



THE ROLE OF BEKP STRENGTH ON ITS MARKET SHARE

Paulo César Pavan



7th ICEP
International Colloquium on Eucalyptus Pulp

*stretching the limits of pulp and energy
throughput from eucalypt forests*

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Sharing with you our understanding:

There is a slow but increasing demand for a higher BEKP strength, dependent on the paper grade.

BEKP producers and customers (papermakers) may obtain relative competitive advantage with this movement.

There are several different ways to provide that.

The trend of increasing BEKP use does not appear to be dependent on this strength increase

OUTLINE

- **BEKP has built a successful history, and shall continue in the foreseeable future**

Recap and update figures shown in the 5th ICEP

- **The dynamics involved in BEKP use**

The Driving Forces for using or for not using BEKP

The strength factor and trade-offs

- **(Paper) Books can still give us important insights**

What professors teach us

How to make it in real life

- **There are benefits to be ahead of competition on BEKP usage**

Anticipating Trends

- **Final Remarks**

“The Role of BEKP Strength on its Market Share”

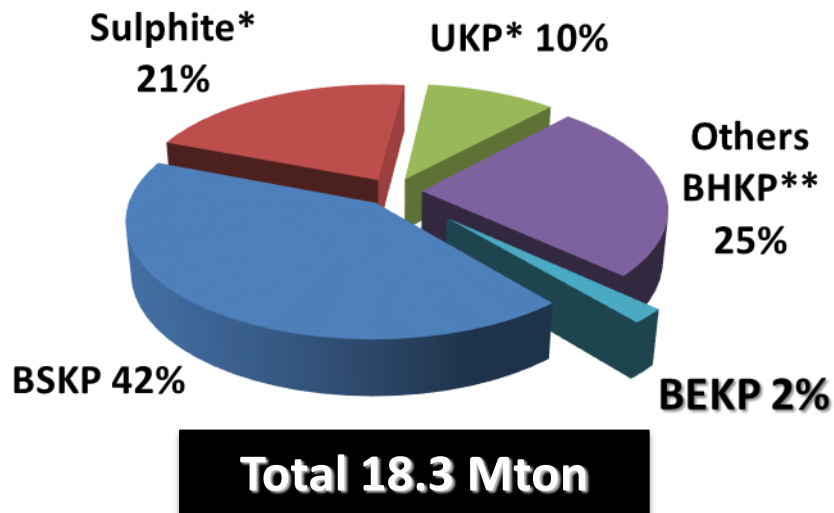
Does it really matter???

BEKP has built a successful history, and shall continue in the foreseeable future

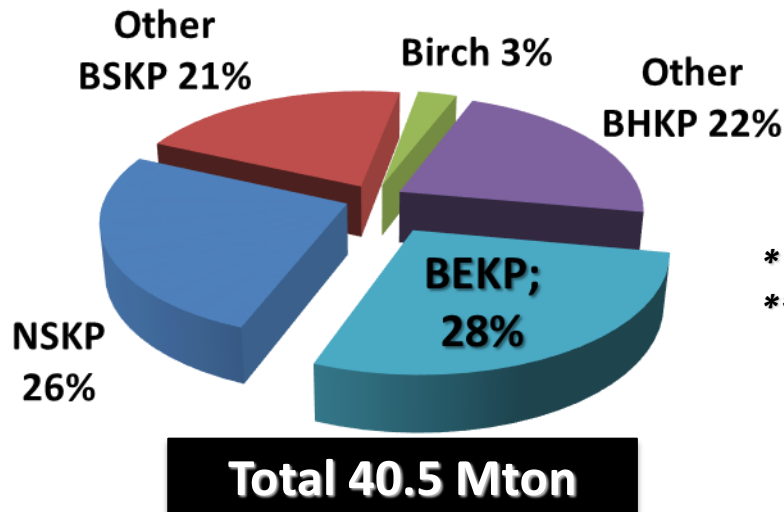
Recap and update figures shown in the 5th ICEP

