise, appearance, and performance level. The motion of the linkage was simulated by computer animation to determine the forces generated. Finite element analysis was used to calculate the stresses in the linkage. The redesigned linkage has reduced noise, increased performance, and enhanced appearance.

SHEET METAL FLANGER FOR AUTO BODY REPAIR

by <u>Eric H. Berg and James M. Mattson</u> Faculty Advisor: John Ward 10 to 10:25 a.m., Room 213

A flanging tool was designed to assist in auto body repair. The tool makes it possible for the replacement panels to remain flush with the body during attachment. Use of the tool retains the natural shape of the body panel and minimizes the amount of fiberglass needed to fill the seam between the replacement panel and the body. The tool can be used manually or with an airpowered ratchet. **RE-DESIGN OF A STRETCHER**

by <u>Edward Abernethy and Paul Barghahan</u> Sponsor: Richard Bartow Faculty Advisor: John Ward 10:30 to 10:55 a.m., Room 213

A stretcher now being manufactured has a patient surface with an articulating upper body section or fowler. The mechanism that provides the articulation is a simple pivot-mounted platform supported by two gas springs. This type of fowler provides very little assistance when a patient is being lifted, and it is difficult to lower when empty. The fowler was re-designed to give improved lift assistance and reduce the force required to lower the empty stretcher.

EFFECTS OF COMBUSTOR HOT STREAKS ON TURBINE BLADES

by <u>Ali Al-Habbas and Boon-Chai Ng</u> Faculty Advisor: Daniel J. Dorney 11 to 11:25 a.m., Room 213

Thermal fatigue due to combustor hot streaks can significantly reduce the life of a turbine blade. A computational analysis was used to predict the timedependent temperature distributions along the surfaces of turbine blades. The hot streak profile and location were varied to study their impact on turbine blade heat transfer.

USING SUPERPOSITION TO REDUCE GEAR PUMP RIPPLE

by <u>Alan J. Arnsman and Jennifer A. Hoey</u> Sponsor: John L. Jones Faculty Advisor: Daniel Dorney 11:30 to 11:55 a.m., Room 213

Flow fluctuations (ripple) in hydraulic pumps are a leading cause of noise in hydraulic systems. Gear pumps are the most common type of pump used for fluidpower. They also produce relatively high amplitude ripple. Analysis of this ripple revealed that wave amplitude could be reduced if similar, but offset, waveforms were combined. This was accomplished by dividing the usual pump output into two phase-shifted flows. As the flows combine, local fluctuations are canceled, yielding an output flow with greatly reduced ripple.

THROTTLE ASSEMBLY FOR V-12 RACING ENGINE

by <u>Steven C. Haslitt and Jason H. Rawlings</u> Sponsors: Adam Aldrin and Raymond Wedel Faculty Advisor: Daniel Dorney 1 to 1:25 p.m., Room 213

An engine throttle and linkage were developed for use in an 858-cubic-inch V-12 high-performance engine used in powerboat racing. The linkage was incorporated to produce low-end response time and top-end performance. General Two-Dimensional Kinematic Analysis software was used to model the linkage. Algor, a finite element analysis software, was used to test the structural integrity of the throttling shafts. Airflow characteristics were modeled on MapleV, a computer algebra system. **IMPROVEMENT OF A SURGICAL INSTRUMENT** by <u>Luan M. Marienfeld and Steven D. Tebbetts</u> Sponsor: Scott Heneveld Faculty Advisor: Judah Ari-Gur 1:30 to 1:55 p.m., Room 213

Surgical instruments used to apply clips to small blood vessels during gall bladder removal are occasionally rejected on the basis of inadequate clip closure. The clip closure system was redesigned to reduce the percentage of rejected instruments. Nonlinear finite element analysis was used to model the system and determine deflection and stress. Variables associated with good clip closure were identified, and several design solutions were fabricated and tested.

