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Thermoformed Molded Fiber Capabilities and Research at the Process Development Center

December 10, 2024

Process Development Center

Innovate ● Validate ● Commercialize

- Fee-for-service contract research center
- Housed in the Chemical & Biomedical Engineering building
- Launched in 1987
- Long history of working with industry
- 9 full time staff
- Fulfill the service mission of the University

Pilot Paper Machine

- 13” reel width
- 10-80 fpm
- 25-200 gsm
- Size press (puddle & metered)
- Secondary headbox
- Production: 1 lb/hour

Current upgrade underway

Faustel Pilot Coater

- 10-100 fpm
- 12” wide
- Bevel blade, bent blade, rod, roll or gravure coating

Refiner Lab

Commercial/pilot scale

- Double disc refiners
  - Two 20”/24” DD 6700
  - One 13”
- Single disc refiner
  - One 20” SD 3000
- Conical Refiners
- Pro 1 and JC-01

Regmed MD-3000 Disc Refiner

Cellulose Nanofiber…*A Platform for Innovation!*

Discovery → **Application Development** → **Commercialization of New Products**

USDA Forest Service

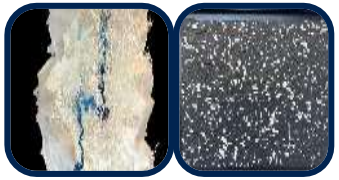
UMaine Researchers & Corporate Partners

Valmet

Replacement for formaldehyde in particleboard

Green replacement for traditional plastics

Coatings to extend shelf life



New media for artists

cGMP CNF Production Run

600 pounds (dry weight) of CNF:

- Hardwood
- 98% fines
- Pressed

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K12 Outreach

CELLULOSE NANOFIBER

Engaging Students using Cellulose Nanofiber

- Teachers get excited about the unique properties – barrier, binder, structural
- Students like the fun texture – like slime, but can also be molded

> "This is the only true science experiment these kids will do in school – where we don't know the outcome!"
>
> *- Jonathan Dumont, 8th Grade Science Teacher, SeDoMoCha Middle School*

We have reached over 800 kids in Maine during the 23/24 academic year via word of mouth

Wet Thermoforming

KIEFEL TECHNOLOGIES

A Member of Brückner Group

Kiefel NatureFormer

- Installed in 2021
- 700 hours, 10,000 articles
- Used by industry clients and researchers

Coming in 2025

- LaCasse & Weston mini production machine

Dry Thermoforming

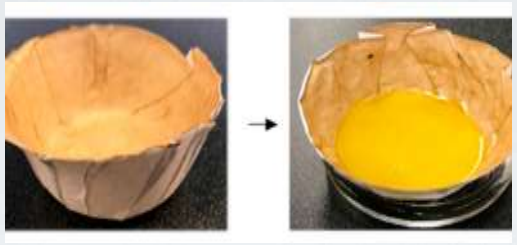
Graylex HTP2620 Hydraulic Test Press

- Installed in 2024
- Used by industry clients and researchers

Thermoformed molded fiber research @LRN

CNF as binder

+



CNF as barrier coating

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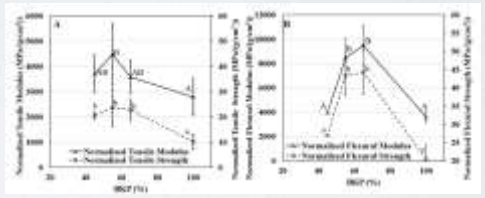
Hybrid molded fiber

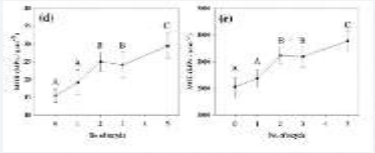
Ongoing research:



- Optimization of pulp/wood flour/CNF content in hybrid thermoformed products

- Supercritical and gas phase post-treatment of hybrid plates to render them water resistant

- Developing CNF/LCNF coating methods for thermoformed molded fiber



- Recyclability of hybrid molded fiber

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Addition to the Pilot Plant at Jenness Hall:
Forest Biomaterials Innovation Center