World Market Pulp Consumption

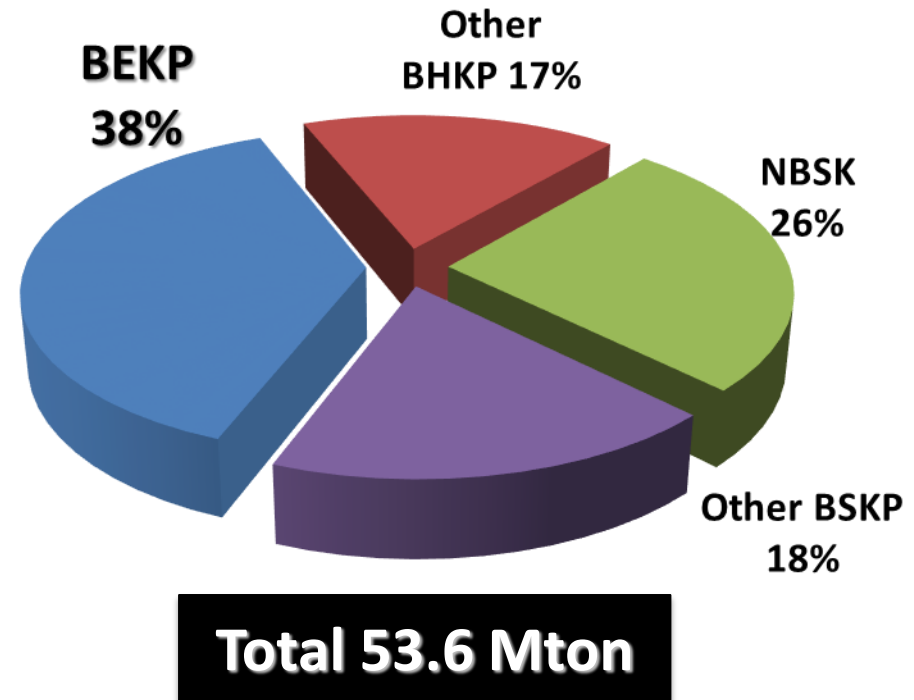
Year: 1974



Year: 2008



Year: 2014



* Estimate

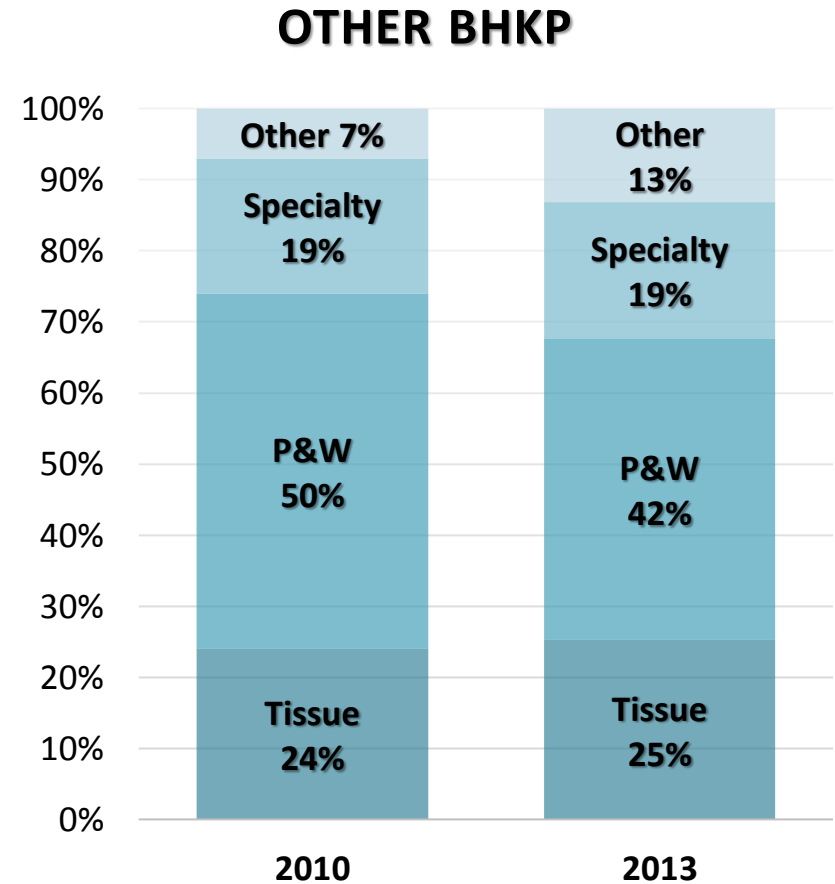
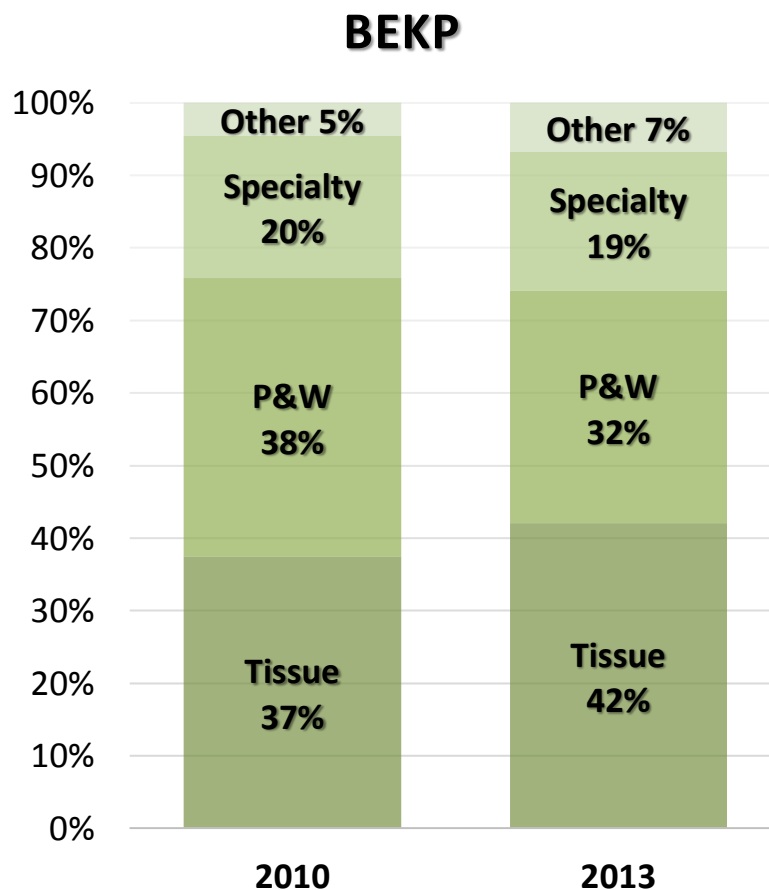
** Others BHKP include Birch, NMHW, SMWHW-US and Indonesian