MULTI-FUNCTIONAL STAND FOR A V-12 RACING ENGINE by <u>William J. Hands, Dennis A. Krawczak, and Daniel W. Lapinsky</u> Sponsors: Adam Aldrin and Raymond Wedel Faculty Advisor: Judah Ari-Gur 2 to 2:25 p.m., Room 213

A stand was designed for a V-12 racing engine. The stand allows total accessibility and continuous assembly of the engine. It maintains low deflections while providing a convenient working height for the mechanic. The engine can be rotated by one person. Finite element analysis was used to optimize the structure.

DESIGN OF A TENNIS RACKET HANDLE TO REDUCE ARM INJURIES by <u>Chris Howard and Michael Parvis</u> Faculty Advisors: Judah Ari-Gur and Mahesh Nallakatla 2:30 to 2:55 p.m., Room 213

A tennis racket handle was designed and built to reduce the number of injuries to the wrist, elbow, and shoulder. The shaft of the racket slides inside the handle when a "bad hit" occurs. The adjustable handle helps prevent arm injuries for tennis players of all skill levels. The new racket has standard tennis racket measurements.

MECHANICAL AND AERONAUTICAL ENGINEERING - SESSION B

Session Chair - Philip Guichelaar Room 211

FAST-DRYING HOUSEHOLD CLOTHES DRYER by J. Scott Branc and David S. Roth Sponsors: John A. Adams, George Angelov, and Mark Jaske Faculty Advisor: Chris Cho 9 to 9:25 a.m., Room 211

Manufacturers of household clothes dryers are always researching new ways to reduce the time needed to dry clothes. A concept for a vacuum-assisted clothes dryer was analyzed. A dryer design was developed that significantly reduces drying times by operating below atmospheric pressure during the drying cycle.

REMOTE-CONTROLLED BYPASS VALVE FOR A TRANSFER PUMP

by <u>Darwin C. Gentile</u> Sponsors: Tom Stoll and Greg Wood Faculty Advisor: Philip Guichelaar 9:30 to 9:55 a.m., Room 211

A bypass valve was designed for a petrochemical mobile transfer pump. The function of the bypass valve is to relive pressure and flow, at full and reduced capacity of the pump. For the operator's safety, valve operation must be remote from the pump. The bypass valve and pneumatic control system were designed, prototyped, and tested to determine acceptable pressure characteristics. Computer-aided testing and flow analysis were used to achieve reliable design data.

ELECTRONIC WEIGHING SYSTEM TO MEASURE BODY FAT

by <u>Brett W. Becker and Wendy L. Ross</u> Sponsor: Mary L. Dawson Faculty Advisor: Philip Guichelaar 10 to 10:25 a.m., Room 211

Hydrostatic weighing is the most common method of determining the percentage of body weight that is fat. The present weighing station uses a spring scale to measure underwater weight. Movement of the test subject makes it difficult to get an accurate reading. A system was needed to minimize the effects of movement. A system that measures and averages the underwater weight of the test subject was designed and constructed using a load cell, basic electronic hardware, and computer interfacing. FIXTURE FOR STRETCHING A HYDRAULIC SERVOCYLINDER

by <u>William Cousins and Todd Sieting</u> Sponsor: Ted MacNeill Faculty Advisor: Dennis VandenBrink 10:30 to 10:55 a.m., Room 211

A fixture was designed to stretch the connecting rod of a hydraulic servocylinder so a split collar can be inserted between the rod eye and the cylinder sleeve. The servocylinder is used to control the flight of an aircraft. The split collar replaces a locking nut that lost torque during cycling on previous servocylinders. The fixture provides a safe operating environment and allows easy installation of the servocylinder. Finite element analysis software was used to model the fixture and determine deflections and stresses.

A FLUID-DRIVE CONVEYOR SYSTEM

by <u>Thomas K. Lago and Daniel L. McCombs</u> Sponsor: David Rozema Faculty Advisor: Curtis Swanson 11 to 11:25 a.m., Room 211

Industrial conveyor systems must be able to accumulate objects at any point in the system while allowing the movement of objects along the rest of the conveyor. Accumulation is accomplished by holding sets of rollers motionless. Conventional line-shaft-driven systems require increased power to overcome friction losses during accumulation. A conveyor system was designed that powers each roller with a separate hydraulic motor. Any combination of rollers can be held motionless without the need for increased power. Most components are designed to be manufactured from low-cost injection-molded plastic. The system's lighter weight, ease of manufacture, and reduced energy use should produce considerable cost savings for the consumer.

