The Department of SUSTAINABLE BIOMATERIALS

DOUGLAS-FIR OR SOUTHERN YELLOW PINE? WHY CHOOSE?

PLANT-BASED NANOPARTICLES ENHANCE PROMISING NEW CANCER TREATMENT TECHNOLOGY

VISITING PROFESSORS, INDUSTRY REPRESENTIVES + MORE

Virginia Tech
Invent the Future

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DOUGLAS-FIR OR SOUTHERN YELLOW PINE? WHY CHOOSE? BY AUDREY **ZINK-SHARP**

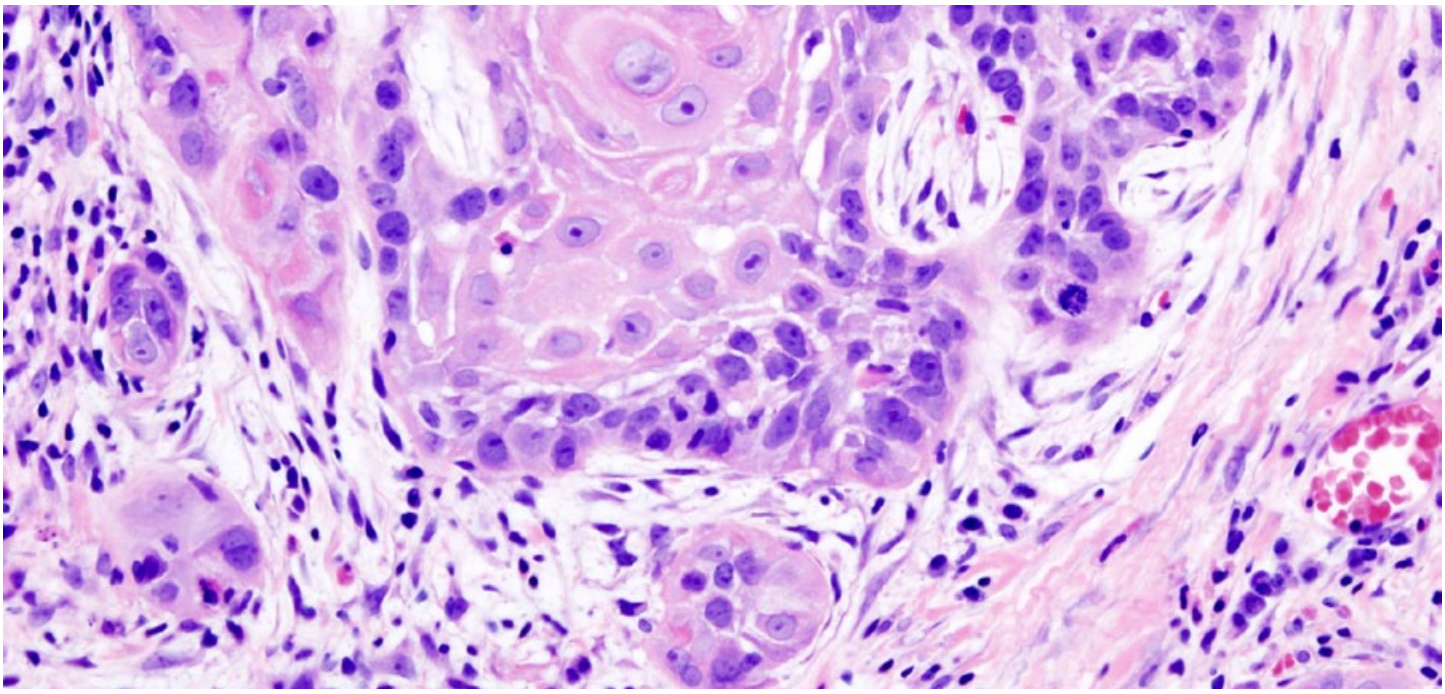
Research being conducted by Kyle Mirabile, Elizabeth Parcell Sharp, Scott Renneckar, and Audrey Zink-Sharp is shedding some light on what features of Douglas-fir versus southern yellow pine are likely leading to the inability of certain adhesives to qualify for use in structural applications that must withstand cyclic moisture conditions. Douglas-fir and southern yellow pine are two of the most widely used woods for structural applications and specialty composites, yet a lack of fundamental knowledge has limited improvement of adhesives that can work equally well on both wood types. The research is sponsored by the Wood-based Composites (WBC) Center and includes Henkel, Momentive, Georgia-Pacific Chemicals, and Ashland as technical partners.