Sources: Hawkins Wright, PPPC

Recap and update figures shown in the 5th ICEP Fibria

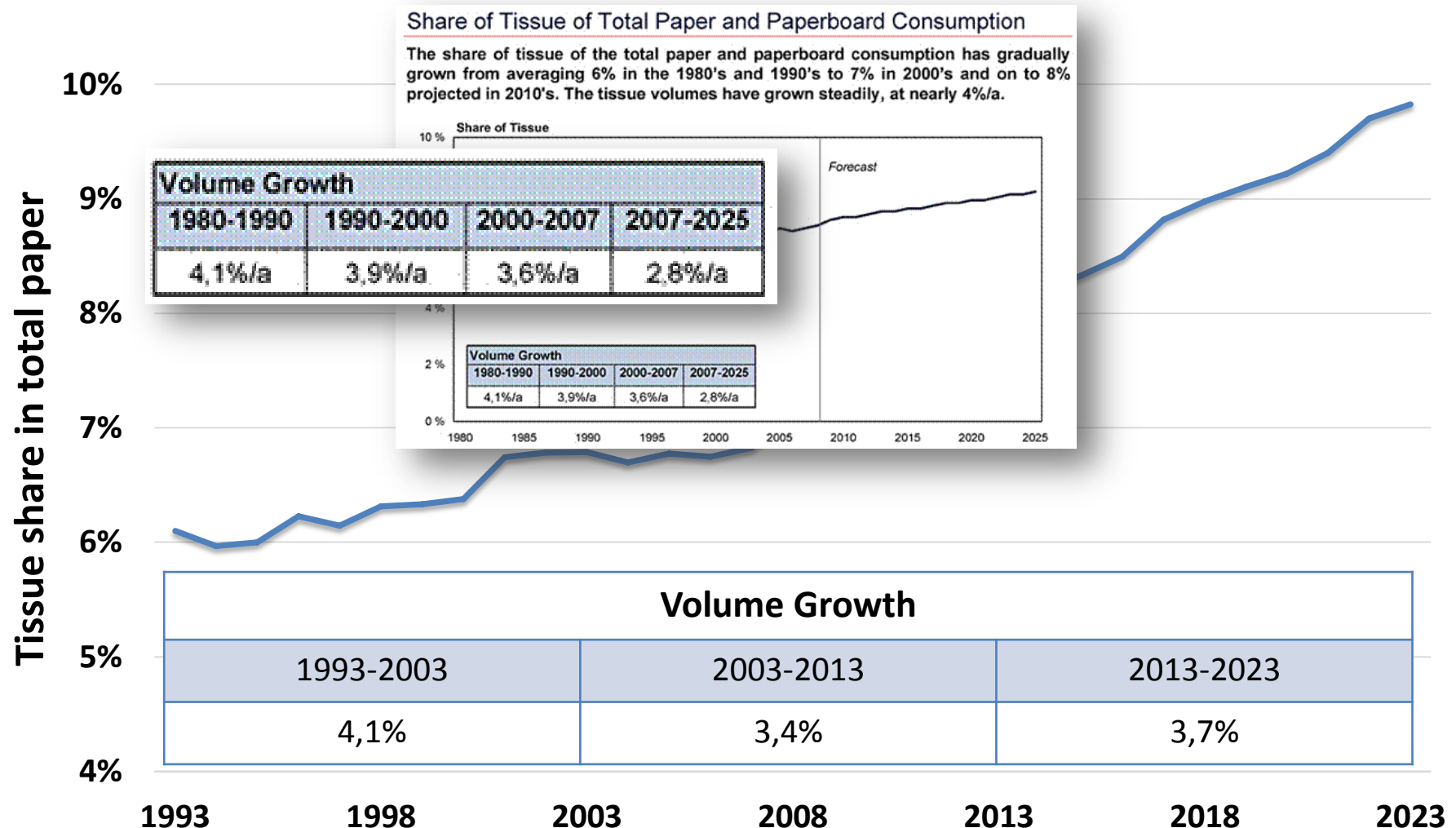
BEKP is strongly relied on a growing paper segment

