Nitrocellulose: a cellulose raw material perspective

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Rooted in tomorrow.

Competition Law Statement

Our free market economic system is based on open and free competition. Antitrust/competition laws have been enacted throughout the world and are enforced to preserve competition and the efficient operation of the market place. Tembec has policies regarding antitrust compliance, and violations of these laws can result in significant fines and other consequences. Compliance with the antitrust laws is clearly a matter of good business.

Antitrust/competition laws do not prohibit legitimate commercial discussions, including between competitors, however competitors need to be particularly careful when engaged in such discussions that they not stray into inappropriate areas. It is essential, therefore, that it be understood that:

- Tembec's presentation and any related discussions will in no way compromise the vigour with which our companies compete;
- Tembec will not disclose prices, pricing information, price lists, marketing plans, marketing strategies, market shares, or production costs;
- Tembec will not disclose or engage in discussion regarding outages or downtime plans; and
- Tembec will not disclose or engage in discussion regarding changes in future production capacities.

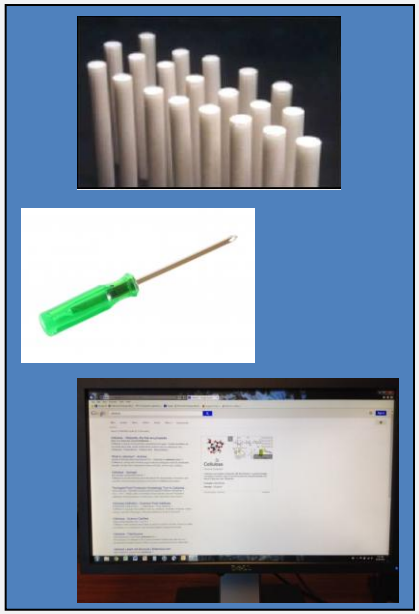
This disclaimer applies equally to the formal presentation and any informal discussions that can take place throughout the day or during a meal. As noted above, the law recognizes that legitimate discussions at meetings such as this promote the public interest, but where competitors interact they can also be viewed by the government authorities as providing opportunities for antitrust violations. So, please use caution to avoid straying into inappropriate areas, and I hope today's meeting is productive and enjoyable for everyone.

Thank you.

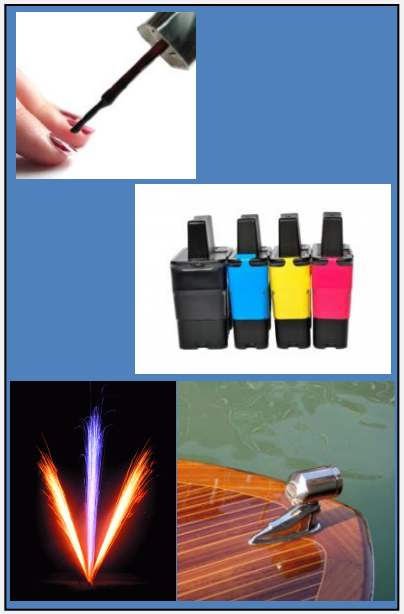
Specialty Cellulose Applications & Cellulose Demand

Cellulose Ethers ~ 400 kT/A

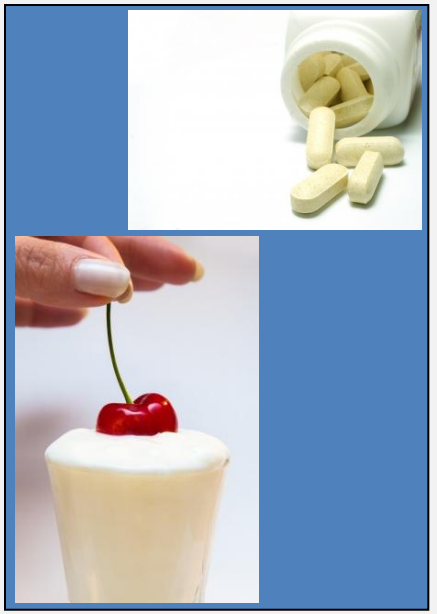
Cellulose Acetate ~ 675 kT/A



Nitrocellulose ~ 130 kT/A



MCC ~ 100 kT/A



Mercerized ~ 60 kT/A

High Strength Viscose (Tire Cord & Casings) ~ 140 kT/A

Two Major Sources of High Purity Cellulose

Cotton

- Cotton Linter Pulp (CLP)
- A by-product from cotton production
- 1000 kT/A, of which 250 kT/A is Specialty
- Most CLP is produced in China

