



Full-circle Pilot-scale Nanocellulose-based Composite Product Development: an update

Mehdi Tajvidi, Ezatollah Amini, Islam Hafez, Douglas Bousfield, Douglas Gardner, William Gramlich

University of Maine, Orono, ME, USA

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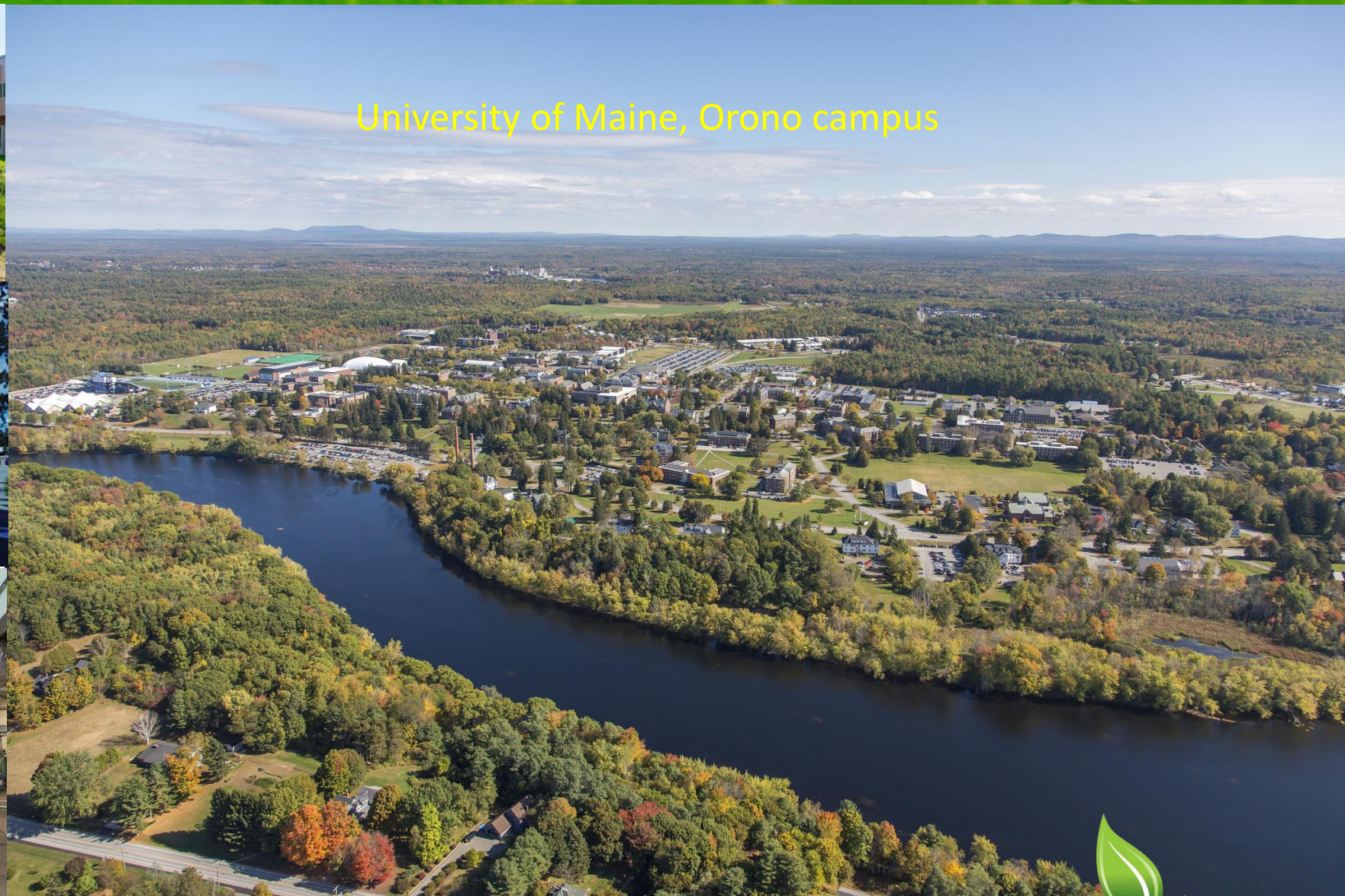
School of Forest Resources