Destination of the most common HWKP



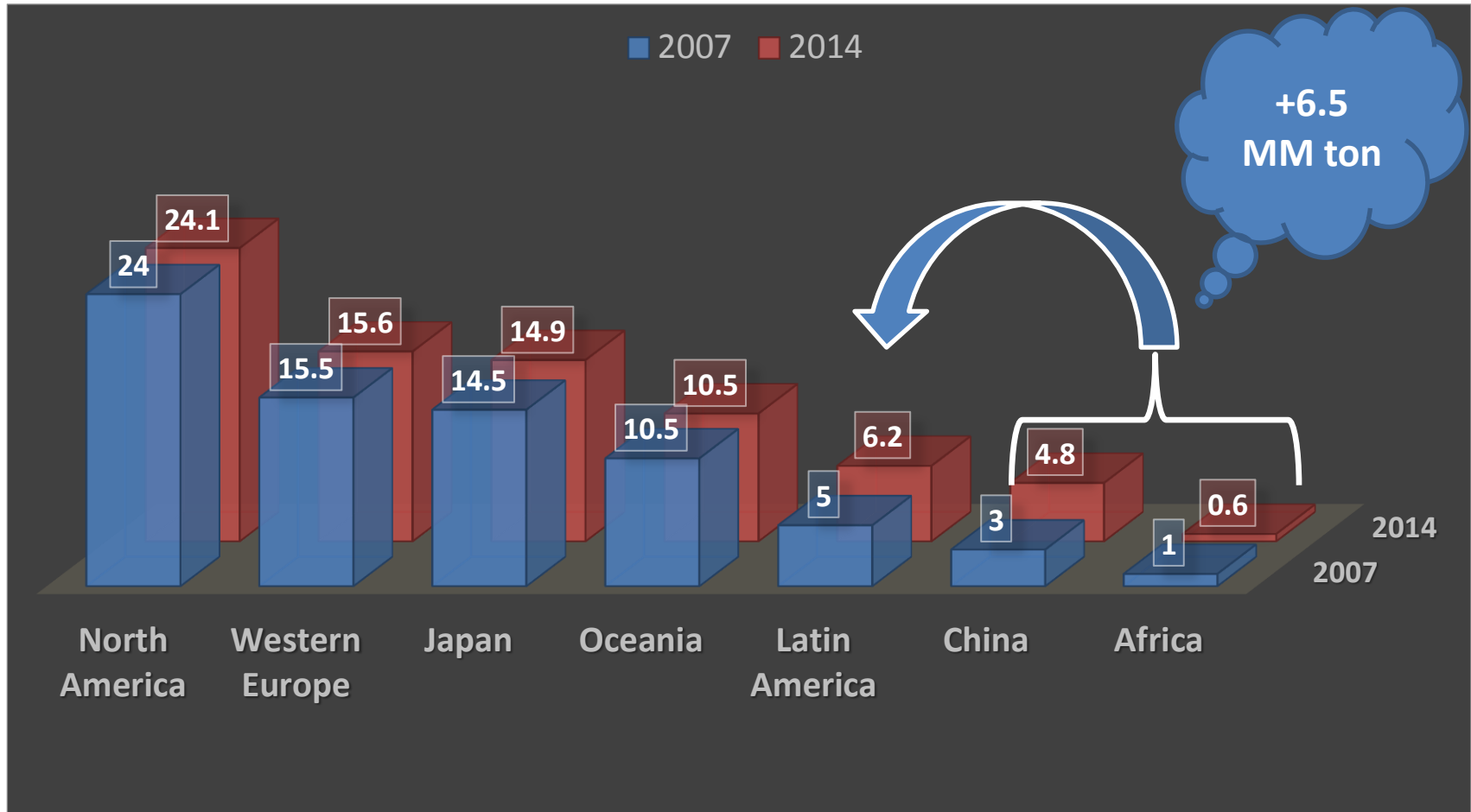
Recap and update figures shown in the 5th ICEP Fibria

