4-1996

18th Conference on Senior Engineering Design Projects

College of Engineering and Applied Sciences

Conference On Senior Engineering Design Projects

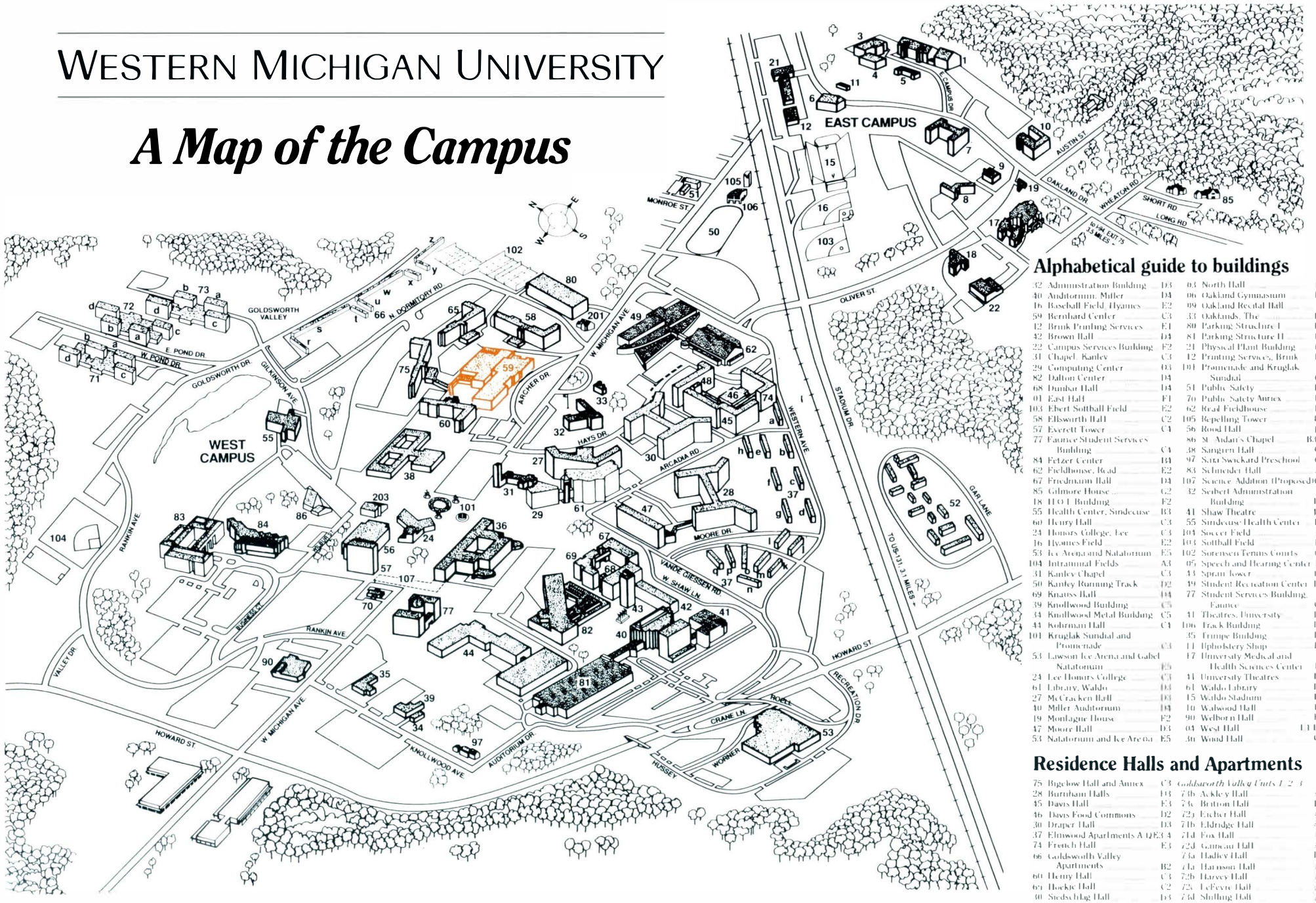
Tuesday, April 9, 1996
Bernhard Center
9 a.m. to 5 p.m.

College of Engineering and Applied Sciences

WESTERN MICHIGAN UNIVERSITY

WESTERN MICHIGAN UNIVERSITY

A Map of the Campus



Alphabetical guide to buildings

32	Administration Building	D3	03	North Hall	F1
40	Auditorium, Miller	D4	06	Oakland Gymnasium	E1
16	Baseball Field, Hyames	E2	09	Oakland Recital Hall	F1
59	Bernhard Center	C3	33	Oaklands, The	D3
12	Brink Printing Services	E1	80	Parking Structure I	D2
42	Brown Hall	D4	81	Parking Structure II	D5
22	Campus Services Building	F2	21	Physical Plant Building	E1
31	Chapel, Kanley	C3	12	Printing Services, Brink	E1
29	Computing Center	D3	101	Promenade and Kruglak Sundial	C3
82	Dalton Center	D4	51	Public Safety	D1
68	Dunbar Hall	D4	70	Public Safety Annex	B4
01	East Hall	F1	62	Read Fieldhouse	E2
103	Ebert Softball Field	E2	105	Repelling Tower	D2
58	Ellsworth Hall	C2	56	Rood Hall	B4
57	Everett Tower	C4	86	St. Aidan's Chapel	B3 4
77	Faunce Student Services Building	C4	38	Sangren Hall	C3
84	Fetzer Center	B4	97	Sara Swetland Preschool	C5
62	Fieldhouse, Read	E2	83	Schneider Hall	A4
67	Friedmann Hall	D4	107	Science Addition (Proposed)	C4
85	Gilmore House	G2	32	Seibert Administration Building	D3
18	H.O.T. Building	F2	41	Shaw Theatre	D4
55	Health Center, Sindecuse	B3	55	Sindecuse Health Center	B3
60	Henry Hall	C3	104	Soccer Field	A3
24	Honors College, Lee	C3	103	Softball Field	E2
16	Hyames Field	E2	102	Sorensen Tennis Courts	C2
53	Ice Arena and Natatorium	E5	05	Speech and Hearing Center	F1
104	Intramural Fields	A3	43	Sprau Tower	D4
31	Kanley Chapel	C3	49	Student Recreation Center	D2
50	Kanley Running Track	D2	77	Student Services Building, Faunce	C4
69	Knauss Hall	D4	41	Theatres, University	D4
39	Knollwood Building	C5	106	Track Building	D2
34	Knollwood Metal Building	C5	35	Trimpe Building	B3
44	Kohrman Hall	C4	11	Upholstery Shop	E1
101	Kruglak Sundial and Promenade	C3	17	University Medical and Health Sciences Center	F2
53	Lawson Ice Arena and Gabel Natatorium	E5	44	University Theatres	D4
24	Lee Honors College	C3	61	Waldo Library	D3
61	Library, Waldo	D3	15	Waldo Stadium	E1
27	McCracken Hall	D3	10	Walwood Hall	F1
40	Miller Auditorium	D4	90	Welborn Hall	B3
19	Montague House	F2	04	West Hall	D3 D4
47	Moore Hall	D3	30	Wood Hall	C4
53	Natatorium and Ice Arena	E5			

Residence Halls and Apartments

75	Bigelow Hall and Annex	C3	*Goldsworth Valley Units 1, 2, 3*		
28	Burnham Halls	D3	73b	Ackley Hall	A2
45	Davis Hall	E3	73c	Britton Hall	B2
46	Davis Food Commons	D2	72j	Archer Hall	A2
30	Draper Hall	D3	71b	Eldridge Hall	A2
37	Elmwood Apartments A	D2 E3 4	71d	Fox Hall	A2
74	French Hall	E3	72d	Gamcar Hall	A2
66	Goldsworth Valley Apartments	B2	73a	Hadley Hall	B2
60	Henry Hall	C3	71a	Harrison Hall	A2
65	Hoekje Hall	C2	72b	Harvey Hall	A2
40	Siedschlag Hall	D3	72a	LeFevre Hall	A2
8	Spindler Hall	F2	73d	Shilling Hall	A2
52	Stadium Drive Apartments	F4	71c	Stinson Hall	A2
7	Vandercook Hall	F1			
48	Zimmerman Hall	D4			

Private Property

201	Lutheran Student Center	D2 3
204	Wesley Foundation	B4 3

Conference on Senior Engineering Design Projects

You are invited to attend the eighteenth Conference on Senior Engineering Design Projects. The conference will be held from 9 a.m. to 5:00 p.m. **Tuesday, April 9,** 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 in front of Hoekje Hall. (See map; take North Dormitory Road. Hoekje is #65 on the map.)

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.

Parking is available in the ramp near the Bernhard Center.

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 number for project descriptions:

Construction Engineering, Materials Engineering, and Industrial Design	204	1 to 4	p. 5
Electrical and Computer Systems Engineering	210	9 to 1:30	p. 7
Industrial and Manufacturing Engineering - A-I	204	9 to 12	p. 10
Industrial and Manufacturing Engineering - B-I	209	9 to 3	p. 12
Mechanical and Aeronautical Engineering - A-I	242	9 to 1:30	p. 16
Mechanical and Aeronautical Engineering - B-I	208	9 to 2	p. 19
Mechanical and Aeronautical Engineering - C-I	213	9 to 3:30	p. 22
Paper Science and Engineering - A-I	211	9 to 12	p. 26
Paper Science and Engineering - A-II	211	1 to 5	p. 28
Paper Science and Engineering - B-I	212	9 to 4	p. 31
Paper Science and Engineering - C-I	215	9 to 10	p. 35
Paper Science and Engineering - C-II	215	10 to 2	p. 36

A **lunch** break is scheduled from noon to 1 p.m. **For more information,** call Dace Copeland at (616) 387-4017.