Forests

- Wood Pulp
- 5500 kT/A, of which 1250 kT/A is Specialty

The Road to CLP

A feedstock for the Chinese viscose industry & some Specialty Cellulose applications.

Feed for Cattle

Cotton in the field → Cotton shipped to ginning mills

Cottonseed (with linters)

Oilseed Crush

- Cottonseed Oil
- Cottonseed Meal
- Cottonseed Hulls

Lint / staple fibers for textiles

Cotton linters
- Mill Run
- 1st & 2nd Cut

Cotton Linter Pulp (rolls, bales, flocs)

Production of Specialty CLP for the manufacture of cellulose derivatives requires a very uniform supply of 2nd Cut linters; otherwise contamination with longer linters and staple fibers negatively affects cellulose reactivity at the customer's facility.

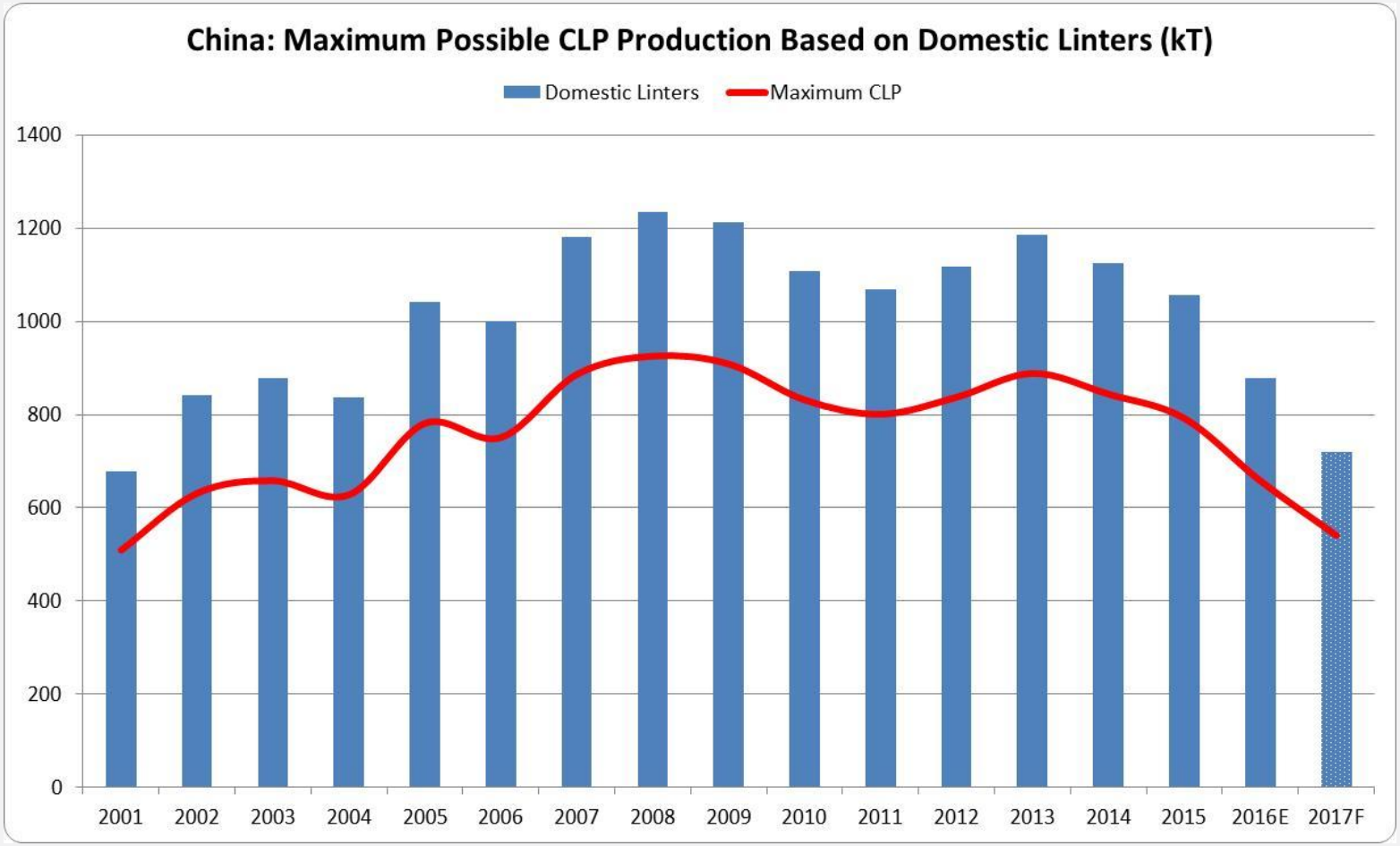
Cotton Linters: An Alternative Cellulosic Raw Material,
Axel Sczostak, *Macromol. Symp. 2009, 280, 45–53.*