Advanced Structures and Composites Center



FBRI/PDC

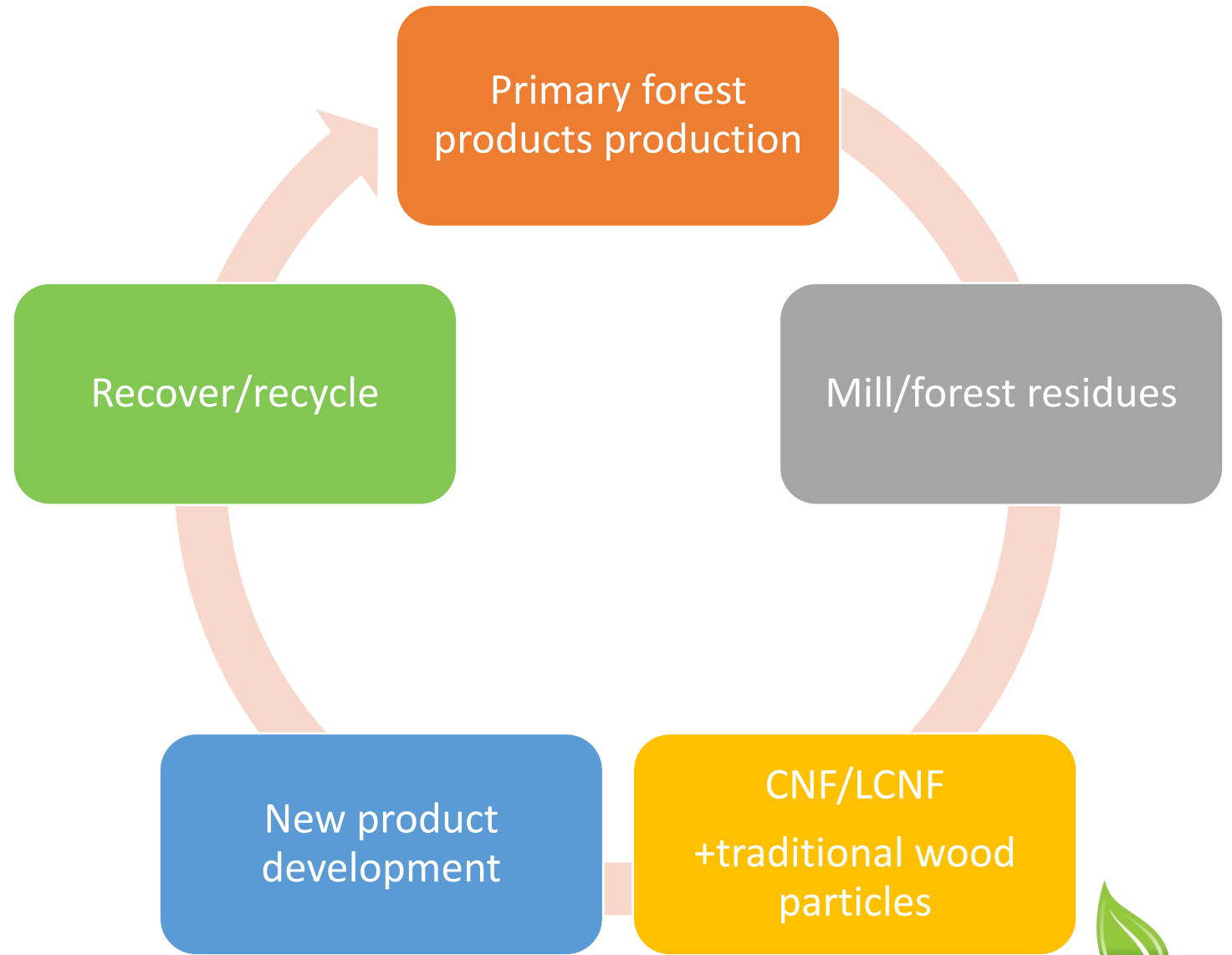


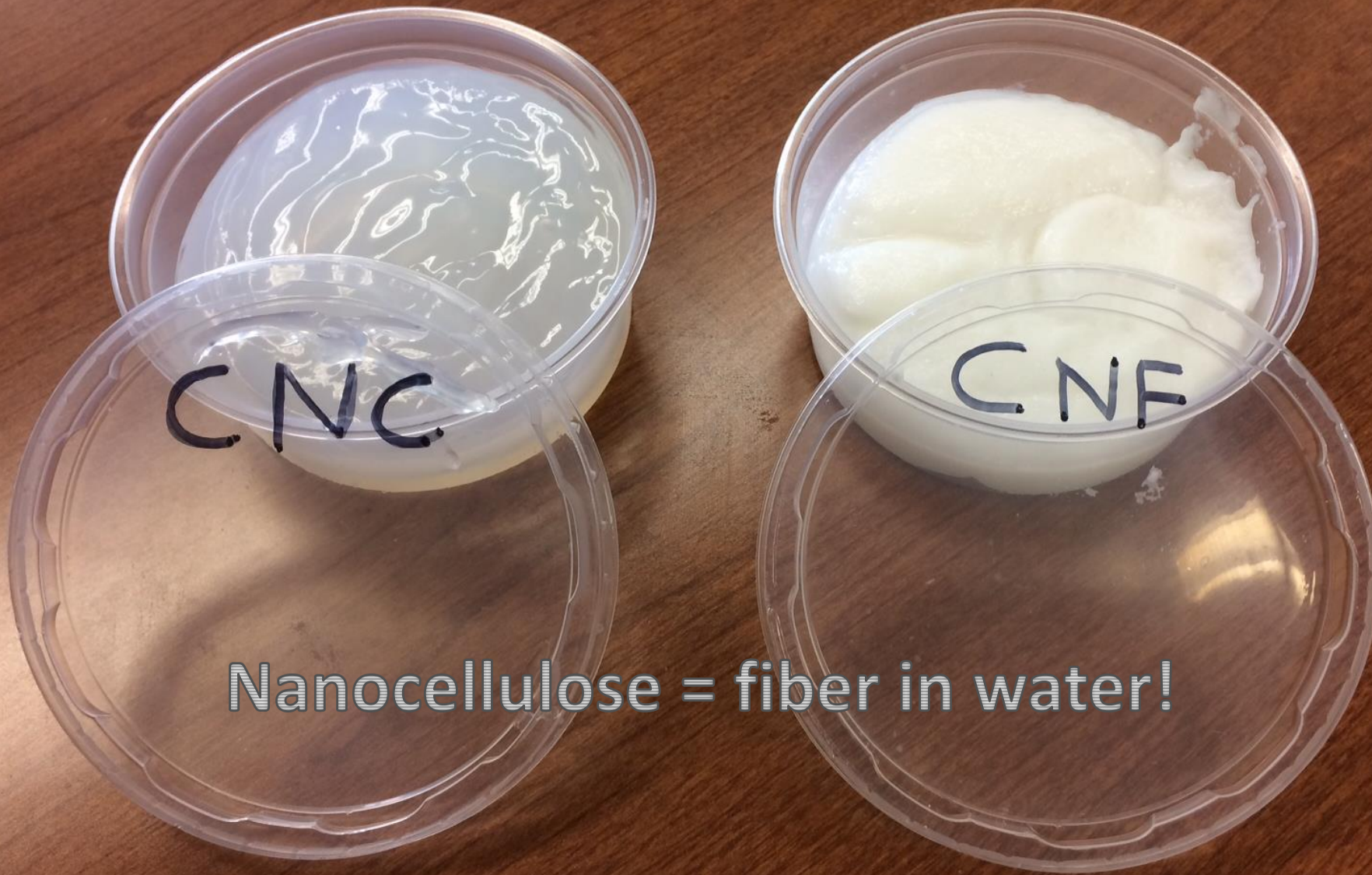
University of Maine, Orono campus

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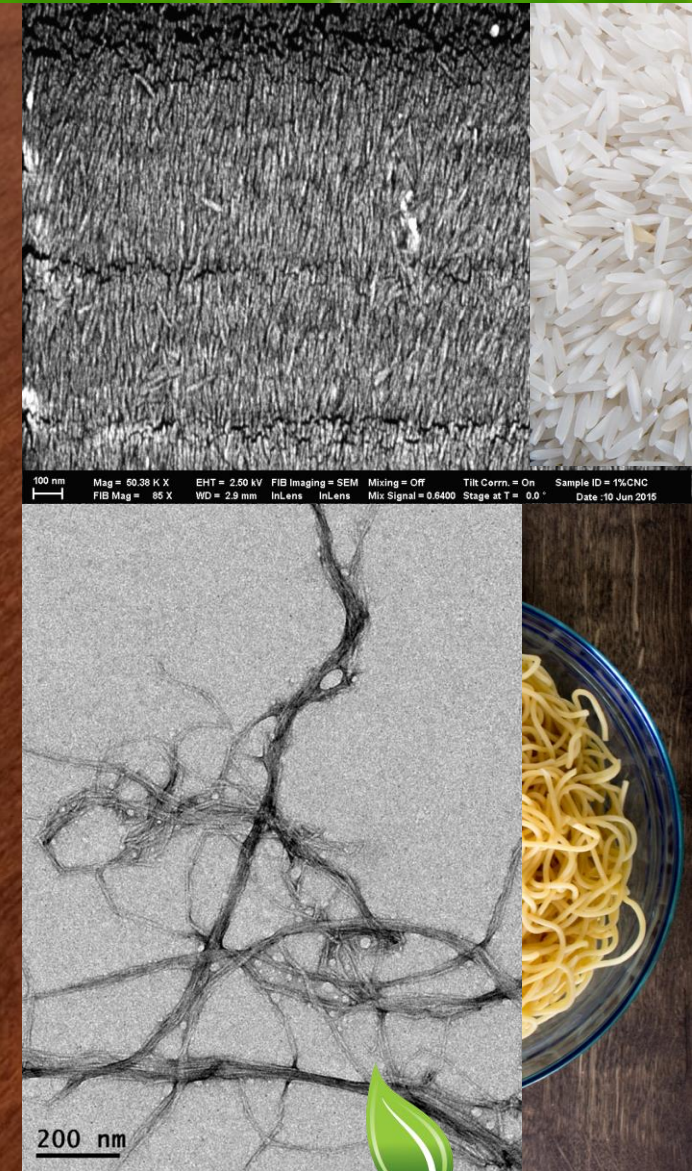


Towards all-wood-based composites by harnessing the intrinsic properties of nanoscale lignocellulosic materials

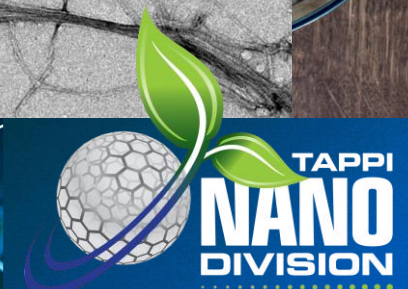


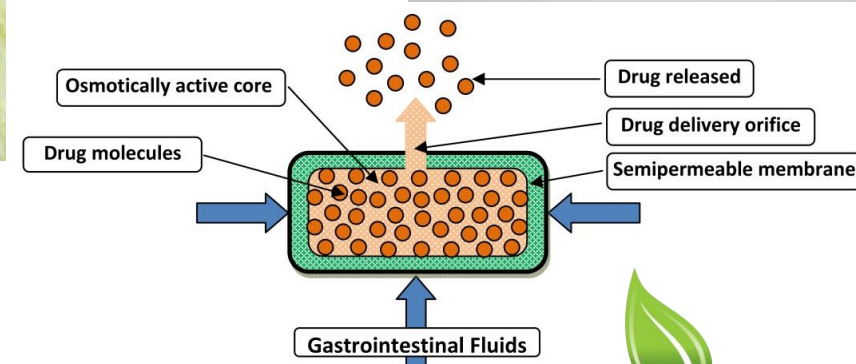
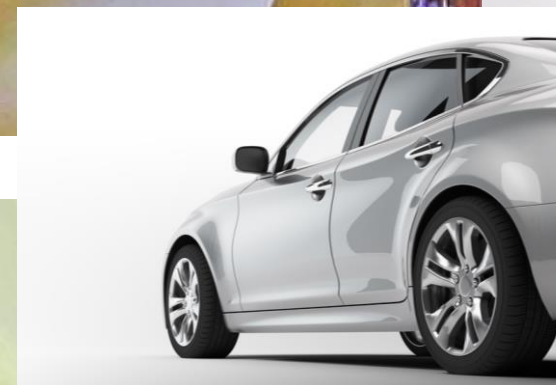
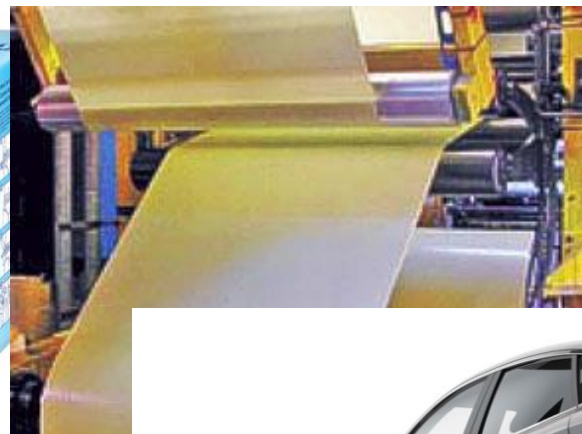


Nanocellulose = fiber in water!