OPTIMIZATION OF A SUPERCHARGER CONTROL SYSTEM

by <u>John C. Cerone and Matthew G. Swartzlander</u> Sponsor: Scott Brownell Faculty Advisor: Richard Hathaway 11:30 to 11:55, Room 211

The bypass system used to control pressure in a supercharged engine was redesigned. The bypass valve was analyzed and redesigned to improve sealing. A model was developed to size the ducting for a variety of engine and supercharger combinations. Methods of valve modulation were researched to determine if a computer-controlled valve is feasible. A prototype was designed and built to verify the proposed design. CONTROL SYSTEM FOR A HYBRID ELECTRIC VEHICLE

by <u>Christopher C. Bennett and Kissman Che Lah</u> Faculty Advisor: Richard Hathaway 1 to 1:25 p.m., Room 211

A system was designed that uses a computer to control the performance of a hybrid electric vehicle. The range of an electric car can be greatly increased by using a small internal combustion engine in the vehicle. A computer control system was needed to manage the energy usage between the methanol-fueled engine and the electric motor while maximizing the benefits of both. A control system was designed that monitors operating conditions and makes logical decisions to maximize overall vehicle efficiency.

DESIGN OF AN "INSTANT-ON" ENGINE COOLING SYSTEM

by <u>Corey Ducklow and David Lach</u> Faculty Advisor: Richard Hathaway 1:30 to 1:55 p.m., Room 211

Engines used in hybrid electric vehicles are commonly turned on and off during city driving to increase efficiency. Proper modification of conventional cooling systems will decrease the engine's fuel consumption. The thermodynamic properties of a methanol-fueled engine model were studied, and a cooling system was developed that allows the engine to better use the heat generated through combustion. The design focuses on maintaining the system's temperature during the "off" period of the cycle to aid with ignition.

INSTRUMENTATION OF A FLIGHT TEST AIRCRAFT

by <u>Steven W. Finup and Steven Jennings</u> Sponsor: Joel Wickham Faculty Advisor: Arthur W. Hoadley 2 to 2:25 p.m., Room 211

An instrumentation package was designed for a remote-controlled flight-test aircraft. The package will enable an educational institution to explore numerous aircraft performance properties at nominal expense. Several flight tests were performed to gather data, which were used to determine various aircraft flight characteristics. The instrumentation package was designed to fit in a wide variety of model aircraft.

ULTRASOUND MEASUREMENT OF ICE ON AN AIRPLANE WING

by <u>Daryl Kreskowiak</u> Sponsor: Larry Linworth Faculty Advisor: Arthur Hoadley 2:30 to 2:55 p.m., Room 211

Ice buildup on airplane wings is very dangerous. Ultrasound was transmitted through a simulated wing to determine its ability to sense and measure ice. The wing was simulated using a piece of aircraft aluminum with ice frozen on one side. The thickness was found by measuring the time it took the sound wave to travel through the aluminum. The accuracy was found by comparing the calculated thickness to a mechanical measurement of the thickness.

MECHANICAL AND AERONAUTICAL ENGINEERING - SESSION C Session Chair - Jerry Hamelink Room 212

SUBMARINE MODELING USING THE ACTUATOR DISK THEORY by <u>Rajakumar Israel</u> Faculty Advisor: Iskender Sahin 9 to 9:25 a.m., Room 212

For realistic prediction of flow around a submarine, the propeller must be included in the simulation. Modeling the propeller presents a problem, however, because of the large amount of memory required to create an accurate representation of its complicated geometry. The "actuator disk theory" was used to simulate the flow around the propeller. The complicated geometry of the propeller was modeled as a disk with a specified discontinuity in normal velocity. The response of the submarine model under varying conditions was calculated using VSAERO, a computational fluid analysis software, and compared to experimental data.

