35th International PARTICLEBOARD COMPOSITE MATERIALS SYMPOSIUM & PRE-SYMPOSIUM TECHNICAL WORKSHOP

April 2-5, 2001
Washington State University
Pullman, Washington, USA

Abstracts of the Technical Forum Presentations

The Technical Forum will be presented Tuesday afternoon, April 3 from 3:00 pm - 6:00 pm in the Compton Union Building (2nd Floor), Junior Ballroom.

The Technical Forum is a cooperative effort between the WSU Wood Materials & Engineering Laboratory, the WSU Conferences & Professional Programs, and the Forest Products Society.

BOOTH 1

Smart Solutions to Wrapping Problems in the Panel Industry

Jacques L. Cadieux, International Sales & Marketing Director, Gemofor Inc., Normandin, Quebec, Canada

Gemofor Inc. has developed a panel wrapping system that can wrap panel stacks in less than 80 seconds. The GEMOWRAP system provides an economical, easy-to-use, and safe panel wrapping system that provides optimal protection against weather and the hazards of transportation. The wrapping system is quality guaranteed and supported by a complete engineering service. It is designed to be flexible so that you can adapt it to your particular mill's operation. The wrap comes labeled with your company's logo and colors.

BOOTH 2

Characterization of Heat and Mass Transfer in the Mat During Hot-Pressing of MDF Panels

Rosilei A. Garcia, M.Sc. Candidate, and *Alain Cloutier*, Associate Professor, Dept. of Wood & Forest Sciences, Laval Univ., Ste-Foy, Quebec, Canada

The hot-pressing of medium density fiberboard (MDF), involves heat and mass transfer in the mat, viscoelastic deformation of the wood fibers, and resin cure, therefore defining the density profile across the thickness and the resulting mechanical properties of the panel. It is then essential to characterize this process in order to optimize the various pressing parameters. Heat and mass transfer in the mat occurs by conduction and convection during hot-pressing, but convection under the effect of pressure gradients is the dominant process. Due to the significance of convective transfers, the gas permeability of the mat plays a key role in the process. The objectives of this work are: 1) To characterize temperature and gas pressure evolution in the MDF mat during hot-pressing as a function of press closing strategy, panel density, and mat moisture content; and 2) To determine the gas permeability of the MDF mat as a function of mat density. MDF panels of 560 by 460 by 16 mm and of 3 densities (650, 725, and 800 kg/m^3) are made in a 600 by 600 mm laboratory press. The movement of heat and moisture in the mat is characterized according to the following manufacturing parameters: press closing strategies (30 sec. at 145, 155, and 165% of the final thickness for a total of 2 min. 30 sec), and initial mat moisture content (10, 12, and 14%). The temperature is measured at the surface and core of the mat using thermocouples. Gas permeability is measured at the surface and core of the mat using probes developed at the Alberta Research Council. The gas permeability of the fiber mat is measured as a function of density (400, 650, 900, and 1150 kg/m^3) and direction of flow (transverse flow and longitudinal flow). A gas permeability apparatus developed in our laboratory is used to make the measurements. This project is part of a broader effort in order to develop a finite element model of the hot-pressing of MDF panels.

BOOTH 3

Axial Collapse of Oil Palm Frond Fiber/Epoxy Circular Cylindrical Composite Shell

El-sadig Mahdi Ahmed, *B.B. Sahari*, *A.M.S. Hamouda*, and *Y.A. Khalid*, Dept. of Mechanical & Manufacturing Engineering, Universiti Putra Malaysia, Serdang, Selangor, Malaysia

Crushing behavior of circular cylindrical composite shell structures made of synthetic fiber-reinforced plastic has been extensively investigated under different load conditions, either numerically or experimentally. In contrast, the problem of crushing behavior of circular cylindrical composite shell structures made of natural plant fiber-reinforced plastic has not received sufficient attention. Up to the authors' knowledge, no work has been carried out in thin shell structure made of oil palm frond fiber/epoxy. This was one of the motivating factors behind this paper. This paper examines the effect of reinforcement type on the crushing behavior, energy absorption, failure mechanism, and failure mode of composite tube. Three types of reinforcement containing oil palm frond, carbon, and glass fibers were used. The static crushing behavior of composite tube under uniform axial compressive load is investigated experimentally. The cylinder vertical length and outer diameter were 100 mm and 110 mm, respectively. Failure modes were examined using the photographs taken while crushing the specimens. The initial failure was dominated by interfacial and shear failure for the filament wound laminated circular cylindrical carbon/epoxy and glass/epoxy composite shells, while for the oil palm frond fiber/epoxy, the initial failure is slightly different from the glass/epoxy and carbon/epoxy. The hand laid up oil palm frond fiber/epoxy composite circular cylindrical shell specimen appears to be buckled in transverse cracking mode with failure at one end. The results showed that oil palm frond fiber/epoxy composite circular cylindrical composite shells appear to have a higher ratio between the average crush load and the instantaneous crush failure load when compared to the other tested types of carbon/epoxy and glass/epoxy cylinders.

BOOTH 4

The Best of Both Worlds: Improved Board Properties and Lower VOC's Using Hybrid Drying Technologies

Peter Zagorzycki, Senior Applications Engineer, Wolverine Proctor & Schwartz, Horsham, Pennsylvania, USA

Previous dryer offerings to the industry have, for the most part, focused on either "high temperature" rotary or "low temperature" conveyor drying of strands. Although there is mounting evidence from the field that conveyor dryers are actually delivering on promises of better board properties with lower emissions, many companies are reluctant to seriously consider conveyor drying because of higher perceived capital costs. This is especially true for potential capacity increases or other upgrade opportunities where there is already considerable sunk capital in existing rotary dryers. Competing technologies usually have both strengths and weaknesses, and often the optimum process and economic solution, if feasible, is to combine technologies in a way that emphasizes the strengths of each. Drying OSB strands is no exception. This paper explores the feasibility of combining conveyor drying with rotary or fluid bed drying in various ways that minimize both capital and operating costs and emissions while retaining the other proven advantages of conveyor drying that relate to improved board properties. Some of the contributors to good board properties that will be discussed are tight moisture control and less breakage curling and brittleness of the strands, along with ways to reduce VOC emissions that go beyond simply reducing the drying temperature. Operating cost reductions through reduced resin consumption and innovative use of existing heat sources will also be discussed.

