MAINE Process Development Center
Innovate. Validate. Commercialize.

PDC October 2018 Newsletter

Welcome to the first edition of the PDC's newsletter. While the majority of the work conducted at the PDC is with clients and is therefore confidential, the PDC staff is active in conducting research and upgrading PDC facilities. As the PDC's new director, I want to make sure that our clients and stakeholders are aware of these activities, as they expand the expertise available at the PDC, and provide more opportunities for research to transform the pulp and paper industry.

Newsletters will be issued each quarter, and will focus on several key areas:

IN THIS ISSUE:

Subscribe

- New PDC Equipment & Capabilities – Upgrades to the pilot plant, new

equipment as well as new expertise in technical areas.

- PDC Research Projects – PDC staff are regular contributors to research projects, primarily funded through grants. PDC staff also collaborate with scientists across campus on a variety of topics. We will feature results from project work in each issue.
- News from PDC's Cellulose Nanofiber Pilot Plant – The PDC operates a near one ton per day plant and provides samples to researchers around the world. Each issue we will feature news about this exciting area.
- Focus on IP – Over the years, PDC staff have developed and patented many findings. Each issue will feature one of these areas.
- Features on PDC Staff – The PDC staff are the most important part of the PDC. Each issue we will feature news and updates about a member of our great team.
- PDC Events – Events hosted by the PDC or attended by PDC staff
- Around UMaine – Each issue will feature a technical finding or research group around the University of Maine that may be of interest to our clients and stakeholders.

We welcome your feedback on this newsletter. Please don't hesitate to reach out to me or one of our staff – we look forward to seeing you at the PDC!

Colleen Walker, Ph.D.
Director, Process Development Center
Colleen.Walker@maine.edu, 207-581-2387
umaine.edu/pdc

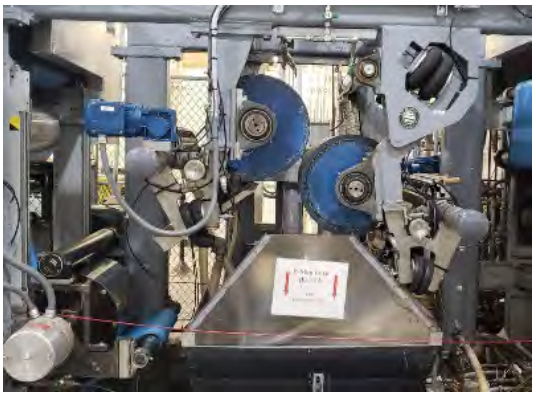
New PDC Equipment & Capabilities

Rod Metering Size Press

The PDC's upgraded size press offers additional flexibility for paper machine trials.

If you have not been to visit the PDC lately, you will not have seen the upgraded size press. Last fall, the PDC replaced its conventional, puddle-type size press with a more modern, rod-metering size press with both grooved and smooth rods. The previous size press at the PDC was a "puddle type" applicator which is limited to applying low solids, low viscosity solutions to the paper. The new size press unit was designed to be capable of applying both low and high solids coatings over a wide range of rheologies. This upgrade

enables better simulation of commercial operations, validation of new paper coating technologies, and development of novel experimental products with an array of coating formulations and materials. In addition, the new module significantly improves efficiency and reduces the time required to produce prototypes for market testing.



In addition, the coating make-down area to support the new size press was upgraded and expanded. This improves the efficiency of coating make-down, allows proper cooking of coating binders, and permits demonstration of novel technologies that could not be evaluated with previous equipment.

This upgrade was made possible through funding from the Maine Technology Institute and the Maine Technology Asset Fund. Paperchine, an AstenJohnson Company, engineered the size press module and provided start-up support. The BTG Group provided metering rods and doctor blades, and SchaeferRolls manufactured roll covers.

New Press Produces CNF at 15% Solids

The PDC has produced over 15 tons of CNF cake using a plate and frame press.

