



## PDC Newsletter - December 2021

2021 has been a busy year at the PDC. We have installed new equipment and have been conducting research on cellulose nanofiber production. This newsletter has some short updates on our activities. Watch for more updates next year!

Wishing you warm winter greetings and best wishes for 2022!

**Happy Holidays from the PDC Staff!**

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## New PDC Equipment & Capabilities

### New Valmet Refiners

#### ***PRO-1 Refining comes to the PDC***

Three new refiners have been added to the refiner farm at the PDC: a) Two new 20"/24" double disk refiners were donated to the PDC as part of the Northern Border Regional Commission grant, and b) the Valmet Conical PRO-1 refiner. The PRO refiner allows two traditional refiners to be replaced with one unit while still delivering a 30% electrical energy savings. The PRO refiners are suitable for all kinds of low consistency refining applications. These new units will add capacity and flexibility to our current 13" double disk and newly reconfigured 20" single disk refiner.



### **Kiefel Fiber Thermoforming Technology**

*The PDC is partnering with Kiefel Packaging to install Kiefel's lab-scale unit.*

Kiefel Packaging's commercial Natureformer KFT90 unit uses a suction process in combination with cold pre-pressing technology to reduce the residual moisture to approximately 60%. The final pressing is accomplished with a heated tool that lowers residual moisture to approximately 7%. Bring your feedstocks and recipes to run trials, or work with the PDC to produce or source needed materials.



If you are interested in learning more about our new thermoforming unit, please contact Colleen Walker at: [colleen.walker@maine.edu](mailto:colleen.walker@maine.edu) 207-581-2387.

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## PDC Research Projects

### UMaine and ORNL Hub & Spoke Partnership

*Research collaboration between Oak Ridge National Laboratory and UMaine in place.*

The goal of the hub-and-spoke partnership between Oak Ridge National Laboratory and UMaine is to accelerate the advancement of nanocellulose and other forest products composite technology, reduce the time from laboratory discovery to market impact, and facilitate the transition of bio-based Additive Manufacturing (AM) technologies to industry. This collaboration is the first large-scale bio-based additive manufacturing program in the US, connecting regional industry and university clusters with national lab resources.

Scientists from ORNL and UMaine are conducting research in several key areas, including CNF production, drying, functionalization, and compounding with thermoplastics, multiscale modeling, and sustainability life-cycle analysis. As a forest product, CNF could rival steel properties and its successful incorporation into plastics shows great promise for a renewable feedstock suitable for additive manufacturing.

program. The webinar series will launch in later January 2022. Watch for more information on the APPTI website, and in our next issue.

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## IP Spotlight

*Many of the University of Maine researchers have developed patentable technologies and processes that may be of interest. Each issue, we will feature one of these inventions.*

### Particleboard manufacturing

**Cellulose nanofibril replacement for urea-formaldehyde resin in particleboard manufacturing.**

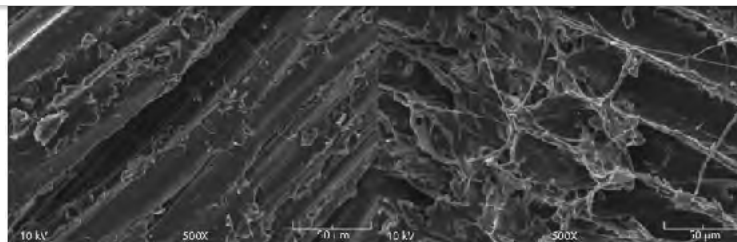


The University of Maine has received a patent for a process that creates construction materials using cellulose nanofibrils as an environmentally friendly binding agent.

Particleboard is traditionally manufactured from wood chips bound with a synthetic resin that typically contains formaldehyde, a well-known carcinogen. Replacing the total amount of urea-formaldehyde resin with CNF provides an all-sustainable option. This results in a product that better resists fracture, and sequesters carbon and oxygen into the building product for its life span.

Preliminary samples were made by mixing southern pine wood particles with a 3 wt% CNF suspension and pressing. At 15 wt% CNF content, the moisture content of the mixture is over 600%. Using a simple cold-press operation reduces the initial moisture content to 100%, which is manageable by controlling the hot press cycle. Reduction of moisture content without using a heat source provides additional energy savings. The samples easily meet the standard minimum levels of both properties for the low-density panels (densities below 0.65 g/cm<sup>3</sup>) but are approximately half the levels of medium-density fiberboards.

The picture below illustrates how wood particles can be bound together using CNF. The image on the left is the surface of a southern pine wood particle used in the production of the CNF-bound particleboard panels. The image on the right shows the surface of a similar wood particle after being mixed with a CNF slurry and air-dried overnight. CNF nanofibrils are easily observed being distributed over the particle surface with some agglomerated into platelet shapes and some preserving their fibrillar nature. It is assumed that CNF particles in the suspension will penetrate into the pores and voids in the structure of wood particles. Once the wood particles with CNF surrounding them are in contact and hot-pressed, a three-dimensional network of CNF fibrils forms and encompasses the particles in the panel structure, giving it strength and stiffness.