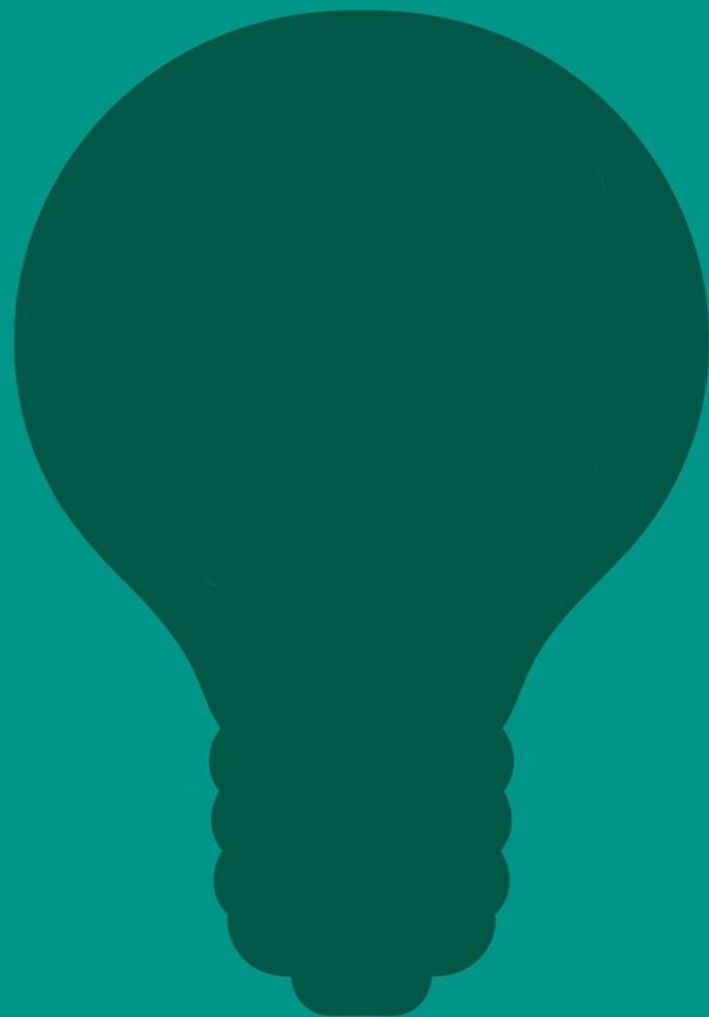
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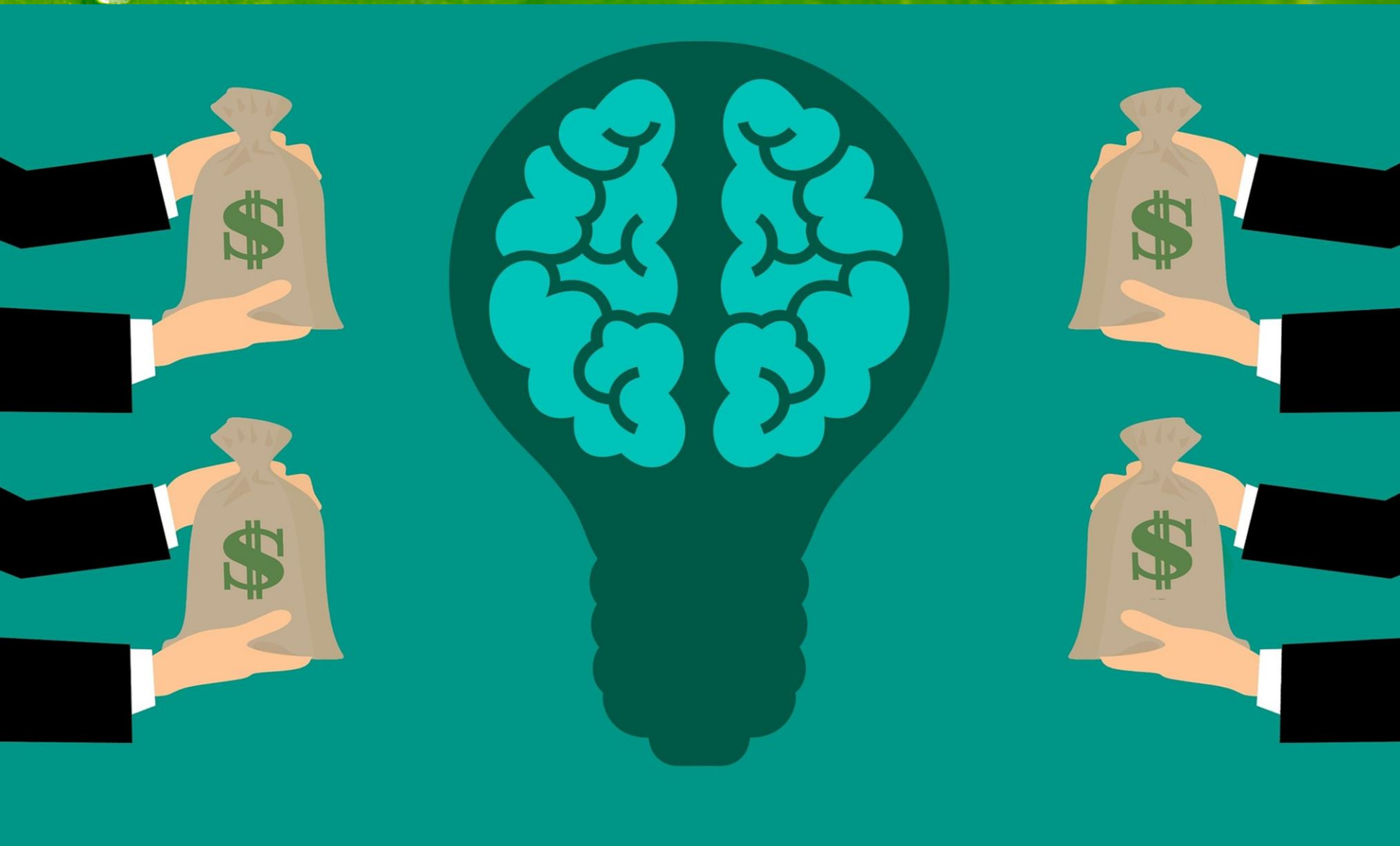




Which
direction
should I go?

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Which
direction
should I go?

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The two options

I Can't Do This.



REPEAT AFTER ME:
“I CAN DO THIS”

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Cost, scale, form



CNF production 1 ton/day



Spray Drying 1 kg/day

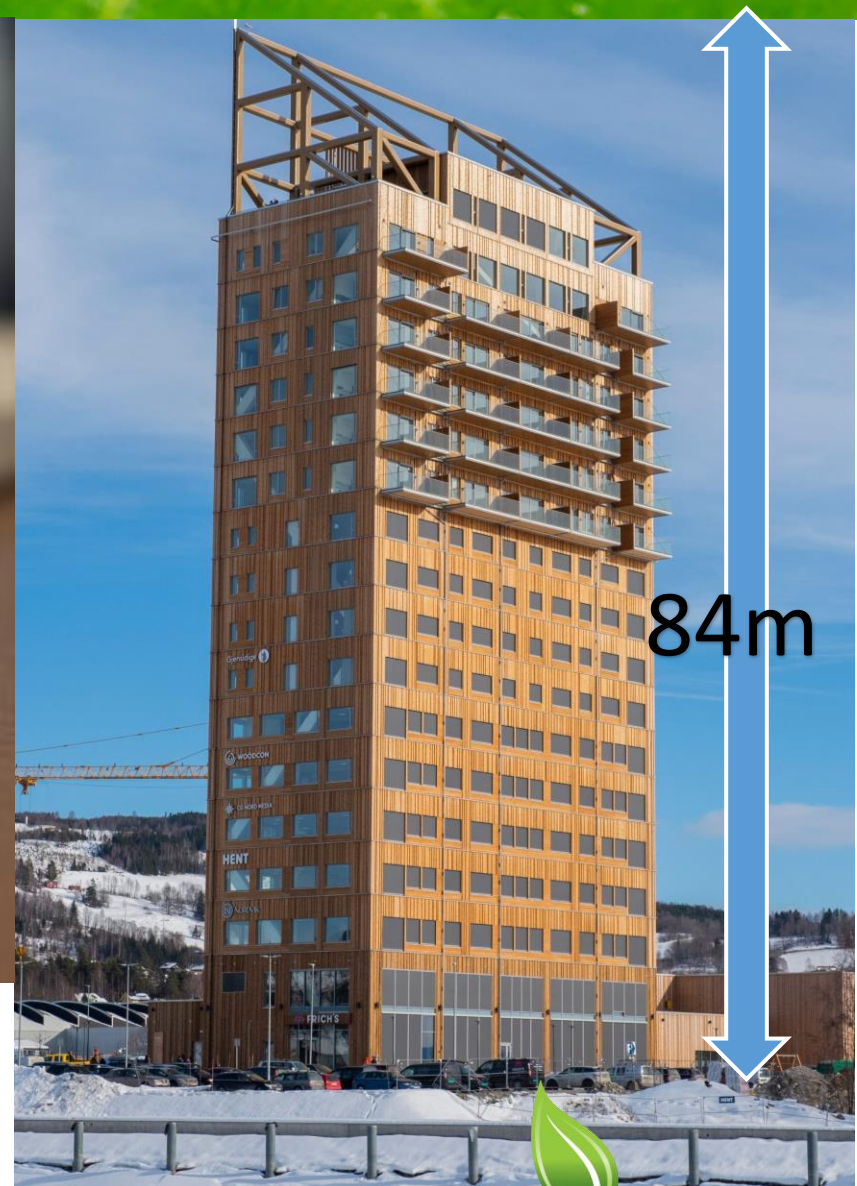
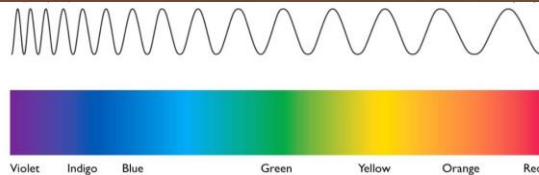
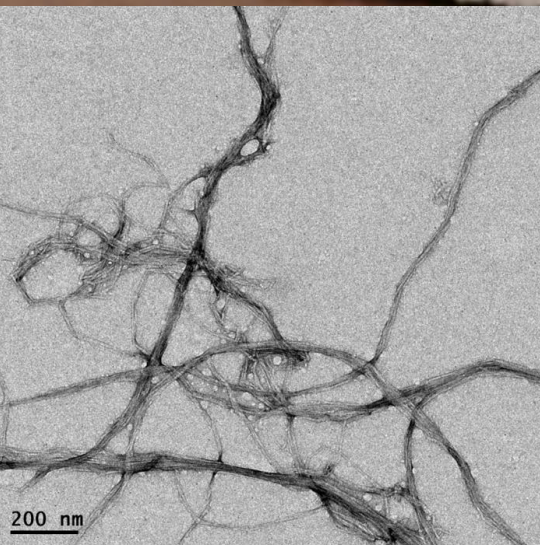
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Research direction @LRN

