Biobased Materials for Advanced Manufacturing

October 14th, 2022

Agenda

Time	Presentation	Presenter	Organization
10:00 – 10:05	Opening	David Turpin	APPTI
10:05 – 10:15	Introduction to Hub and Spoke Program	Soydan Ozcan	ORNL
10:15 – 10:25	An Overview of Oak Ridge National Laboratory and University of Maine's Technical Collaboration Process	Greg Simms	University of Maine
10:25 – 10:40 *(10 min presentation, 5 min Q&A)*	Biobased Materials and Advanced Manufacturing in Architectural Design	John Cerone	SHoP Architects
10:40 – 10:55	Supercomputing for Nanocellulose	Jeremy Smith	ORNL
10:55 – 11:10	Nanocellulose Dewatering/Drying Technologies and Energy Improvement	Douglas Gardner	University of Maine
11:10 – 11:25	Promising Applications for Cellulose Nanofibrils	Mehdi Tajvidi	University of Maine
11:25 – 11:30	Wrap-up	Susan MacKay	University of Maine

1) **Presenter:** Gregory Simms

Title: An Overview of Oak Ridge National Laboratory and University of Maine's Technical Collaboration Process as Funded through the Department of Energy's Hub and Spoke Program

Abstract: The Department of Energy's Hub and Spoke Program, through the use of technical collaborations, provides companies with US based operations an opportunity to leverage the significant research and development capabilities of its Hub and Spoke partners. The goals of the program are to decarbonize industrial processes, advance manufacturing technology and develop regional economic hubs. The first such partnership combines Oak Ridge National Laboratory's (ORNL) development of 3D printing technology with the University of Maine's knowledge of cellulose applications to further the development of biocomposite feedstocks for large area additive manufacturing. This presentation will provide an overview of the technical collaboration process for companies looking for opportunities to advance their R&D efforts in these areas.

2) **Presenter:** John Cerone

Title: Biobased Materials and Advanced Manufacturing in Architectural Design

Abstract: Innovations in Material, Process and Manufacturing are providing new opportunities for Architectural Design to tackle rising environmental and social challenges. SHoP's previous experience with Additive Manufacturing (AM) - at the time the largest AM pavilion for the opening pavilion of the Design Miami festival- was successful in its efforts towards proving a digital delivery process pipeline. A continued pursuit of innovative design for manufacturing methods, and the incubation of AssemblyOSM dedicated to off-site manufacturing for post modular residential building has exposed new opportunities for both AM and biomaterial to play a revolutionary role in providing components and sub-assemblies for those building systems. The ability to utilize AM systems to replace labor-intensive build-ups, and plug into other-trade assemblies, allows for a unique Design for Manufacturing (DfMA) that engages well with a distributed supply-chain strategy. Biobased materials on their side offer a unique opportunity to reduce overall embodied carbons emissions and plug into the larger environmental potentials offered by modular construction. The specific case study is looking at the viability and benefits of replacing traditional multimaterial floor cassette sub-assemblies with their wood flour-filled polylactic acid AM equivalent within a pipeline of mid-to-high rise Off Site Manufactured residential building in urban centers.

3) **Presenter:** Jeremy Smith

Title: Supercomputing for Nanocellulose

Abstract: Oak Ridge National Laboratory (ORNL) has been a world leader in high-performance computing for over 25 years, and houses the world's most powerful supercomputer. Supercomputers are particularly useful in performing molecular dynamics simulations of large systems at atomic detail. We show how computer simulations using ORNL supercomputing have been used to guide research on cellulose and lignin, particularly from the point of view of solvent-based lignin and cellulose solubilization.

4) **Presenter:** Douglas J. Gardner

Title: Nanocellulose Dewatering/Drying Technologies and Energy Improvement

Abstract: An important process step in the development of composite feedstocks for advanced manufacturing applications is the removal of water from aqueous nanocellulose suspensions. Phase I of the Hub and Spoke research program explored various traditional and novel dewatering/drying technologies to remove water from cellulose nanofibers (CNFs). A major goal of the work is to provide dry CNFs that can be easily compounded in thermoplastic polymer matrices using conventional polymer processing equipment. CNFs are currently produced in aqueous suspensions at 3 wt. %, which means that 97% of the water needs to be removed to provide dry material for further processing. Dewatering methodologies being explored include filter pressing, contact dewatering, and high shear (cold) pelletization. Drying technologies being explored include: conventional and ultrasonic spray drying, super critical CO2 processing, high shear drying, and twin screw extrusion fibrillation and dewatering/ drying. A summary of current status of results on the various dewatering/drying techniques will be presented along with available energy analyses of the various processes.

5) **Presenter:** Mehdi Tajvidi

Title: Promising Applications for Cellulose Nanofibrils

Abstract: Cellulose nanofibrils (CNFs) are a versatile material with a wide range of applications. For these materials to be used in industrial applications however, there is a need to identify and optimize applications where the inherent properties of these materials can be used for maximum benefit. This presentation gives an overview of recent advances in the binder and barrier applications of CNF.