The technology can be used to create a variety of commonly used building materials. The primary application for the patent focuses on a replacement for particleboard, which is used widely for furniture and countertops.

The PDC is the only publicly accessible U.S. facility that can manufacture CNF at a rate of one ton per day. The center supplies CNF and cellulose nanocrystals to academic, public, and private research groups interested in evaluating and developing applications for the materials.

For more information on the patent, please contact Dr. Mehdi Tajvidi at: [mehdi.tajvidi@maine.edu](mailto:mehdi.tajvidi@maine.edu) | 207-581-2852

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## PDC Staff

### Promotions and New Hires

#### *Congratulations and Kudos to Our Staff*

The PDC is pleased to announce the Haixuan Zou, Ph.D. has been promoted to Senior Scientist. In Haixuan's new role, he is responsible for managing the PDC's refining projects. With a background in both mechanical (M.S.) and chemical engineering (Ph.D.), he will be vital to the operations of our upgraded nanocellulose facility and new refiners.



Seongkyung Park (M.S.) has also been promoted to Senior Scientist. In her new role, she is responsible for coating projects at the PDC. Seong will also continue to work with PDC clients to execute analytical projects. Seong will also work with clients on the new Kiefel fiber thermoforming unit.

Nick Hill has joined our PDC team as Engineering Assistant. In his role, Nick is responsible for the maintenance of PDC

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## PDC Events

### PDC Hosts 3rd Annual Cellulose Nanomaterials Forum

*Over 50 UMaine scientists gather to share research findings using cellulose nanomaterials*

In August this year, the PDC hosted the third Cellulose Nanomaterials Forum. The forum was held in-person and virtual for those not able to travel due to Covid-19 restrictions. The agenda for the 2-day event included keynote speakers, Blake Marshall and JoAnn Shatkin, invited guests from other universities and organizations as well as UMaine researchers. The event, with its 100 attendees, was capped with a tour of the UMaine nanocellulose facility and highlighting products using nanocellulose from researchers. The Student Soiree with 17 graduate student research posters and presentations was well attended.



**Blake Marshall**  
**Technology Manager**  
**Advanced Manufacturing Office,**  
**Department of Energy**

Blake manages research and development programs that advance the state of the art in additive manufacturing technologies. These programs aim to increase U.S. manufacturing competitiveness, save energy, and develop novel technologies that meet the cost, rate, and performance requirements of industry.

**Dr. Jo Anne Shatkin**  
**President, Vireo Advisors**

Dr. Shatkin is an environmental health scientist and recognized expert in novel product safety and environmental and health policy issues, with over 20 years of experience leading projects in risk analysis, safety, and regulatory policy work including numerous publications. She is founder and president of Vireo Advisors.



**Mark your calendars for next year's event:**

For more information on the Cellulose Nanomaterials Forum or upcoming PDC events, please contact Proserfina Bennett at: [pbennet@maine.edu](mailto:pbennet@maine.edu) | 207-581-2281.

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## Around UMaine

### Maine College of Engineering, Computing, and Information Science

*A statewide, integrated solution to providing the technical workforce and innovations that are critical to moving Maine's economy forward.*

**MCECIS is focused on the future:** High-performing, impactful public higher education service has to include anticipating state workforce needs and delivering solutions that provide critical industries, communities, and employers with the skilled workers needed to meet demand and move Maine forward. It is about providing the number of graduates with the requisite skills to maintain our state infrastructure and institutions, pursue opportunities in emerging markets, and grow the Maine economy.

**MCECIS will deliver solutions:** Thousands of new engineering and computing graduates are needed to replace members of Maine's existing workforce and to fill new jobs that will have to be created in our increasingly interconnected, digital global economy. The development of the Maine College of Engineering, Computing, and Information Science is a transformational, forward-looking approach to planning and solution delivery for the University of Maine System.

**MCECIS is a statewide approach:** The UMS TRANSFORMS MCECIS initiative is led by UMaine College of Engineering Dean Dana Humphrey, Professor and UMaine School of Computing and Information Science Director Penny Rheingans, and Dean and Professor of the USM College of Science, Technology, and Health Jeremy Qualls. It seeks a statewide solution that will provide additional undergraduate engineering programs at the University of Maine and University of Southern Maine, UMaine graduate engineering programs offered in Portland, expanded pathways into the statewide college from all University of Maine System universities, community colleges, and K-12, and new opportunities for shared programs, interdisciplinary structures, and partnerships.

### Fernald Engineering Education and Design Center



The initiative also includes renovations to UMaine's engineering education infrastructure in addition to the new Fernald Engineering Education and Design Center in Orono, slated for completion in summer 2022.

The E. James and Eileen P. Fernald Engineering Education and Design Center (FEEDC) is a multi-use academic and laboratory building destined to become the heart of undergraduate engineering education at the University of Maine. This three-story, 107,000-square-foot state-of-the-art facility will help meet

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## Key PDC Contacts

If you have questions or would like more information about what you have read in this first issue of the newsletter, please don't hesitate to contact one of our staff.

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