"Linters fibres have a higher reactivity than staple fibres due to their better accessibility for chemical reagents."

"Cotton linters fibres comprise a certain amount of staple fibres because – after ginning - the fuzz remaining on the seed consists of cotton linters fibres and a varying quantity of staple fibres."

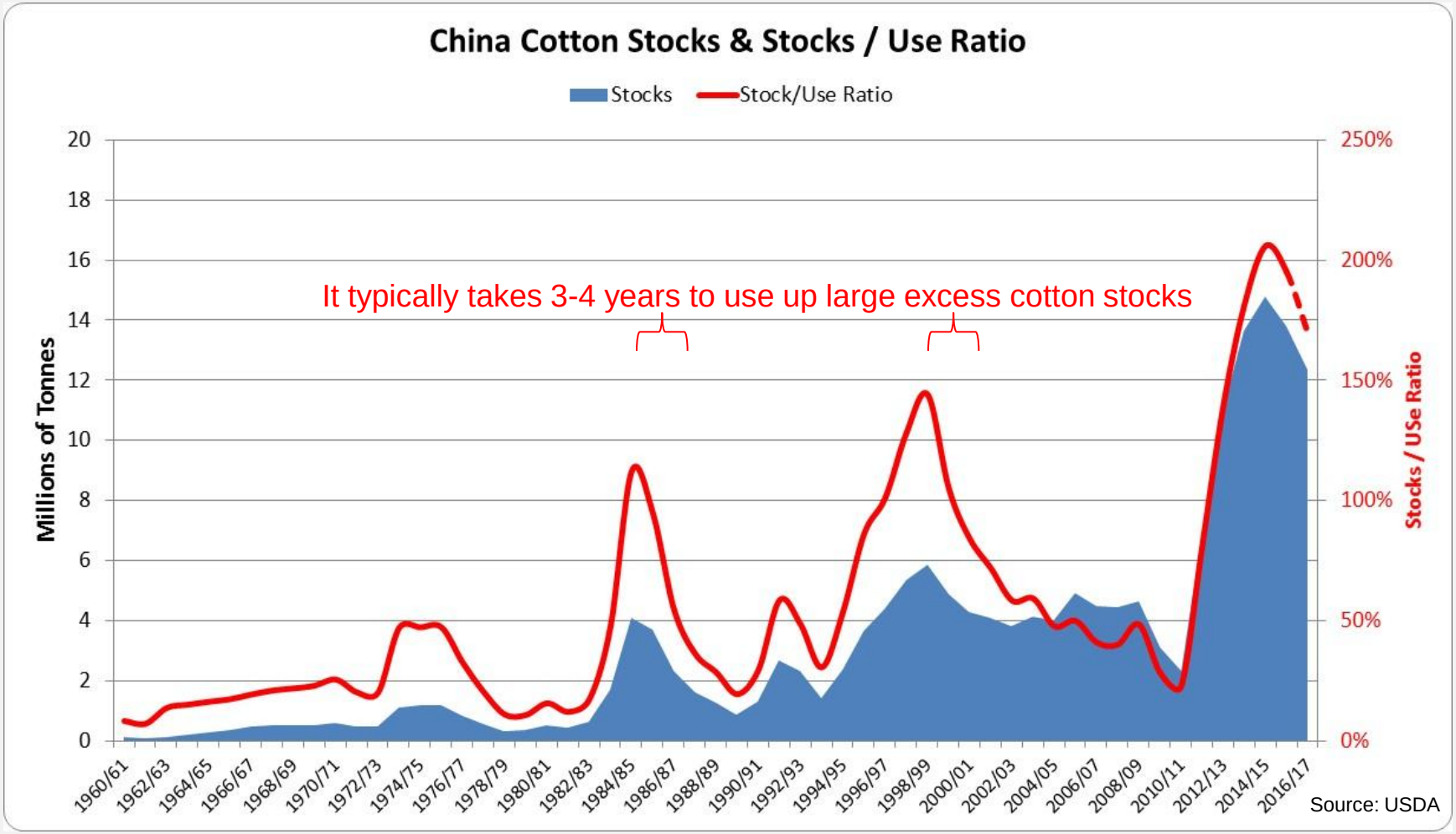
When based on high-quality 2nd Cut linters, CLP can be an excellent source of cellulose; however, the availability of these linters is an on-going concern.

