



*The Department of*

# SUSTAINABLE BIOMATERIALS



STUDENTS WIN  
AWARDS AND EARN  
SCHOLARSHIPS  
MORE

COURSE MATCHES  
STUDENT GROUPS  
WITH LOCAL  
BUSINESSES

THE FUKUSHIMA  
NUCLEAR REACTOR  
DISASTER CLEAN-UP

# SUSTAINABLE NATURE-BASED ENTERPRISES COURSE MATCHES STUDENT GROUPS WITH LOCAL BUSINESS

BY JOHN BOULDIN

Sustainable Nature-Based Enterprises (SBIO 3004) is a service learning course that draws students from disciplines across campus into the study of business sustainability. The course matches student groups with local business or non-profit clients to explore how to apply sustainability concepts into daily organizational operations. The students are required to perform volunteer work for each client, with the goal of learning how the organization is currently practicing sustainable business attitudes and methods. Course content provides specific tools for assessing and improving the environmental footprint of the company, which the students then put into practice in their volunteer work and field activities. Once a week, experts in various aspects of sustainability appear as guest lecturers to share their knowledge and experiences in 'greening' the organizations they work for. Another significant portion of course content deals with analyzing current events in business, governmental regulation, and sustainability. A fundamental



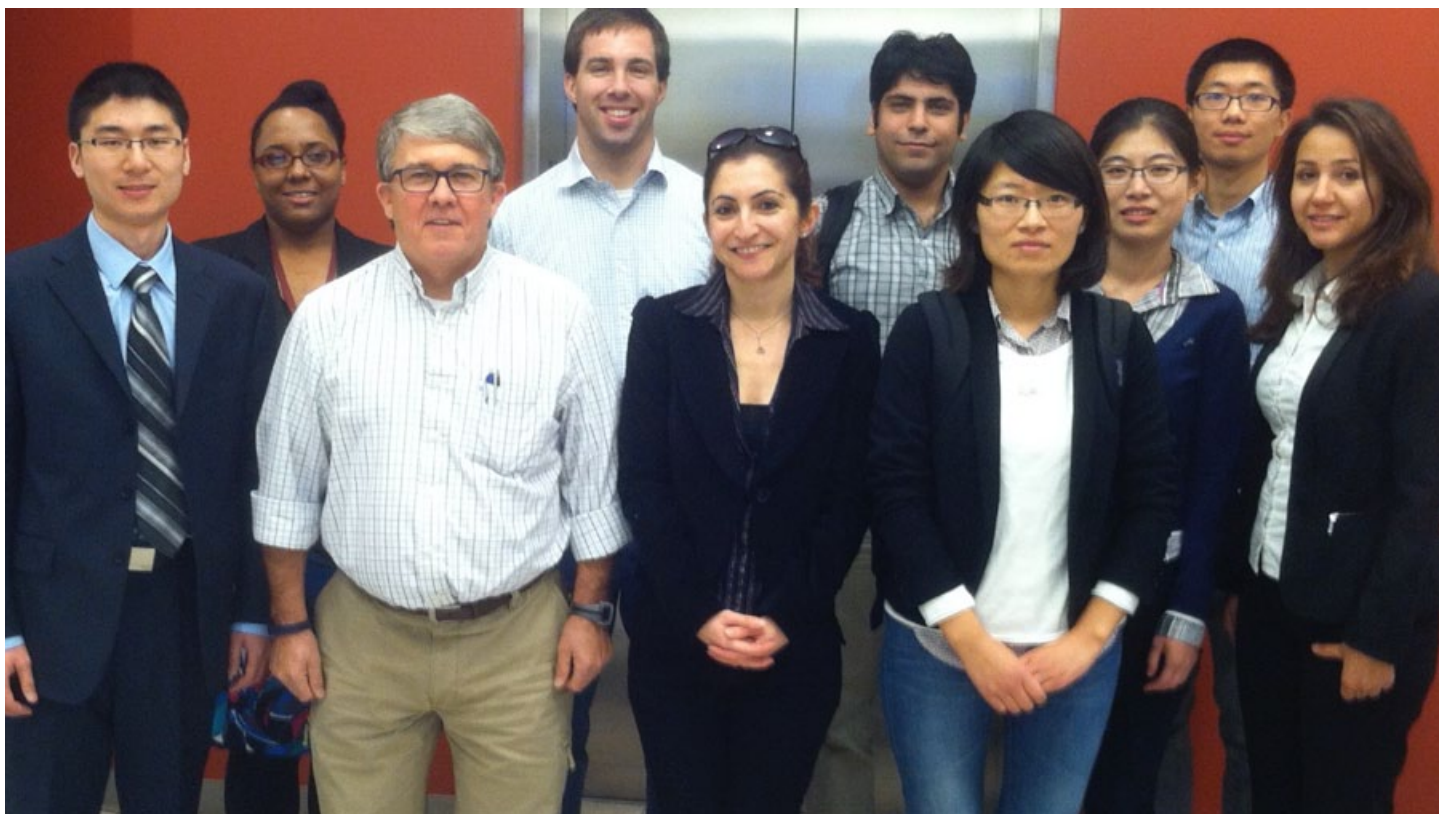
Mr. Richard Palmer of Appalachian Power explains how the hydro-electric turbine generates electricity.