CMD = Construction Engineering, Materials Engineering, and Industrial Design
ECE = Electrical and Computer Engineering
IME = Industrial and Manufacturing Engineering
MAE = Mechanical and Aeronautical Engineering
PSE = Paper Science and Engineering

Time	Room	Dept.	Topic
9	210	ECE	Mains Signaling Control for Home Appliances
	204	IME-A-I	Ergonomic Safety Improvements in Manufacturing
	209	IME-B-I	Filtration of Ductile Iron
	242	MAE-A-I	Thermo-Hydrodynamic Analysis of a Mechanical Seal
	208	MAE-B-I	C-5 Aircraft Main Hydraulic Pump Modification
	213	MAE-C-I	Electric Power Tool Balancer
	211	PPSE-A-I	The Effect of Pigment/Liquid on Coating Properties
	212	PPSE-B-I	Comparison Between AZC and KZC as Coating Insolubilizers
	215	PPSE-C-I	Correlation of BOD5 and COD for Specific Mill Operations
9:30	210	ECE	Induction Motor Speed Controller
	204	IME-A-I	Development of a Tool and Fixture Tracking System
	209	IME-B-I	The Effects of Polymer Regrind on Rotational Efforts
	242	MAE-A-I	High Pressure Bi-Metallic Steam Trap
	208	MAE-B-I	Outdoor Furniture Environmental Test Chamber
	213	MAE-C-I	Anti-Vibration Solutions for Manual Shift Lever
	211	PPSE-A-I	The Use of a New Jumbo Flute Profile (K-Flute) to Replace Common Grades of Single- and Double-wall Container Board
	212	PPSE-B-I	Recycling and the Strength of Secondary Fibers
	215	PPSE-C-I	Determination of the Energy Value and Volume Reduction from Incineration of Paper Industry Sludge
10	210	ECE	Medical Drill Test System
	204	IME-A-I	An Approach to Improving Production Flow
	209	IME-B-I	Copper Inserts Improve Cooling in Injection Molds
	242	MAE-A-I	Testing Instrumentation for a Servo Valve
	208	MAE-B-I	Drag Comparison for Kitfox Landing Gear Systems
	213	MAE-C-I	Aeration System for Fish Hatchery Water
	211	PPSE-A-I	Image Analysis: Quantifying Differences in Printing Processes
	212	PPSE-B-I	Fractionation of Double Kraft Liner Clippings
	215	PPSE-C-II	Dimethyldioxirane Bleaching Optimization of a Thermomechanical Pump

10:30	210	ECE	Automated Actuator Test System (ATS)
	204	IME-A-I	Increasing the Efficiency of an Assembly Process
	209	IME-B-I	The Implementation and Design Usage of Mechanica
	242	MAE-A-I	High Efficiency Transmission for the Solar Car
	208	MAE-B-I	Improving the Efficiency of a Hydraulic Gear Pump
	213	MAE-C-I	Laser Scribing Device for Silicone Carbide Mechanical Seals
	211	PPSE-A-I	Retention Aid Optimization on an Acid Text Grade
	212	PPSE-B-I	Recycle Properties of Different Papermaking Fibers
	215	PPSE-C-II	Improving Recycled Pulps Through Enzyme Treatment
11	210	ECE	A Serial Interface for Pneumatic Valves
	204	IME-A-I	Reducing Landfill Waste Through Alternative Packaging
	209	IME-B-I	Pro/Engineer vs Ideas: A Comparative Analysis
	242	MAE-A-I	Bag Opening Device for a Packaging Process
	208	MAE-B-I	Plastic Plant Tag Separator
	213	MAE-C-I	Automated Test Station for Small Surgical Drills
	211	PPSE-A-I	Anionic Waxy Maze Starch as a Coating Cobinder
	212	PPSE-B-I	Repulping Wet-Strength Papers
	215	PPSE-C-II	The Use of Dimethyl Dioxirane in Refiner Bleaching of High-Yield Pulps
11:30	210	ECE	Bus Location System
	204	IME-A-I	Improving Foundry Efficiency After Shakeout
	209	IME-B-I	3D Animation of a CFR Engine Flame Front
	242	MAE-A-I	Sunseeker Dynamometer
	208	MAE-B-I	Handlebar Safety and Analysis for Mountain Bikes
	213	MAE-C-I	Transmission Oil Cooler Relocation and Redesign
	211	PPSE-A-I	The Effect of Carboxylmethyl Cellulose and Polyacrylate on Coating Properties
	212	PPSE-B-I	High Consistency Kneader Evaluation
	215	PPSE-C-II	The Optimization of Organosolv CMP Brightness

NOON TO 1 - LUNCH BREAK

1	204	CMD	Wear Protection of Metal Casting Tooling
	210	ECE	Microcontroller-Based Dual Channel Servo Amplifier
	209	IME-B-I	Engine Knock Detection Using Spark Plug Voltage Analysis
	242	MAE-A-I	Race Car Chassis Monitoring System
	208	MAE-B-I	Quick Release Rope Clamp
	213	MAE-C-I	Armrest Redesign for Cost Reduction
	211	PPSE-A-II	The Effect of a Reduction/Oxidation Filter on Pilot Plant Effluent

	212	PPSE-B-I	The Effect of Washing Between Bleaching Stages on Brightness Reversion of High-Yield Pulps
	215	PPSE-C-II	Color Stripping of Recycled W/F Papers Using Ozone
1:30	204	CMD	Strata - Auditorium Seating Concept
	209	IME-B-I	Repair, Development and Technical Use of a Wiedemann Laser L-4060
	208	MAE-B-I	Caster Adjustment Mechanism for Race Car Suspension
	213	MAE-C-I	Robot for Measurement of Engine Acoustic Power
	211	PPSE-A-II	Fines' Effects on Recycled Paper Surface Properties
	212	PPSE-B-I	The Effect of Washing Between Stages on Brightness Reversion for Sodium Hydrosulfite on Unbleached High-Yield Pulps
	215	PPSE-C-I	The Effects of Various Pigments and Binders on the Coated and Print Gloss
2	204	CMD	Handy-Mate EL-50 (Modular and Mobile Tool Storage)
	209	IME-B-I	Autolisp Programming for Efficiency
	213	MAE-C-I	Drive Shaft Design and Optimization
	211	PPSE-A-II	The Use of Demolition Wood in Papermaking
	212	PPSE-B-I	High Consistency Kneader Evaluation
2:30	204	CMD	POWER LINK, Retractable Cord Reel Design
	209	IME-B-I	Height Adjustable Jet-Ski Service Stand
	213	MAE-C-I	Robot Gripper for Part Handling
	211	PPSE-A-II	Press Dewatering of Sludge Using Electrokinetic Forces
	212	PPSE-B-I	Repulping Bottle Carrier Paperboard - I
3	204	CMD	Ovation - Auditorium Seating Concept
	213	MAE-C-I	Centrifugal Force Compensation in Power Chucks
	211	PPSE-A-II	Environmental Comparison of Soy to Petroleum Ink with Respect to Degradation of Effluent
	212	PPSE-B-I	Repulping Bottle Carrier Paperboard - II
3:30	204	CMD	Customized Automobile Interior Center Console/Armrest Create-A-Case
	211	PPSE-A-II	The Deinkability of Different Papers Printed with Soy and Petroleum Inks
	212	PPSE-B-I	The Effect of Suspending Liquid Viscosity on Flocculation
4	211	PPSE-A-II	Diverting Sludge from Landfills to Insulation
4:30	211	PPSE-A-II	Deinking in A Closed Loop and the Effect of Solids on Paper Properties

CONSTRUCTION ENGINEERING, MATERIALS ENGINEERING, AND INDUSTRIAL DESIGN

Session Chair - Pnina Ari-Gur
Room 204

WEAR PROTECTION OF METAL CASTING TOOLING

by Thomas Myers and Jana Papaioannou
Faculty Advisors: Sam Ramrattan and Pnina Ari-Gur
1:00 p.m. to 1:25 p.m., Room 204

Abrasive wear occurs on pattern surfaces used in the green sand molding process. By applying wear resistant coatings to the patterns, these problems were reduced. This phenomenon was studied using titanium nitride and electroless nickel. The coatings were used to monitor wear on the pattern surface by color change. Tests were performed to determine the effectiveness of the coatings and their costs.

STRATA - AUDITORIUM SEATING CONCEPT

by Yong Bang, James Logan, and Steve Mesik
Faculty Advisor: Dmitry Azrikan
1:30 p.m. to 1:55 p.m., Room 204

This project investigated the design of an auditorium seat to create better harmony between the user and writing surface. Problems with current designs, based on interviews and surveys, were addressed. The design incorporated a larger writing surface, improved ergonomics, and open access for the user. Other benefits included lower cost, flexible installation, and quick maintenance. A narrow folding envelope increased aisle width. Cultural differences were evaluated and applied for worldwide applications. Styling created a distinct overall effect in an auditorium. A full scale working prototype was constructed.

HANDY - MATE EL-50 (MODULAR AND MOBILE TOOL STORAGE)

by James Doll, Bradley A. Small, and Iian Thornton
Sponsor: Dan Dinverno - Carry-Van Technologies
Faculty Advisors: Dmitry Azrikan and Roman Rabiej
2:00 p.m. to 2:25 p.m., Room 204

This project utilized in-depth research, detailed questionnaires and product testing in areas such as ergonomics, style, function and user input to manufacture the EL-50, a modular and mobile tool storage facility, which allows users to organize a variety of tools to their own specific needs. The EL-50 is capable of being transported up and down stairs with its unique three-wheel design creating versatility and improved work-site efficiency. The EL-50 incorporates adjustability and versatility into an attractive light-weight design.