When the PDC first began producing CNF, it was most readily available as a 3% slurry. This made sending larger volume samples, particularly overseas, impractical. The PDC can freeze dry or spray dry CNF, but freeze-drying & spray-drying are done on a small scale, and they both alter some of the properties of the CNF.

In 2016, the PDC purchased a commercially available plate and frame press as part of a NSF-funded project. PDC Staff experts Mark Paradis and Donna Johnson conducted a research project to evaluate the potential of dewatering CNF with this new press.

Their work, reported at TAPPI Nano 2018 in Madison, Wisconsin, showed that

CNF produced from northern bleached softwood kraft pulp, pressed to either 16% or 19% solids, performed nearly equally to that of the 3% traditional slurry.

With this new plate and frame press, the PDC has produced well over 15 tons of CNF product. One pound samples are available for $100 per pound (plus shipping), and can be requested using the online order form. For bulk volumes, CNF at 15% solids is available for $2,200 per metric ton. If you are interested in bulk volumes, please call the PDC directly for more information.

For more information regarding PDC equipment & capabilities, please contact Mark Paradis at: mparadis@maine.edu | 207-949-4175

Return to Top

PDC Research Projects

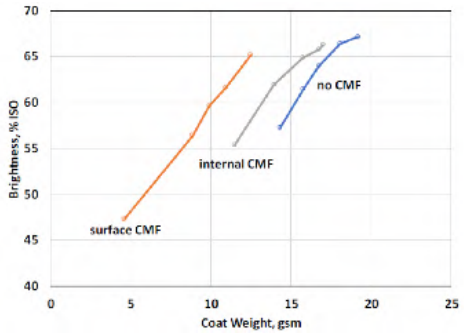
CNF Surface Addition Enhances Coating Holdout

Coat weights are reduced when applying CNF to the surface.

The PDC has explored adding CNF to the base sheet to gain improvements in strength properties. When the CNF layer is added to the top of the sheet, there is an improvement in smoothness and porosity. In a recent presentation at TAPPI Nano 2018 in Madison, Wisconsin, Donna Johnson reported on her work with Mark Paradis in applying CNF to the surface of the base sheet to improve coating holdout.

Paper base stock for this work was produced on the PDC's pilot paper machine using a unique secondary headbox design to apply CNF and other slurries to the wet sheet. Coating was performed on the PDC's Faustel coater.

Work from this project showed that to achieve a given brightness, lower coat weights were needed when CNF was previously applied to the surface of the sheet. Similar results were found when running both bleached and unbleached grades.



The graph shows brightness levels for unbleached grades when CNF was

added in the base stock (internal) and to the surface (using secondary headbox) as compared to no CNF addition.

If you would like to know more about this project, please contact Donna Johnson at the PDC. The PDC has secured additional funding to upgrade the secondary headbox on the paper machine to ensure more even distribution on the sheet. Watch for updates in future newsletters.

For more information regarding PDC research projects, please contact Donna Johnson at: donna.johnson@maine.edu | 207-944-3964

Return to Top

News from the PDC Nano Pilot Plant

Over 100 CNF Production Runs Completed

Over 2,000 hours of operation and over 25 tons of CNF produced.

Opened in 2013, the UMaine Nanomaterial Pilot Plant was a cutting-edge addition to the PDC at Jenness Hall. The pilot plant was funded through a joint venture with the USDA Forest Service and is the only one of its kind in the country. The goal was to accelerate commercialization of cellulose nanomaterials by providing large quantities for researchers and product developers.

The PDC pilot plant contains both an ultrafine grinder (Masuko supermass colloider) and an upgraded refiner lab. The refiner lab contains the patented technology developed by UMaine, which is now available from GL&V. The refiner lab includes high-efficiency pumps, piping and agitators specifically designed to handle the large volume and viscosity of the CNF. The refiner lab can produce up to one ton per day of CNF.

Since 2012, the PDC has completed over 100 production runs producing slurry CNF at 3% solids. Some of this material has been distributed around the world to researchers, but the majority of the CNF has been used by the PDC and PDC clients.