- Look at what CNF is good at naturally
- Do not dry unless you really have to
- Maintain nano-scale in final product
- Large volume, lower value products
- Make CNF cheaper

Can CNF be an adhesive?



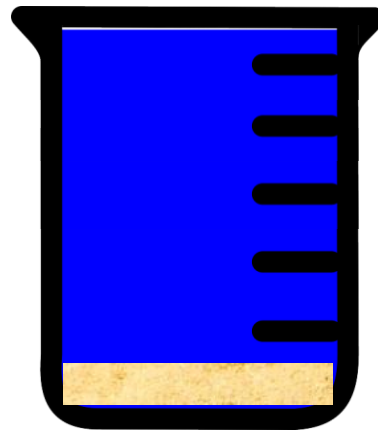
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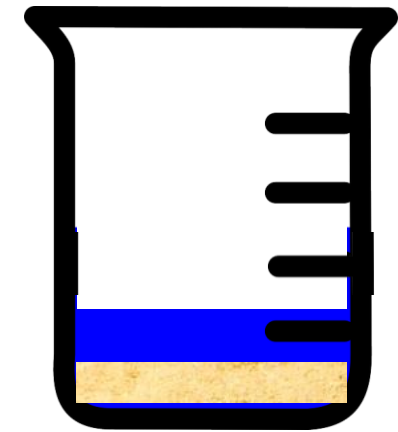
Contact dewatering /'kɒntækt di'wɔ:tərɪŋ / (n): *Removal of water from a CNF suspension upon contact with porous polar surfaces*



15% SC

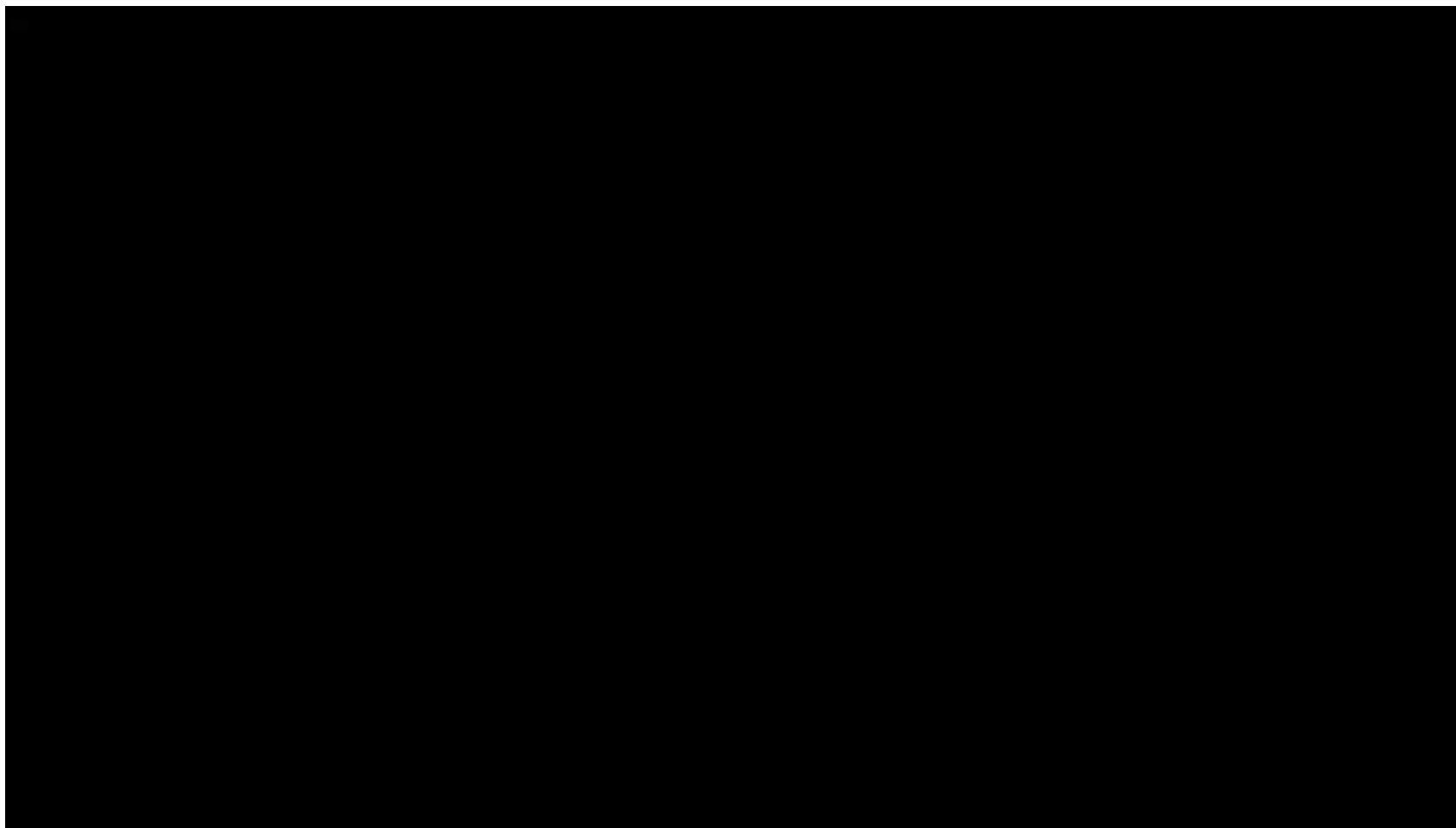


50% SC



2257 kJ/kg energy to evaporate water

Contact Dewatering in Action!