BOOTH 5

Forintek MDF Pilot Plant

André Moffet, Industry Advisor, Composite Wood Products, Forintek Canada Corp., Ste-Foy, Quebec, Canada

The Composite Wood Products Department has the trained personnel and necessary equipment to produce under controlled laboratory conditions wood-based panels similar to industry manufacturing panels. The MDF Pilot Plant is located at the Forintek's Quebec Laboratory. This facility has all the necessary equipment to: 1) Produce MDF fibers from sawdust, planer shavings, and chips obtained from wood or agricultural-based raw material; 2) Dry fiber at any required humidity level; 3) Add glue to fibers using a blowline blending system, an air spray atomizer, or a rotary blender; and 4) Press fiber-based panels. The MDF Pilot Plant is based on the following state-of-the-art system: 1) Refining System – The Andritz pressurized refiner is equipped with a large 56 cm (22 in.) disc, 160 kW (215 hp) motor with a variable speed drive that can go from 0 to 3600 rpm. This equipment is designed to operate close to industrial conditions and can produce very high quality fiber. Throughput can vary between 50 and 250 kg (110 and 550 lbs.) of dried material per hour. The digester and the refiner can operate up to 18 bar (266 lb.f/in.^{2}); 2) Resin Injection System – The blowline injection system includes a pressurized pump that can inject up to 65 kg (140 lb.) of resin per hour. A mass-flowmeter measures the exact quantity of resin being injected. The blowline is made of sections so resin can be injected at different points throughout. A stand-alone system can spray resin on fiber already dried when the use of a refiner is not needed. A conventional rotary blender is also available; 3) Flash Tube Dryer – This dryer is an industrial type flash tube dryer 90 m (300 ft.) long. Heating is done with a 4 million BTU/hour natural gas burner, which has a variable control that permits operation at different temperatures. Sensors in the dryer continuously monitor the temperature throughout the length of the dryer; 4) Mat

Forming and Bagging Station – At the outlet of the dryer, a fiber mat can be formed or the fiber can be put in industrial type 50 kg (110 lb.) bags for further use; 5) Presses – A state-of-the-art Dieffenbacher press with an 86 cm by 86 cm (34 in. by 34 in.) platen with steam injection capacity is available. This press has a completely automated pressing cycle. Platen position, gas pressure, and temperature are monitored continuously. Available pressure from the press is 750 tons and temperature can go up to 230ºC (446ºF); 6) Complete Monitoring System – The monitoring system installed on the MDF Pilot Plant produces reports for all the main operating variables; 7) Testing Services – Forintek has the necessary equipment to perform all major tests related to MDF manufacturing (MOR, MOE, IB, Linear Expansion, Baur MacNett, Freeness Tester, VOC emissions, etc.); 8) A Team of Experts at Your Service – Forintek has a team of over 100 technicians and scientists who can help you analyze your problems and propose solutions that can be tested in our Pilot Plant. We have specialists in composite products and processes, resin development, raw material analysis, and environmental issues; and 9) Answers to your Questions – This facility will help you answer questions related to MDF manufacturing without the need to do a costly full-scale trial in a large industrial plant. For example: 1) What is the impact of using a new type of raw material such as recycled wood, agricultural residues, or annual plants on the panel properties? 2) What operating parameters will permit production of the required physical properties for a new type of MDF panel? 3) How can we diminish electrical consumption? 4) How can we diminish VOC emissions from the press? 5) What is the best pressing cycle for recycled wood?

BOOTH 6

Software Model of MDF Fiber Processing for Plant and Process Optimization

Shusheng Pang, Scientist, and *Jeremy Warnes*, Project Leader, Composites, *Forest Research*, Rotorua, New Zealand

Based on a fundamental knowledge of wood fiber-water relationships and heat/mass transfer, a mathematical model was developed to simulate fiber drying and fiber equalization processes in medium density fiberboard (MDF) production. The model can predict moisture movement in the fibers, moisture content, and air condition changes in the fiber dryers and in the dried fiber conveyers. After initial validation, the developed model was extended to include energy and material balance calculations in the chip presteaming bin, digester, refiner, and blowline. This extended model has recently been compiled into a user-friendly software package and is being tested in commercial MDF manufacturing operation. It is anticipated that the software package will be customized for individual mills so that it may be used as a tool to understand and optimize the operation. Some scenarios of the software application include: 1) Fast and cost-effective parameter optimization; 2) Energy optimization for dryers and fiber conveyers, and energy management for the whole fiber processing system; 3) Optimization of fiber processing operation and system design; 4) Training tools and assistance in operation control; and 5) Use in troubleshooting and identifying moisture-related factors causing defects.

BOOTH 7

Finishing Line Challenges when Producing OSB with a Continuous Press

Michael Tart, Machine Sales, Globe Machine Manufacturing Co., Tacoma, Washington, USA

The increasing popularity of OSB production using continuous pressing has raised the standards for the equipment at the back end of the press. Increased piece counts of finished panels out of the press call for new approaches to the material handling methods after the press. Demands are created by cutting panels to size directly at the press outfeed or cutting larger and faster moving master panels to finished sizes down stream of the press. The call for improvements started with the introduction in the late 1990s of the 12-foot-wide OSB multi-opening press. These new presses increased the down stream piece count to the finishing line by one-third when producing 4-foot by 8-foot panels. The response to this extra demand was addressed by evolving existing technologies to meet the new demands. Two of the five operating 12-foot lines used new designs for panel handling, and the others used variations of more standard finishing line technologies for their solution. Since 1998 there have been four continuous presses installed for the manufacturer of OSB in North America. New plants under consideration show that the continuous press will be the wave of the future in the production of OSB. This poster presentation will explore options to be considered in the post press design of these new plants.