tenet of the course is that improvements in sustainability can be implemented in any organization, even those ventures who are not thought of as 'green'.

As a part of the course, students participate in a series of field trips to experience various applied sustainability efforts. We wish to extend a special thank you to Appalachian Power employees Mr. Larry Jackson for arranging our visit, and to Mr. Richard Palmer for conducting the tour.

SBIO 3004 is offered during fall semesters and all students are welcome. Class size is limited.

COVER: Fall 2014 students from SBIO 3004 at the Radford AEP hydroelectric facility on the New River. Pictured from left to right: Levi Callahan, Nick Frohock, Kat Bryan, Josh Mayne, Stephanie Betzel, Nadeem Khan, Derek Robords, Bridget Cantwell, JP Huard, Tori Kellinger, Haden Ponish, Smita Sharma, Wendell Foster, Brenda Villarreal. Not pictured: Dr. John Bouldin, and Johnny Vest.



Left to right: Xing Yang, Joyann Marks, Larry Brammer, Devin Barrett, Cigdem Arca, Mohammed Tasooji, GuiGui Wan, Ruoran Zhang, Xiangtao Meng, Elham Mohammad Zadeh

## SBIO/MACR STUDENTS WIN AWARDS AT EASTMAN SYMPOSIUM

BY KEVIN EDGAR

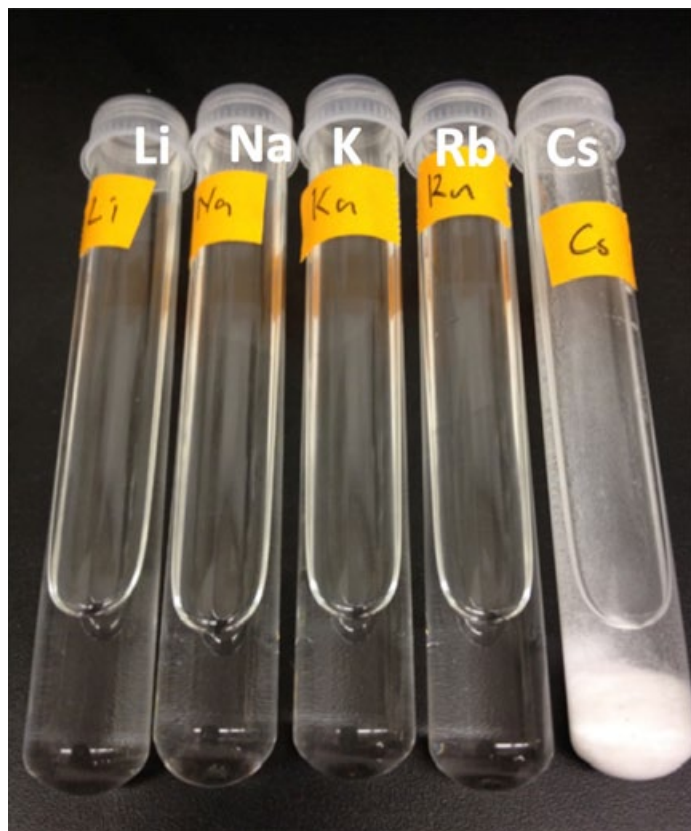
On November 6, 2014, Eastman Chemical Company sponsored the 6th annual Eastman Graduate Symposium at Virginia Tech, showcasing the work of VT graduate students working in fields related to polysaccharide chemistry. Nine Ph.D. students from SBIO as well as from the Macromolecular Science and Engineering (MACR) interdisciplinary program enjoyed the experience of making oral presentations about their work, with many VT faculty members in attendance, as well as Drs. Larry Brammer and Devin Barrett from Eastman's technical group. The entire group enjoyed an