Kyle Mirablile at the microtome.

This past summer, southern yellow pine trees (*Pinus taeda*) were harvested from the Reynolds Homestead Forest in Critz, VA. In late December, 2013, WBC colleagues at Oregon State University assisted with harvest and transport of Douglas-fir logs to Blacksburg. Boards were sawn from the logs using our department's portable sawmill and then dried in the kiln. Various and numerous (!) specimens have been prepared from each tree type and are awaiting further processing.

Currently underway are analyses of cellular anatomy, wood density, surface wettability, and chemical composition. Very soon, bonded assemblies will be constructed and tested for bond strength, bond durability, bondline thickness, adhesive penetration, and dimensional stability while enduring cyclic moisture fluctuations. Exploration of bondline chemistry with 2D and 3D mapping is also planned.

Results from the project could lead to adhesive formulations that meet qualification requirements when the adhesives are applied to either Douglas-fir or southern yellow pine composites destined for structural laminated wood products located in exterior exposure situations. New formulations that function equally well with either wood type likely will decrease production cost, improve production efficiency, and enhance composite performance.

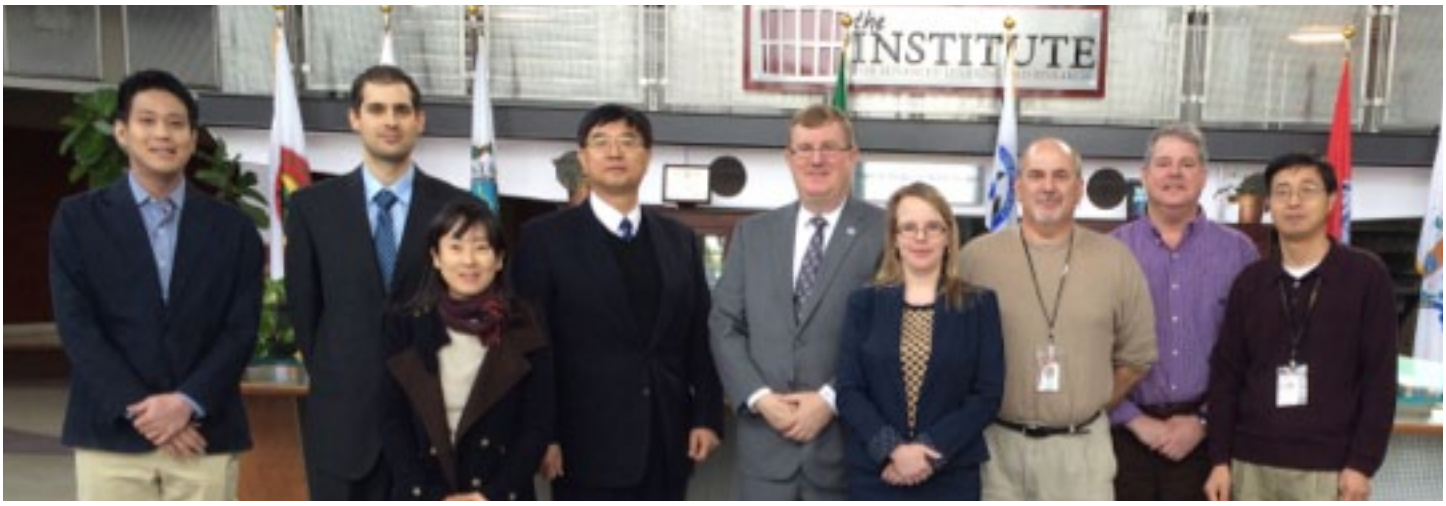


PLANT-BASED NANOPARTICLES ENHANCE PROMISING NEW CANCER TREATMENT TECHNOLOGY BY MAREN **ROMAN**

Irreversible electroporation (IRE), a promising new technique for removing cancerous tumors, uses microsecond electrical pulses to damage the cell membranes of tumor cells past the point of recovery. While IRE affects tumor cells, it does not cause damage to nearby blood vessels and nerves. This selectivity enables the treatment of tumors that are considered surgically inoperable because of their close proximity to these sensitive structures. Among the main challenges associated with IRE are, no. 1, that it is not able to distinguish between cancerous and healthy cells within the treatment volume and therefore causes some loss of healthy tissue and, no. 2, that it is not able to treat tumor extensions beyond the margin of the treatment volume.