BOOTH 8

Ceramicrete®-Bonded Building Materials Using Forest Waste

Donald W. Brown, Staff Member, and *Lauren K. Powell*, Post-Baccalaureate Student Researcher, GeoEngineering, Los Alamos National Laboratory, Los Alamos, New Mexico, USA; *Arun S. Wagh*, Staff Member, Energy Technology Div., and *Seung-Young Jeong*, Staff Member, Chemical Technology Div., Argonne National Laboratory, Argonne, Illinois, USA

A chemically-bonded phosphate cement called Ceramicrete® is currently used to stabilize radioactivity contaminated wastes. Due to its desired properties as a binder, Ceramicrete®'s applications are being explored in benign waste encapsulation, oil well completions, and the construction industry. The goal of our research is to produce a Ceramicrete®-wood composite with structural and insulating properties comparable to traditional building materials, at a competitive price. Our efforts are motivated by the need for economical uses of small-stem timber crowding forests across the western United States. Thinning of small-diameter trees (< 12 in.) is a vital prescription for forest health and wildfire prevention. A value-added product that can use "waste" from thinning procedures will undergird forest management techniques seeking sustainability and economic enrichment of local communities. Ceramicrete® is solidified through a room-temperature acid-base reaction between the common, low-cost materials magnesium oxide, monopotassium phosphate, and water. Particles mixed with the binder are encapsulated by an impermeable phosphate layer that provides resistance to fire, humidity, chemicals, and weathering. Initial experiments incorporated sawdust and small wood particles into the cement, with wood-to-binder weight percent ratios between 50:50 and 70:30. After pressurized molding, the end products are fireproof, structurally competent, light weight (r = 1.1 to 1.3 g/cm^3), and can be nailed, screwed, or drilled. Materials are non-toxic and do not emit volatile organic compounds, and forest waste particles do not need to be dried before mixing with Ceramicrete®. Further experiments upon wood-binder ratios, wood particle dimensions, molding pressures, and end product dimensions are needed before an industry-grade product is available, but the potential is strong for a successful product.

BOOTH 9

Developing Strategies for MACT Compliance

Kevin D. Kaff, Sales Manager, M-E-C Company, Neodesha, Kansas, USA

M-E-C Company has long worked with the structural and composite panel industry in developing approaches to deal with the control of criteria and HAP pollutants. Over the past 8 years, M-E-C has designed, built, and started up 24 "press vent to control" and "dryer to control" systems. This work has allowed us to see a variety of approaches with varying results. Recently, we have been talking with panel producers about developing MACT compliance strategies, which emphasize: 1) A comprehensive plan to meet MACT compliance deadlines by 2004; 2) A cost-effective approach, which does not compromise existing plant operations; 3) A coordinated, systems oriented plan; 4) Focus on providing the best solution to fit the unique parameters of each plant; and 5) Minimizing reusing or recycling airflow and therefore the size and number of control devices needed. Some of the elements the comprehensive MACT plan should address are: 1) Current point source inventory and needs; 2) HAP/VOC control options available; 3) Control device application requirements and what, if any, ancillary equipment is required; 4) Impact or potential impacts on production; 5) Capital, operational, and maintenance costs; and 6) Life-cycle costs. By working on developing a rigorous, well thought-out strategy, complying with the wood products MACT rule in a cost-effective way can potentially be a competitive advantage for a panel mill.

BOOTH 10

Statistical Methodology to Characterize Variability of Wood Composites

Alejandro M. Bozo, Graduate Research Assistant (Professor of Wood Engineering, Univ. of Chile), and *Michael P. Wolcott*, Associate Professor/Research Director, Wood Materials & Engineering Lab., Washington State Univ., Pullman, Washington, USA

One point not considered in the property analysis of oriented strandboard (OSB) is that the data belong to some location in space. Spatial features of the data set, which are often of considerable interest, include the location of extreme values, the overall trend, the degree of continuity, and weak areas. The purpose of spatial characterization was to inspect the data set considering spatial location. The objective of this research was to analyze the horizontal density distribution (HDD) of OSB and to define an accurate statistical methodology to characterize variability of wood composite properties. To conduct a spatial characterization, several tools were used that were divided into graphical methods and analytical methods. The plots illustrated the continuity and sampling regularity of the spatial attributes and revealed the presence of many trends. The three-dimensional plot provided a clear picture of the level of variability that existed within a panel, but it was not possible recognize patterns of density. When contour plots were used, patterns of density appeared. Specimen size was important; the larger specimens were sufficient to recognize patterns of density, however, smaller specimens provide a more detailed contour plot. A time series analysis was conducted on individual arrays. The autocorrelation function was plotted against the lag, k, to obtain a correlogram plot. The spectral density function was obtained by performing a fast Fourier transform (FFT) on the correlogram to change the data from a spatial domain to a frequency domain. Another method to study spatial continuity of the data set was a variogram, which is defined as a plot of the variance of paired sample measurements as a function of the distance between samples. The results obtained from the correlogram and variogram showed that there was an indication of spatial dependence of density both along and across machine directions. The recommendation is to continue this research, improving techniques and methods to detect spatial variation.