Eastman-sponsored lunch and then an afternoon session, followed by the awards presentation. Ruoran Zhang of Prof. Edgar's group won first prize for her oral presentation, with Xing Yang of Dr. Frazier's group taking second place. Cigdem Arca and Xiangtao Meng of Dr. Edgar's group were tied for the third place presentation, and all students received from Eastman commemorative certificates as well as Eastman water bottles and other useful items. We greatly appreciate Eastman's continuing support of our students.

# PRECIPITATING A SOLUTION: THE FUKUSHIMA NUCLEAR REACTOR DISASTER CLEAN-UP

BY BARRY GOODELL

Two visiting researchers from Japan, on sabbatical in Professor Barry Goodell's laboratory in ICTAS II on the Virginia Tech campus, recently made a finding that may help to clean up radioactive pollution from the Fukushima Daiichi Nuclear Disaster in Japan. Dr. Yuichiro Otsuka, a researcher at the Forestry and Forest Products Research Institute in Tsukuba, Japan, and Professor Tomonori Sonoki from Hirosaki University in Japan, have been working with Goodell on ways to utilize waste lignin from pulp and paper processing to produce more useful "platform chemicals" – chemicals that can be used as precursors for production of biofuels or biopolymers (bioplastics). Successful production of one compound known as PDC has been successful in scale-up laboratory studies, and the biosynthetic pathways for production of large amounts of PDC from a crude fraction of kraft lignin from pulp mills have been worked out by the team now. Although the targeted PDC molecule was intended as a platform chemical for biopolymer production, a surprising finding by Otsuka in lab has led to a discovery that may help clean up radioactive Cesium in waste-water from the Fukushima-Daiichi Nuclear Power plant in Japan. Radioactive Cesium is the major radioactive component from the reactor, and millions of gallons of radioactive Cesium contaminated



Test tubes containing dissolved salts that are found in seawater and other contaminated waters. Only Cesium (far right) is pulled out of solution by the unique PDC compound being produced by Goodell and the Japanese research team on sabbatical in his laboratory at Virginia Tech. One PDC precipitates the Cesium, it can be readily filtered from contaminated waters.

water are now stored at the Fukushima site. Further, the Cesium has leaked into the seawater of the area in some cases. Researchers in Japan have been seeking better ways to selectively separate out, and collect radioactive Cesium from the waste water and seawater, but it has been a difficult challenge. Cesium is unique compound known as an "alkali metal". Metals like this can be removed from solutions if appropriate metal binding compounds

can be identified, but finding an appropriate compound for the binding of Cesium has been very difficult and the Japanese people have been desperate to find an alkali metal binding compound that is specific to Cesium. However, in the lab, when the newly synthesized PDC compound was tested in binding Cesium (a non-radioactive isotope) the PDC was found to be especially good at both binding it and also pulling it out of solution in a manner that it could be readily collected. Further, when tests of the PDC were done with mixtures of other metal salts – such as sodium chloride (common table salt which is also the major salt in seawater), Cesium was selectively bound by the PDC, allowing it to be pulled out of solution for selective disposal. This could be a finding of major importance for the clean-up of the Fukushima-Daiichi reactor disaster, and

Japanese researchers, including Dr. Masaya Nakamura who previously did a sabbatical in Dr. Goodell's lab, are now exploring how the PDC compound can be further scaled up, and how it can be applied to waste water contaminated with radioactive Cesium in Japan.