Dr. Maren Roman's research group in the Department of Sustainable Biomaterials is investigating potential biomedical applications of plant-based nanoparticles, specifically cellulose nanocrystals. In a recent collaboration with Drs. Rafael Davalos and Yong Woo Lee of the School of Biomedical Engineering and Sciences, Dr. Roman has shown that a carefully timed treatment of cancer cells with cancer-targeted cellulose nanocrystals prior to the application of the electric pulses augments the cytotoxic effect and selectivity of the IRE treatment. The

research findings signify that eradication of a tumor after treatment with cancer-targeted cellulose nanocrystals requires a lower electric field strength and results in less damage to the healthy tissue in the treatment volume. By further modifying the cancer-targeted cellulose nanocrystals with chemotherapeutic drugs, it is possible to simultaneously target and treat extensions of the tumor. The study will appear shortly under the title "Folate conjugated cellulose nanocrystals potentiate irreversible electroporation-induced cytotoxicity for the selective treatment of cancer cells" in the journal *Technology in Cancer Research & Treatment*.



The delegation of the Koran Pallet Pool system tours the laboratories of the Institute of Advanced Learning and Research.

REPRESENTATIVES OF THE KOREAN PALLET POOL SYSTEM VISIT VIRGINIA TECH BY LASZLO **HORVATH**

Two representatives if the Korean Pallet Pool (KPP) system visited Virginia Tech February 5-7, 2014 to explore a joint venture between Korean Pallet Pool systems, Institute of Advanced Learning and Research (IALR) and Virginia Tech. Dr. Shin a well know researcher in plastic pallet development was leading the delegation. During the stay the representatives observed the results of a joint testing project that KPP currently has with Virginia Tech then the group traveled to IALR to explore further collaboration. The joint venture will help KPP, IALR, and Virginia Tech to be leaders in natural fiber reinforced bio-plastic composite pallet development.

VISITING PROFESSOR FROM BRAZIL

Dr. Elias Taylor Durgante Severo a professor at the São Paulo State University-UNESP, Brazil is vising Professor Brian Bond in the Department of Sustainable Biomaterials for one year. Dr. Elias has a background in wood drying, physical properties of wood and wood preservation. He will be working on several projects related to wood drying and thermally modified wood.

PARTICIPATION IN THE 2014 PACKAGING ICPF TELECONFERENCE BY YOUNG TECK **KIM**

There were two packaging students, Cyrus Adibpour (Senior) and Megan Stallings (Sophomore) honorably selected by ICPF to participate at the broadcast site in East Lansing, MI during the 17th annual ICPF Careers in Corrugated Packaging & Display Teleconference conducted on February 20, 2014. This ICPF award also includes their participation as a guest speaker in the ICPF reception party, dinner and many meetings with other Teleconference industry speakers. The Center for Packaging and Unit Load (Virginia Tech, Director: Laszlo Horvath) sponsored one flying ticket for educational participation of students. Previously, ICPF has donated several pieces of equipment including a CAD table, scholarships, and travel awards to the VT-Packaging program. Very recently, ICPF donated a few packaging testing equipment (arranged by Dr. Bob Bush). These donations help our packaging program continue to remain high quality in order to raise leaders within the packaging society.