China's supply of domestic linters will decrease substantially in 2016 & 2017.

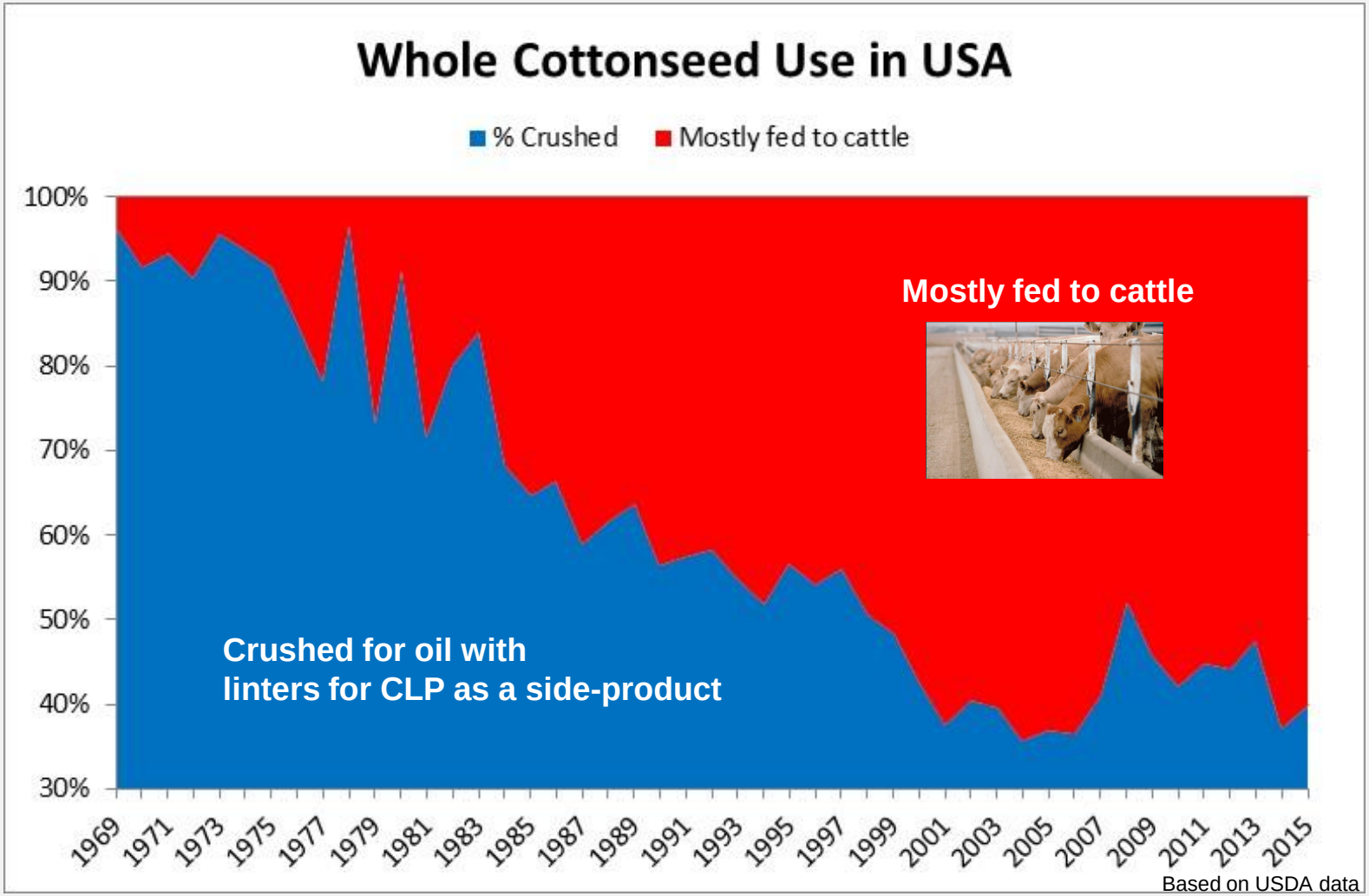


Based on USDA data

Chinese cotton stocks are so high that there is little reason to expect cotton plantings to increase in 2017-2020.



In the USA most whole cottonseed (with the linters attached) is fed to dairy cattle.



China is starting to move to feedlots for dairy and beef cattle.

Like the USA, whole cottonseed will probably be used in the feed mix as a substitute for corn & soybean meal (50-60% of WCS in USA).

China: 8.5 million dairy cows producing 38 million tonnes of milk

USA: 9.3 million dairy cows producing 96 million tonnes of milk Source: USDA

China is the world's largest producer of CLP (~700 kT/A of commodity & specialty). If whole cottonseed is fed to cattle at the same rate as in the USA then Chinese CLP production will drop to ~300 kT/A.

Long term: very limited linters for CLP?

New generations of Upland cotton are being developed without linters (i.e. fuzzless). Upland cotton (*G. hirsutum*) makes up most of global cotton production.

American Journal of Plant Sciences, 2012, 3, 799-804
doi:10.4236/ajps.2012.36096 Published Online June 2012 (http://www.SciRP.org/journal/ajps)

Scientific Research

A New Fuzzless Seed Locus in an Upland Cotton (*Gossypium hirsutum* L.) Mutant

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Yi Chuan. 2012 Aug;34(8):1073-8.

[Genetic analysis of fuzzless in cotton germplasm].

[Article in Chinese]