Otsuka, Goodell and Sonoki recently presented their findings at an international Symposium in Concepcion, Chile (the LignoBiotech III) conference. won a second prize award for best content. That research presentation, by Y. Otsuka, M. Nakamura, T. Sonoki, B. Goodell and H. Ogata is entitled: *Production and properties of 2-pyrone-4,6-dicarboxylic acid biosynthesized from lignin for use as a unique platform chemical and as an alkali metal chelator for disaster remediation.*



## PACKAGING SYSTEMS & DESIGN STUDENTS EARN SCHOLARSHIPS

BY BOB BUSH



Left to Right: Virginia Tech student Michael Fortunato, Kristine Roupas, Stephanie Betzel, and Elica Huggins

Four Packaging Systems & Design students recently were awarded scholarships by the [Paperboard Packaging Alliance](#). The students are Michael Fortunato, Kristine Roupas, Stephanie Betzel, and Elica Huggins. All of the students are seniors and will be among the first graduating class under the new Packaging Systems & Design degree program. Since 2012, a total of 12 SBIO students have been honored

as recipients of PPA scholarships and received, in total, \$15,000 in support

According to their website, “the Paperboard Packaging Alliance (PPA) is a joint initiative of the American Forest & Paper Association and the Paperboard Packaging Council.” The mission of PPA is to “promote the benefits of paperboard packaging and products to influence preference for these materials in packaging design

and selection.” In addition to scholarships, the PPA supports university packaging programs by sponsoring the prestigious annual *Student Design Challenge* and by providing educational materials and supplies.

The Department of Sustainable Biomaterials, along with the students in Packaging Systems & Design, thank the members of the Paperboard Packaging Alliance for their continued support.



Entire bondline image, unstained, southern yellow pine, phenolic adhesive, brightfield, K. Mirabile

## ADVANCES IN MICROSCOPY OF ADHESIVE BONDLINE ANALYSES

BY AUDREY ZINK-SHARP

WBC Graduate Fellow Kyle Mirabile and Professor Audrey Zink-Sharp have explored and established a video microscopy technique in Zink-Sharp’s lab that digitally acquires and stitches up to 50 microscopic images into a single large-scale image of a wood and adhesive bondline. This is the first large-scale effort into comprehensive visualization of adhesive penetration and flow with wood adherends. Kyle’s technique allows imaging large, continuous regions of earlywood and latewood in one integrated bondline image for the first time. Previously, scientists were required to use tiny

incomplete portions of microscopic images to accomplish what Kyle has provided in large format for our research. Our laboratory is the only one of its kind with this capability due entirely to Kyle’s efforts. The large-scale digital microscopy is a complement to other adhesive bonding research being conducted by the NSF I/UCRC Wood-Based Composites Center at Virginia Tech.



Tom Hammett (far left) speaks about the need to include training and education needs in the discussion about climate change. Other panel members who joined Tom on the stage included the Environmental Officer from the local USAID Mission, the Dean of AFU, and international climate change specialists