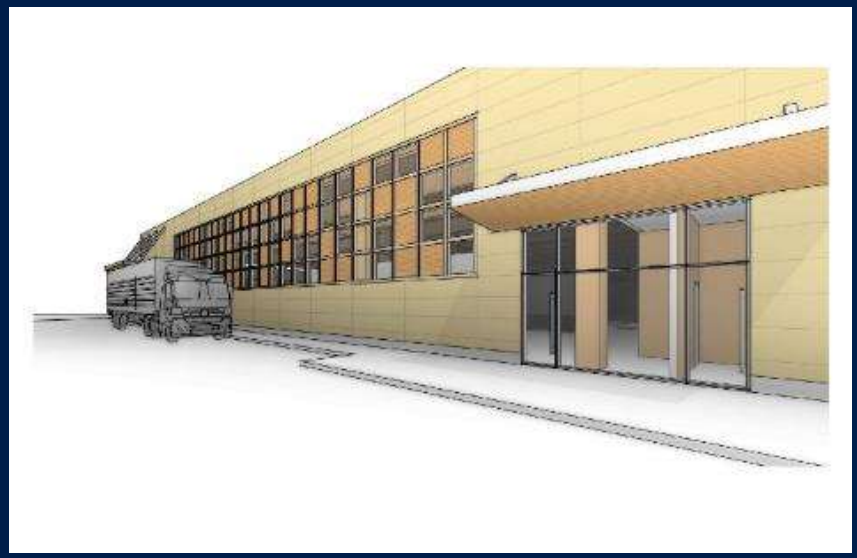
Funding Support: NIST

$10 M Total Investment

$7.425 M construction

$2.5 M for equipment

- Pilot fiberboard machine
- Microwave drying
- 1000-liter reactor for CNF modification
- Slot die coating head
- Mocon WVTR
- Optical tensiometer



What capabilities would you like to see?

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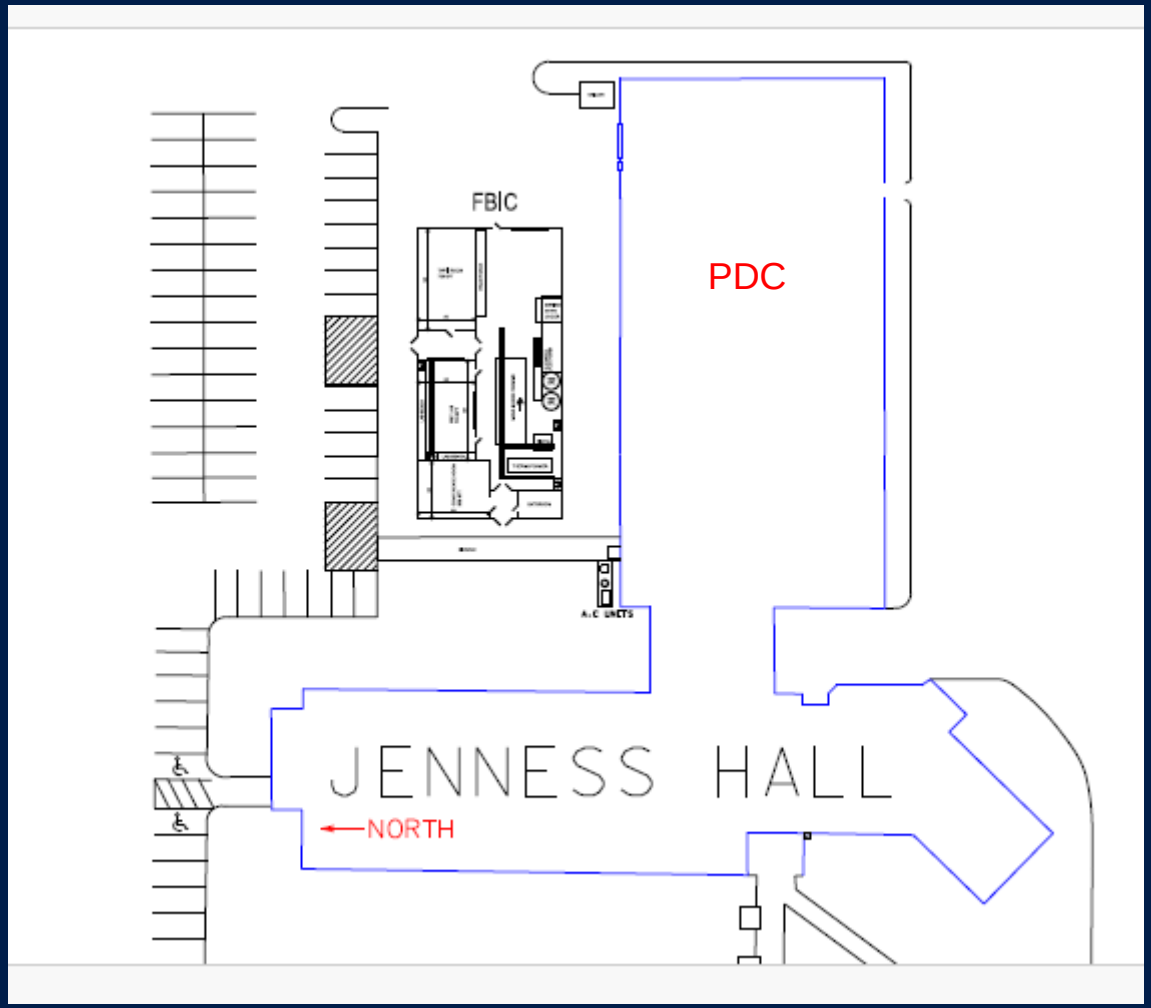
Current Concept