BEKP is strongly relied on a growing paper segment



Recap and update figures shown in the 5th ICEP BEKP is strongly relied on a growing paper segment

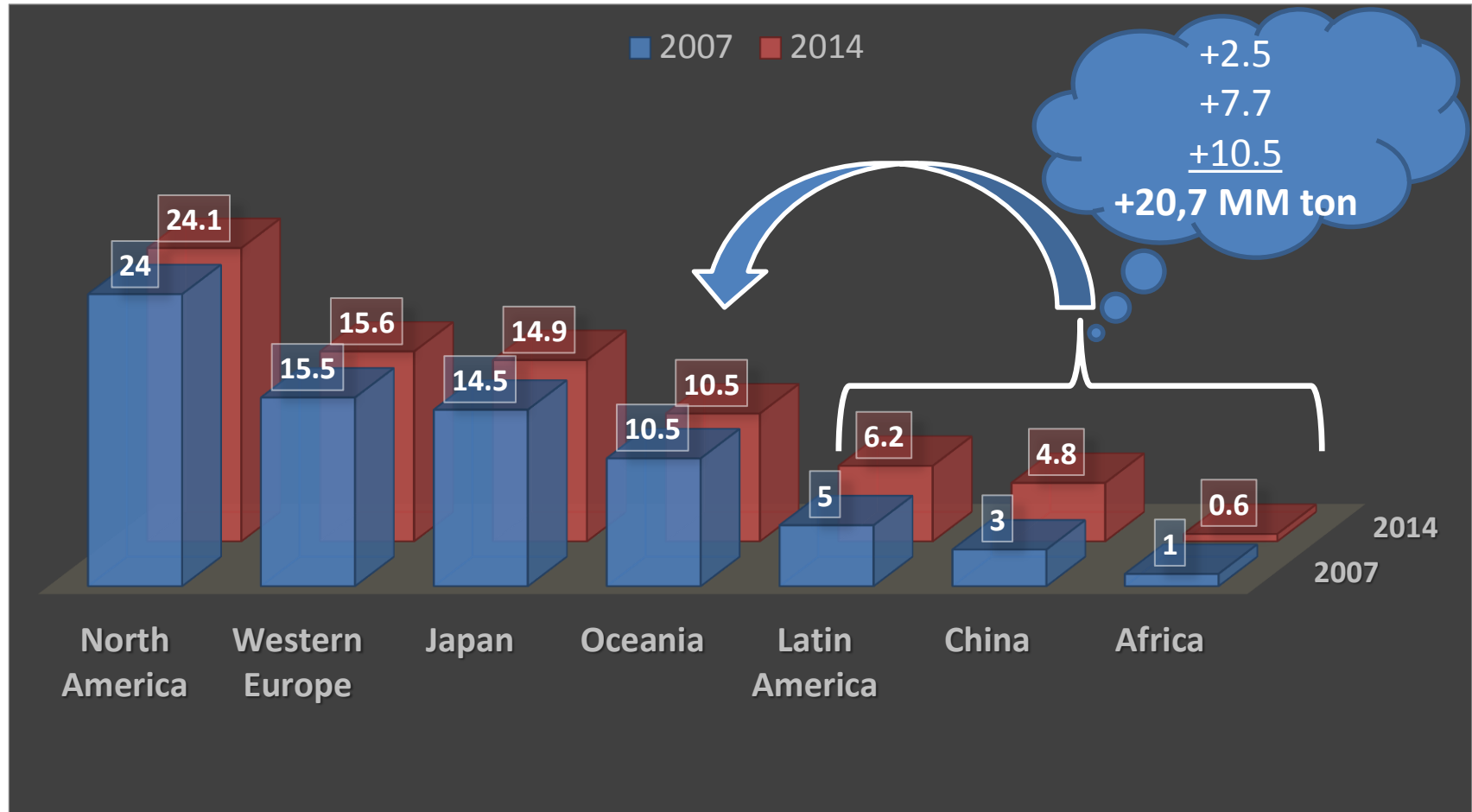
Per Capita Consumption of Tissue by World Region 2014 (kg/person)