BOOTH 11

Modeling of the Core Temperature Gradient of MDF with Control Limits for Data Signatures

Timothy M. Young, Assistant Professor, Tennessee Forest Products Center, Univ. of Tennessee, Knoxville, Tennessee, USA; *Chris Huber*, Technical Director, Georgia-Pacific Resins, Inc., Orangeburg, South Carolina, USA

A non-linear regression model was developed for the core temperature gradient of medium density fiberboard (MDF) for a southeastern U.S. manufacturer. The non-linear regression model was developed from real-time data using a probe of the MDF mat during pressing. The second derivative iterative method of non-linear regression was the best algorithm for the non-linear solution. Thirty-four core temperature curves were used to develop the non-linear regression model. The model was developed for one ¾-inch product type that had a target density of 47.5 pcf. The form of the model was: Core Temperature = IMT + $A/(1 + B(e^{-Akt}))$; where, IMT = initial mat temperature, A = constant, B = constant, K = constant, t = time (sec.). The non-linear regression model was developed in the spirit of minimizing the sum of square errors (SSE) and the mean square error (MSE). The core temperature curves were considered data signatures where the entire curve and its shape were important process parameters in the manufacture of MDF. Control limits for the core temperature curves for the same MDF data set were developed using the non-linear regression model solution as the process centerline. Control limits for the core temperature data signatures were developed using Bonferroni's method to obtain simultaneous process intervals for a whole curve.

BOOTH 12

On-Line Laser Measurement of OSB Strand Alignment

Siguo Chen, Project Manager, Forest Products, Alberta Research Council, Alberta, Ontario, Canada

The strand alignment is key to OSB structural properties. Improving surface strand alignment will increase panel bending strength and stiffness, which would allow OSB producers to reduce panel weight to save materials. The objective is to effectively and efficiently measure OSB strand alignment on-line using the laser technology. Laser scanning experiments were conducted at the Alberta Research Council (ARC). Manual measurement with a protractor was used to verify the laser measurement. The laser measurement has proven to be repeatedly accurate. A four-head industrial system and a one-head portable system have been developed and tested in OSB mills. The results show that it is feasible to use a laser system to measure strand alignment of OSB mat on-line. The quantitative information gathered in the mill can provide mill operators with a basis to evaluate and adjust manufacturing parameters.

BOOTH 13

GluScan Resin Distribution

Kevin Groves, Forintek Canada Corp., Vancouver, British Columbia, Canada; *Tim M. Worthen*, Sales Development, Leading Edge Applications Inc., Surrey, British Columbia, Canada

GluScan is an off-line quality control tool developed by Forintek Canada Corporation for measuring phenol-formaldehyde (PF) and isocyanate (MDI) resin distribution on furnish in OSB mills. Low resin levels can jeopardize panel strength while high levels can unnecessarily increase resin consumption costs. Uneven resin distribution can increase resin consumption costs and jeopardize panel strength. Advantages of GluScan include: 1) Lower resin consumption costs; 2) Identifying immediate problems with the blender; 3) Providing invaluable feedback when optimizing resin blending; 4) Excellent day-to-day quality control measurement; 5) Correlating IB and other tests; 6) Ease of use and calibration, no maintenance; 7) Quick measurement (test completed within 30 min.); 8) Excellent for benchmark comparisons to other mills or pilot plant data; and 9) Trial units are available.

BOOTH 14

Computer Software Programs for Wood Composite Processing

Brad J. Wang, Wood Composites Scientist, and *Chunping Dai*, Wood Composites Scientist/Group Leader, Forintek Canada Corp., Vancouver, British Columbia, Canada

During the past several years, Forintek Canada Corporation has developed a number of practical computer software programs to simulate various steps of composite manufacturing processes. Such software programs include: Logcon© (Log Conditioning Simulator), Peeling© (Veneer Peeling Simulator), VYield© (Veneer Recovery Simulator), VGrader© (Veneer Grading Optimizer), MatForm© (OSB Mat Forming Simulator), and MatPress© (OSB Mat Pressing Simulator). These programs, which have been developed based on sound scientific concepts and extensive experimental data, have been widely used in the Canadian veneer, plywood/LVL, and OSB industry. They have served as useful tools to examine and further optimize the interactive variables affecting the manufacture processes. This poster will allow these software programs to be introduced and demonstrated.

BOOTH 15

Pyrolysis Oil for OSB Wood Adhesives

Felisa D. Chan, Research Associate, Pyrovac Institute Inc., Ste-Foy, Quebec, Canada; *B. Riedl*, Professor, Dept. of Wood Science and CERSIM, Laval Univ., Ste-Foy, Quebec, Canada; *X-M. Wang*, Research Scientist, Forintek Canada Corp., Ste-Foy, Quebec, Canada; *X. Lu*, Research Associate, and *C. Roy*, Project Leader, Pyrovac Institute Inc., Ste-Foy, Quebec, Canada

Pyrolysis oil (PO) derived from softwood bark residues was used to develop a wood adhesive for OSB, an exterior grade wood composite product. The phenolic-rich oil produced by the Pyrocycling™ process was used to replace part of the phenol (P) in phenol-formaldehyde (PF) resin formulations. Some parameters, *e.g.,* F/P-PO and NaOH/P-PO ratios, have been investigated in the development of this new type of adhesive. The developed resins were applied on 3-layer, 11.1-mm boards using the standard commercial manufacturing conditions. The effect of post-curing on the properties of the boards was examined. The properties (thickness swelling, MOR, MOE, and IB) of the OSB panels bonded with PO-PF resin (25 to 50% phenol replacement by pyrolysis oil) exceeded the minimum requirements set by CSA 0437 Series 93, both in dry and wet

(2-hr. boil) tests. Results showed that up to 50 percent replacement of phenol with pyrolysis oil in PF resin formulation could be used in surface resin in OSB manufacture. A 25 percent replacement of phenol by pyrolysis oil with an accelerator could likewise be used as core resin. Post-treatment significantly improved the wet IB and resistance to thickness swelling of the boards.

BOOTH 16

USDOE – Office of Industrial Technologies (OIT): Win-Win Industry/Research Community Opportunities

John Ryan, Cooperative Extension - Energy Program, Washington State Univ., Spokane, Washington, USA

This poster presentation will include: 1) Summary of the forest products industry $MM funding opportunities for forest products industry/research community collaborations; 2) Description of the Washington State Industries of the Future (IOF) program, upcoming events, and opportunities for forest products; 3) Example of successful OIT technology projects with detailed descriptions and contacts; 4) BestPractice program software and training for plant motors, steam, pumping, and compressed air systems; 5) The planned OIT/IOF Technology Showcase with a focus on the forest products industry at an industry leader's site; and 6) Information resources, including the OIT Clearinghouse for a full range of OIT products and services.