POWER LINK, RETRACTABLE CORD REEL DESIGN

by Rodger Gibson
Sponsor: Russ Kowalisyn - Aero-Motive Company
Faculty Advisors: Dimitry Azrikan and Roman Rabiej
2:30 p.m. to 2:55 p.m., Room 204

POWER LINK is a new-spring powered retractable cord reel, designed to cutting edge style and competitive cost. This product was developed to address increased competition in the cord reel market and to further penetrate the global market. The final design was achieved by design research, concept rending and soft modeling.

OVATION-AUDITORIUM SEATING CONCEPT

by Brett Fisher, Scott Sabin, and Chad Zimmerman
Sponsor: Steven E. Finney - Irwin Seating Company
Faculty Advisors: Dmitry Azrikan and Roman Rabiej
3:00 p.m. to 3:25 p.m., Room 204

The traditional approach to auditorium seating was examined with regards to manufacturing, comfort, assembly, ergonomics and style. This overview led to a modular seat design structured around two rails supporting multiple seats. This support system simplifies repair and janitorial work compared to the traditional use of vertical supports for each seat. The accompanying components are made of advanced materials such as aluminum and plastic. These materials allow the consolidation of assemblies, reduction of the number of parts, and the lowering of material and assembly cost. They also offer a varying degree of shapes and forms for contemporary styling.

CUSTOMIZED AUTOMOBILE INTERIOR CENTER CONSOLE/ARMREST CREATE-A-CASE

by Gerald Dostal
Sponsors: Henry White and Tom Comille - Lear Plastics Corporation
Faculty Advisors: Dmitry Azrikan and Roman Rabiej
3:30 p.m. to 3:55 p.m., Room 204

The customized automobile interior allows the buyer of a new automobile to tailor the center console and armrest to meet his/her needs. Features such as a coin storage area, compartment for sunglasses, CD or cassette storage area, lockable storage area, navigational system, or cellular phone holder may be selected. Research indicates that consumers are not completely satisfied with interior configurations available in current automobiles and the only way to completely satisfy them is to offer them a choice. This product was designed specifically for the Ford Taurus.

ELECTRICAL AND COMPUTER ENGINEERING

Session Chair - John Gesink
Room 210

MAINS SIGNALING CONTROL FOR HOME APPLIANCES

by Eng Heng Khoo, Wai Khuin Khoo, and Tuan Hwee Tan
Faculty Advisor: Janos Grantner
9:00 a.m. to 9:25 a.m., Room 210

In modern society, demands for convenience and security are increasing. This project was designed to improve the convenience and security for the modern home owner. Mains signaling control is a method by which signals are sent into the mains (home electrical distribution wiring) to turn 'ON' or 'OFF' home electrical appliances. This system consists of a single transmitter and one receiver per appliance. A personal computer is used to set up a time schedule to turn 'ON' or 'OFF' the home electrical appliances. A transmitter (controlled by the personal computer) sends a signal to the receiver to turn 'ON' or 'OFF' a particular appliance.

INDUCTION MOTOR SPEED CONTROLLER

by Khalifa Saeed, Othman Harun, and Surenthiran Maheswaran
Faculty Advisor: Frank Severance
9:30 a.m. to 9:55 a.m., Room 210

A speed controller for typical fractional horsepower induction motors such as are found in many home appliances was designed, built and tested. This low-cost controller can control the motor's speed between half and twice the effective nominal speed of the motor. The controller also enables the motor to deliver at least 60% of its rated output power at any speed.

MEDICAL DRILL TEST SYSTEM

by Don Greiner, Greg Rabick, and Richard Wells
Faculty Advisor: John L. Mason
10:00 a.m. to 10:25 a.m., Room 210

A local company manufactures and tests a product line of surgical and dental drills. The company allocates equal time to drill assembly and drill motor testing. The current testing methods are too slow and inconsistent. A drill test system was designed which reduces testing time and yields more accurate results. The drill test system consists of a computer, virtual instrumentation software, temperature monitor, hi-pot controller, signal processor, and a dynamometer. The drill test system accurately measures temperature rise, current draw, and drill motor speed.

AUTOMATED ACTUATOR TEST SYSTEM (ATS)

by Robert Porrett, John Schindler, and Jesse Sullivan
Sponsors: Jim Black, Mike Chybik, and Curt Hutchins - Abex NWL Aerospace
Faculty Advisor: Dean Johnson
10:30 a.m. to 10:55 a.m., Room 210

An automated test system (ATS) was produced to control and analyze the performance of a thrust-reverse actuator for an F-16 aircraft. The ATS was designed to replace an older hardware-oriented test system. The ATS uses a Digital Signal Processor (DSP) board to monitor the position of the actuator to provide control of the system. Control of the ATS is obtained through a personal computer using LabVIEW software. The ATS is menu driven to provide the capability to apply various loads to thoroughly test the thrust-reverse actuator. Also, the menu driven environment makes the overall system more user friendly.

A SERIAL INTERFACE FOR PNEUMATIC VALVES

by Eric Klien, Scott Klien, and Charles Swartz
Sponsor: Chris DeFrancisco and David Klien - Humphrey Products
Faculty Advisor: Mark Nikodem
11:00 a.m. to 11:25 a.m., Room 210

In modern industry, machines have been automated by controlling air valves for a variety of pneumatic actuators. Traditionally these valves were controlled using a Programmable Logic Controller (PLC) requiring two wires per valve. Emerging serial networks, such as DeviceNet, have simplified this process by allowing control of multiple valves using only two wires. These types of networks require an interface to be built between the network and the controlled valves. An interface prototype was built using a microcontroller to meet the DeviceNet specifications, and software was written to actuate and monitor a manifold of sixteen valves. A DeviceNet Developers Toolkit was used to design and evaluate the prototype.

BUS LOCATION SYSTEM

by Richard Carpenter, Brian Derhammer, and Christopher Plank
Faculty Advisor: Frank Severance
11:30 a.m. to 11:55 a.m., Room 210

Many people who are blind depend on public buses. However, using the public bus system presents a number of challenges for them such as: finding the correct bus, locating a bus out of hearing range and making a driver aware that the person needs to board. A two unit Bus Location System was designed to solve these difficulties by allowing the user to alert the appropriate bus. The first unit is a hand held radio transmitter that broadcasts the desired bus number. The second unit is a bus mounted receiver that alerts the driver and activates a public address speaker.

MICROCONTROLLER-BASED DUAL CHANNEL SERVO AMPLIFIER

by Chyuan-Horng Jang, Douglas S. Jansen, and Jose M. Venero

Sponsors: David Zahn - Zahn Electronics, Inc., Warner Schultz - Saurer Automation Systems, Inc.

Faculty Advisor: Joseph A. Kelemen

1:00 p.m. to 1:25 p.m., Room 210

Automated Guided Vehicles (AGVs) are battery powered vehicles. AGV traction and steering motion is controlled by DC motors and servo amplifiers. Presently, AGV manufacturers must purchase separate amplifiers for the traction and steering motors. These amplifiers are too large for some vehicle styles and can be expensive. A prototype amplifier utilizing power MOSFETs in a pulse-width modulated H-bridge configuration was developed that merges traction and steering channels into a single device. By incorporating a microcontroller based digital controller into the design and implementing only essential functionality, the size, cost and complexity have been reduced over currently available analog based devices.

INDUSTRIAL AND MANUFACTURING ENGINEERING - A-I

Session Chair - Liwana Bringelson
Room 204

ERGONOMIC SAFETY IMPROVEMENTS IN MANUFACTURING

by Nick M. Jayanetti, Lynnetta Robinson, Andrew J. Seiser, and Niki M. Thurkow
Sponsor: Kenneth J. Rose - The Johnson Corporation
Faculty Advisors: Liwana S. Bringelson and Joseph W. Petro, Jr.
9:00 a.m. to 9:25 a.m., Room 204

A local manufacturing facility was ergonomically studied and evaluated to help reduce the number of employee injuries and worker compensation claims. Machinery and methods were analyzed to improve current procedures and equipment to reduce bending and lifting hazards.

DEVELOPMENT OF A TOOL AND FIXTURE TRACKING SYSTEM

by Carolann Grant, Jennifer Klungle, and Mark Stamper
Sponsor: Gary Bernauer - DLP, Division of Medtronic, Inc.
Faculty Advisors: Liwana S. Bringelson and Joseph W. Petro, Jr.
9:30 a.m. to 9:55 a.m., Room 204

A manufacturer of disposable medical products required the investigation of documentation relating to the development and alteration of tooling and fixtures. Conformance to both ISO 9001 and FDA Good Manufacturing Practice's guidelines had to be considered in solution development. Investigation of requirements for the control of the fixtures and tools led to the development of Standard Operating Procedures and a comprehensive database file with corresponding templates for new fixture integration.

AN APPROACH TO IMPROVING PRODUCTION FLOW

by Christopher Czuk, Ronald G. Henderson II, Traci Kemp, and Siheon Kim
Faculty Advisors: Liwana S. Bringelson and Joseph W. Petro, Jr.
10:00 a.m. to 10:25 a.m., Room 204

A Southwestern Michigan office chair manufacturer was experiencing an excess of inventory build-up between the welding, paint, and assembly departments. An evaluation of this situation focused on the material handling, scheduling, and the storage of parts. The use of cost analysis, production control techniques, and ergonomic considerations resulted in a reduction of the floor space required for work in process inventory.

INCREASING THE EFFICIENCY OF AN ASSEMBLY PROCESS

by Sammy W. Coleman, Mohammad Tarik Hassan, and Mark J. Markillie
Sponsor: Mark L. Wallace - HI-LEX Corporation
Faculty Advisors: Liwana S. Bringelson and Joseph W. Petro, Jr.
10:30 a.m. to 10:55 a.m., Room 204

A cable assembly process, operating with excess capacity and at a loss, was studied and redesigned to be more efficient. Time studies, simulation, and statistical analysis were used. A new assembly process, designed to balance capacity with demand and increase efficiency, was developed and implemented. The new production characteristics were studied and compared to those of the former line, allowing improvements to be measured.