Recap and update figures shown in the 5th ICEP Fibria

BEKP is strongly relied on a growing paper segment

Per Capita Consumption of Tissue by World Region 2014 (kg/person)



*“The Role of BEKP Strength on its
Market Share”*

What are the driving forces?

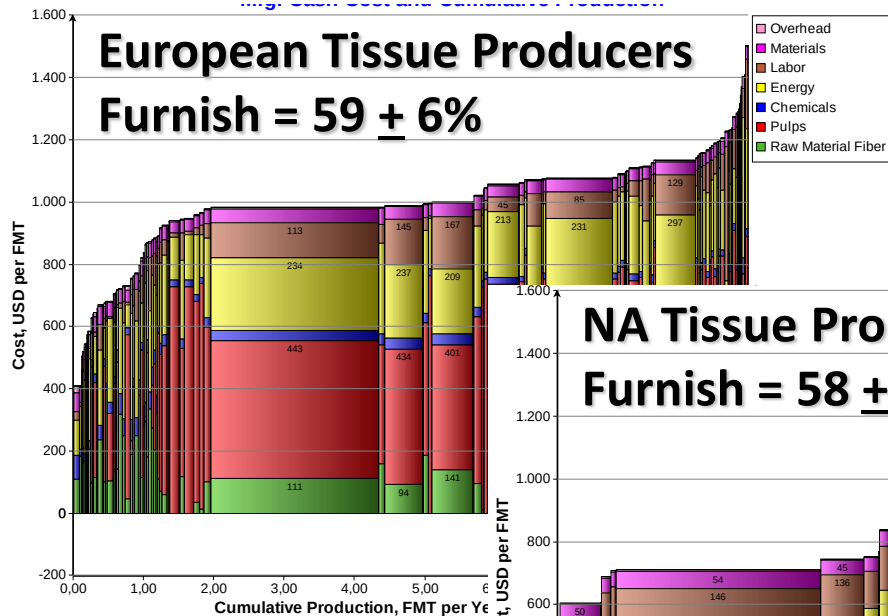
**It is worth using BEKP even though
the way may seem hard**