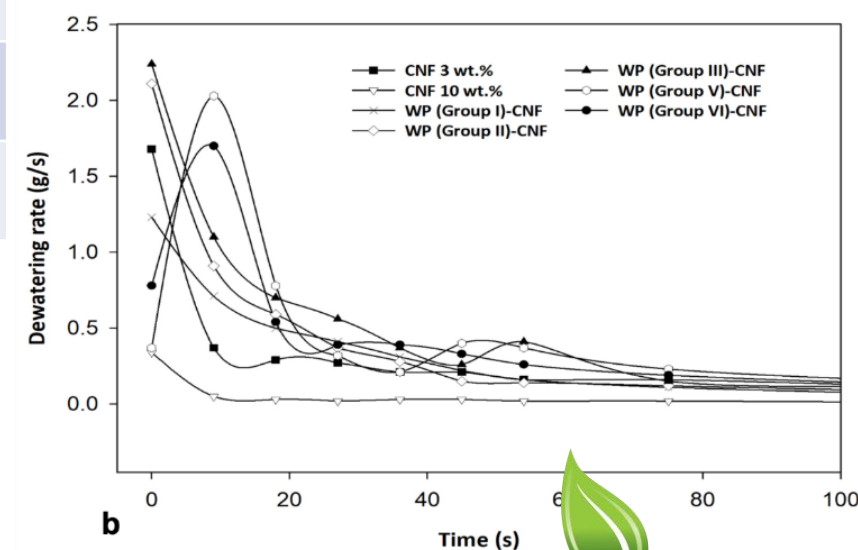
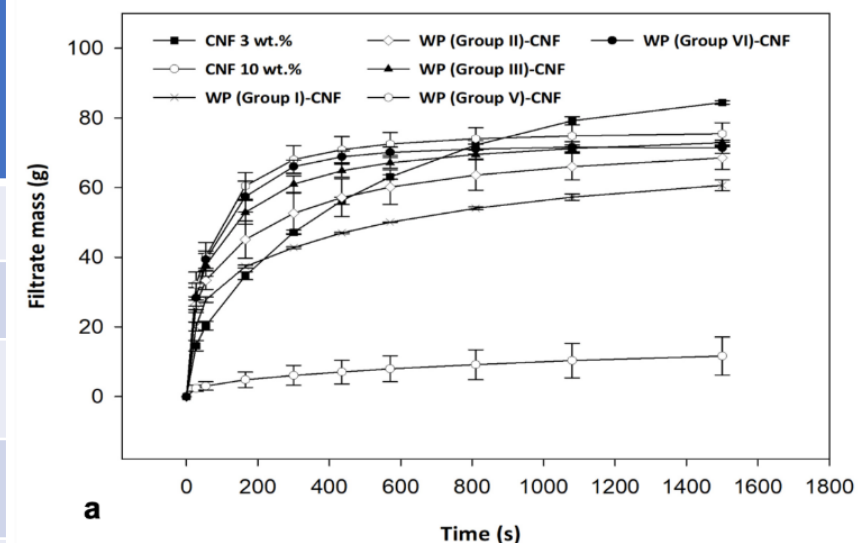


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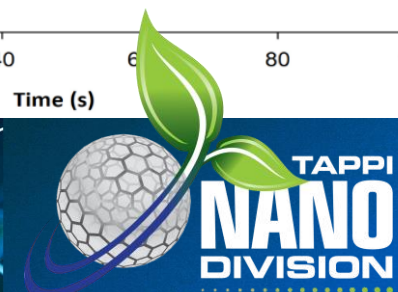
Formulation	Permeability (m ²)			Instantaneous dewatering (g)
	k ₁	k ₂	k ₃	
CNF 3 wt.%	10 ⁻¹⁶	7x10 ⁻¹⁷	1.7x10 ⁻¹⁷	3.3
CNF 10 wt.%	1.1x10 ⁻¹⁷	1.1x10 ⁻¹⁷	10 ⁻¹⁷	0.66
WP (Group I)-CNF	6.5x10 ⁻¹⁶	8.5x10 ⁻¹⁷	4.5x10 ⁻¹⁷	6.61
WP (Group II)-CNF	9.3x10 ⁻¹⁶	8.3x10 ⁻¹⁷	3.3x10 ⁻¹⁷	9.56
WP (Group III)-CNF	6.9x10 ⁻¹⁶	4x10 ⁻¹⁶	2.7x10 ⁻¹⁶	10.59
WP (Group V)-CNF	7.7x10 ⁻¹⁶	5.7x10 ⁻¹⁷	8x10 ⁻¹⁸	8.52
WP (Group VI)-CNF	8.3x10 ⁻¹⁶	2x10 ⁻¹⁷	2x10 ⁻¹⁸	9.55

Average values of permeability over three regions and instantaneous dewatering.

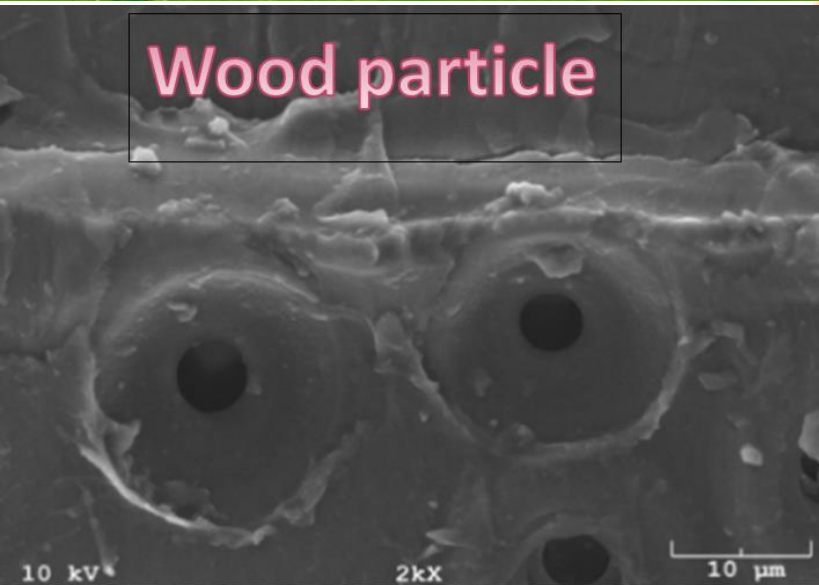


Amini, E. N., Tajvidi, M., Bousfield, D. W., Gardner, D. J., & Shaler, S. M. (2019). *Scientific Reports*, 9(1), 1-10.

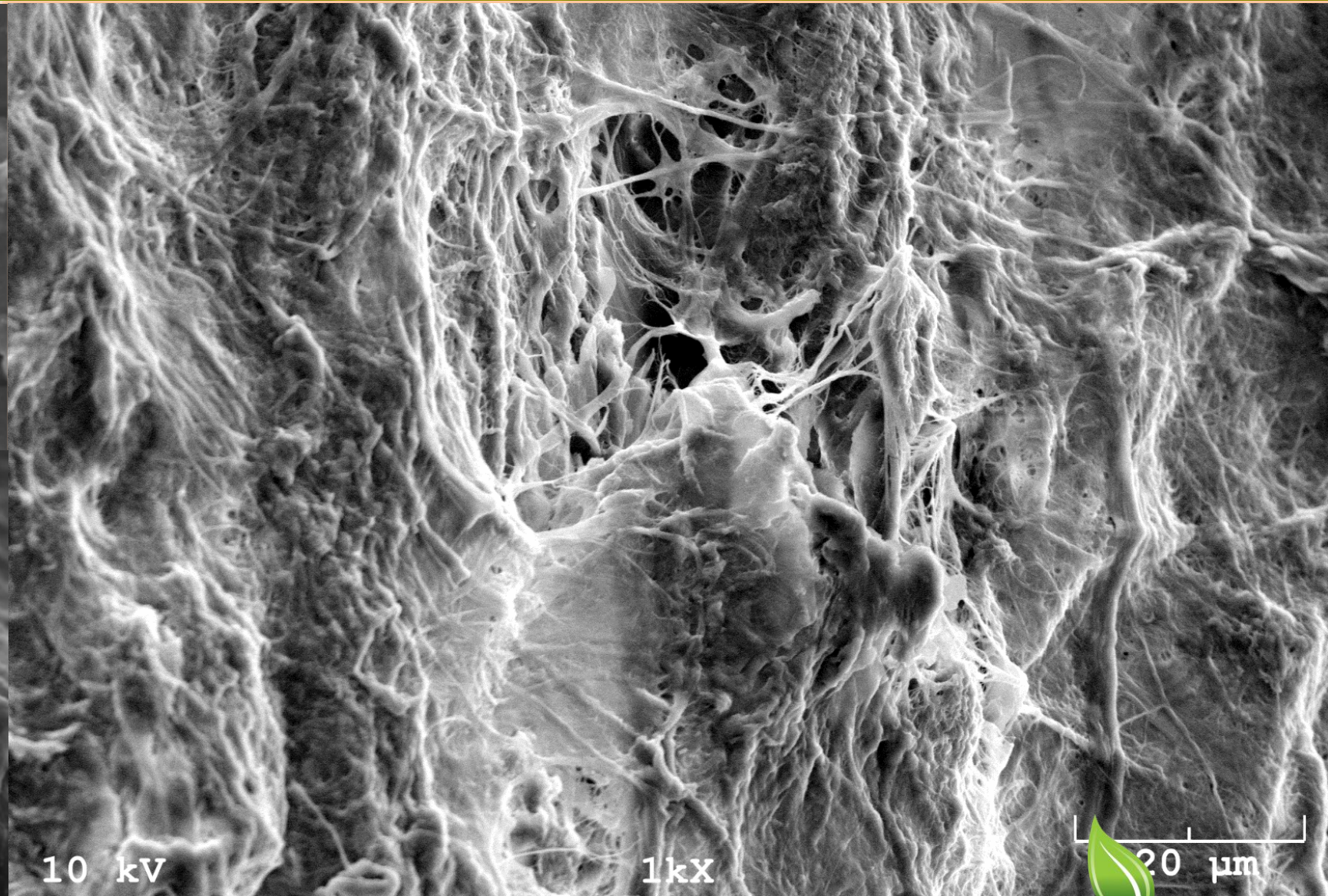
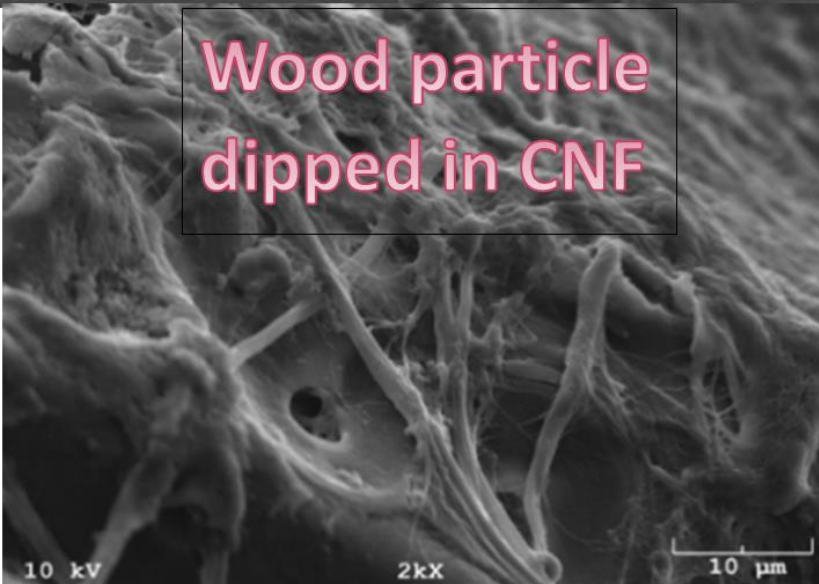
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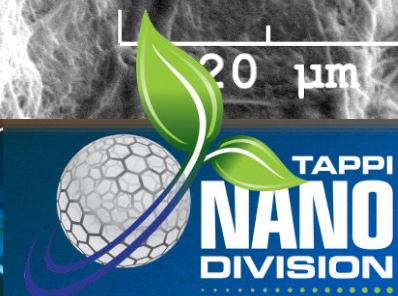
Wood particle