REDUCING LANDFILL WASTE THROUGH ALTERNATIVE PACKAGING

by Paul C. Franz and Michelle L. Myles
Sponsor: Dale Bronkema - Delphi Energy and Engine Management Systems
Faculty Advisors: Liwana S. Bringelson and Joseph W. Petro, Jr.
11:00 a.m. to 11:25 a.m., Room 204

Automobile engine components filled with oil are shipped to Europe in coated cardboard boxes. By the time the materials reach their destination, oil leakage has occurred. Environmental concerns prompted an investigation on how to reduce the amount of packaging waste that is added to landfills. We examined several packaging options and conducted research on recycling criteria. Based on cost comparison and impact on the local manufacturing facility and their customer's assembly line, the best alternative was suggested.

IMPROVING FOUNDRY EFFICIENCY AFTER SHAKEOUT

by Brenda Berkompas, Eric Brewer, and Mike Zindler
Sponsor: Michael J. Chenoweth - AC Foundry, Inc.
Faculty Advisors: Liwana S. Bringelson and Joseph W. Petro, Jr.
11:30 a.m. to 11:55 a.m., Room 204

In a foundry, aluminum sand castings are broken out of the mold by a shakeout machine. The movement of materials from shakeout through finishing was being accomplished in an inefficient manner. We improved material flow and efficiency by utilizing tools such as plant layout and material handling techniques.

INDUSTRIAL AND MANUFACTURING ENGINEERING - B-I

Session Chair - Ralph Tanner
Room 209

FILTRATION OF DUCTILE IRON

by John S. Gitschlag, Andrew J. Malpass, and Jerrod A. Weaver
Sponsor: East Jordan Iron Works
Faculty Advisor: Sam Ramrattan
9:00 a.m. to 9:25 a.m., Room 209

This project studied the use of ceramic foam and extruded filters in the gating system and the impact they have on flowability and casting quality. A pattern was designed and built to produce sand molds into which molten ductile iron was poured. The resulting castings were analyzed for the presence of inclusions using radiographic techniques (x-rays). The results of this study can be used by the foundry industry to identify proper filter selection and filtering techniques for ductile iron.

THE EFFECTS OF POLYMER REGRIND ON ROTATIONAL EFFORTS

by Matt Johnson, Karen J. Mitchell, and C. Richard Truza
Faculty Advisors: Sam Ramrattan and Paul V. Engelmann
9:30 a.m. to 9:55 a.m., Room 209

Plastics companies produce scrap plastics material as a bi-product. There is uncertainty in the industry about the effect of reusing plastics on final part performance. This process scrap is generally either sold at a fraction of it's value or thrown away. By regrinding this scrap material and reusing it, large savings could be realized. The research team used three regrind mixtures to injection mold air conditioning outlets. They then tested the efforts needed to rotate the barrel in the housing and compared the variations between mixtures.

COPPER INSERTS IMPROVE COOLING IN INJECTION MOLDS

by Ole Hansen, Jerome Hund, C. Dennis Rosten, and Ryan Wejrowski
Sponsor: Dr. Dale Peters - Copper Development Association
Faculty Advisor: Paul Engelmann
10:00 a.m. to 10:25 a.m., Room 209

The results of this project have shown that by using copper alloys in plastics injection molding reduces process cycle time. The test method was developed to show differences between steel and copper inserts. Changing the mold materials from steel to a copper alloy improved the cooling characteristics. These cooling changes provided more uniform heat removal from the mold. Thus, the use of copper alloys enhanced the dimensional stability of the parts. In addition, comprehensive data was obtained on the improvements made by the copper alloy mold materials.

THE IMPLEMENTATION AND DESIGN USAGE OF MECHANICA

by Darren DelDuco, Lance Lie, and Christine Viger
Faculty Advisor: Michael Atkins
10:30 a.m. to 10:55 a.m., Room 209

Analyzing, modifying, and optimizing engineering designs, is something engineers have been trying to improve upon for many years. Mechanica is an analysis and design optimization software, utilizing three main areas; Motion, Structural, and Thermal. Mechanica greatly reduces the time to complete engineering analysis. A study was conducted to gain an understanding of the application and use of Mechanica in product design. Results were reported and explained in a User Guide/Tutorial, which has been written and created for future Mechanica users.

PRO/ENGINEER vs I-DEAS: A COMPARATIVE ANALYSIS

by David Bird, Davette Lubonski, and Jeff Miller
Faculty Advisor: Michael Atkins
11:00 a.m. to 11:25 a.m., Room 209

Two predominate CAD systems, Pro/ENGINEER and I-DEAS, were compared to evaluate their relative strengths and weaknesses. A benchmark comparison was performed that was based on a developed criteria to identify and illustrate the operational characteristics of the respective systems. The results of the study led to several comparative conclusions concerning the operational characteristics of the systems evaluated. Implementation guides to assist the novice user in operational characteristics of both CAD systems were developed. This documentation will serve as an introductory tutorial to aid students and faculty at Western Michigan University.

3D ANIMATION OF A CFR ENGINE FLAME FRONT

by Andy Morris, Michael Rocheleau, and Oliver Sebele
Faculty Advisors: James VanDePolder, Michael Atkins, and Ralph Tanner
11:30 a.m. to 11:55 a.m., Room 209

The 3D Animation of a Coordinating Fuel Research (CFR) Engine Flame Front, produced with Autodesk 3D Studio, showed the progression of gasoline combustion in a standard fuel research engine. The primary animation showed the CFR engine configured with a disk-shaped chamber operating under normal combustion conditions. The disk chamber was designed for minimum turbulence (air/fuel mixing). Animating the combustion cycle in the engine gave information relevant to chamber design. Seeing the effect of engine variables on the flame front assisted in combustion chamber analysis.

ENGINE KNOCK DETECTION USING SPARK PLUG VOLTAGE ANALYSIS

by Sean Clarke, Sean Donnelly, and Natalie Gonzalez
Faculty Advisor: James VanDePolder
1:00 p.m. to 1:25 p.m., Room 209

The current method of recognizing abnormal combustion in an internal combustion engine utilizes a single sensor. This single location of the sensor provides inconsistent results due to the distances between the sensor and individual cylinders. When corrections are made to compensate for knock in one cylinder, all cylinders are affected uniformly by a single control system. This allows for inconsistencies between cylinders and is therefore not as accurate as individual cylinder control. This experiment was conducted to analyze the energy pattern observed when the burn was initiated in a cylinder to determine if combustion was occurring normally or abnormally. This analysis allows future designers to control each cylinder individually and maximize power output.

REPAIR, DEVELOPMENT AND TECHNICAL USE OF A WIEDEMANN LASER L-4060

by William H. Blumka, Jeffrey J. Veryser, and Andrew J. Youngblood
Faculty Advisors: Ralph Tanner and Fred Sitkins
1:30 p.m. to 1:55 p.m., Room 209

A carbon dioxide gas laser, the Wiedemann Laser L-4060, was donated to Western Michigan University's Department of Industrial & Manufacturing Engineering but the machine has sat idle and is not in running condition. Several of the machine's components needed repair or replacing. This project was a "hands-on" exploration of the inspection, repair and technical use of the laser.

AUTOLISP PROGRAMMING FOR EFFICIENCY

by Travis Bell, John Miller, and Jared Warrick
Sponsor: Parker Hannifin, Brass Products Division
Faculty Advisor: Charles Woodward
2:00 p.m. to 2:25 p.m., Room 209

A local company uses AutoCad 12 and a datamanager program to produce drawings used in manufacturing operations. This project researched and organized the company's database into sub-divisions and documented the specific file destinations and directories. In addition AutoLISP programs were written to streamline the design process. These programs, along with the database restructure, utilized AutoCad's resources which reduced actual drawing times.

HEIGHT ADJUSTABLE JET-SKI SERVICE STAND

by Greg Gornick, Brian Moser, and Dave Thomas
Sponsor: Ron Santoro - Aero-Motive Company
Faculty Advisor: Charles Woodward
2:30 p.m. to 2:55 p.m., Room 209

Personal watercraft owners need a way to move their watercraft around the driveway or shop for storage and maintenance while protecting their investment. Problems arise from the fact that all of the stands on the market are manufactured to remain at fixed heights. The non-adjustable stand presents a problem to users when trying to load and unload the jet-ski from trailers of different heights and when maintenance is performed on the top and bottom of the watercraft. This project team re-designed, modified and tested the Jet-Ski Service Stand. The adjustability problem was solved by utilizing an electric actuated height adjustable stand.

MECHANICAL AND AERONAUTICAL ENGINEERING - A-I

Session Chair - John Valasek
Room 242

THERMO-HYDRODYNAMIC ANALYSIS OF A MECHANICAL SEAL

by Jeffrey DePayva and Derek Moczulski
Faculty Advisor: Parviz Merati
9:00 a.m. to 9:25 a.m., Room 242

A detailed experiment was conducted in the Fluids Laboratory at Western Michigan University pertaining to a mechanical seal. Information on temperature and velocity distributions at the seal interface were obtained using thermocouples impregnated on the seal and Laser Doppler Velocimetry respectively. The inherent thermal and hydrostatic stresses were then predicted based on the results of the experiment. A mathematical model was developed to safely predict these stresses and provide assistance in the development of a more efficient mechanical seal.

HIGH PRESSURE BI-METALLIC STEAM TRAP

by Erich Bernhardt and Timothy Totten
Sponsor: Mike Hellman - Armstrong International
Faculty Advisor: Jerry Hamelink
9:30 a.m. to 9:55 a.m., Room 242

A bi-metallic steam trap is a device used to remove air and condensate from a steam line during start-up and operation. Although common in low pressure applications, there was a need to adapt this type of trap for a high pressure, superheated steam environment. In this environment, corrosion resistance, yield resistance, and thermal deflection rate were primary concerns. Mathematical modeling was used to select the shape and material of the bi-metallic element. Performance plots for various materials and shapes were used to validate the design.