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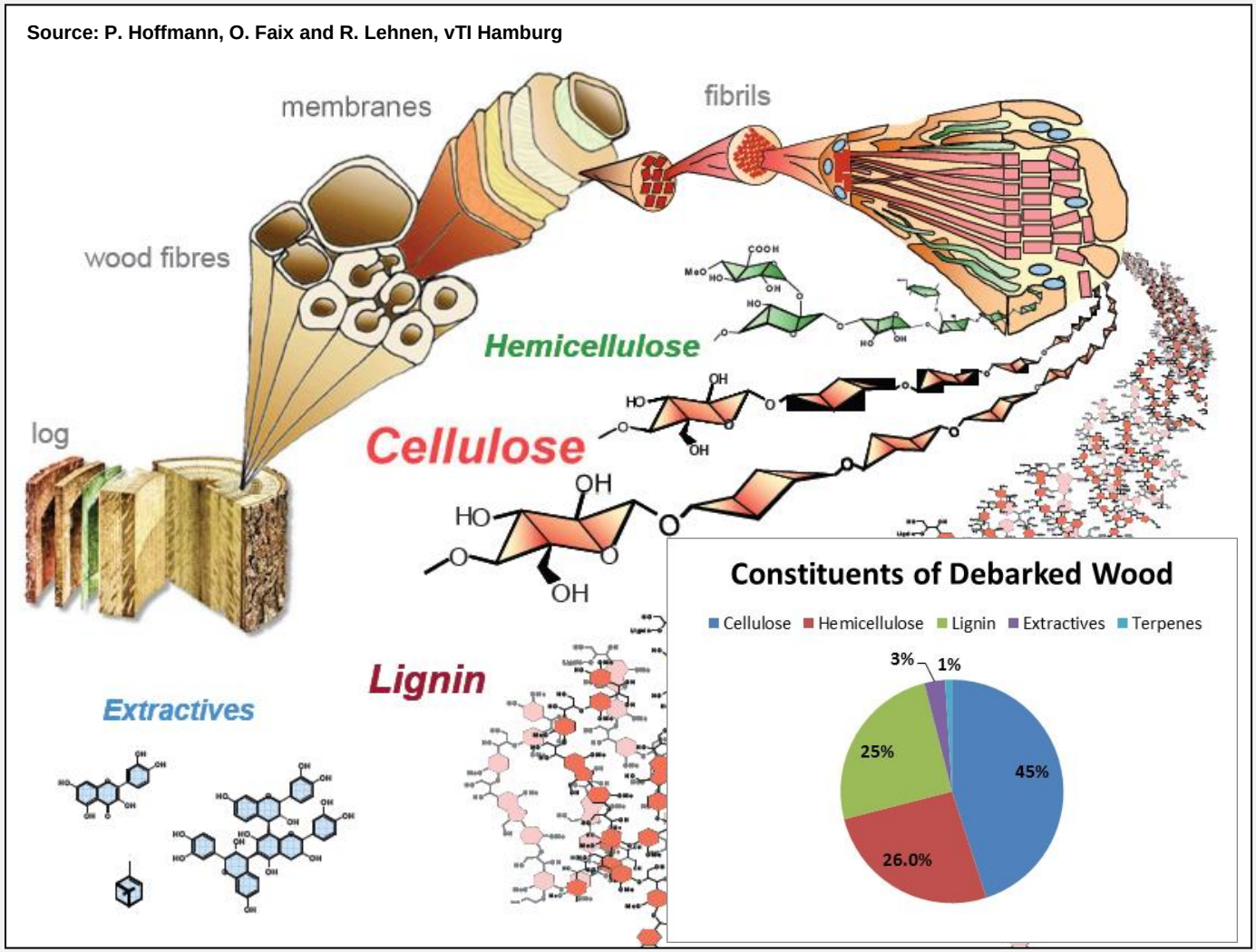
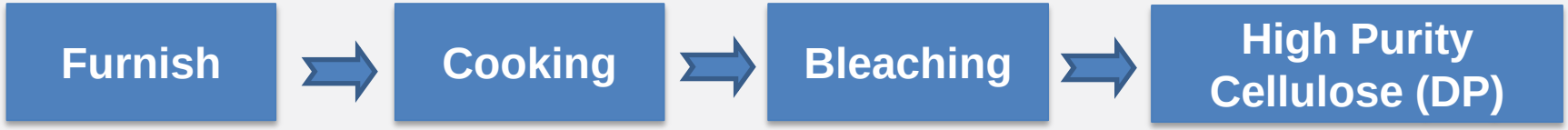
Wood fiber is the major source of cellulose for both viscose and Specialty applications.

Dissolving Pulp (DP): the starting point.