BOOTH 17

Case Study of Progressive Marketing and Leading Technology for Tafisa and Plum Creek

Francesco Zenere, Director, IMEAS SpA, Villa Cortese, Italy; *Frederick T. Kurpiel*, President, IMEAS, Inc., Peachtree City, Georgia, USA

Two of the most recent panel operation start-ups represent the world's largest particleboard (PB) capacity (Tafisa – Lac Meganic, Quebec, at 1 million m^3) and the world's largest medium density fiberboard (MDF) capacity (Plum Creek, Columbia Falls, Montana, at 450,000 m^3). These capacities were achieved by utilizing leading-edge technologies including continuous process pressing, increased cycle speeds, and full panel width (3.2 m) in-line sanding. Tafisa's expansion included the installation of a 38-m continuous press; Plum Creek installed a 28-m continuous press. Both operations include an in-line MEAS Super Performance right-head "extra-wide," 3.2-m sanding line. The new sanding lines evolved from the technology used for decades in the metal industry for up to 12-foot-wide lines. The precision calibrating and polishing machines for the continuous-press steel belts are made by MEAS. The continuous process provides much greater flexibility in achieving increased capacity than multi-daylight processes, and also provides greater control of board thickness as well as density profile formation and other factors that affect board properties. Plum Creek's new thin MDF line will provide a wider product mix and will open up value-added markets such as core material for laminated flooring, furniture backs for casegoods, moldings, doorskins, dresser bottoms, and other uses in the thickness range of 1/10 inch to 1/2 inch.

BOOTH 18

Minimizing NO_x and VOC Emissions Reductions from Energy Plants in the Board Industry

Tom Wechsler, Manager, Wood Division, and *Eric Dessecker*, Vice President, GTS Energy, Marietta, Georgia, USA

As pressures by regulators to reduce emissions from board making operations mount, it is becoming more important to eliminate all potential sources. One source of emissions in board plants is the energy system. By careful system design and use of the latest air pollution control technologies, emissions from the energy system may be reduced to meet today's BACT standards for NO_x emissions, and VOC containing gases may be taken from other parts of the plant and used in the energy system to reduce these total pollutants as well. One GTS energy system employing a combination of these techniques is presently under construction at Homanit USA, a specialty MDF producer in North Carolina. The plant uses a combination of Selective Non-Catalytic Reduction (SNCR) with urea injection, with flue gas recirculation and advanced combustion controls to reduce NO_x emissions from the energy system by over 50 percent. Since sanderdust burning from MDF or particleboard operations usually produces a high level of NO_x emissions due to the high nitrogen content of the dust, sanderdust is burned directly in the furnace. This way, gases produced by these sources may be treated by the same SNCR reduction system. VOC containing press exhaust is taken by the energy system to be used as combustion air for the furnace to reduce overall sources of plant VOC emissions. This poster examines the above emissions reductions methods and their effects on system design.

BOOTH 19

Electrostatic Effect of Lining Materials in Blenders on Powder PF Resin Distribution on Strand Surfaces

Xiang-Ming Wang, Research Scientist/Group Leader, *Hui Wan*, Research Scientist, *Daniel Lefebvre*, Technologist, and *Danny Giguère*, Technologist, Forintek Canada Corp., Ste-Foy, Quebec, Canada

The inside of a blender lined with different materials may influence powder phenolic resin distribution on strand surfaces during blending due to an electrostatic effect, which in turn influences the resultant strandboard performance. Two identical blenders 36 inches in diameter and 36 inches in depth were used in this study to blend strands with a commercial powder PF resin at two dosages (1.6% and 2.2%). One blender was lined with a stainless steel sheet and the other with an ultra high molecular weight polyethylene (UHMW-PE) sheet. Four blended strand mixtures (100% aspen, 50% aspen/50% white birch, 50% aspen/50% red maple, 50% sweetgum/50% southern yellow pine) were examined with an image analysis system to determine the percentage of resin coverage. Each type of mixed strands was also used to make 7/16-in. by 24-in. by 24-in. strandboards with a target density of 40 lb./ft.^{3}. The board performance was evaluated for internal bond (IB), thickness swelling (TS), water absorption (WA), modulus of rupture (MOR), and modulus of elasticity (MOE) according to CSA Standard 0437.1-93. It was observed that the resin distribution and coverage were dependent on blender type, wood species, and resin content. The blender lined with UHMW-PE resulted in higher resin coverage on strand surfaces than did that with the stainless steel. Blending mixed strands of wood species yielded uneven resin coverage on the strand surfaces. Statistical analysis showed that IB, TS, and WA of boards were also dependent on blender type, wood species, and resin content. Increasing resin coverage on the wood improved the dimensional stability of strandboard.

BOOTH 20

Towards the use of Melamine in Standard and Moisture Resistant Adhesives: Economics and Additional Performances

Willem Cramer, Manager, Technical Service Group, DSM Melamine, Geleen, The Netherlands; *Arne Jansen*, Ph.D. Student, Univ. of Hamburg, Hamburg, Germany; *Kai Kruze*, Senior Researcher, Federal Research Centre for Forestry & Forest Products, Hamburg, Germany

Melamine-based adhesives are widely used to add value to standard panels. These adhesives can be divided into two categories based on their melamine content: UFm and MUF resins. UFm resins have a low melamine content (<10% M). They give a lower thickness swell and allow a larger production operating window compared to UF. MUF resins are characterized by a high(er) melamine content (10 to 40%). MUF resins can be used to produce panels at relatively short press factors, resulting in a panel that is light in color with low thickness swell that can be used in humid environments. Use of melamine containing adhesives will increase production costs, but these costs will be more than recovered through increased production rates and higher margins. In this poster, it will be shown – using economical models – that MUF is frequently the most beneficial glue system to make moisture resistant particleboards. We signal an opportunity for panel manufacturers using other glue systems (eg. MDI & PF): increased volumes can be easily achieved without major investments by switching to MUF resins if pressing is the bottle neck. In flooring applications there is a drive towards higher dimensional stability and lower thickness swell. This is caused by the glue-free, do-it-yourself, "click" laminate flooring systems. Again we will show, for MDF and HDF, that based on identical thickness swelling the extra costs from using UFm instead of UF adhesives are more than overcome by the added value and thus higher market price given to the panel.