AERODYNAMIC ANALYSIS OF AIRCRAFT WINGS

by <u>Noriaki Okita</u> Faculty Advisor: Iskender Sahin 9:30 to 9:55 a.m., Room 212

Aerodynamic performance of an aircraft wing is usually determined through wind tunnel testing, but the testing is time-consuming and expensive. A relatively economical computer analysis was substituted, and the experimental data were verified. Key factors affecting wing performance were determined, and various wing configurations were evaluated.

SPRAY APPLICATOR FOR TISSUE ADHESIVE

by <u>Kurt Feller and Jason Reichard</u> Sponsors: Jeff Arnett and Mike Orrico Faculty Advisor: Iskender Sahin 10 to 10:25 a.m., Room 212

A surgical device company is developing a tissue adhesive derived from the patient's own blood plasma before surgery. When the plasma derivative is mixed with a chemical, the result is a biological glue. A versatile application device was designed to allow the sterile transfer and application of the adhesive in a multitude of surgical applications including skin grafts, open heart surgery, and plastic surgery.

DETERMINATION OF ENERGY CONSUMPTION FOR SPAS

by <u>Chris Redmond and Jorge Soto</u> Sponsor: Thomas Walker Faculty Advisor: Jerry Hamelink 10:30 to 10:55 a.m., Room 212

A spa company needed an energy study on the hot tubs they manufacture. The company is expanding into the Midwest and needed actual experimental data. Factors contributing to energy consumption were determined, and data were analyzed by statistical methods to predict energy costs for different factors.

USE OF EXHAUST GAS IN A TURBOGENERATOR SYSTEM by <u>Matthew Schick and Lyle V. Ward</u> Faculty Advisor: Jerry Hamelink 11 to 11:25 a.m., Room 212

A turbogenerator system was designed and built to increase the energy efficiency of Western Michigan University's hybrid electric vehicle. The system uses the exhaust gases of an internal combustion engine to drive a turbine that is connected mechanically to an electric generator. The electric generator supplies power to the vehicle battery pack and electric motors.

MOUNTING FIXTURE FOR USE IN ENDOSCOPE EVALUATION

by <u>Garland C. Piper</u> Sponsor: Rich Leder Faculty Advisor: Jerry Hamelink 11:30 to 11:55 a.m., Room 212

A mounting fixture was designed to hold endoscopes during optical verification of lens defects detected by a computer simulation program. The fixture must be safe to operate and quickly adjustable for use with as many as 60 different endoscopes. Several prototypes were constructed, and a final design was chosen.

FOUR-PARAMETER TEACHING AID FOR DESIGN OF EXPERIMENTS

by <u>Mousa Al-Bishrawi and Kent Wellhoff</u> Faculty Advisor: Jerry Hamelink 1 to 1:25 p.m., Room 212

Quality control and efficiency in industry depend upon the use of proper methods in designing experiments. A four-parameter device was designed and built to be used in teaching "Design of Experiments" at Western Michigan University. CONTROL UNIT FOR AN INTERIOR AUTOMATIC DOOR

by <u>Robert L. Haeske and Cynthia G. Hood</u> Sponsor: John Beuker Faculty Advisor: James Kamman 1:30 to 1:55 p.m., Room 212

Exterior automatic doors are commonplace in commercial businesses, but few are encountered for interior use. The use of automatic interior doors could increase the mobility of the handicapped. A unit was designed to control an interior swing-style door. The unit is compact and lightweight for easy mounting above existing doorways and can be designed into new buildings.

AUTOMATED ASSEMBLY OF AN AUTOMOBILE SUN VISOR

by <u>Michael Douglass and Steven J. Engelgau</u> Sponsor: Duane Baker Faculty Advisor: James Kamman 2 to 2:25 p.m., Room 212

An automotive parts supplier who plans to manufacture a new line of vinyl sun visors will use a process that requires the visor components to be loaded automatically into a radio-frequency welder. The visor assembly consists of five parts: two pieces of foam, two pieces of vinyl, and a plastic core. Mechanisms were designed to hold and cut the vinyl rolls, place the five parts in the welder, and remove the finished assembly. The process was optimized to improve production and reduce cost.

