Nanocellulose: Packaging Applications and Commercial Development

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TAPPI

Agenda

- Opportunities in packaging
- Challenges to commercial development
- State of commercial development
- Forecast

Spoiler Alert:

Today, 75% of all nanocellulose is produced by mills and used in their own paper and paperboard production.

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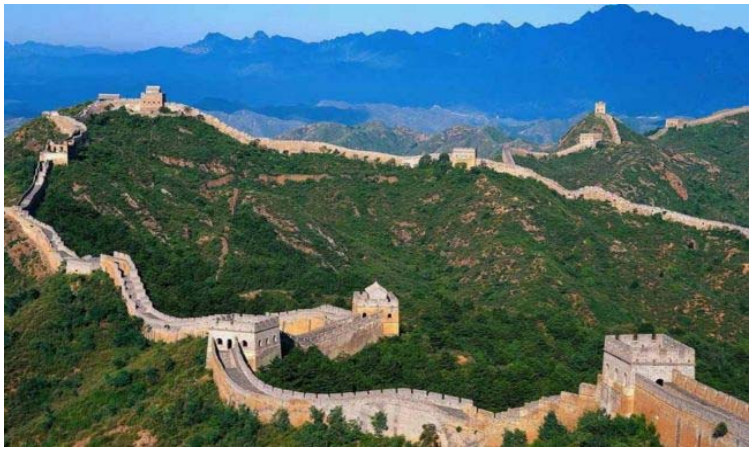
Opportunities for nanocellulose in packaging…
Obviously, strength…

Opportunities for nanocellulose in packaging…
Obviously, strength and barrier



Packaging Opportunities

But there's much more

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Packaging Opportunities

- lightweighting to reduce environmental impact

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- lightweighting to reduce material cost

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- lightweighting to reduce transport cost

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But it's not just about light weighting

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Packaging Opportunities

- wet-end web strength permits greater productivity
- lower cost fiber: recycled vs. virgin; hardwood vs softwood
- more low-cost filler; less fiber
- more filler means more opacity and better printability
- coatings to eliminate harmful materials such as fluorocarbons
- replace non-biobased plastics with biobased
- improved barrier to replace plastic, glass, or metal
- eliminate non-recyclable films and foils
- biodegradable materials to replace non-biodegradable materials