## HAMMETT VISITS KATHMANDU, NEPAL

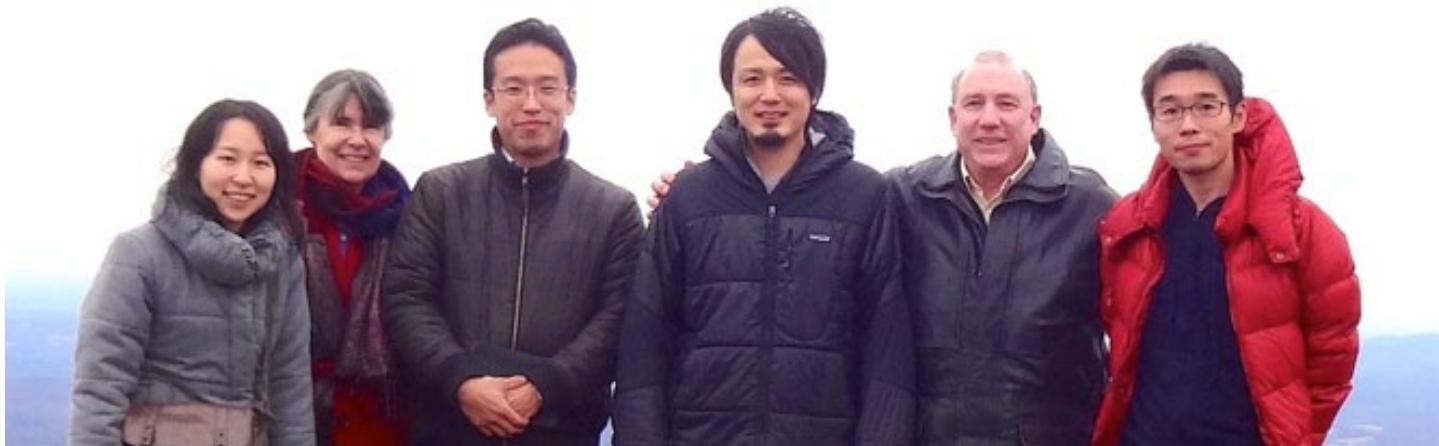
After a two year absence, Tom Hammett returned to Nepal in January. He held meetings with the US Agency for International Development (USAID) and was busy making lots of good connections for Virginia Tech. He met with faculty and funding organizations to plan a teaching and learning workshop in April to be hosted by the Agriculture and Forestry University (AFU), the only land-grant university in Nepal. With Virginia Tech’s partners he developed a training strategy to help USAID funded projects in Nepal develop capacity on

the ground. In spite of the power cuts (“load shedding”) and a nationwide transport strike he managed to also squeeze in meetings with NGOs, private sector partners, and a new private agriculture college. The transport strike meant a day-long blockage of all vehicle traffic. So Tom walked to his meetings – it was a nice quiet way to see different parts of Kathmandu city!

He also attended an international conference on climate change attended by over three

hundred people from nearly 30 countries. This was a great opportunity to pick up knowledge of the current thinking on climate change. Of special interest was the focus on economic development. At the conference he presented an invited paper entitled “Building capacity to

meet climate change and resilient livelihood challenges: education and training are the missing link”, and he participated on a blue ribbon panel and chaired a session on incorporating research on gender and enterprise development into adaptation to climate change.



Touring the Blue Ridge and the Rocky Knob region near Floyd, Virginia. From left: Graduate Student Yuka Kojima (Tokyo Univ Ag Tech), Professors Jody Jellison (VT), Asst. Professor Ryota Kose (Tokyo Univ Ag Tech), Assoc. Professor Makoto Yoshida (Tokyo Univ Ag Tech), Professor Barry Goodell (VT), and Asst. Professor Satoshi Nakaba (Tokyo Univ Ag Tech)

## NEWS FROM GOODELL LAB BY BARRY GOODELL

Four Japanese researchers from Tokyo University of Agriculture and Technology visited Virginia Tech, and Professor Barry Goodell’s lab to discuss research and give a presentation entitled: “Eco-Materials Research in Japan - Applications for Nanocellulose, New Fungal Enzymes, and Physiological Control.” Their seminar was sponsored by the Department of Sustainable Biomaterials and also by the Macromolecules and Interfaces Institute (MII) on campus. Dr. Kose discussed his latest research on nanocellulose while Dr. Nakaba reviewed his research on tree physiology and heartwood formation. Dr. Yoshida

and his graduate student, Ms. Yuka Kojima, reviewed their research on fungal biotechnology with Professor Goodell, and they advanced discussion on a new concept for the biorefinery industry to deconstruct lignocellulose. Professors Goodell and Yoshida are both part of a new \$3.6 million research project lead by Dr. Gry Alfredsen in Norway (formerly a visiting foreign scholar on sabbatical with Goodell), and funded by the Norwegian Forskningsrådet, to examine interactions between enzymes and the chelator-mediated Fenton system for development of advanced lignocellulose bioprocessing technologies.