Two major commercial processes for producing DP: Sulfite & Pre-hydrolysis Kraft (PHK)



- Wood
  - Softwood
    - Northern
    - Southern
  - Hardwood
    - Northern
    - Southern
- Other

- Sulfite
- PHK
- Other

- ClO_2
- H_2O_2
- NaOH
- NaOCl
- O_2, O_3
- Other

- Purity
- Viscosity
- Density
- Extractives
- Ash
- Calcium
- Iron
- Copper
- Brightness
- Basis weight
- Sheet strength
- Attrition behaviour
- Soda solubles
- Chemical accessibility
- Reactivity

Tembec Specialty Cellulose Operations

A unique dual sourcing opportunity for customers interested in Specialty Cellulose.

Both facilities have MIL-C-216 compliant grades.

Témiscaming, Québec, Canada

160 kT/A, Northern Softwood

Ammonium Sulfite Process

Hot Caustic Extraction, ECF bleaching

FSC ® Certified

Tartas, France

150 kT/A, Maritime Pine

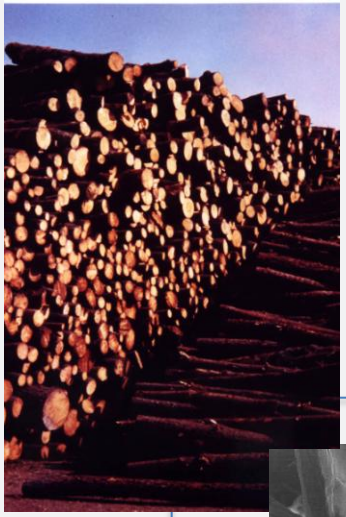
Ammonium Sulfite Process

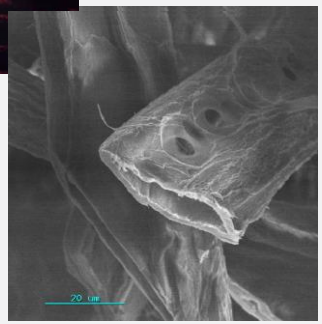
Hot Caustic Extraction, ECF bleaching

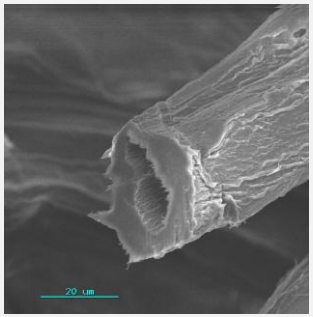
FSC ® Certified Chain of Custody

PEFC™ Certified Chain of Custody

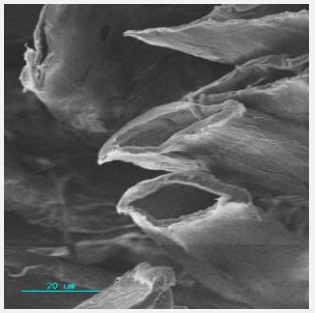
Tembec uses both Northern & Southern Softwoods. Each has specific fiber properties that may be beneficial to a Nitrocellulose producer. Grades can be tailored to a customer's needs (e.g. sheet properties, purity, viscosity).







Tartas: Southern Softwood (Juvenile / Mature fibre supply)



Temiscaming:
Northern Softwood

Tembec Sustainability

Tembec and its partners manage ~16 million ha of FSC® certified forest (= 4x the size of Switzerland)

Technical Service & Development

- **Location: Bordeaux, France**
- **Specialty Cellulose Development for Témiscaming & Tartas**
  - Grade optimization for quality and cost
  - New grade development
  - Technical support for Témiscaming & Tartas
  - Technical customer service
  - Technical cooperation with public and private institutes
- **Under development for the Nitrocellulose market**
  - Biofloc XV20: an ultra-high viscosity grade for dynamite applications

Conclusion

- Linters availability for cotton linter pulp (CLP) production will be reduced…
  - Short-term: cotton linters production will drop due to reduced cotton plantings
  - Mid-term: whole cottonseed availability for linters in China should drop
  - Long-term: new grades of Upland cotton *might* be linter-free.
- Wood based cellulose pulps are the major source of supply for viscose & Specialty Cellulose applications, including Nitrocellulose.
- Tembec has invested to remain a leading supplier to the Specialty Cellulose market.
  - Temalfa 93N (from Canada) and Biofloc 94 (France) are MIL-C-216 compliant.