The PDC has cultivated extensive experience over the many years of working

with this equipment. Many different types of fibers have been processed and used in a variety of research projects across campus. Please stop by for a visit or reach out if you have questions.

PDC Distributes Over 4 tons of CNF to over 300 Companies

Samples of CNC and CNF delivered to 43 countries

Since 2013, the PDC has been providing samples of cellulose nanomaterials to scientists around the world. The PDC provides both cellulose nanofibrils, produced in house, and cellulose nanocrystals, produced by the Forest Products Laboratory in Madison, Wisconsin. Materials are available in either a wet slurry, cake or freeze-dried form.

The PDC is very busy sending out samples to researchers around the globe, and represents the scale of global activity using these materials. While our distribution list is confidential, we can share that the PDC has sent samples to over 600 entities in 43 countries.

Distribution	
Companies	305
Universities	276
Others (non-profit, gov't):	49
Total Served:	630

Material	Amount
UMaine CNF	7,381 lbs
FPL CNC	687 lbs
FPL Tempo	11 lbs

To place an order for nanocellulose, please follow the link here to the PDC 'Nanocellulose Request Form' and send a completed form to umaine.pdc@maine.edu.

For more information on PDC nanocellulose production and distribution, please contact Derek Raschke at: derek.raschke@maine.edu | 207-944-0847

Return to Top

PDC IP Spotlight

Over the years, the PDC has conducted research that has resulted in invention disclosures and patentable technology and processes. Each issue, we will summarize one of these inventions.

Improved Manufacturing and Surface Properties of Release Base Papers Using CNF

WO Application # WO 2013/188739 A1 – Release paper and method of manufacture

This technology demonstrates how the addition of cellulose nanofiber (CNF) to the base sheet or surface of release papers can deliver improvements over typical release papers. This invention presents several opportunities for new products, increased productivity on the paper machine, as well as a reduction in silicon loading. This technology was co-developed by the PDC with Bob Hamilton of Stirling Consulting.

The patent includes two examples to demonstrate the invention. In the first example, several furnishes of differing freeness levels were prepared from a softwood/hardwood blend, representing a more traditional furnish for paper as well as higher refined furnishes typical of a traditional release paper grade. When CNF was added to the slightly refined fibers, porosity can be obtained that equals that from more highly refined fibers. This effect can be nearly doubled by adding starch to the CNF. Similar effects were noted when measuring apparent density, shrinkage and smoothness. This provides an opportunity to save refining costs to produce a base sheet of similar properties.

The second example demonstrates how performance of the release paper can be improved by adding CNF to the base sheet. Two different papers were produced on the PDC pilot paper machine – one at a low freeness level and one at a higher freeness level. A CNF-starch mixture was added to the lower freeness level paper. The resulting papers were then silicone-coated and a staining technique used to determine bleed through. The CNF-starch containing paper demonstrated a remarkable ability prevent the test stain from penetrating the silicon-coated layer as compared to the higher refined paper. This discovery offers the potential to reduce the amount of silicon added to the release paper base.

These findings offer specialty paper producers advantages to develop new products and businesses as well as reduce energy costs. If you are interested in this technology or other PDC patents, please contact the PDC Licensing

Officer, Kris Burton, Director, Technology Commercialization at kris.burton@maine.edu or 207-581-1488.

Return to Top

PDC Staff

Congrats to Donna Johnson and Mark Paradis

Two PDC experts recognized for their achievements

The PDC is pleased to announce the Donna Johnson, Ph.D. has been promoted to Research Manager. In Donna's new role, she is responsible for managing the PDC's research program. The PDC maintains a small yet robust research program funded by local and federal grants. PDC staff also collaborate with other researchers on campus or at other research institutions on projects. Donna will continue to work with PDC clients to execute client projects.

The PDC is also pleased to announce that Mark Paradis has been promoted to Operations Manager for the PDC. In Mark's new role, he is responsible for overall operations of the PDC, with a key focus on safety and productivity. Mark will also continue to work with PDC clients to execute projects.