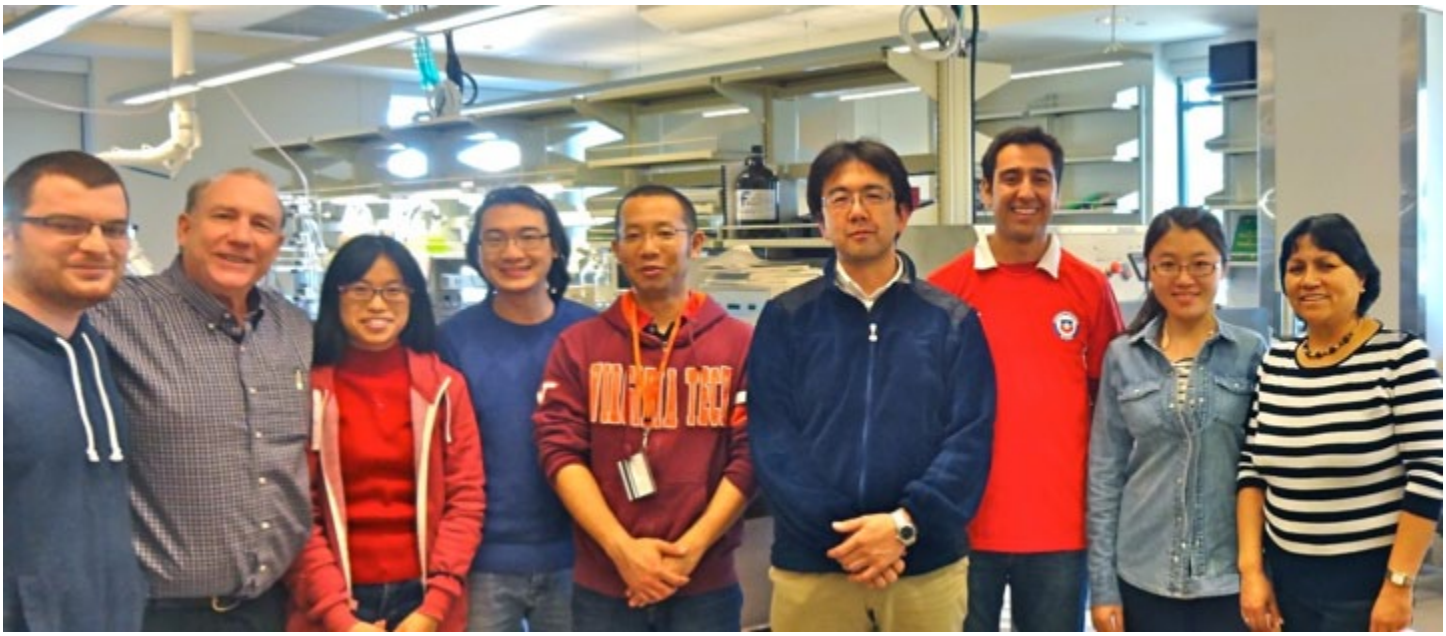
Tyler Matusevich, alumni of VT packaging program, is moderating the 17th ICPF Teleconference Meeting at Lancing, WI.

Around 25 current packaging students participated in the meeting through video conference call at Cheatham and the first generation of VT packaging students, Tyler Matusevich (2013 class) who is working at Rocktenn (second largest company in the corrugated industry), was invited to this meeting as a moderator.

VISITING SCIENTISTS WORKING WITH GOODELL'S RESEARCH GROUP BY BARRY **GOODELL**

The Sustainable Biomaterials Department welcomes Dr. Tomonori Sonoki from Hirosaki University in Japan to Professor Barry Goodell's research group. Dr. Sonoki joins two other visiting scientists currently on sabbatical stay with Dr. Goodell, Dr. Yuichiro Otsuka from the Forestry and Forest Products Research Institute in Tsukuba, Japan, and Dr. Omar Uyarte Noriega from the University of São Paulo in Lorena, Brazil.

Dr. Sonoki will be exploring new methods to utilize waste lignin residues using a unique microbial process that utilizes lignin as a feedstock to produce platform chemicals that can be polymerized into bio-based polymers. Dr. Otsuka is already working on a related project in Goodell's lab, and the next goal is to engineer the organism to produce a new platform chemical that can be synthesized into plastics like Nylon 6,6 and PET. Dr. Uyarte Noriega is working on a variety of projects focused on enhanced methods to deconstruct woody biomass related to bioproducts and biofuels generation.



The Department welcomes three visiting scientists to Barry Goodell's lab in the ICTAS II Building on campus. From left: Mr. Atanur Satir, MS student working on the incorporation of carbon nanotubes from wood, into steel. Professor Barry Goodell. Ms. Alison (Yun) Qian, PhD student working on the biosynthesis of unique platform chemicals from lignin. Mr. Lam Thieu, PhD student working on the synthesis of polymers from bio-based monomers. Dr. Yuichiro Otsuka - Japan. Dr. Tomonori Sonoki-Japan. Dr. Omar Uyarte Noriega - Brazil. Ms. Yiming Zhang, MS student working on the incorporation of cellulose nanomaterials into aerospace composites, and Mrs. Lourdes Orejuela, PhD student (and visiting Professor from Quito, Ecuador), working on novel techiques for the deconstruction of lignocellulose biomass.