IMPROVEMENT OF THE REAR SUSPENSION FOR A MOUNTAIN BIKE by <u>James Blackwell and John St. Pierre</u> Faculty Advisor: James Kamman 2:30 to 2:55 p.m., Room 212

Mountain bikes with rear suspensions are complex and expensive, but the rear suspension lessens rider fatigue and increases control in rough terrain. Changes in placement of the pivot point alter the suspension's reaction to changes in terrain. Different suspension setups were analyzed, and a simple suspension that is attachable to a rigid frame was designed and evaluated. The simplicity of the suspension should reduce production costs and allow installation by the customer.

PAPER SCIENCE AND ENGINEERING - Session A

Session Chair - Ellsworth Shriver Room 215-16

THE EFFECT OF FIBER ON FLOTATION DEINKING KINETICS

by <u>Kyle J. Smith</u> Faculty Advisor: Raymond L. Janes 9 to 9:25 a.m., Room 215-16

Previous studies have shown that the rate of flotation is first order with respect to concentration of ink. Effects of fibers on the reaction rate were evaluated. The work concentrated on the fiber/particle interaction and its effect on flotation deinking kinetics. The fiber and ink were non-fused to avoid the variables that ink removal from the fiber would introduce, allowing focus on flotation and not the entire washing/flotation process.

LINEAR OPTIMIZATION IN THE SELECTION OF FILLER COMPONENTS

by <u>Gary P. Ewert</u> Sponsor: Denise Trainer Faculty Advisor: Ellsworth H. Shriver 9:30 to 9:55 a.m., Room 215-16

This study involved the use of linear optimization to predict the amounts and types of fillers to add to the furnish (recipe) in order to achieve desired optical properties at minimum cost. The linear optimization was achieved by entering a formula derived from experimentation into Lindo System Inc.'s "What's Best" linear optimization software. The program was used to make furnish recommendations for commercial grades of paper.

REPLACEMENT OF SILICATE IN HYDROGEN PEROXIDE BLEACHING

by <u>Kevin F. Burd</u> Faculty Advisor: Ellsworth H. Shriver 10 to 10:25 a.m., Room 215-16

Sodium silicate is used in the hydrogen peroxide bleaching process of recycled fibers as an inexpensive chelating agent, buffer, and source of alkalinity. The use of silicate, however, causes scaling in tanks and process lines, which can be costly. Recent developments have been made in the use of chelating agents that replace the silicate while purporting to maintain the brightness levels achieved with hydrogen peroxide bleaching using silicate. This research project explores the use of one such chelating agent on lab and mill scale levels. USE OF KENAF IN CORRUGATING MEDIUM FOR STRENGTH IMPROVEMENT by <u>Mike Kackmeister</u> Faculty Advisor: Ellsworth H. Shriver 10:30 to 10:55 a.m., Room 215-16

This thesis involved the use of kenaf fiber incorporated into corrugating medium to achieve a stronger board make-up. This represents a cost savings with liner downgrading. Kenaf has several advantages (growing season, yield ratios) when compared to trees. Kenaf fibers are very similar to the fibers found in trees.

OPTIMUM PULPING CONDITIONS OF FLEXOGRAPHIC PRINTED NEWS FOR FLOTATION DEINKING by <u>Scott Andres</u>

Faculty Advisor: William K. Forester 11 to 11:25 a.m., Room 215-16

Water-based flexographic inks are becoming increasingly popular but present difficult challenges in deinking. This study was devoted to the effect of pulping variables on deinking parameters. It was found that pulping variables had little influence on deinking results.