**Virginia  
Cooperative  
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Virginia Tech  
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[www.ext.vt.edu](http://www.ext.vt.edu)

# SBIO Extension

## 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.

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## Specialists

### Brian Bond

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Wood Processing

### Urs Buehlmann

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Secondary Industry  
Manufacturing

### Henry Quesada

[quesada@vt.edu](mailto:quesada@vt.edu)  
Continuous  
Improvement

## Fifth Student Innovation Competition and Workshop delivered



The Multiform team explains their project to the audience at Fralin Auditorium.

On December 5, 2014 Dr. Henry Quesada, associate professor at the Department of Sustainable Biomaterials and Dr. Jaime Camelio, associate professor at the Department of Industrial Systems Engineering both at Virginia Tech organized and delivered the fifth Student Innovation Student

Competition and Workshop at Virginia Tech. This event has been held every year since 2010 and it is funded through the Center for Innovation-based Manufacturing (CibM) at Virginia Tech. This year's event featured two presentations from entrepreneurs. Louis Cirillo, President and CEO at Virtual U, a business located at the VT Corporate Research Center, delivered the first entrepreneurial presentation. VirtualU centers its efforts in pioneering technology to create hyper-realistic digital avatar creation for multiple applications. Matt Jackson, Engineering Community Manager

at Local Motors, delivered the second presentation. Mr. Jackson introduced Local Motor's concept of open innovation as well as an ARPA-E student competition that is open for students across the nation. Local Motor's competition awards \$60,000 for first place.

For the student innovation competition, three student teams competed. The first team presented a business idea of an automatic chalkboard eraser. The second team introduced an emergency light (V-Lamp) that works by harnessing energy generated from human's head. The final project named Multiform, consisted on a customizable system for designing and manufacturing handle grips for sport applications. After deliberation from the judges, the first place was awarded to the Multiform team. Students competed for a business start-up package that included \$5,000, space, and business planning support from VTKnowledgeWorks. A total of 35 people attended the event including students, faculty, and administrative personnel at VT.

### **Energy Savings Through Lean Thinking Workshop delivered in Marion, VA.**



Dr. Earl Kline explained how to generate and interpret a value stream map to the audience. The event took place at the Marion Extension Office.

Speakers from various organizations including Virginia Tech, the Manufacturing Technology Center (MTC) of Southwest Virginia, and Enernoc traveled to Marion, VA on November 20, 2014 to present and introduce knowledge on lean thinking and energy saving opportunities. The audience was composed of industry, academy, and state organizations supporting education in Southwest Virginia.

From Virginia Tech, Drs. Earl Kline and Edgar Arias presented the concept of value-stream mapping (VSM) and data mining for energy consumption respectively. Dr. Henry Quesada, also from Virginia Tech, presented on energy audits and the linkage between VSM and energy savings. Mr. Nelson Teed from the Southwest Virginia MTC introduced the concept of lean thinking. Finally, Mr. Howard Henward from Enernoc introduced and explained how energy management systems can be used to monitor, control, and forecast energy consumption. A total of 14 people attended the workshop including speakers. The event was funded through a grant from the Virginia Tobacco Commission. The name of the educational grant is the

“VCE Agricultural Energy Efficiency Initiative” led by Dr. Martha Walker, Extension Specialist on Community Viability at Virginia Tech.

All presentations were recorded and they can be accessed them by visiting to the Wood Products Community of Practice (CoP) eXtension web site. To see the presentations please go to the web site [http://www.extension.org/wood\\_products](http://www.extension.org/wood_products).