Applications with paper and paperboard

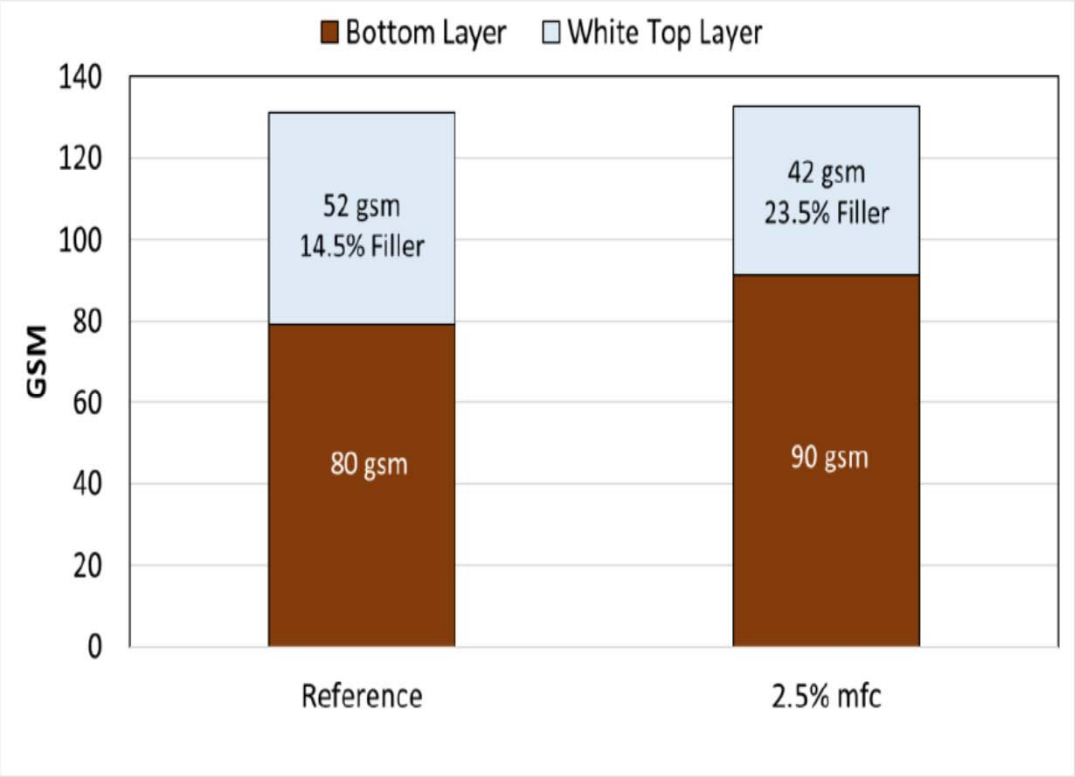
Surface applications

- Holdout/porosity
- Barrier
- Smoothness
- Opacity
- Printability
- Reduce cost

Base sheet additives

- Strength: tear, tensile, Scott bond
- Wet web strength: runnability
- Porosity
- Opacity
- Reduce fiber cost

An example…MFC in white top liner



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Source: Svending, P. Developments in Use of MFC in Packaging Specialties, Specialties Paper Europe 2018, Cologne, April 24, 2018. https://fiberlean.com/developments-in-use-of-mfc-in-packaging-specialties/

Technical Challenges

- Drying and dispersion
- Compatibilization
- Cost
- Consistent quality from batch to batch
- Safety and regulatory issues

Commercial Challenges

- Proof of concept
- Need solid value proposition through the supply chain
- Funding challenges: the Valley of Death
- Applications development
- Who develops the applications? Who does the R&D? Who owns the IP?
- Which material is best for a given application?
- What loading is optimal?
- It is not a “drop in”: implications for customer process
- End user learning curve
- Market development
- Scale up in production
- Scale up of applications
- Consistent quality from batch to batch
- Competitive materials
- Low oil prices
- Lack of multiple sources of supply
- Safety and regulatory issues

Classic Challenges

- Drying and dispersion
- Compatibilization
- Cost
- Value proposition
- Regulatory

Mills producing their own CNF or MFC

- Drying and dispersion: moot
- Compatibilization
- Cost
- Value proposition
- Regulatory

Mills producing their own CNF or MFC

- Drying and dispersion: moot
- Compatibilization: not an issue
- Cost
- Value proposition
- Regulatory

Mills producing their own CNF or MFC

- Drying and dispersion: moot
- Compatibilization: not an issue
- Cost: minimized
- Value proposition
- Regulatory

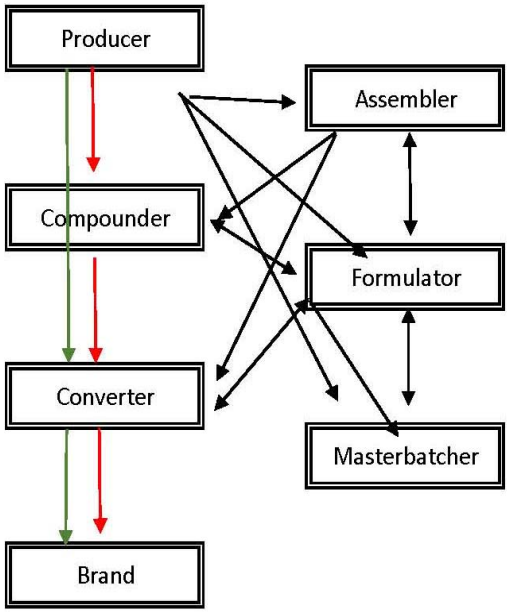
Mills producing their own CNF or MFC

- Drying and dispersion: moot
- Compatibilization: not an issue
- Cost: minimized
- Value proposition: internal
- Regulatory