Wood particle
dipped in CNF



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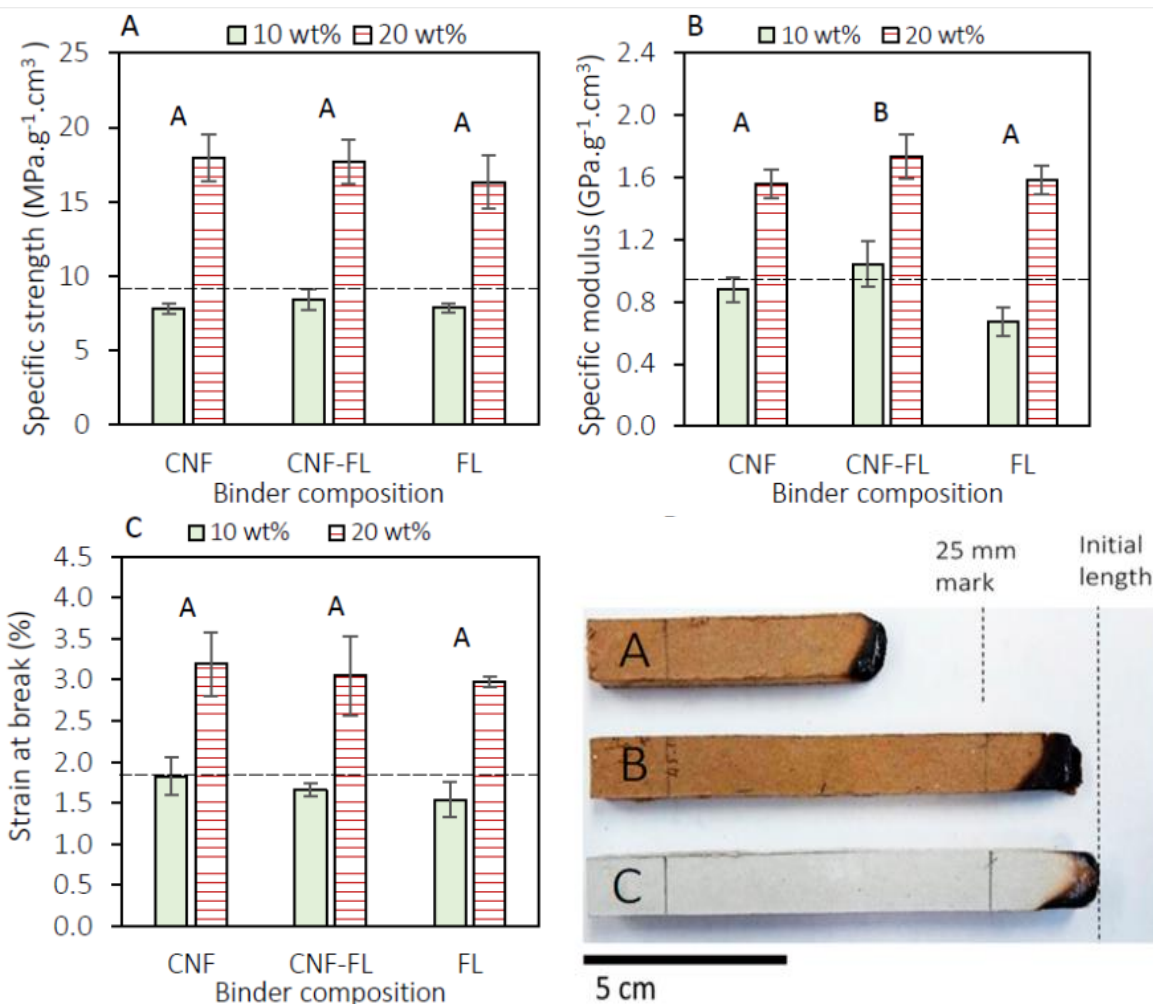




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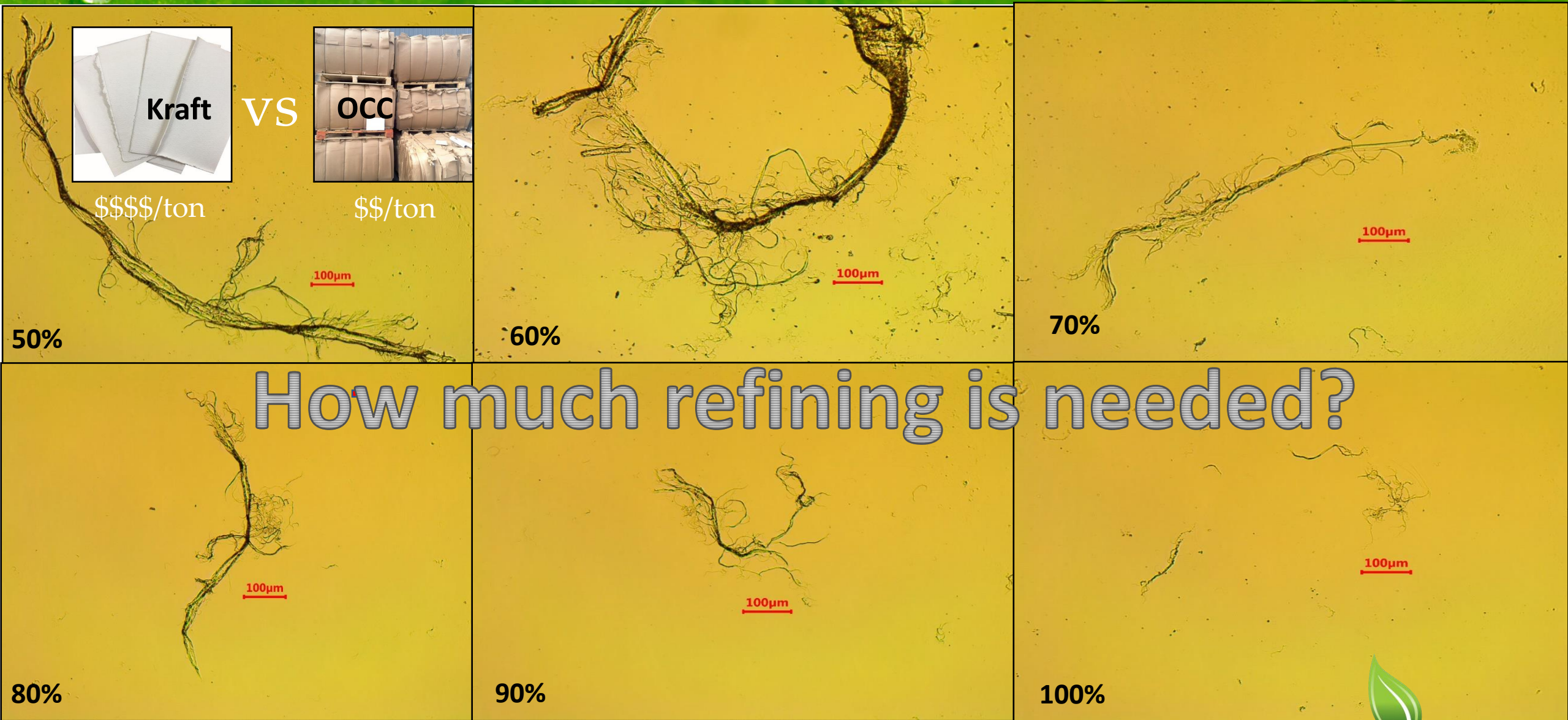
Pilot-scale wallboard production