TESTING INSTRUMENTATION FOR A SERVO VALVE

by Van Le and Damond Timmerman
Sponsor: Sweet Manufacturing, Inc.
Faculty Advisor: Jerry Hamelink
10:00 a.m. to 10:25 a.m., Room 242

A local company requested the testing of spool valves in the power steering of race cars, the component that controls the flow of fluid throughout the servo valve. The "feel" in the steering of a race car is critical since the amount of movement in the steering wheel is very small compared to the conventional road car. Testing instrumentation was designed to accurately test spool valves for race cars to provide the same "feel" to the driver when replacement of this component of the power steering is required.

HIGH EFFICIENCY TRANSMISSION FOR THE SOLAR CAR

by Kurt Achenbach and Mark Fairbanks
Faculty Advisor: Jerry Hamelink
10:30 a.m. to 10:55 a.m., Room 242

A highly efficient variable speed transmission is an extremely important component of the Western Michigan University solar car. A high efficiency transmission was designed to meet all the design requirements, including small volume, light weight, and four to five speed ratios. A mathematical model was used to analyze the efficiency losses in the transmission system.

BAG OPENING DEVICE FOR A PACKAGING PROCESS

by Adam Bienkowski and Brian Dunlap
Sponsor: Roy Dunlap - The Dow Chemical Company
Faculty Advisor: Jerry Hamelink
11:00 a.m. to 11:25 a.m., Room 242

Herbicides are often distributed in small, water soluble packets which are inserted in a larger bag that is then sealed and sent to the customer. The task of opening the larger bag in the packaging process was found to be quite cumbersome for operators. A machine was designed to assist operators by opening these large bags for insertion of the small packets.

SUNSEEKER DYNAMOMETER

by Clark Bay and Jayson VanHoosear
Faculty Advisor: Jerry Hamelink
11:30 a.m. to 11:55 a.m., Room 242

A dynamometer measures the horsepower of an engine by applying a braking force to the motor. The dynamometer that the WMU Sunseeker team uses now does not give an accurate reading of the solar car's electric motor. A new dynamometer was designed that included a stronger frame, removable motor, and a more accurate reading of the solar car's output horsepower.

RACE CAR CHASSIS MONITORING SYSTEM

by Gregg R. Kittinger, Chris D. Schmeichel, and Edward F. Wettlaufer
Sponsors: Mike Roush - R & H Industries and Chas Howe - Howe Racing
Faculty Advisor: Jerry Hamelink
1:00 p.m. to 1:25 p.m., Room 242

Current techniques used to optimize race chassis adjustments entail time-consuming trial and error methods. A kinematic analysis was performed to provide a mathematical model of the chassis. Mathematical modeling provided a detailed understanding of the critical parameters affecting chassis motion. A data acquisition system was designed to monitor the critical parameters under operating conditions. The data acquired provided analytical and visual representation which were compared to the theoretical models for the optimum chassis adjustments.

MECHANICAL AND AERONAUTICAL ENGINEERING - B-I

Session Chair - Srinivas Garimella
Room 208

C-5 AIRCRAFT MAIN HYDRAULIC PUMP MODIFICATION

by James Farrell and Mark Loewen
Sponsor: Greg Warner - Abex NWL Aerospace
Faculty Advisor: Daniel Dorney
9:00 a.m. to 9:25 a.m., Room 208

The mechanical effects of cavitation have been observed during tear-down and overhaul of the C-5 aircraft main hydraulic pump. Cavitation has caused premature surface wear of some internal components, reducing pump efficiency and service life. The result can be increased maintenance costs and downtime for the C-5 aircraft. A modification to the existing pump was designed, which reduces the tendency for cavitation. Computational fluid dynamics techniques were used to analyze the design, and an engineering test plan was developed to measure the performance of the modified pump.

OUTDOOR FURNITURE ENVIRONMENTAL TEST CHAMBER

by James M. Bucholtz and Andrew J. Fytczyk
Sponsor: Dick Butcher - Landscape Forms, Inc.
Faculty Advisor: Srinivas Garimella
9:30 a.m. to 9:55 a.m., Room 208

Outdoor furniture needs to be tested so that it can be proven safe when exposed to different climates. A test chamber was designed that would accurately simulate different environmental conditions that would be encountered by the product. To ensure optimum performance and cost effectiveness, research was done in the areas of heating, cooling, artificial sunlight and other pertinent aspects. The test chamber met the criteria of testing for safety and performance of the furniture.

DRAG COMPARISON FOR KITFOX LANDING GEAR SYSTEMS

by Gary Lee and Jeff Tolonen
Faculty Advisor: Arthur Hoadley
10:00 a.m. to 10:25 a.m., Room 208

The Kitfox experimental aircraft had minimal performance data when equipped with a float-type landing gear. A drag comparison was performed for both a wheel and float landing gear configuration. Those configurations were modeled and tested using computational fluid dynamics (CFD) and wind tunnel testing. PMARC-12, a 3-D computational fluid dynamics code, was used to model both systems. A scale model of the float gear was built and tested in a wind tunnel. These results were then compared to the CFD data for verification. This data was used to predict the performance characteristics of the Kitfox aircraft equipped with floats.

IMPROVING THE EFFICIENCY OF A HYDRAULIC GEAR PUMP

by Greg Alberda and Matt Simon
Sponsors: John Brondyke and Tim Connor - Parker Hannifin Corp., Hydraulic Pump/Motor Div.
Faculty Advisor: Iskender Sahin
10:30 a.m. to 10:55 a.m., Room 208

An existing hydraulic gear pump exhibits very low efficiency due to a high amount of internal friction. By modeling the internal workings of the pump, the causes of the frictional losses were determined. The components causing the majority of the inefficiency were modified to reduce the frictional losses. It was required that the pump housing not be changed, thereby avoiding high retooling costs. The result was a pump whose performance greatly exceeded that of the original design, while maintaining cost effectiveness.

PLASTIC PLANT TAG SEPARATOR

by Erik J. Kostbade and Kenneth R. Manschesky
Faculty Advisor: Dennis VandenBrink
11:00 a.m. to 11:25 a.m., Room 208

A plastic plant tag manufacturer required a device to separate groups of tags from a stack of perforated tag sheets. Previously the tags had been separated manually with a pair of pliers. This method of separation was unpleasant and caused wrist problems in employees that could lead to company liability. An automated device was designed that separates the tags and deposits them for later sorting and shipping.

HANDLEBAR SAFETY AND ANALYSIS FOR MOUNTAIN BIKES

by Mark A. Chapman and Michael G. Rafail
Faculty Advisor: Dennis VandenBrink
11:30 a.m. to 11:55 a.m., Room 208

Mountain bike handle bar failure has become a great concern among cyclists and manufactures alike. A means of handlebar testing was achieved through data acquisition and machine design. Using the determined in-field shock loads, the design parameters for a handlebar testing machine were determined. In addition, the design of the handlebar testing machine was completed.

QUICK RELEASE ROPE CLAMP

by Paula Cortizo and Jesus Reyes
Sponsor: Richard Wegner - Steadfast Company
Faculty Advisor: Dennis VandenBrink
1:00 p.m. to 1:25 p.m., Room 208

A quick release clamp is specially designed for small boats to clamp an anchor rope to restrain the boat's movements. The clamping device has a "U" shape supporting structure which is attached to the side of the boat. Finite element analysis was used to determine the weak points of the present structure so that modifications could be made to strengthen the design without affecting the appearance, cost, and utility of the device.

CASTER ADJUSTMENT MECHANISM FOR RACE CAR SUSPENSION

by Geoffrey Theyken and William Tuer
Faculty Advisor: Richard B. Hathaway
1:30 p.m. to 1:55 p.m., Room 208

A mechanism was designed to allow caster adjustment on a beam-axle front suspension as used by many supermodified race cars. Caster setting contributes to the area of the tire footprint, which must be maximized to achieve optimum handling performance. The mechanism allows the caster to be adjusted for maximum performance at each of the different tracks these cars visit. The design was analyzed and tested to insure that it would withstand the forces created by a supermodified race car.

MECHANICAL AND AERONAUTICAL ENGINEERING - C-I

Session Chair - James Kamman
Room 213

ELECTRIC POWER TOOL BALANCER

by Law Yiu Cheong and Kevin Nguyen
Sponsor: Russell N. Kowalisyn - Aero-Motive Company
Faculty Advisor: James Kamman
9:00 a.m. to 9:25 a.m., Room 213

Tool balancers are used in assembly lines; they are reeling devices which partially or fully offset the weight of a hand tool. Presently, assembly industries typically use tool balancers in conjunction with a coiled electric cord set to provide power to the hand tool, creating a safety problem. Integrating the power supply line into the balancer offers significant advantages to the user. A new easy to install electro-mechanical balancer was designed to support the hand tool in any vertical position.

ANTI-VIBRATION SOLUTIONS FOR MANUAL SHIFT LEVER

by Jae Choi and Yosep Kim
Sponsor: Eaton Corporation
Faculty Advisor: James Kamman
9:30 a.m. to 9:55 a.m., Room 213

The transmissions of heavy trucks experience low frequency pitching motion as the truck travels over rough terrain. This motion in turn causes the shift lever to oscillate. When these oscillations become large enough, the transmission "jumps-out" of the set gear. A modified shift lever system was designed to eliminate this jump-out problem using a computer program to analyze the dynamics of various designs. The final design decreased the noise level in the cab and increased the safety of the truck operation.

AERATION SYSTEM FOR FISH HATCHERY WATER

by David Frye and Marie Jackson
Faculty Advisor: Molly Williams
10:00 a.m. to 10:25 a.m., Room 213

Aerating raw well water is a common method used at fish hatcheries to improve water quality. The Wolf Lake Fish Hatchery aeration system is continuously dependent on electricity. Any interruption in the power source will result in the death of fish. A passive aeration system was designed utilizing an alternative method to provide backup aeration in the event of a power failure. Using data from research and a small scale model, the feasibility and efficiency of the system were determined.