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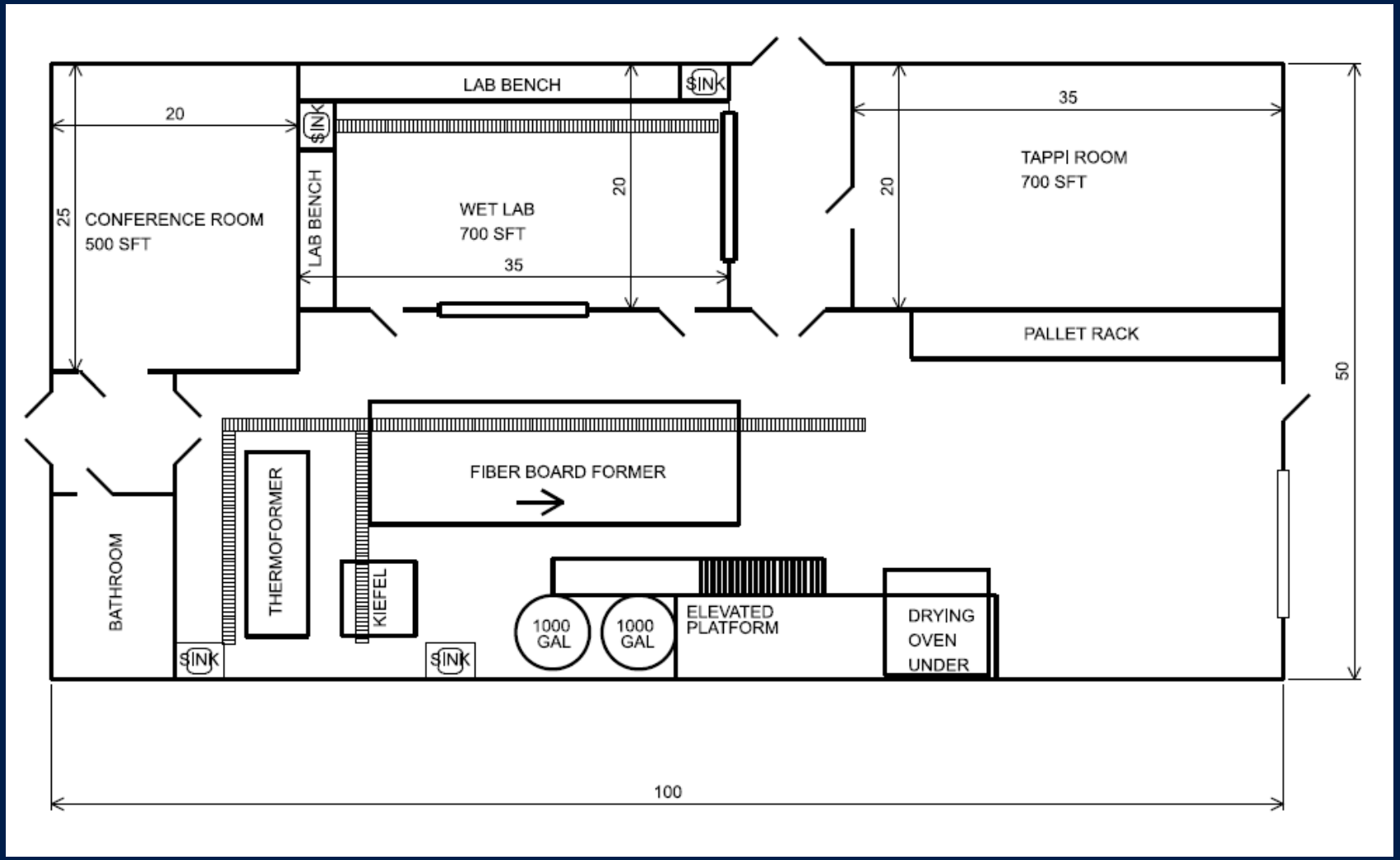
Current Concept