Mills producing their own CNF or MFC

- Drying and dispersion: moot
- Compatibilization: not an issue
- Cost: minimized
- Value proposition: internal
- Regulatory: may not be an issue

Nanocellulose Supply Chain



Source: J. Miller *Nanocellulose: Packaging Applications and Markets,* RISI, Jan, 2019

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Commercial Development Highlights: Paper and Paperboard

- **FiberLean:** 8,800 tpy MFC including NorPaper, 800 tpy for WTL
- **GranBio**: GreenBox++ collaborations with containerboard mills in Malaysia, Canada, United States
- **Melodea**: partner with Klabin and Holmen: pilot plant for CNC in Israel and 35 tpy CNC plant in Örnsköldsvik, Sweden in final stage of commissioning
- **Norske Skog:** 1 tpd MFC in SC magazine paper
- **Stora Enso:** test market Eastern Europe – 100 million Elopkak packages with liquid packaging board containing MFC. Potential for up to 500,000 tonnes of paperboard packaging with MFC.
- **BillerudKorsnäs** and **RISE Innventia:** collaboration for MFC trials; full-scale testing in 2017 of packaging products using Exilva MFC from Borregaard.
- **Sherpack:** created in 2017 to reinvent paper-based flexible packaging. Borregaard, Ahlstrom Munskjö, and Cargill, plus CTP, ITENE, and PCF: "replace materials such as plastics or aluminum foil currently used on the market by an advanced biomaterials."

Source: J. Miller *Nanocellulose: Packaging Applications and Markets,* RISI, Jan, 2019

Nanocellulose Producers at Demonstration Scale or Larger

(tonnes per year, dry basis)

Producer	Material	Capacity
FiberLean Technologies, UK	MFC	8,800
Kruger, Canada	CF	6,000
Borregaard, Norway	MFC	1,100
Nippon Paper, Japan	CNF	560
CelluForce, Canada	CNC	300
Norske Skog, Norway	MFC	260
University of Maine, U.S.A	CNF	260
Daicel, Japan	MFC	200
RISE, transportable container factory	MFC	200
American Process, U.S.A	CNC	130
American Process, U.S.A	CNF	130
CelluComp, UK	CNF	100
Chuetsu Pulp and Paper, Japan	CNF	100
International Paaper	MFC	*
Stora Enso	MFC	*

International Paper and Stora Enso are also reported to be producing MFC, largely for use in their own paper and paperboard. The 2017 Stora Enso Annual Report says "Stora Enso invested €9 million in new MFC production at Imatra, Ingerois and Fors mills. The new capacity corresponds to 500 000 tonnes of board made with MFC after a ramp-up period of 3–5 years."

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Source: J. Miller Nanocellulose: Packaging Applications and Markets, RISI, 2019

Cellulose Nanomaterials
Potential Volume in Packaging Applications
(million tonnes)

	Market volume	Potential CNM loading	Potential CNM
Containerboard	171	5%	8.6
Boxboard	60	5%	3.0
Specialty and packaging papers	24	5%	1.2
Plastics	71	3%	2.1
TOTAL	326		14.9

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Source: J. Miller *Nanocellulose: Packaging Applications and Markets,* RISI, Jan, 2019

Nanocellulose in Packaging Forecast
(tonnes)

2018 Estimate	22,000
2020 Forecast	44,000
2025 Forecast	162,000
CAGR 2018-2025	33%

Source: J. Miller *Nanocellulose: Packaging Applications and Markets,* RISI, Jan, 2019

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Thank you

Nanocellulose: Producers, Products, and Applications – a guide for end users, TAPPI 2017

Nanocellulose: Challenges and Opportunities – end user perspectives, TAPPI, 2018

Nanocellulose: Packaging Applications and Markets, RISI, 2019

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