IMPROVEMENT OF STRENGTH PROPERTIES FOR CURRENCY PAPER

by <u>Michael D. Schultz</u> Faculty Advisor: Ellsworth H. Shriver 11:30 to 11:55 a.m., Room 215-16

Currently, U.S. government currency paper has a life-expectancy of only nine months. This thesis was an attempt to prolong the life of currency paper by creating alterations of the U.S. government's currency furnish. Simulated pulp furnishes were designed using various amounts of cotton, flax, and spruce fibers, in addition to strengthening chemicals. The strength characteristics of each furnish were tested and compared to U.S. government specifications as well as previous studies.

DEPTH-SPECIFIC SAMPLING OF BAILERS IN A WATER COLUMN

by <u>Greg Gilmore</u> Faculty Advisor: Van Maltby 1 to 1:25 p.m., Room 215-16

Bailers are devices that take samples from water columns for testing of contaminates in the water. Current monitoring literature states it is uncertain at what depth a sample is taken, due to the mixing effects and sampling artifacts of the bailer in the water column. Some manufacturers of bailers state that bailers are depth-specific with respect to sampling. In this experiment, an eight foot PVC column simulates a water column. A fluorescent dye is used to identify zones of water. Several bailers were used to test the water below that point. The water sample was retrieved and tested through a fluorometer to measure the concentration of the dye, if any, in the sample. The water tank and new dye were drained and filled back up after each test.

THE EFFECTS OF pH AND SOAKING TIME ON THE REPULPING OF OCC

by <u>Jason S. Eley</u> Faculty Advisor: William K. Forester 1:30 to 1:55 p.m., Room 215-16

Efforts to increase production capacity and meet recycled fiber content regulations include the utilization of recycled OCC (Old Corrugated Containers) as a fiber source. Therefore, the paper industry is forced to find ways to achieve maximum strength from an inferior starting material. One method under investigation is caustic soaking. This method involves repulping and soaking the fiber source under alkaline conditions. This study investigates the effects of pH and soaking time on the recycling of OCC and attempts to identify the optimum repulping conditions.

STARCH APPLICATION WITH A ROD COATER

by <u>Timothy E. Hagenbuch</u> Sponsor: William G. Schmidt Faculty Advisor: William K. Forester 2 to 2:25 p.m., Room 215-16

One use of starch in the paperboard industry is to provide strength to the sheet. Paper will be made in our Pilot Plant and tested to evaluate and compare the traditional method of starch application (wet stack) to a new method (rod coater). The paper will then be tested to see if the new application gives improved results and how they compare against the norm. The paper furnish will remain constant and the starch solids will be varied to find an optimum application.

THE MEASUREMENT OF SIZING IN PAPER

by <u>Scott Timmer</u> Faculty Advisor: William Forester 2:30 to 2:55 p.m., Room 215-16

Paper sizing can be defined as the water repellency in paper achieved by addition and interaction of one or more chemical compounds. Two popular methods of quickly measuring sizing are the Hercules and Cobb sizing tests. Sizing can also be determined by the contact angle method. This method has been very tedious to perform, making it an impractical alternative. Recently, an instrument has been developed which can run contact angle measurements quickly. This research project explored the possibility of using this instrument in conjunction with the Hercules and Cobb instruments for quick sizing evaluation.

OPTIMIZATION OF RECYCLED PAPERBOARD COATING PROPERTIES

by <u>Lance S. Mikus</u> Sponsor: Merri Beebe Faculty Advisor: Ellsworth H. Shriver 3 to 3:25 p.m., Room 215-16

Recycled paperboard, which is used for cereal boxes and other containers, is coated with a variety of pigments in order to establish a surface suitable for subsequent printing operations. This study evaluated the partial replacement of an industry standard #1 clay coating with calcined clay and fine particle clay coatings. The findings provided a means of improving the surface properties (smoothness, brightness, etc.) of recycled paperboard. The project included a comparison of recycled paperboard coating properties, a study of the rheological (flow) properties of each alternate coating, and cost analysis of the most desirable coatings.