BOOTH 21

Next Generation Hydro-Dyn® Press Fluid Technology

James Habermehl, Applications Specialist, Dow Corning Corp., Midland, Michigan, USA

A poster presentation at the *28th International Particleboard/Composite Materials Symposium* featured a newly developed silicone fluid that provided improved thermal stability relative to fluid technology in use at that time in Bison Werke Hydro-Dyn® Presses. This poster, titled "Advances in the Stability of Fluid Used in the Bison Werke Hydro-Dyn® Press," featured Dow Corning® 2-2716 Phenyl Fluid. Since the successful commercialization of this fluid, Dow Corning has continued its innovative research and has developed a next generation Hydro-Dyn® Press Fluid that provides even greater thermal stability relative to Dow Corning® 2-2716 Phenyl Fluid. Silicone fluid plays a key role in the efficient operation of the Hydro-Dyn® Press, but also represents a significant portion of the operating cost of these presses. Efforts to improve this component of the operating cost of the Hydro-Dyn® Press led to the development of Dow Corning® 2-2717 Fluid. The enhanced thermal stability of this novel product should result in longer fluid operating life and thus, improved operating economics of Hydro-Dyn® Presses currently manufactured by Valmet Corporation. The thermal stability of this next generation fluid was evaluated in the laboratory via accelerated heat aging. Results of laboratory work comparing the viscosity performance of Dow Corning® 2-2717 Fluid to Dow Corning® 2-2716 Phenyl Fluid will be highlighted in this poster. Data indicates that the Dow Corning® 2-2717 Fluid can likely operate in the press for a period of time approximately 50 percent longer relative to the current fluid technology.

BOOTH 22

PMDI as an Additive to UF- and MUF-Resins for Particleboard Production

Ted Frick, Technical Manager, Wood & Foundry Products, Bayer Corp., Pittsburgh, Pennsylvania, USA; *Bill Motter*, Scientist, Borden Chemical, Inc., Springfield, Oregon, USA

The improvements in productivity and board properties offered by the use of PMDI as an additive to UF-resin-based particleboard production have long been recognized in Europe, as well as implemented in production. This is particularly true with so-called E1-resins (UF resins yielding particleboard with Perforator values < 8 mg/100 g). Application of this technology to North American condensation resins has also shown that particleboard bonded with combinations of PMDI and UF- or MUF-resin give improved properties, even at reduced cure times. The effect of PMDI loading and condensation resin type (UF or MUF) on cure speed and board properties was examined. Results of laboratory experiments will be presented.

BOOTH 23

Mechanical Characterization of the Curing Process of Adhesives During Hot-Pressing of Wood-Based Panels

Christian Heinemann, Doctoral Student, and *Arno Fruehwald*, Professor, Dept. of Wood Technology, Univ. of Hamburg, Hamburg, Germany

Curing of adhesives is one of the critical mechanisms concerning the formation of wood-based panel properties during hot-pressing. The bonding kinetics of the adhesives are mainly influenced by temperature and mechanical pressure. The bond strength of the panel leaving the hot-press has to exceed the internal forces caused by the built-up gas pressure and by the densification of the wood material. Our knowledge about the bond strength development of thermosetting adhesives in the presence of wood particles is limited. Several theories are used to describe the interaction of adhesives and wooden materials, but none of them are proven, so far. In this poster a project is presented that deals with the curing process of thermosetting adhesives in wood particle or wood fiber mats. Therefore, the first method developed is based on internal bond measurements. Round particle or fiber mats with an external diameter of 100 mm are pressed, and the internal bond is determined subsequently within the press setup. By using a variety of resin systems as well as different pressing conditions and wood materials, the bond strength development is determined as a function of pressing time. The measurements of springback and thickness over a 2-hour period are used to determine the bond strength development of laboratory-made panels. Conventional standardized testing methods, e.g., IB-tests and 24-hour Thickness Swelling, are used to evaluate mechanical properties of these laboratory-made panels. Preliminary testing results will be compared with conventional methods of pure glue characterization, e.g., gelation time, pH value, and buffer capacity.

BOOTH 24

GreCon Raw Density Profile Analyzer StenOgraph

Stephan Zimmermann, Sales Director, GreCon Inc., Tigard, Oregon, USA

The GreCon Raw Density Profile Analyzer StenOgraph makes it possible to continuously evaluate density profiles during the manufacturing process, without damaging any panels. This contributes toward continuous and comprehensive quality control by providing physical information on the board's internal structure to allow fast and effective adjustment of the production line. This eliminates the relatively long delay when measuring samples in the laboratory. The measuring position is at the outlet of the continuous press and x-rays are directed through the panel. The density distribution is evaluated from the absorption and distribution of this radiation. The profile is displayed on a screen in the same way as a laboratory density analyzer. The measuring time takes just a few seconds, depending on the panel thickness. Measurements are made in the same position for every panel. This new system provides many benefits to the user by allowing prompt influence on the production processes. Apart from continuous quality control of the panels, changes to the product type can be made quickly and controlled effectively. Also, the startup period of new production plants is shorter. The production process can be optimized by minimizing the use of raw materials and energy and maximizing the line speed, realizing substantial cost savings.