SBIO FACULTY PRESENT AT NANOTECHNOLOGY WORKSHOP BY BARRY **GOODELL**

Professor Barry Goodell attended a Nanotechnology Workshop on February 21, 2014 at the National Institute of Aerospace in Hampton, Virginia with colleagues, Gary Seidel and Rakesh Kapania from the Department of Aerospace and Ocean Engineering at Virginia Tech.

The group presented work on the use of cellulose nanomaterials in aerospace composites at the meeting along with colleagues Scott Renneckar (SBIO) and Michael Philen (AOE). The title of their presentation was: Applications of Cellulose Nanocrystals and Carbon Nanotubes in Hybrid Nanofibers for Improving Damage Tolerance and Damage Detection in Aerospace Composites.

BIO-BASED MATERIALS CENTER TO HOLD SYMPOSIUM ON APRIL 30 BY MAREN **ROMAN**

On Wednesday, April 30, 2014, the Bio-based Materials Center (BBMC) at Virginia Tech is holding its 3rd Graduate Research Symposium. This year's keynote speaker is Prof. Dr. rer. nat. Petra Mischnick from the Institute of Food Chemistry of the Technische Universität Braunschweig in Germany. The title of her presentation is "Sequencing polysaccharides and polysaccharide derivatives - What is possible?". The symposium program and presentation abstracts will be posted under Events on the BBMC's Web site at www.bbmc.ictas.vt.edu.

The BBMC, lead by Professor Kevin Edgar of the Department of Sustainable Biomaterials, is a multidisciplinary research and education center under the Institute for Critical Technology and Applied Science with funding from the USDA National Institute of Food and Agriculture. Among the faculty members of the BBMC are also Professors Chip Frazier, Barry Goodell, Scott Renneckar, and Maren Roman.

VT SBIO AT THE 247TH NATIONAL MEETING OF THE AMERICAN CHEMICAL SOCIETY

BY MAREN **ROMAN**

During the third week of March, the American Chemical Society is holding its 247th National Meeting in Dallas, TX with the theme: Chemistry and Materials for Energy. The Virginia Tech Department of Sustainable Biomaterials will be represented at this meeting by Prof. Kevin Edgar and his graduate students Ruoran Zhang, Xueyan Zheng, Joyann Marks, and Xiangtao Meng, Prof. Chip Frazier and his graduate students Guigui Wan and Xing Yang, Prof. Scott Renneckar and his graduate student Wei Zhang, Prof. Barry Goodell, and Prof. Maren Roman's graduate students Jung Ki Hong and Xinyi Tan. Prof. Audrey Zink-Sharp is a co-author of one of the papers. The delegation will deliver thirteen oral and four poster presentations:

ORAL PRESENTATIONS:

1. **Versatile design and synthesis of cellulose derivatives for amorphous solid dispersions (Edgar)**
   Design and Self-Assembly of Bio-Inspired Nanocomposites Based on Renewable Building Blocks, Division of Cellulose and Renewable Materials

2. **Regioselectively synthesized aminopolysaccharides for high performance applications (Edgar)**
   ACS Award for Affordable Green Chemistry: Symposium in Honor of Arthur J. Ragauskas, Division of Energy and Fuels

3. **Synthesis of curdlan derivatives regioselectively aminated at the C-6 position (R. Zhang)**
   Design and Self-Assembly of Bio-Inspired Nanocomposites Based on Renewable Building Blocks, Division of Cellulose and Renewable Materials

4. **Efficient method for regioselective synthesis of cellulose esters (Zheng)**
   USDA-NIFA Sponsored Biobased Materials as Resources for Tomorrow: Graduate Interdisciplinary Research in Biobased Materials, Division of Cellulose and Renewable Materials

5. **Pairwise polymer blends for oral drug delivery (Marks)**
   USDA-NIFA Sponsored Biobased Materials as Resources for Tomorrow: Graduate Interdisciplinary Research in Biobased Materials, Division of Cellulose and Renewable Materials

6. **Isolation and structural analysis of lignin from glycerol thermal pretreated (GTP) biomass (W. Zhang)**
   Lignin Biosynthesis, Characterization and Modifications: Anselme Payen Award Symposium in Honor of Dr. John Ralph, Division of Cellulose and Renewable Materials