Both Mark and Donna have worked for the PDC for many years. Their dedication to the PDC provides continuity for PDC clients, and an in-depth knowledge of PDC capabilities. Both Donna and Mark are highly valued staff,

and their service to the PDC and UMaine is greatly appreciated. Please join us in congratulating Donna and Mark!

Return to Top

PDC Events

PDC Hosts Inaugural UMaine Cellulose Nanomaterials Forum

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

In August this year, the PDC hosted the first UMaine Cellulose Nanomaterials Forum. This was the first time that researchers across campus gathered to share experiences producing and using cellulose nanomaterials. This event served to strengthen the on-campus community, but future events are planned which will be open to industry.

The PDC wanted to make sure that researchers understood the wide variety of CNF “flavors” that can be produced at the PDC. CNF can be made from a wide variety of fiber sources, utilizing chemical or enzymatic pretreatments, and produced to varying fines level. This gives researchers lots of options. UMaine researchers are exploring a wide range of applications, including a host of composite materials, bone replacements, cement additives, and barrier films. Forum participants represented several colleges:

- College of Engineering – Chemical Engineering, Biomedical Engineering, Civil Engineering, Environmental Engineering
- College of Liberal Arts & Sciences – Chemistry
- College of Natural Sciences, Forestry, and Agriculture - Forest Resources, Food & Agriculture
- Forest Bioproducts Research Institute
- Advanced Structures & Composites Center
- Laboratory for Surface Science & Technology
- Process Development Center

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

The PDC will be hosting more forums and other events to increase collaboration across departments. With so many people using these materials, and these materials still new and not well characterized, it is important that knowledge be shared. The next internal forum is planned for January 2019, with smaller events like student poster sessions being planned for the fall. In Spring 2019, a larger event is being discussed to bring in Maine companies and other organizations to showcase UMaine's activities using cellulose nanomaterials.

For more information on the Cellulose Nanomaterials forum or upcoming PDC events, please contact Proserfina Bennett at: pbennet@maine.edu | 207-949-4176

Return to Top

Around UMaine

Additive Manufacturing

UMaine expertise in wood-based 3D printing materials and metal additive manufacturing.

Additive manufacturing is the latest technology advancement that is transforming manufacturing to become more flexible and efficient. UMaine is building capabilities

to support industries interested in leveraging this expanding technology.

For the past 18 years, the UMaine Advanced Structures and Composites Center has been developing technologies to extrude plastics filled with wood cellulose and nanocellulose fibers.

These plastics contain up to 50 percent wood fiber by weight. This technology is directly transferable to large scale 3D printing and will drastically reduce the cost of feedstock materials compared to carbon or glass fiber filled thermoplastics. Lower cost feedstocks will broaden the range of industries that can benefit from large scale 3D printing, such as composite tooling for marine applications. For more information, please contact James Anderson at james.m.anderson@maine.edu or 207-518-2817.

The Advanced Manufacturing Center (AMC) at UMaine has launched a Center for Additive Metal Manufacturing (CAMM). CAMM will provide industry focused technical and engineering services, with additional research and work force development training for the technology.

A additive metals 3d printer and sintering oven are scheduled to arrive in January 2019, along with a metallurgical microscope, sample preparation equipment. A high definition FARO laser 3D scanner has arrived and is in use. One of the key objectives of the center will be helping industry rapidly understand and use this new additive technology. For more information, please contact AMC Director John Belding at john.belding@maine.edu or 207-581-2717.

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.

Operations Manager: Mark Paradis, mparadis@maine.edu, 207-949-4175

donna.johnson@maine.edu, 207-944-3964
Administrative Coordinator: Derek Raschke, derek.raschke@maine.edu, 207-944-0847
Managing Director: Proserfina Bennett, pbennett@maine.edu, 207-949-4176
Director: Colleen Walker, colleen.walker@maine.edu, 207-581-2387

Return to Top

Process Development Center
Research Manager: Donna Johnson,
5737 Jenness Hall, University of Maine, Orono, ME 04469
(207) 581-2237 | umaine.edu/pdc

Unsubscribe