The Driving Forces for using BEKP or not

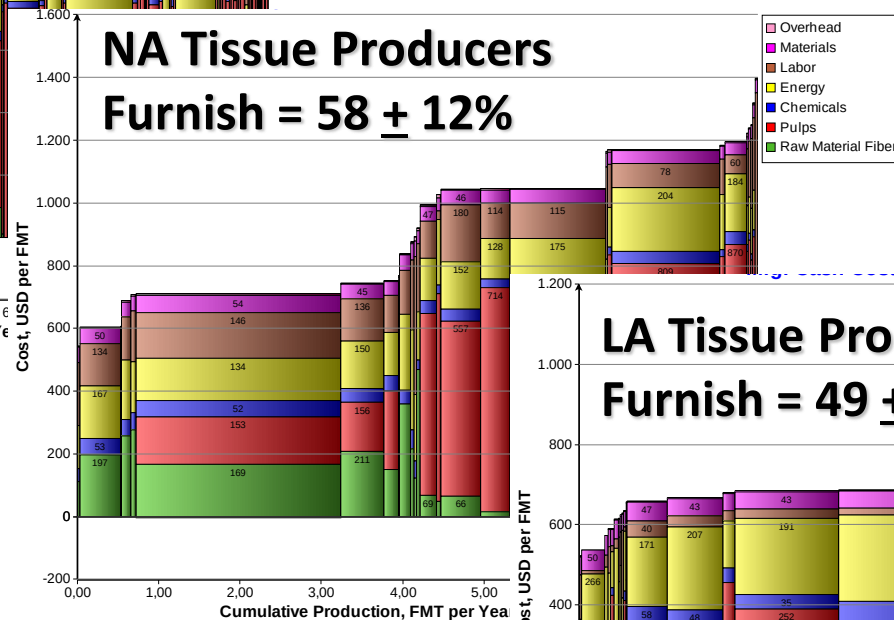


The Driving Forces for using BEKP

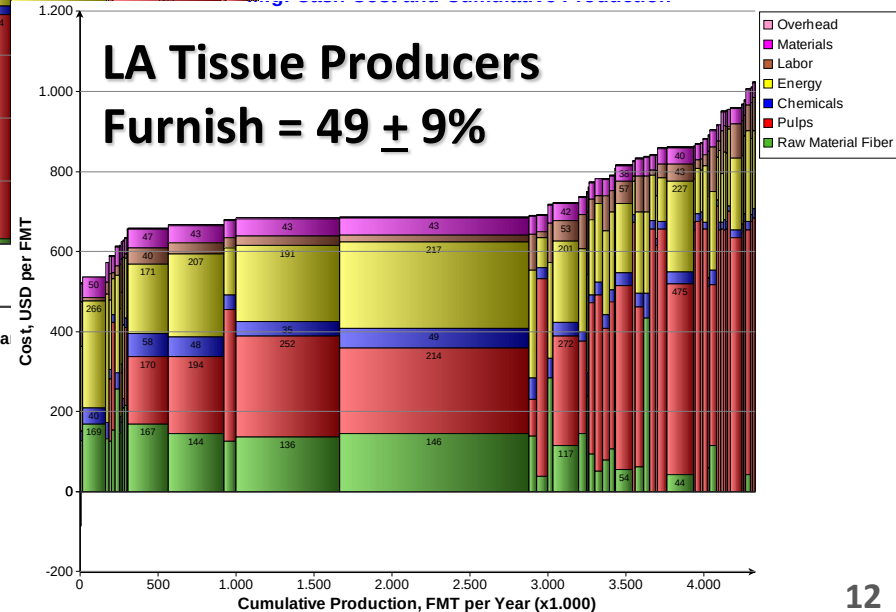
Furnish* Cost (% $\pm$ 1 SD)