BOOTH 25

Flake Preparation – Klöckner Wood Technology Products Reduce Machine Downtime and Increase Processing Efficiency

Bengt Nilsson, Bruks-Klöckner Inc., Duluth, Georgia, USA

In chipboard production very often high quality flakes have to be generated from low-grade raw materials. Flake preparation must be able to cope with wide variations in the raw material mix, enabling the production of panels for various end-uses at the same time. In advanced concepts it should be possible to use flakers also as refiners for the most economical plant design and to allow an adjustment of the material to be flaked. Therefore, Klöckner Wood Technology in Hirtscheid, Germany, has introduced the all-in-one flaker/refiner to the market. The intelligent Klöckner flaker (KHZ), designed for the production of high-quality flakes with a thickness down to 0.3 mm, also allows conversion into refining mill (KSM) by exchanging the flake knives by a sieve/milling ring. A hammer rotor can also exchange the turbo impeller of the machine so that the machine can be operated as a hammer mill. With the modular Klöckner KHZ/KSM either flakes for the core panel layer or flakes/fibrous material for the surface layer can be processed. The stationary flaking or milling rings are removed by means of an easy-to-maneuver lifting carriage; any one of the modular inserts can be put hydraulically into position through the front door and operated. Klöckner has demonstrated in chipboard plants around the world that the advanced design significantly reduces power consumption and machine downtime and increases the operating interval.

BOOTH 26

Influence of Efficiency Improvement on Process Belts in the Board Industry

Markus Kraft, Manager, Product Development, and *Bernd Roser*, Business Unit Manager, Habasit AG, Reinach, Switzerland

Cost-effectiveness for the board and panel industry is a main competitive factor. Habasit, a world-leader in belt manufacturing serving this industry with forming and pre-press belts, is aware that homogeneous and consistent board quality, efficient manufacturing processes, and low downtime costs are a must if one wants to be part of this challenging industry. Due to their longitudinal stability, combined with excellent flexibility and an abrasion-resistant and closed surface, belts coated with thermoplastic polyurethane (TFU) have proven to be the choice for such demanding applications as particleboard and medium density fiberboard manufacturing. Habasit belts offer a longer service life, when used as forming belts and pre-press belts, due to their ability to resist mechanical damages in this rough environment. Latest trends in the industry to reduce cost and increase efficiency include the use of new release agents and increased plant speed. According to our observations, this leads to accelerated aging of the TPU belt surface and causes premature belt failure. Habasit has found that several factors contribute to the aging process, which we call hydrolysis: 1) Type of wood species; 2) Water content of wood particles/fibers; 3) Temperature of cake; and 4) Additives like release agents or the like. Due to these findings, an improvement of belt aging performance can be addressed by using more resistant TPU without losing the excellent properties of Habasit TPU belts.

BOOTH 27

Improving Wood Flour Processing Efficiency

Jason Kessler, Regional Manager, Bliss Industries, Inc., Fort Mill, South Carolina, USA

The aggressive growth of the plastic composite industry has placed new demands on size reduction system technology. Bliss Industries has responded to the needs of the industry by reducing system power requirements and improving flour characteristics. The following will briefly describe the system designs used to produce wood flour at varying grades. Wood flour is commonly graded by mesh size. Generally speaking, the finer the flour, the higher the flour grade. Low-, medium-, and high-grade flours require different processes. A low-grade flour, 100 percent minus 20 US mesh, can be achieved in one pass through a fine grind hammermill with an incoming material of 1/2-inch minus. Production rates range from 20 to 30 pounds per horsepower per hour. A medium-grade flour, 100 percent minus 50 US mesh, requires a two-stage reduction. The primary fine grind hammermill will reduce approximately 50 percent of the 1/2-inch minus material to specification. A sifter is utilized in the system to make the separation of acceptable/unacceptable flour. The plus 50 mesh product is then processed through a secondary fine grind hammermill to be reduced to the minus 50 mesh specification. Production rates range from 20 to 30 pounds per horsepower per hour on the primary reduction and 10 to 20 pounds per horsepower per hour on the secondary reduction. A high-grade flour, 100 percent minus 80 US mesh requires a three-stage reduction. The process is identical to the medium-grade flour process, however, only one-third of the incoming material is to specification after the first reduction and an additional one-third after the second reduction. The balance of the material flow is processed through an air swept pulverizer. This system has the capability to process fiber to extremely fine specifications. Production rates range from 5 to 10 pounds per horsepower per hour. Wood flour may be produced by a plastic composite manufacturer with the sole purpose of supplying filler to their own facility. Other times, wood flour is produced to market to a wide range of applications. In either scenario, Bliss Industries can provide the most efficient system to accomplish the specific process demands.

BOOTH 28

New Generation Fast Cure Phenol-Formaldehyde Resins for Improved Dimensional Stability in Particleboards and OSB

Peter Collins, CSIRO Forestry & Forest Products, Melbourne, Victoria, Australia

Research on improving the cure speed and performance of phenol-formaldehyde (PF) resins has been ongoing at CSIRO Forestry & Forest Products for over a decade. Much of this work has been driven by the need to find economic bonding solutions for difficult-to-glue wood species in the Australian wood processing industries. However, much of the technology that has been developed is easily transferable to more mainstream wood species and products. Recently, a new generation of PF adhesives has been developed. The adhesives can be synthesized at low alkali levels, yet are fully phenolic nuclei substituted and sufficiently condensed to be consequently very fast curing. Press times for particleboard and OSB test panels manufactured using these new resins are markedly shorter. In addition, the physical properties of panels are also significantly improved. This applies in particular to their dimensional stability; the improvement in the latter property is attributed to the lower alkali levels in the resin. Formaldehyde emissions from test panels are also extremely low.