7. **Glycerol thermal processing as a new pretreatment to fractionate biopolymers and improve enzymatic saccharification (W. Zhang)**
   USDA-NIFA Sponsored Biobased Materials as Resources for Tomorrow: Graduate Interdisciplinary Research in Biobased Materials, Division of Cellulose and Renewable Materials

8. **Non-enzymatic decomposition of lignocellulose by brown rot fungi and the role it plays in carbon sequestration and cycling (Goodell)**
   Changing Atmospheric Chemistry: Environmental Implications of Land-Air Interactions, Division of Environmental Chemistry

9. **Cellulose nanocrystal reinforced polymeric bone scaffolds (Hong)**
   USDA-NIFA Sponsored Biobased Materials as Resources for Tomorrow: Graduate Interdisciplinary Research in Biobased Materials, Division of Cellulose and Renewable Materials

10. **Mechanisms of wood-generated formaldehyde emission (Wan)**
    USDA-NIFA Sponsored Biobased Materials as Resources for Tomorrow: Graduate Interdisciplinary Research in Biobased Materials, Division of Cellulose and Renewable Materials

11. **Influence of biomass fillers in phenol-formaldehyde wood adhesion (Yang)**
    USDA-NIFA Sponsored Biobased Materials as Resources for Tomorrow: Graduate Interdisciplinary Research in Biobased Materials, Division of Cellulose and Renewable Materials

12. **Decoration of nanocellulosic fibrils with spatially distributed inorganic crystals using biomimetic processes (Renneckar)**
    Cellulose Structures, Surfaces, and Interfaces: Towards Truly Nanostructured Materials, Division of Cellulose and Renewable Materials

13. **Novel process combining biomass pretreatment for cellulosic bioethanol production and synthesis of alkyl glycosides (Tan)**
    USDA-NIFA Sponsored Biobased Materials as Resources for Tomorrow: Graduate Interdisciplinary Research in Biobased Materials, Division of Cellulose and Renewable Materials

POSTER PRESENTATIONS:

(each presented at two different poster sessions)

1. **Olefin cross-metathesis as a source of novel polysaccharide derivatives (Meng)**
   Poster Session of the Division of Cellulose and Renewable Materials and Sci-Mix (a convention-wide poster session)

2. **Remarkably regioselective deacylation of cellulose esters using tetrabutylammonium hydroxide (Zheng)**
   Excellence in Graduate Polymer Research, Poster Session of the Division of Polymer Chemistry and Sci-Mix

SBIO Extension

Virginia Cooperative Extension

Virginia Tech
Virginia State University

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Specialists

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Continuous
Improvement

Extension highlights

The wood products industry in Virginia is a critical contributor to the economy of the state, an industry represented by more than 1,000 primary and secondary industries and over $25 billion in economic impact.

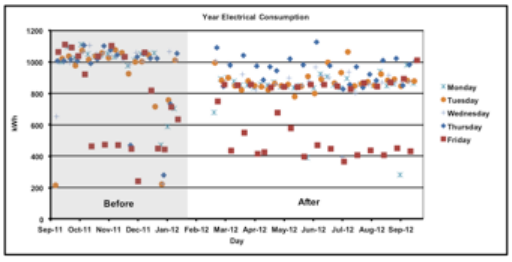
The Department of Sustainable Biomaterials (SBIO) at Virginia Tech is one of the leading U.S. academic programs in the field of renewable materials with a focus on cellulosic materials such as wood products. Besides research and teaching efforts, SBIO has an important role in dissemination of new knowledge in the area of renewable materials through SBIO's three extension specialists.

SBIO Extension Faculty visits sawmills in Southside Virginia

Drs. Brian Bond, Henry Quesada, John Bouldin, Elias Severo, and Jianfang Yu visited Hopkins Lumber Contractors and Griffith Lumber Company located in Southside Virginia in middle February. The visit was an opportunity for SBIO faculty to interact with VA entrepreneurs and introduce visiting professors Severo from Brazil and Yu from China to the lumber industry in Virginia. Hopkins Lumber Contractors has recently expanded operations into a new facility in Ridgeway, VA. Soon the company will be able to integrate this new operation with its current location in Critz, VA. Griffith Lumber was in the news about 5 years ago when its facility caught on fire. Today, the company looks renewed and ready to continue to grow and support economic development in the region.