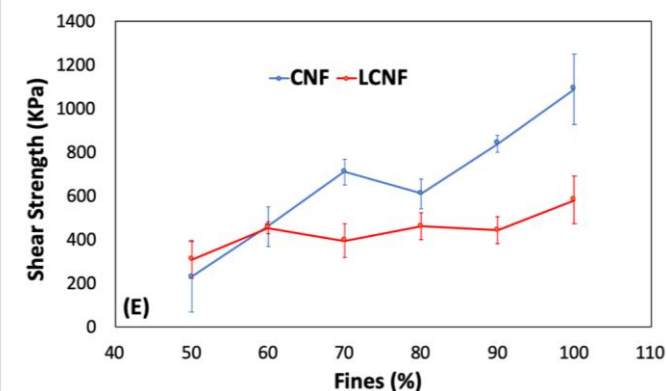
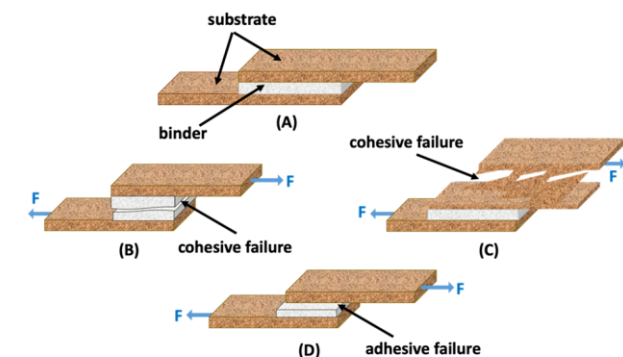
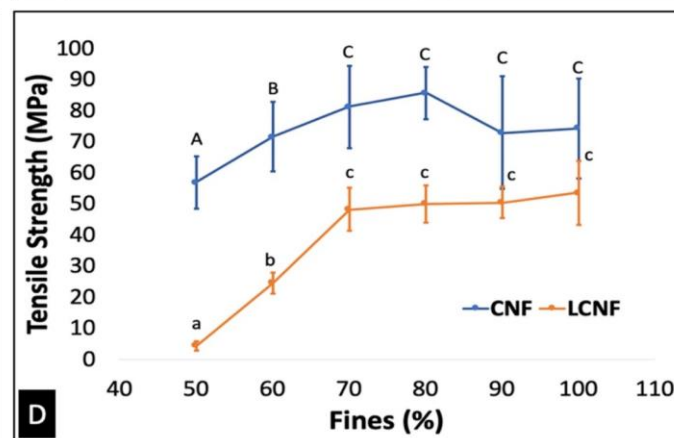
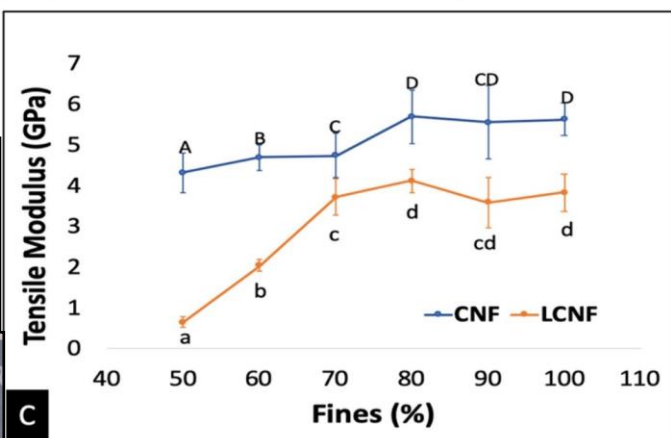
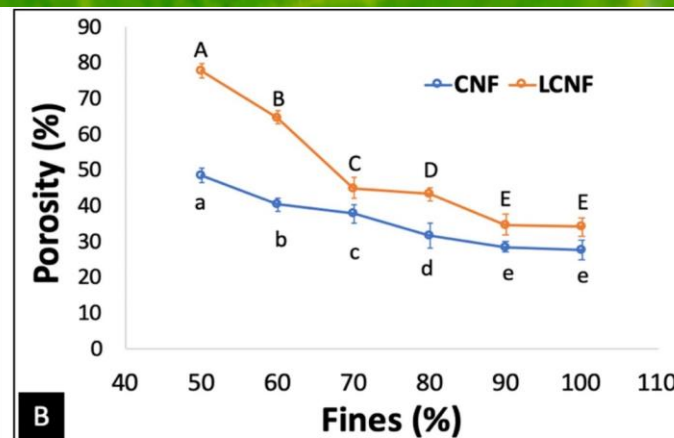
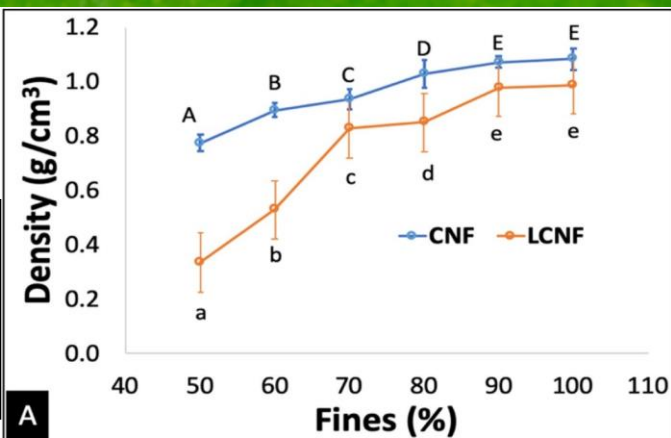
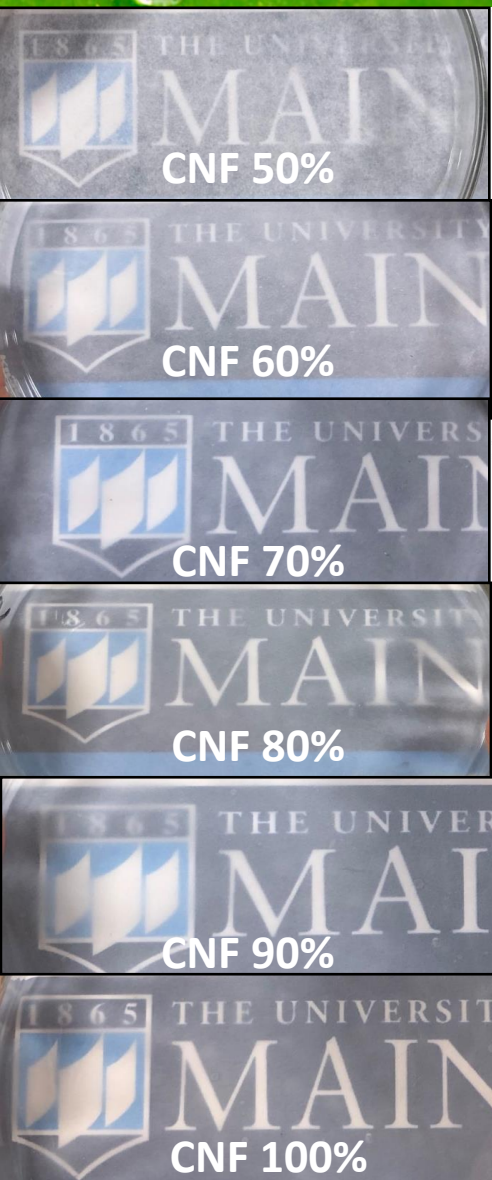


Hafez, I., & Tajvidi, M. (2020). *Materials*, 13(6), 1303.

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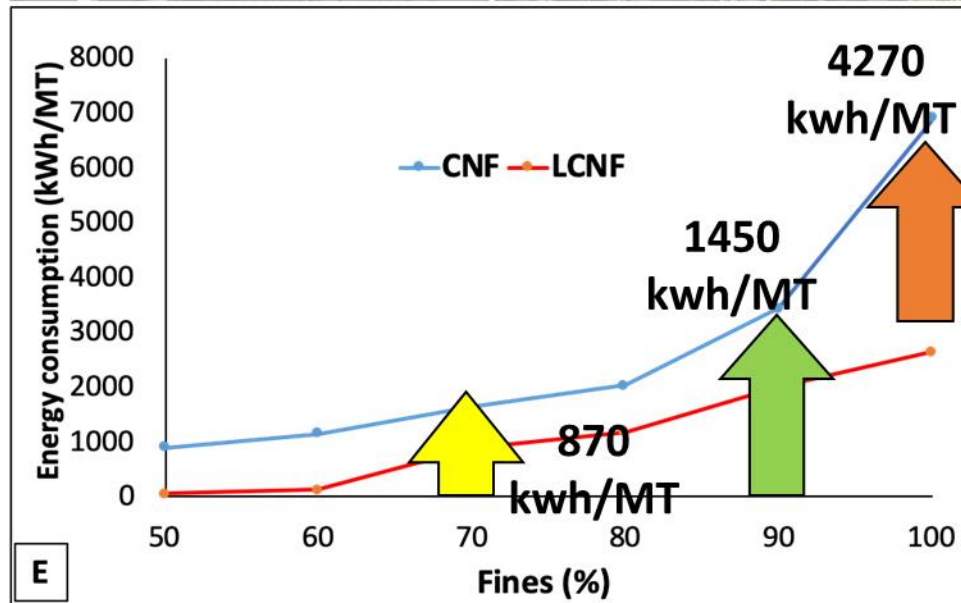


Amini, E., Hafez, I., Tajvidi, M., & Bousfield, D. W. (2020). *Carbohydrate Polymers*, 117011.