BOOTH 29

Roll Screening for PB, MDF, and OSB

Michael McNeley, Sales, IMAL-PAL North America, Inc., North Bend, Washington, USA

The deep experience in roll screening and the continuous innovation allowed PAL to develop a revolutionary screening concept for OSB strands. The new roll screen, named Quadradyn, performs with several advantages compared to the rotary drum screens usually installed for OSB plants: 1) Very efficient fines removal; 2) No strands damage; 3) High classification; 4) Extremely low maintenance; 5) Variable inter-roll opening for quick adjustment of the sizing gaps; and 6) Space conservation – smaller footprint than rotary screen.

BOOTH 30

Determination of Dynamic MOE of Particleboards Made Solely from Recycled Particles

Sumire Kawamoto, Forestry & Forest Products Research Inst., Ibaraki, Japan; *James Muehl* and *R. Sam Williams*, Forest Products Lab., USDA Forest Service, Madison, Wisconsin, USA

In previous reports on the properties of particleboard manufactured from recycled material, the boards were made using a combination of recycled and new fiber to improve their mechanical properties. Results from the fundamental study reported herein provided the properties of three remanufactured, three-layered particleboards made solely from recycled particles. The decrease in the dynamic modulus of elasticity (MOE), caused by the remanufacturing, was determined using acousto-ultrasonic (AU) techniques.

BOOTH 31

Double Trough Blending Reduces Fiber Damage and Increases Resin Distribution Efficiency

Doug Moore, North American Representative for Gisiger Technik AG, EuroSource, Seattle, Washington, USA

The Gisiger Double-Shaft blender offers several advantages over traditional particleboard blenders. By using two blending shafts, the Gisiger design achieves maximum throughput at a much lower shaft RPM than single shaft blenders. The low RPM operation minimizes fiber destruction and maximizes blending efficiency. The action of the furnish within the blender is a tossing motion back and forth between the shafts. This action applies resin more efficiently by gently wiping resin from fiber-to-fiber as the furnish is transported between the shafts. Often, resin consumption is decreased while retaining the desired board properties.

BOOTH 32

Update...Low Temperature, Conveyorized Strand Drying, and Exhaust Abatement Technology

Jeffrey L. Dexter, Sales Manager, Drying Technologies, George Koch Sons, LLC, Evansville, Indiana, USA; *Bill Nowack*, President, Industrial Technology Midwest, Wilmot, Wisconsin, USA

With the emergence of low temperature, conveyorized strand dryers over the past few years, this poster presentation provides an in-depth look at the most recent developments regarding Koch's patented "drying and exhaust abatement" technology, along with its added benefits of low VOCs and particulate emissions. The exhaust abatement process, which is an environmental enhancement, eliminates the need for expensive regenerative thermal oxidizers (RTOs) on the exhaust streams, thereby playing an important role in reducing both capital equipment investment and associated operating costs. With the commissioning of five (5) systems in 1995, one (1) in April of 1996, three (3) in April of 2000, and now with four (4) more soon to follow, this drying technology continues to become the preferred choice for select OSB manufacturers. This presentation also highlights the assessment and acknowledgement by the Minnesota Pollution Control Agency of Koch's drying process as being "Best Available Control Technology" (BACT) along with the compliance test data. Finally, with increased demand throughout the industry for both higher production and increased yields, this presentation features the most recent performance data from our Generation II systems, which have been specifically designed to evaporate 40,000 pounds of water per hour, per system. This drying technology, along with discussions concerning lower plant emissions, reduction in fire hazards, improved energy balance, increased wood utilization, and the ability to dry longer strands without curling will be of particular interest to OSB mill managers, environmental engineers, product engineers, process engineers, production managers, and maintenance supervisors.

BOOTH 33

Production Parameters Affecting the Palmboard Quality

S.A. Kandeel, Professor/Department Head, and *R.A. Abohassan*, Graduate Student, Faculty of Meteorology, Environment, & Arid Land Agriculture, King Abdulaziz Univ., Jeddah, Saudi Arabia

Few parameters controlling the quality of palmboards produced from palm trees in Saudi Arabia. Polynomial models were developed to evaluate the effect of particle geometry on board properties. Previously published work results were ameliorated through improving the geometry sensitivity testing. Prediction equations for MOE, MOR, and linear swelling thickness accounted for 98, 99, 94, and 90 percent, respectively, of the expected variations in these properties. These findings indicate the suitability of these boards and the necessity of using precise particle geometry devices before considering these variables when evaluating palmboard properties. The anatomical inherent variability of the monocot xylem bundles might be the cause in particle geometry faculty measures.

BOOTH 34

New PB and OSB Flake Technology

Robert Loth, General Manager/Owner, B. Maier Zerkleinerungstechnik GmbH, Bielefeld, Germany

High efficient and economic knife ring flakers with higher capacity and higher flake quality are the basis for modern flaking departments and high quality particleboards. A high cleaning degree at the heavy particle separators due to a special developed airflow system provides flake cleanness and reduces the maintenance costs. A special designed knife ring provides constant knife projection, less oversizes in the final material and an aerodynamic and free flake discharge gap which guaranties less flake cracks, therefore less fines and no blockings in the knife ring. The requirements of different chips and chips sizes as infeed material for knife ring flakers can be fulfilled with different cutting speeds at the knife ring. Due to higher cutting speeds it was possible even to use microchips in knife ring flakers with the result that a high part of this flat cutting flakes can also be used for surface layer material. For the production of OSB flakes, new ideas for using other wood resources are developed. With a two step OSB flake production, it will be possible to use new resources as trees, branches, small wood and even recycling wood like pallets, crates, and packaging wood. The modern flake management divides between flakes for OSB and flakes for PB. This way of production (PB and OSB as parallel lines) together with the new two step OSB flaking system will be able to reduce today's high costs for the raw material in a decisive range.

BOOTH 35

4x Productivity Increase, 5x Improved Tool Life And Superior Cut Quality Using Ceramic Tipped Saws

Tom Walz, President, NW Research Inst., Inc. and Carbide Processors, Inc., Tacoma, Washington, USA

(Abstract not available at time of printing.)

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