### Vacuum Drying Workshop Held in Princeton, WV

A workshop discussing the advantages of vacuum drying technology for lumber was held at the Wood Education and Resource Center, Princeton, WV on November 4, 2014. Over 30 people participated at the WERC center or on the live webinar. The purpose of the workshop was to provide current information about the vacuum drying technology available for lumber drying and its potential advantages over traditional methods. Speakers included: Brian Bond, Associate Professor of Sustainable Biomaterials and Extension Specialist, Virginia Tech; Oxana Brenes, graduates student, Virginia Tech, Dennis Soding, President, Process Control Specialist, Inc., PCs VacDry; Jim Parker, Director of Application Development, Vacutherm, Inc; Larry Lashway, Owner and Vice-president of Lashway Lumber, and Ingo Wallocha, Sales Director for Brunner-Hildebrand Lumber Dry Kiln Co.

### Sustainable Biomaterials researchers travel to India

Drs. Robert Smith and Henry Quesada professors at the Department of Sustainable Biomaterials at Virginia Tech traveled to Hyderabad, India during November 6-17, 2014 to participate in the second conference and research meeting of the Indo-US Joint Clean Energy Research and Development (JCERD) project. The event took place at the Indian Institute of Chemical Technology in Hyderabad.



Drs. Smith and Quesada enjoying a break during the second day of the lignocellulosic biofuel conference in Hyderabad, India.

During their visit, Drs. Smith and Quesada participated as speakers and panelists at the Indo-US conference on Advanced Lignocellulosic Biofuel. Dr. Quesada presented on the challenges that lignocellulosic biofuel plants are facing today in the U.S. and Dr. Smith discussed the future of the industry and why is important to better understand not just the production technology but also markets and the source of feedstocks.

Also, both researchers presented their progress on this research project.

Smith and Quesada are identifying barriers and drivers impacting lignocellulosic ethanol production in the US. They are also working on the development of an optimization model to minimize cost and environmental impact in the supply chain of cellulosic feedstocks such as sorghum.

## **SBIO Extension Professors awarded USDA grant to support the export of wooden modular homes to developing countries**

Last October 2014, the Federal State Marketing Improvement Program (FSMIP) at the U.S. Department of Agriculture (USDA) awarded a competitive grant to Dr. Henry Quesada-Pineda and Dr. Robert Smith to explore market opportunities for U.S. modular home manufacturers in selected countries. Virginia and the mid-Atlantic region have a number of modular home companies that could improve their performance by increasing the export of homes to developing countries. Since homes can be customized at the factory, it is believed that smaller homes can be shipped in containers and erected quickly by semi-skilled labor at the job site in developing countries in Latin America.

According to the Inter-American Development Bank, one out of three families in the Latin America region lives in an inadequate housing structure. Almost 2 million families that are formed each year are obligated to live in marginal zones in informal housing structures. In countries such as Costa Rica and Colombia there is a high demand for social housing solutions. For example, the social housing deficit in Costa Rica is 1.1 million and in Colombia it is 2.2 million. In both countries there is an important engineering community with growing interest in using more wooden housing solutions to alleviate the current housing deficit. However, in both countries efforts to promote the benefits of using wooden houses needs to be increased to change consumer's perceptions of wood against other construction materials.

## **Upcoming Events**

### **Category-12 Wood Preservation Re-certification Workshops**

The department will hold two workshops for those needing category-12, wood preservation, recertification. The first will be held in at Madison Wood Preservers in Madison, VA from 9:00-12:00 on March 25th and the second in Lexington, VA at the Rockbridge County extension office from 9:00-12:00 the morning of Friday, March 27th. Pre-registration is required, please contact Dr. Bond at (540) 231-8752 or [bbond@vt.edu](mailto:bbond@vt.edu).

### **Web-Based Unit Load Design Short Course for Pallet Suppliers**

“How to Use Pallet Design Differently”

Date: April 21-23, 2015

Location: Live Webinar

Topics include: Principles of unit load design; Unit load material handling audit procedures; Packaging design; Pallet design; Material handling systems; Interactions between material handling equipment, packaging, and pallets; Diagnosing and solving material handling problems; stringer and block class pallet design using Best Load™

For more information visit <http://unitload.vt.edu/> or call (540) 231-7673