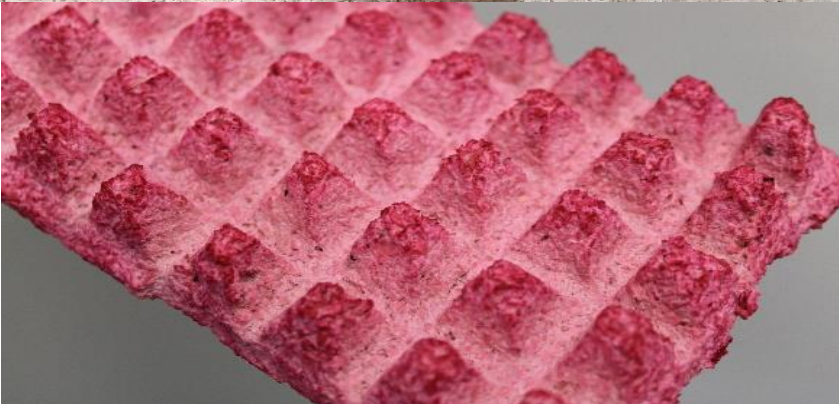
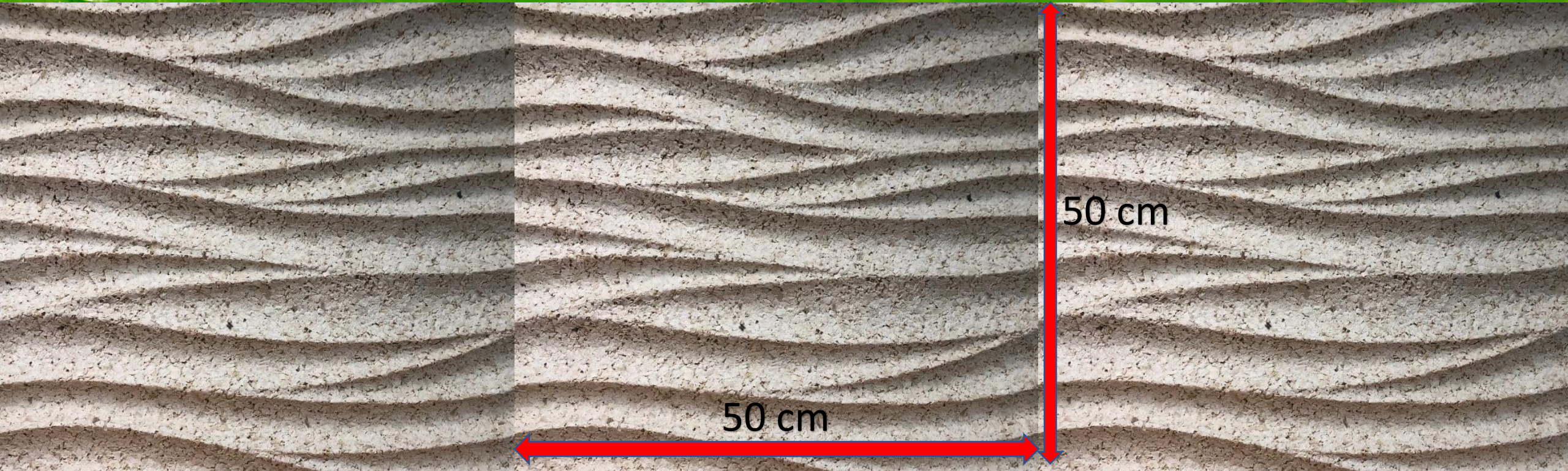
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LCNF production energy consumption



Potential to reduce energy cost without losing strength



Molded interior decorative panels

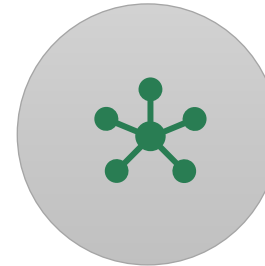


Packaging applications



- Customizable Mold Design

Molds are first designed electronically and then 3D printed or machined



- All natural bio-based ingredients

Wood flour and nanocellulose are mixed and formed into molds



- Innovative foaming process

The formed wet furnish is dewatered and dried to produce foam-like structure



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 **U.S. Endowment**
for Forestry and Communities

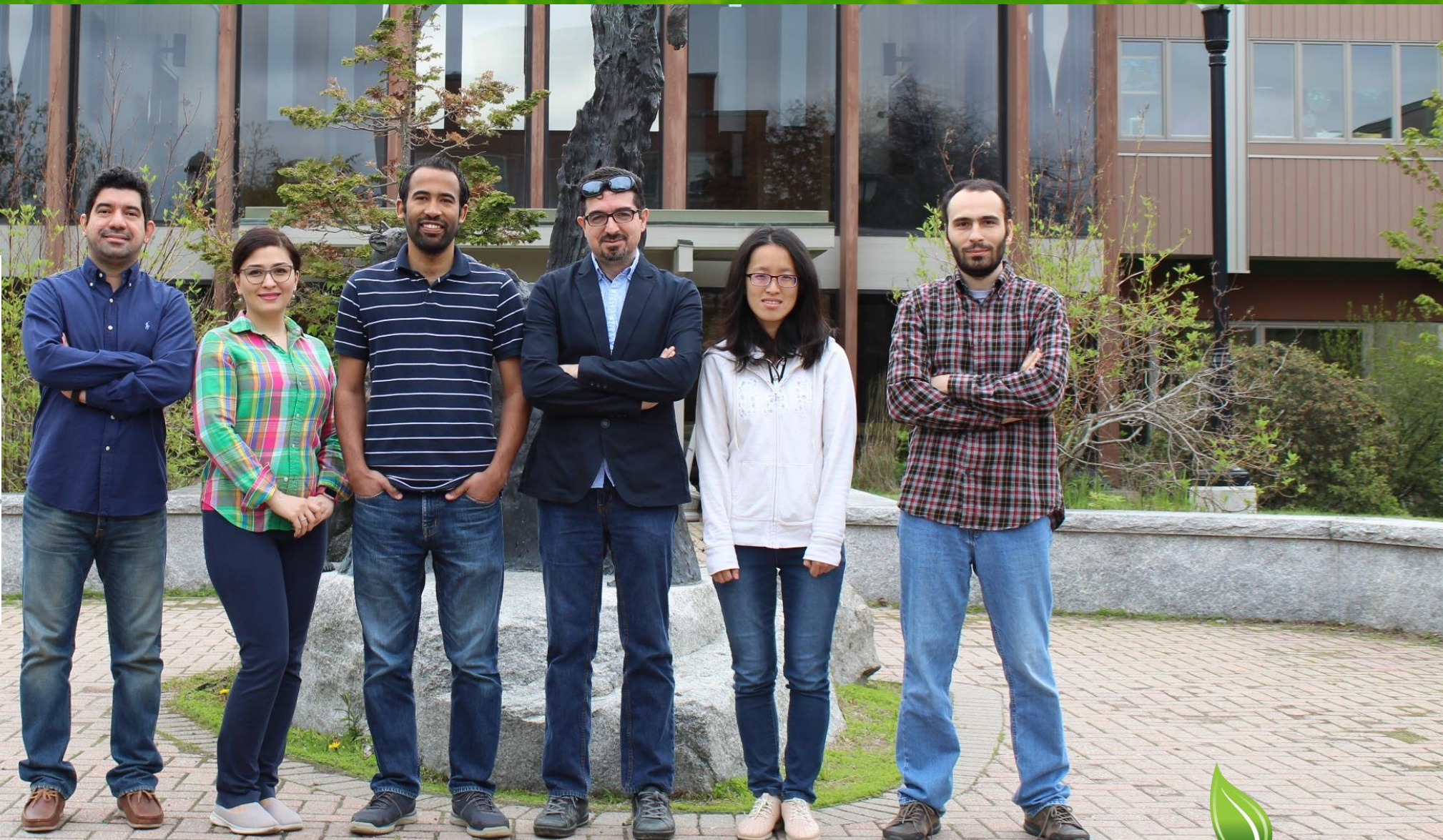


USDA
ARS



FiberLean
Technologies

Innovative by nature



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