LASER SCRIBING DEVICE FOR SILICONE CARBIDE MECHANICAL SEALS

by Rami Z. Abdel-Sayed and Christopher Lee Dow
Faculty Advisor: Philip Guichelaar
10:30 a.m. to 10:55 a.m., Room 213

The process of permanently marking silicone carbide has proved to be difficult. A laser scribing device was developed that vaporizes small areas of the silicone carbide surface without damaging the bulk material. The final product incorporated computer software and hardware for moving the silicon carbide surface relative to the laser.

AUTOMATED TEST STATION FOR SMALL SURGICAL DRILLS

by Jennifer Leigh Brinn, Kerri Suzanne Lake, and Kurt Philip Lentner
Sponsor: Rich DeVault - Stryker Instruments
Faculty Advisor: Philip Guichelaar
11:00 a.m. to 11:25 a.m., Room 213

Inspection is a very subjective, time consuming, non-value added activity for the assemblers of surgical drills. For these reasons, it was necessary to develop a new method for inspecting handpieces that reduced test time and produced accurate data. A method of testing drills electronically in a way that produced accurate data without sacrificing the cosmetic integrity of the handpiece was designed. This test system allows assemblers to test drills more quickly and accurately while reducing the cost of inspection to the company.

TRANSMISSION OIL COOLER RELOCATION AND REDESIGN

by Thomas Butler and Matthew Selwa
Sponsor: Gary Talbot - General Motors Corporation
Faculty Advisor: Chris Cho
11:30 a.m. to 11:55 a.m., Room 213

Transmission oil coolers are currently integrated into the engine radiator in most passenger automobiles, posing a potential fire hazard during a frontal impact due to the low flash point of the transmission fluid currently used. To minimize the risk of the oil cooler rupturing during an impact and reduce the time required to install the oil cooler on an assembly line, the transmission oil cooler was integrated into the transmission casing. The heat dissipation of the production unit was used as a "benchmark" for the prototype design with the size of the heat exchanger being the primary concern.

ARMREST REDESIGN FOR COST REDUCTION

by Justin Healy and Dave Martin
Sponsor: Dan Hawkins - Lear Plastics Corp.
Faculty Advisor: Philip Guichelaar
1:00 p.m. to 1:25 p.m., Room 213

Storage Armrests have become a large selling point for pickup trucks due to the lack of interior storage. The cost of the current 1996 CK Front Storage Armrest was too high. The lid frame was redesigned to reduce cost and remove any unnecessary materials.

ROBOT FOR MEASUREMENT OF ENGINE ACOUSTIC POWER

by Jesse Killion and Chris Nelson
Sponsor: Declan Allen and Pat Pierz - Ricardo North America
Faculty Advisor: Koorosh Naghshineh
1:30 p.m. to 1:55 p.m., Room 213

In the past, one popular way to measure acoustic power radiated from an engine was to have a human operator sweep a hand held acoustic intensity probe over an area in a grid pattern. Because of this human involvement, measurement conditions were restricted to relatively safe engine loads and speeds. A programmable, low-cost, two degree of freedom robot was designed to automate the process of sweeping an acoustic intensity probe. This allowed an increase in both repeatability and the range of test conditions. The robot was designed such that the noise generated by the robot is negligible compared to the actual noise source.

DRIVE SHAFT DESIGN AND OPTIMIZATION

by Heather M. Ketchel and Chien Ming Ng
Sponsor: H.Wayne Seeds - American Axle and Manufacturing
Faculty Advisor: Koorosh Naghshineh
2:00 p.m. to 2:25 p.m., Room 213

Weight, packaging, and performance for drive shafts is a major concern in the automotive industry. The investigation of light weight, high performance composite materials led to the modeling of the shafts using a finite element analysis (FEA) package to design the optimal shaft, offering comparable or superior performance characteristics. The comparison of the FEA generated data and test results from the ultimate torsion load and vibration tests enabled the verification of the FEA results.

ROBOT GRIPPER FOR PART HANDLING

by Richard L. Kaiser and Darrell D. Telgenhoff
Sponsor: H. Wayne Seeds - American Axle and Manufacturing
Faculty Advisor: Koorosh Naghshineh
2:30 p.m. to 2:55 p.m., Room 213

Robots can be used to automate processes involving tedious part handling tasks. A multipurpose gripping device was designed to facilitate therobotic automation of loading parts. The gripper takes universal joints from a conveyor and loads them into boxes. The device also places cardboard sheets as layers between the parts. Magnetic- vacuum- and jaw-type grippers were researched to determine the best solution. Considerations of the part orientation were crucial in the design.

CENTRIFUGAL FORCE COMPENSATION IN POWER CHUCKS

by Anantha Sankey and Woldemikeal Ghebrhiwot
Sponsor: Jerry Norton - Buck Chuck Company
Faculty Advisor: Judah Ari-Gur
3:00 p.m. to 3:25 p.m., Room 213

A chuck which is used to hold a work piece on a lathe machine is subjected to various static and dynamic forces. The gripping force of the jaws on the chuck is significantly affected by the centrifugal force that increases as the rotating speed of the machine increases. Loss of the jaw force can result in work piece slippage which can affect the precision and accuracy of the final product. A new design was developed which uses counter balancing to reduce the loss of gripping force by the jaws, thus improving the quality of the finished product.

PAPER AND PRINTING SCIENCE AND ENGINEERING - A-I

Session Chair - Brian Scheller
Room 211

THE EFFECT OF PIGMENT/LIQUID ON COATING PROPERTIES

by Steven C. Payne
Faculty Advisor: Brian Scheller
9:00 a.m. to 9:25 a.m., Room 211

The end properties of a coated paper are greatly influenced by the rheology and dewatering of the applied coating. The rheological properties of several coating formulations were studied at various sheer rates using Brookfield and Hercules viscometers. The dominant pigment in the coating formulations was either clay or calcium carbonate. The water retention was measured for each coating formulation with a pressure filtration-based water retention meter. By varying the concentrations of coating components it was possible to determine which component(s) had the most influence on coating rheology and dewatering.

THE USE OF A NEW JUMBO FLUTE PROFILE (K-FLUTE) TO REPLACE COMMON GRADES OF SINGLE- AND DOUBLE-WALL CONTAINER BOARD

by Ron Pristash
Faculty Advisor: Brian Scheller
9:30 a.m. to 9:55 a.m., Room 211

This study examined the use of a new specialty flute profile (K-Flute) as a replacement for commonly used grades of single- and double-wall container board. The first series of tests held the liner and medium weights constant. The only variable was the flute profile. These tests examined the effect that caliper has on edge crush and full box compression. The next series of tests involved using various liner and medium combinations of K-Flute to yield structural strength similar to commonly used grades. K-Flute yielded the same structural strength using significantly less paper board.

IMAGE ANALYSIS: QUANTIFYING DIFFERENCES IN PRINTING PROCESSES

by Christopher E. Adams
Faculty Advisors: Brian Scheller, Gerry Wouch, and John Serafano
10:00 a.m. to 10:25 a.m., Room 211

Image analysis is used to measure print quality for various printing materials and processes. This study was done to determine if image analysis can be used to quantify variations in printing processes. Thirty samples were taken from a water-based gravure printing trial, which printed four different engravings across the base paper. Area and perimeter of ink dots were obtained using an image analyzer. By statistically analyzing the data, the results showed how the ink dots vary in one sample, in samples across the sheet, and in samples along the machine direction.

RETENTION AID OPTIMIZATION ON AN ACID TEXT GRADE

by Kathleen Miles
Sponsor: Vijay Mehta - Simpson Paper Company
Faculty Advisor: Brian Scheller
10:30 a.m. to 10:55 a.m., Room 211

An anionic polyacrylic retention aid was optimized on an acid text grade. The retention aid level was varied in order to obtain the highest opacity with an acceptable formation. The machine process was monitored for variables such as refining, machine speed, and headbox consistency which can affect retention. Strength, brightness, percent titanium dioxide, and other sheet properties were also examined.

ANIONIC WAXY MAZE STARCH AS A COATING COBINDER

by Peter D. Yake
Faculty Advisor: Brian Scheller
11:00 a.m. to 11:25 a.m., Room 211

This project investigated the use of an anionic 100% Waxy Maze starch as a coating co-binder. Oxidized starches, which carry an anionic charge, were widely used as primary binders in the late 1970's. Problems in papermachine broke systems as well as effluent turbidity caused the use of oxidized starches to decline sharply through the 1980's. The starch that was used in this thesis, being of different chemistry (relative to oxidized starch), and used as a co-binder was evaluated based upon its performance relative to an uncharged 100% Waxy Maze starch. Coating rheology and coated paper properties were assessed.

THE EFFECT OF CARBOXYLMETHYL CELLULOSE AND POLYACRYLATE ON COATING PROPERTIES

by Tom Eugate, Jr.
Faculty Advisor: Brian Scheller
11:30 a.m. to 11:55 a.m., Room 211

This study analyzed the effects that different flow modifiers had on a control coating formulation (color) when added in varying amounts at different coating color solids contents. An experimental design was devised that incorporated carboxylmethyl cellulose and polyacrylate as flow modifiers in the color. Rheological tests were performed on the different coating formulations, along with Cylindrical Laboratory Coater runs using the coatings and surface tests on the coated sheets. Correlations were made between color rheology, water retention, healing ability, and solids levels of the coating formulations.