Reducing Energy Consumption Through Lean Thinking: Presentations and Article

Practitioners and academicians can access now pre-recorded presentations on a recently concluded research project led by SBIO extension faculty to demonstrate the impact of lean thinking strategies on energy consumption in wood products industries.



Upcoming Events

Wood Industry Week @ WERC
-- IMPROVING OPERATIONS TO REMAIN COMPETITIVE AND PROFITABLE --
11 March – 13 March, 2014 - Princeton, WV

Today, given the fierce competition in the marketplace, negotiating power is firmly in buyers' hands, requiring organizations to execute well to assure business success. This workshop is intended as a refresher course to improve woodworking companies' effectiveness and efficiency to help them be and remain profitable.

This workshop will teach manufacturing managers' knowledge of proven techniques to analyze their operations, find weaknesses, develop and implement solutions, and to continuously improve their operations to remain competitive. A short refreshing session about the nature of wood will be followed by in-depth material on statistical process control and plant optimization. The workshop discusses how world-class manufacturers achieve their success and how they continuously improve what they do to stay ahead of their competitors. In addition, it offers guidance through the jungle of management buzzwords and discusses the fundamentals of Pareto Analysis, flowcharts, cause-and-effect diagrams, design of experiments (DOE), the Theory of Constraints (TOC), Lean Manufacturing, Six Sigma, and others. In collaboration, these methods help organizations of any kind, any size, and any type to achieve world-class business excellence.

This workshop will prove helpful for management and production personnel from organizations, trade associations, consultants, research and training specialists, educators, and government representatives. For more information please see

http://woodproducts.sbio.vt.edu/wiwatwerc/ or contact Urs Buehlmann at buehlmann@gmail.com or (540) 231-9759.

Category-12 Wood Preservation Re-certification Workshops

Two workshops for those needing category-12, wood preservation, recertification will be held this April. The first will be held in Lexington, VA at the Rockbridge County extension office from 9:00-12:00 the morning of April 1st, the second will be held at Madison Wood Preservers in Madison, VA from 9:00-12:00 on April 2nd. Pre-registration is required, please contact Dr. Bond at (540) 231-8752

Educational Sessions offered for the 2014 Richmond Expo

The Department of Sustainable Biomaterials (SBIO) at Virginia Tech in conjunction with the Virginia Forest Products Association (VFPA) and Virginia Cooperative Extension (VCE) is offering an educational session on May 15, 2014 as part of the 2014 Richmond Expo organized by VFPA. The educational session is divided in two tracks. The morning track will focus on drying operations and the afternoon track will focus on financial management principles for forest products industries. For more information and registration: http://sim.sbio.vt.edu/?p=1961

Workshop for Drying Lumber with a Solar Kiln

A course designed to introduce solar lumber drying to the small scale woodworking facility or hobby woodworker will be held on May 30th at Virginia Tech. Information about how to design, modify, build and operate a solar based on the Virginia Tech design will be presented. Solar lumber drying provides a safe and ecomical way to dry lumber given limited knowledge and experience. For more information or to register: http://sbio.vt.edu/workshops/solar-drying/

WORKSHOP

INTERNATIONAL MARKETING FOR FOREST PRODUCTS INDUSTRIES

WHEN

May 7th, 2014

WHERE

National Hardwood Lumber Association Headquarters
Raleigh Lagrange Rd, Memphis, TN 38134
Phone: (901) 377-1818

BROUGHT TO YOU BY:

- **The Federal State Market Improvement Program (FSMIP) at USDA**
- **The Center for Forest Products Business at Virginia Tech**
- **The National Hardwood Lumber Association (NHLA)**

WHO SHOULD ATTEND?

- Sales Managers, Export Sales Managers, Sale Representatives
- General Managers, Plant Managers, Purchasing Managers, Materials Planning Managers, Marketing Directors, Product Managers, Plant Supervisors
- Employees with responsibilities in Marketing that would like to increase their knowledge of the current situation for US Wood products in international markets
- Owners and managers of Small and Medium Enterprises in wood products industries
- Personnel related to local organizations that support development of new market opportunities for wood products industries
- Independent consultants and academicians who are interested in updating their knowledge in International marketing for US Wood products

REGISTRATION

Investment is $250 and it covers workshop materials, coffee breaks, and lunch.

Link:

http://www.nhla.com/default.aspx?p=77246&evtid=168505:5/7/2014

Contact Henry Quesada at quesada@vt.edu or (540) 231-0978 for more details