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Sustainable Packaging Initiative
$1.6 M Donation from PCA
Accelerating the transition to renewable packaging

PACKAGING CORPORATION OF AMERICA

Summer 2024

P&G

amazon

Mondelēz International

Tetra Pak

ESTĒE LAUDER COMPANIES

MISSION:

Through industry-valued research, innovation, and education, accelerate the transition to more circular and sustainable (lower carbon footprint) packaging solutions by leveraging paper and other bio-based materials.

Three Focus Areas Defined:

- Sustainable Materials Development
- Prototyping and Scale-up
- Carbon Impact/End-of-Life Testing

Launching January 2025

Donation from BTG/Voith

Focus on Molded Fiber

$150,000 in new testing equipment:

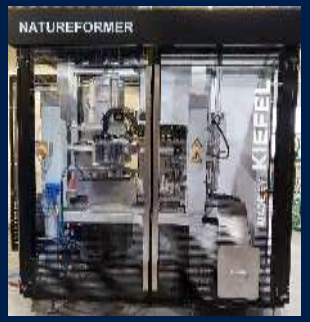
- **Mutek DR-05 - Drainage, Freeness and Retention**
- **Mutek PDC-06 – Particle Charge Detector**
- **Mutek SZP-10 – System Zeta potential**

PDC Research

Research Underway – preparing to publish

Kiefel Thermoformer

- PFAS-free molded pulp trays : effects of pulp type, refining level, and cellulose nanofibril or biowax addition on tray performance



Regmed Refiner:

- Small refiner runs – 2-4 pounds
- CNF production, regular refining
- How compares to SMC and pilot refiners

Impact of Filter Pressing on CNF Properties

- Pressed up to 30%
- Impact on paper properties

New Equipment & Capabilities

Funded thru grants

USDA ARS project

Developing Novel Food Packaging Applications Using Lignocellulosic Materials

- **Graylex press**
- **Recyclability – development of a new standard**

2023 Northern Border Regional Commission Project

Pilot scale production of High-Value Molded Pulp Products to Accelerate the Transition from Plastics to Forest-based Packaging

- **Mini production machine from LaCasse & Weston**

engineered systems
LACASSE & WESTON

Recyclability

SUSTAINABLE PACKAGING COALITION®

A Project of greenblue

TLMI

PAPER PACKAGING RECYCLABILITY COLLABORATIVE

Focused on answering some of the most timely questions that companies are facing as they design innovative new paper-based packaging.

Repulpable and recycling certification now available at Western Michigan University

Cepi RENEWABLE RECYCLED RESPONSIBLE EUROPEAN PAPER

FIBRE BOX ASSOCIATION®

Recyclability

Goal: Support innovation in the use of paper-based materials for packaging by:

- **Develop a lab-based method to determine recyclability**
- **Using common equipment**
- **Is relevant to industry practice**
- **That is repeatable and reproducible**

- **USFS Forest Products Laboratory is leading this effort**
- **UMaine has been involved developing this new, lab scale method**

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Student Posters

Parameters that Influence the Ability of Barrier Coatings to Withstand 3D Dry Thermoforming Events
Bright Appiah, Ph.D. Candidate
Dr. Doug Bousfield

Development of an effective CNF coating process for molded fiber
Nabanita Das, Ph.D. Candidate
Dr. Mehdi Tajvidi

Application of Nanocellulose on Substrate and functional surface modifications
Sandro Zier, Ph.D. Candidate
Dr. Caitlin Howell

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Grant funded by USDA FPL

Sustainable Molded-Pulp Packaging from Hot-Water Extracted Restoration Wood

Aysan Najd Mazhar, Postdoctoral Fellow
Dr. Mehdi Tajvidi & Dr. Colleen Walker

- Develop a benchtop system for producing a standard molded pulp article
- Compare this benchtop standard to articles formed on the Kiefel lab machine
- Develop formulations using the hot-water extracted fibers from forest residuals
- Produce articles on the Kiefel lab machine and characterize performance

Thank you for your support!!

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