PAPER AND PRINTING SCIENCE AND ENGINEERING - A-II

Session Chair - David Peterson
Room 211

THE EFFECT OF A REDUCTION/OXIDATION FILTER ON PILOT PLANT EFFLUENT

by Matt McNamara
Faculty Advisor: David Peterson
1:00 p.m. to 1:25 p.m., Room 211

This project was concerned with the effects of a reduction/oxidation filter on water quality in Western Michigan University's Paper Pilot Plant. The filter was installed after the clarifier in the pilot deinking system. The filter is used to remove heavy metals and chlorine. It also reduced the amount of scale formation in the system. The results were analyzed by taking samples for heavy metals and chlorine after the clarifier and after the redox filter. In order to measure the system's tendency to corrode or scale, Langilier's Saturation Index was used. The success of the redox filter was determined through testing. Economical feasibility for a large mill was investigated.

FINES' EFFECTS ON RECYCLED PAPER SURFACE PROPERTIES

by Lawrence E. Fleck
Sponsor: James Kluesener - Simpson Paper Company
Faculty Advisor: David Peterson
1:30 p.m. to 1:55 p.m., Room 211

Fines are an integral part of the paper making process. With increased recycling comes increased fines generation. It is understood how increased fines affect properties in a virgin pulp, but little is known about how recycled fines behave and how they affect surface properties. Virgin pulp and recovered paper of similar composition were separately pulped and the fines fraction removed. Fines were then re-applied to each stock at varied levels. Handsheets were made and surface strength, smoothness, absorbency, and optical properties were analyzed.

THE USE OF DEMOLITION WOOD IN PAPERMAKING

by Todd W. Anderson
Faculty Advisor: David K. Peterson
2:00 p.m. to 2:25 p.m., Room 211

Decreasing landfill space, increasing tipping fees, and tightening governmental regulations are causing concern among environmentally aware industries. Demolition wood provides an alternative source of fiber for the paper industry while diverting wood waste from landfills. Two different demolition wood sources were compared to kiln dried and green wood of a similar species. Sheets were made from lab scale, batch pulps and strength tests and formation observations were performed and used to draw comparisons. These comparisons were used to determine if the demolition wood fiber has the appropriate properties to form a satisfactory sheet of paper.

PRESS DEWATERING OF SLUDGE USING ELECTROKINETIC FORCES

by David Knudsen
Faculty Advisor: David Peterson
2:30 p.m. to 2:55 p.m., Room 211

The problem of paper mill sludge disposal is very prevalent in the paper industry today. This thesis studied the effects that electrokinetic forces have on the dewaterability of sludge. A simulated piston press was designed and set up to allow an electrical field to pass through the sludge while being pressed. Tests were run at varying degrees of electrical potential, and data were collected on the dewaterability rate and quantity. With the application of electrokinetic forces to the sludge, an increase in dewaterability is possible, resulting in big savings in transportation and disposal costs of sludge within the industry.

ENVIRONMENTAL COMPARISON OF SOY TO PETROLEUM INK WITH RESPECT TO DEGRADATION OF EFFLUENT

by Monique Musgrave
Faculty Advisor: David K. Peterson
3:00 p.m. to 3:25 p.m., Room 211

There are environmental advantages and disadvantages of soy ink versus petroleum ink with respect to aerobic and anaerobic degradation. This study investigated an environmentally safe alternative to petroleum ink. Petroleum inks, commonly used in the printing industry, produce emissions of volatile organic compounds, which are known health hazards. It is possible to replace petroleum oils with vegetable oils, such as soybean oil. The project analyzes the rate and ultimate degradation of soy versus petroleum ink in aerobic and anaerobic conditions.

THE DEINKABILITY OF DIFFERENT PAPERS PRINTED WITH SOY AND PETROLEUM INKS

by Sonja Olendorf
Faculty Advisor: David Peterson
3:30 p.m. to 3:55 p.m., Room 211

The paper printing industry currently uses inks which are formed from petroleum resources. The use of petroleum based inks in the printing process have some hazardous ramifications which may be alleviated through the substitution of a soybean derived oil. There is concern within the paper industry that the integration of soy inks into the recycle stream may cause problems with regard to deinking effluent and final paper quality. This project examined the effects of printing and deinking papers containing different quantities of lignin with each type of ink.

DIVERTING SLUDGE FROM LANDFILLS TO INSULATION

by Tracy Stevens
Faculty Advisor: David Peterson
4:00 p.m. to 4:25 p.m., Room 211

As landfill capacities are exhausted and landfill costs and "green movement" pressures increase, paper mill clarifier sludge disposal is an ever increasing problem. There is a need to develop alternatives to the typical landfill disposal of sludge. The potential use of sludge in insulation is one such alternative. The objective of this study to divert sludge from a recycle paper mill and produce an insulation board of optimum density and blend resulting in a competitive product. The insulating quality of the insulation board was determined and production costs calculated to determine feasibility.

DEINKING IN A CLOSED LOOP AND THE EFFECT OF SOLIDS ON PAPER PROPERTIES

by Chad Henry Warmbier
Faculty Advisor: David Peterson
4:30 p.m. to 4:55 p.m., Room 211

Closed loop deinking is a relatively new concept in the art of papermaking. A system of this kind reutilizes the wastewater and uses it for the reprocessing of secondary fiber. Suspended and dissolved material can build up and cause problems with machinery and the final product. Secondary fiber was repulped and ink removed by chemical addition. The removed ink and water was recirculated for further reprocessing of the newsprint. The final stage involved making and testing paper and monitoring the process water for solids content.

PAPER AND PRINTING SCIENCE AND ENGINEERING - B-I

Session Chair - Ellsworth Shriver
Room 212

COMPARISON BETWEEN AZC AND KZC AS COATING INSOLUBILIZERS

by Scott Brigham
Sponsors: Steve Parker - Kalamazoo Paper Chemical and Dan VanCalcar - Hopton Technology, Inc.
Faculty Advisor: Ellsworth Shriver
9:00 a.m. to 9:25 a.m., Room 212

Potassium Zirconium Carbonate (KZC), gives an alternative to Ammonium Zirconium Carbonate (AZC) as a coating insolubiliser without containing ammonium. This study compared changes in coating viscosity, insolubilising performance, and optical properties between AZC and KZC. The trial was run on the CLC coater and tested in the department testing facilities. KZC performed as well as AZC as a coating insolubiliser.

RECYCLING AND THE STRENGTH OF SECONDARY FIBERS

by William Byrd
Faculty Advisor: Ellsworth Shriver
9:30 a.m. to 9:55 a.m., Room 212

The societal push towards increased recycling in America has added many new variables to the science of papermaking. The effect of increasing the percentage of secondary fibers on the strength characteristics of the paper being produced is one of these variables. To study this parameter handsheets were produced from old corrugated containers. By repulping these containers, producing sheets of paper, and then repeating this series of recycling and handsheet making, tests showed that strength was decreased with every degree of recycle from this common source of secondary fiber.

FRACTIONATION OF DOUBLE KRAFT LINER CLIPPINGS

by Stephanie Rose
Faculty Advisor: Ellsworth Shriver
10:00 a.m. to 10:25 a.m., Room 212

Recycled fibers lose physical characteristics such as strength, flexibility, and dimensions. The fractionation process separates long fibers from short fibers by passing pulp through a screen system, which can improve quality of recycled products. Evaluation of the Sinclair Float Wash using variable screen sizes revealed its efficiency as a fractionator for double kraft lined clippings. Further evaluation of samples determined fiber yield and ratio, average fiber length, weighted fiber length, and fiber distribution.

RECYCLE PROPERTIES OF DIFFERENT PAPERMAKING FIBERS

by Amy L. Schwalm
Faculty Advisor: Ellsworth Shriver
10:30 a.m. to 10:55 a.m., Room 212

This project examined the effects of recycling on paper made from different fiber furnishes. Three types of handsheets (laboratory paper samples) were made, tested, and recycled five times. These contained 100% cotton, 100% softwood, and 100% abaca hemp, respectively. Little research has been done in the past to determine the effects of fiber furnish on the strength and fiber life after numerous recycles. Differences in fiber furnishes were observed.

REPULPING WET-STRENGTH PAPERS

by David S. Barr
Faculty Advisor: Ellsworth Shriver
11:00 a.m. to 11:25 a.m., Room 212

Repulping wet-strength papers is a problem throughout the paper industry. Wet-strengths claim valuable landfill space, and a valuable fiber source is lost. Repulping wet-strengths can be done but often there are large amounts of fiber degradation. Two chemicals, sodium borohydride and chlorine dioxide, were evaluated to determine their effectiveness in the repulping process. Each chemical was used at two concentrations to determine the effect of this variable. The results of the repulping runs were compared to a control run.

HIGH CONSISTENCY KNEADER EVALUATION

by Elisabeth Evanoff
Faculty Advisor: Ellsworth Shriver
11:30 a.m. to 11:55 a.m., Room 212

Recycling of post-and pre-consumer papers is becoming very popular. Old newspapers are included in post-consumer paper. Newspaper contains inks, which require mechanical action to break it into particles small enough to be removed in the recycling process. The mechanical action is produced by a high consistency kneader. This evaluation analyzed the effect of the kneader on ink particle sizes, fiber degradation, and power consumption. The variables for the operation of the kneader included two power loadings and two values of stock pH. The data obtained from this project relates to final product requirements and the needs of the paper industry.

THE EFFECT OF WASHING BETWEEN BLEACHING STAGES ON BRIGHTNESS REVERSION OF HIGH-YIELD PULPS

by David Kaminski
Faculty Advisor: Ellsworth Shriver
1:00 p.m. to 1:25 p.m., Room 212

There is a brightness reversion problem that occurs in the final paper products made from high yield pulp sources. If this problem can be solved, the use of high yield pulps for high quality printing papers can prove beneficial. Hydrogen peroxide and sodium hydrosulfite was used separately to bleach a sample of high yield pulp. The effects of washing between bleaching stages on brightness reversion and yellowing was studied. Washing showed better brightness control in the final product.