APPLICATION OF ELECTROKINETICS TO IMPROVE SLUDGE DEWATERING

by <u>Maureen Donnelly</u> Faculty Advisor: David Peterson 3:30 to 3:55 p.m., Room 215-16

The pulp and paper industry sends a relatively large amount of waste, or sludge, to landfills. The sludge from mills often contains a considerable amount of water depending on the mill's sludge-handling processes. Various operations, including presses and filters, are commonly used to remove water from the sludge prior to disposal in a landfill. The primary objective of this project is to determine if the application of electrokinetics can improve sludge dewatering.

RHEOLOGICAL BEHAVIOR OF STARCHES USED IN PAPER PIGMENT COATINGS

by <u>Brian G. Hart</u> Faculty Advisor: Raymond L. Janes 4 to 4:25 p.m., Room 215-16

This project was a study of the effects different starches have on paper coating viscosity and rheology. The three starches that were used were corn, wheat, and potato. The starches were subjected to different kinds of conversion processes and then mixed with latex to form basic coating formulas. The coating was tested for viscosity and rheological behavior. Correlations and differences of the coating rheology with relation to the starch type were shown and related to the molecular structure of the starch. THE EFFECT OF MOISTURE AND TEMPERATURE ON AKD SIZING by <u>Marc DeRidder</u> Sponsor: Tom Rienzo Faculty Advisor: Raymond L. Janes 4:30 to 4:55 p.m., Room 215-16

Alkyl Ketene Dimer (AKD) sizing is added to paper to make a sheet resistant to water penetration. However, sizing is not easily bonded to paper fibers and is greatly affected by temperature and moisture content during the paper drying process. The experimentally prepared papers were evaluated for Hercules sizing values to optimize these drying parameters for highest efficiency.

PAPER SCIENCE AND ENGINEERING - Session B Session Chair - Raymond L. Janes Brown and Gold Room

THE REMOVAL OF WHITE PITCH BY FLOTATION

by <u>Steven Hahn</u> Faculty Advisor: Raymond L. Janes 9 to 9:25 a.m., Brown and Gold Room

The research performed in our laboratory indicates that it may be possible to use a flotation cell to lessen the effects of a serious problem, white pitch, encountered when recycling old magazines, as well as other coated paper products. This may allow for a greater recycling rate of old magazines.

THE EFFECT OF CORN, WHEAT, AND POTATO STARCH ON COATINGS AND COATED PAPER PROPERTIES by John M. Muchukot

Faculty Advisor: Raymond L. Janes 9:30 to 9:55 a.m., Brown and Gold Room

Starch is commonly used in the paper industry for a variety of applications, including coating. In coating, starch is used as a binder to hold coating pigments together and to hold coatings to the paper. Every type of starch as a different effect on characteristics such as runnability, optical printing, and physical properties. Research was done to quantify which starch optimizes certain properties. Unmodified starch was converted using enzymes to prepare coatings. The coatings were then applied to paper. Testing and evaluation followed to observe the effect that the different starches had on the overall properties of the sheet. The College of Engineering and Applied Sciences at Western Michigan University offers a wide variety of programs.

UNDERGRADUATE PROGRAMS

School of Aviation Sciences

Aircraft maintenance engineering technology Aviation technology and operations Professional pilot Maintenance management Technical management

Electrical Engineering

Computer systems engineering Electrical engineering

Engineering Technology

Applied materials science Automotive engineering technology Construction science and management Engineering graphics Industrial design Manufacturing engineering technology

Industrial Engineering

Engineering management Industrial engineering Production technology

Mechanical and Aeronautical Engineering

Aeronautical engineering Mechanical engineering

Paper and Printing Science and Engineering

Paper engineering Environmental processes Pulp and paper processes Paper science Printing Management Marketing

GRADUATE PROGRAMS

The master of science in engineering is offered in electrical, mechanical, and industrial engineering.

The master of science is offered in engineering management, manufacturing science, operations research, and paper science and engineering.

The Ph.D. is offered in mechanical engineering.

THANK YOU!

The College of Engineering and Applied Sciences is grateful to these firms, which have provided or cooperated in Senior Engineering Design Projects being presented in April 1994.

If you have a project for our students, or if you would like more information, please call Linda Hager at (616) 387-4017.

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