THE EFFECT OF WASHING BETWEEN STAGES ON BRIGHTNESS REVERSION FOR SODIUM HYDROSULFITE ON UNBLEACHED HIGH YIELD-PULPS

by Gregory L. Semashko
Faculty Advisor: Ellsworth Shriver
1:30 p.m. to 1:55 p.m., Room 212

Currently, the paper industry is looking for new and improved methods to achieve a more stable sheet. There have been many studies on how to strengthen the sheet, but the sheet that will not yellow is still elusive. Brightness reversion or yellowing of paper is due to the reaction of paper, air, and light. By using hydrosulfite and washing between two-stage bleaching sequences, the effect of washing on brightness reversion can be determined. A high-yield chemithermomechanical pump was used with lignin preserving chemicals. The experiments were done using different chemical charges to determine the optimum quantity for brightness appearance.

HIGH CONSISTENCY KNEADER EVALUATION

by Lance Teunissen
Faculty Advisor: Ellsworth Shriver
2:00 p.m. to 2:25 p.m., Room 212

This project analyzed how effective the application of mechanical energy is in breaking up thermoplastic inks used in some printing applications. The high consistency kneader was evaluated utilizing a 2^2 factorial design with pH and power loading as the two control variables. A furnish of mixed office paper including computer paper and colored ledger was used to evaluate the kneader. These variables were investigated: the degree of fiber degradation, ink particle size, and sticky shapes.

REPULPING BOTTLE CARRIER PAPERBOARD - I

by Mahsa Khosravani
Faculty Advisor: Ellsworth Shriver
2:30 p.m. to 2:55 p.m., Room 212

The effectiveness of chemical reagents in promoting the efficiency of recycling bottle carrier paperboard was explored. This product is difficult to repulp due to the addition of chemical additives, such as wet-strength resins, to the virgin pulp. These resins employ cross-linking of the fibers which provide resistance of the paper product to break down with exposure to moisture, either through water or humidity. Wet-strength products are major contributors to landfills in the United States, thus there is an existing need to explore recycling procedures. Research and experimentation has shown that a combination of mechanical shear and chemical reagents improve recycling abilities of this product.

REPULPING BOTTLE CARRIER PAPERBOARD - II

by Jennifer Giver
Faculty Advisor: Ellsworth Shriver
3:00 p.m. to 3:25 p.m., Room 212

The effectiveness of chemical reagents in promoting the efficiency of recycling bottle carrier paperboard was explored. This product is difficult to repulp due to the addition of chemical additives, such as wet-strength resins, to the virgin pulp. These resins employ cross-linking of the fibers which provide resistance of the paper product to break down with exposure to moisture, either through water or humidity. Wet-strength products are major contributors to landfills in the United States, thus there is an existing need to explore recycling procedures. Research and experimentation has shown that a combination of mechanical shear and chemical reagents improve recycling abilities of this product.

THE EFFECT OF SUSPENDING LIQUID VISCOSITY ON FLOCCULATION

by Heather R. Groat
Faculty Advisor: David Peterson
3:30 p.m. to 3:55 p.m., Room 212

This study was undertaken to further understand the mechanisms by which highly viscose formation aids affect sheet formation. It is believed that the acceleration and deceleration of fibers required to initiate the formation of flocs diminishes with increasing viscosity. There are several other methods by which additives can affect formation. Solutions of the same viscosity were prepared using different additives. These solutions served as the suspending medium for a pulp. If the formation is comparable for each additive, then the mechanism by which they affect formation should be due to the liquid viscosity of the suspension.

PAPER AND PRINTING SCIENCE AND ENGINEERING - C-I

Session Chair - Van Maltby
Room 215

CORRELATION OF BOD5 AND COD FOR SPECIFIC MILL OPERATIONS

by Jeff Jacobson
Faculty Advisor: Van Maltby
9:00 a.m. to 9:25 a.m., Room 215

The benefits to the pulp and paper industry, from a study like the one conducted here, is the time reduction that will result from results obtained. The traditional BOD5 (biological oxygen demand) test takes five days to determine the amount of dissolved oxygen that is being discharged. This study shows how a COD (chemical oxygen demand) test result, which takes three hours to obtain, can be used to estimate BOD5 test results. This is done by treating different pulping operation wastewaters, then running BOD5 and COD tests. These test results are then plotted and ratios developed to determine treated BOD5 to treatable COD.

DETERMINATION OF THE ENERGY VALUE AND VOLUME REDUCTION FROM INCINERATION OF PAPER INDUSTRY SLUDGE

by Kristy Kozlowski
Faculty Advisor: Van Maltby
9:30 a.m. to 9:55 a.m., Room 215

Paper industry sludge is composed of solid residuals from paper manufacturing and wastewater treatment. Most sludge is landfilled, but landfilling costs are quickly increasing. Therefore, alternatives to landfilling, such as sludge burning, are being explored. Incineration greatly reduces sludge volume, and often provides some energy to offset fuel costs. This study quantifies these benefits. The data are presented in graphical format so that moisture and ash effects can be seen simultaneously.

PAPER AND PRINTING SCIENCE AND ENGINEERING - C-II

Session Chair - Raja Aravamuthan
Room 215

DIMETHYLDIOXIRANE BLEACHING OPTIMIZATION OF A THERMOMECHANICAL PUMP

by Roger Allen Rouleau
Faculty Advisor: Raja Aravamuthan
10:00 a.m. to 10:25 a.m., Room 215

Dimethyldioxirane, an environmentally friendly bleaching agent, has experimentally been shown to remove lignin from kraft pulps, thereby increasing the bleachability. In this thesis, optimum conditions were determined for dimethyldioxirane to attack only the color-containing groups in the lignin-fraction. The selective destruction of the color-containing groups provides increased brightness without lignin removal. The pulp quality variables were pH, temperature, and dimethyldioxirane addition level. A 3^3 factorial design experiment was used to determine the interactions between these variables. The bleached pulps were tested for brightness, yield, lignin content, zero-span tensile index, and tensile index. The object parameters in optimization were brightness and strength properties.

IMPROVING RECYCLED PULPS THROUGH ENZYME TREATMENT

by Kraig Weber
Sponsor: Neil Franks - Novo-Nordisk
Faculty Advisor: Raja Aravamuthan
10:30 a.m. to 10:55 a.m., Room 215

Pulp properties (fiber degradation, fines content) change during recycling. These changes cause the pulp to suffer from poor drainage and decreased strength. Enzyme treatment can improve the pulp's properties. The changing properties influence the effectiveness of enzyme treatment, therefore, evaluating enzyme treatment requires consideration of the effect of recycling. To determine the relationship between the amount of recycling and the effectiveness of enzyme treatment, virgin pulp was recycled repeatedly. At each recycle, a portion of the pulp was treated with enzymes and a portion remained untreated. These samples were evaluated for water drainage, sheet strength, and changes in pulp properties.

THE USE OF DIMETHYL DIOXIRANE IN REFINER BLEACHING OF HIGH-YIELD PULPS

by Michael J. Harmes
Faculty Advisor: Raja Aravamuthan
11:00 a.m. to 11:25 a.m., Room 215

Hydrogen peroxide, a common bleach applied to high yield pulps, cannot be used in the refiner environment to bleach high yield pulps, since it requires the use of refiner-scaling sodium silicate. To avoid this problem, dimethyl dioxirane, which does not need silicates, was used as a refiner bleaching agent. Comparisons of the dimethyl dioxirane results were done with a peroxide refiner bleached pulp (without silicates) and a post refiner peroxide bleached pulp (with silicates). The feasibility of using dimethyl dioxirane as a refiner bleaching agent was determined.

THE OPTIMIZATION OF ORGANOSOLV CMP BRIGHTNESS

by Brian W. Johnson
Faculty Advisor: Raja Aravamuthan
11:30 a.m. to 11:55 a.m., Room 215

Chemi-mechanical (CMP) organosolv pulping has been shown to save significant amounts of energy in comparison to conventional high-yield pulping processes. However, the brightness of the CMP organosolv process has not in the past reached acceptable levels for quality paper. This project involved optimization of pulping variables in CMP (chemical mechanical pulp) and use of non-chlorine bleaching agents to determine the viability of such pulps in producing quality papers. The parameters of interest were brightness, brightness reversion, and chemical consumption.

COLOR STRIPPING OF RECYCLED W/F PAPERS USING OZONE

by Wendy L. Stus
Faculty Advisor: Raja Aravamuthan
1:00 p.m. to 1:25 p.m., Room 215

The market drive towards Totally Chlorine-Free (TCF) bleaching and increased post-consumer (PC) content papers have caused a need to quantify the effects of carious TCF chemicals on pulp strength and color stripping ability. Although ozone has been used successfully to bleach virgin chemical pulps, very little research regarding ozone's effect on recycled fiber has been done. A multi-level factorial experiment was performed on four shades of 30% PC fine papers; results of which were compared to those of two conventional chemicals (hydrosulfite and hypochlorite). Pulp brightness, viscosity and strength tests showed ozone to be viable at removing reductive shades.

THE EFFECTS OF VARIOUS PIGMENTS AND BINDERS ON THE COATED AND PRINT GLOSS

by Bob DeMay
Faculty Advisor: Raymond Janes and Brian Scheller
1:30 p.m. to 1:55 p.m., Room 215

A major concern with coatings is the gloss and the print gloss. The gloss and printability of the coating is a good measure of its quality. Different formulations were made using various pigments and binders, which were tested for a number of properties. All other variables were isolated in order to determine the effects of the pigments and binders. Along with gloss, other tests such as IGT pick, wet rub, K&N ink, and the Helio test were performed. The four pigments used were #2 clay, delaminated clay, calcined clay, and calcium carbonate. The two different binders used were latex and starch. These coating formulations were run on the Cylindrical Laboratory Coaters and then printed using the Vandercook proof press and the Moser rotogravure press. Printing results were analyzed.

THANK YOU

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