© 2006-2015 Fisher International, Inc.
Source: FisherSolve™



© 2006-2015 Fisher International, Inc.
Source: FisherSolve™

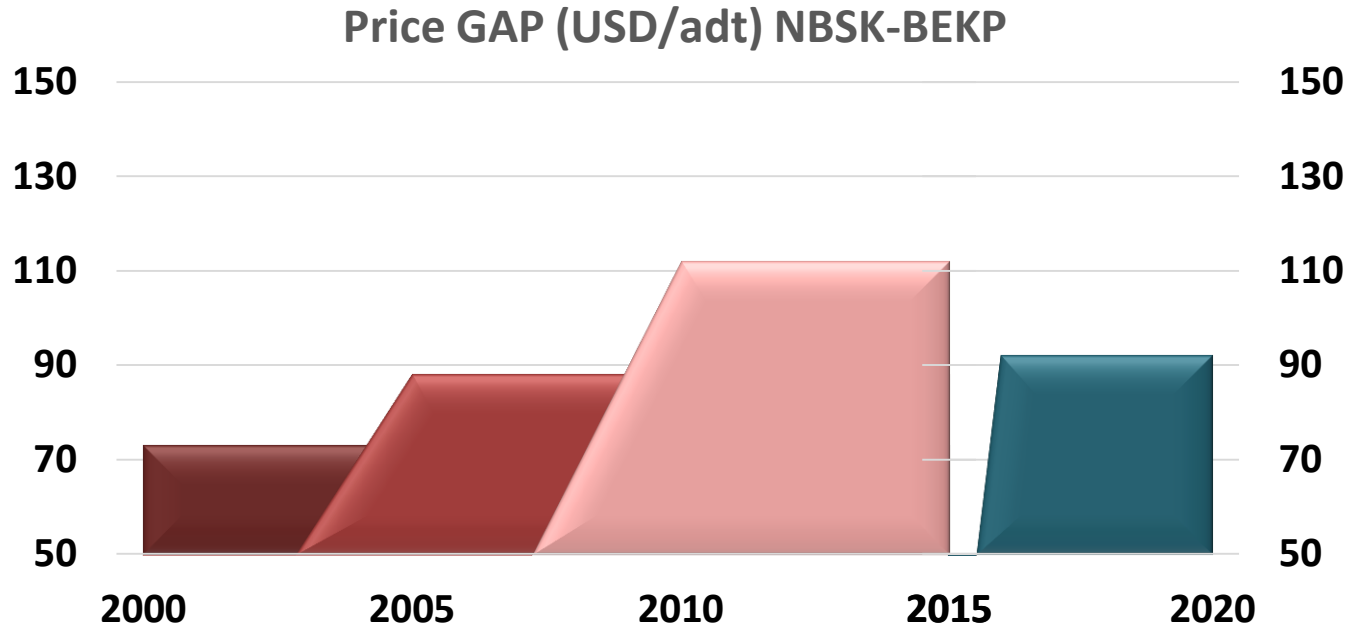


© 2006-2015 Fisher International, Inc.
Source: FisherSolve™

* Pulp + Raw Material: Fiber

The Driving Forces for using BEKP

Pulp Price – Competitiveness: NBSK vs BEKP



Track Record
Source FOEX.FI

Forecast
Source RISI

15 Years **10 Years** **5 Years**

4 Years

The Driving Forces for using BEKP

Superior Paper Quality through BEKP



There is no single fiber which would provide the best solution for all the requirements: softness / smoothness / absorption / fluffiness / bulk / strength...
... BHKP in general - and BEKP in particular - fulfils well most of the (tissue) key quality demands.

Source: Happy and lasting marriage, *Timo Teras -Leading Advisor, Pöyry Forest Industry Consulting*, Tissue World Magazine April/May 2009

- **Uniform paper formation and high opacity:** important for all grades of fine papers. BEKP: high number of fibers/gram and short fiber length.
- **High Bulk and stiffness:** critical for board or printing papers, and kept when eucalyptus pulp is used.
- **Smoothness:** one of the most sought property in coated papers, especially art papers having a matt finish. BEKP: Low coarseness.
- **Softness:** unquestionably the most desirable characteristic in tissue papers. BEKP: high fibre count and low coarseness.

The Driving Forces for using BEKP

Sustainability from the Forest to the Mills



“... Brazil has 7.6 million hectares of planted eucalyptus (72%), pinus (21%) and other species ... Planting for industrial purposes is carried out according to sustainable forestry management principles that seek to reduce environmental impacts and promote economic and social development of the communities surrounding the plantations and mills ... about 60% are certified by the Forest Stewardship Council (FSC) and by Brazilian Forestry Certification Program (Cerflor), endorsed by the Programme for the Endorsement of Forest Certification Systems (PEFC).”

The Driving Forces for using BEKP

Sustainability from the Forest to the Mills



Evolution of Pulp Production Technologies

Contracted Performance (actual numbers)

		1990s	2000s	2010s	2015s
Production Capacity	ADtB/day	1150	2400	3920	5600
Chemical Consumption	kg act.Cl/ADtB	41		34	30
Effluent (Bleaching)	m ³ /ADtB	18		15	10-15
Brightness Target	% ISO	91	92	92	92
Brightness Reversion	% ISO		< 2.0	1.6	1.6

Source: Paulo Aguiar - Fiber Business Line **Metso Paper South America**; and **Fibria** own data

The Driving Forces for avoiding BEKP use Papermaker Mind-sets



Source: memoryofpaper.oeaw.ac.at/

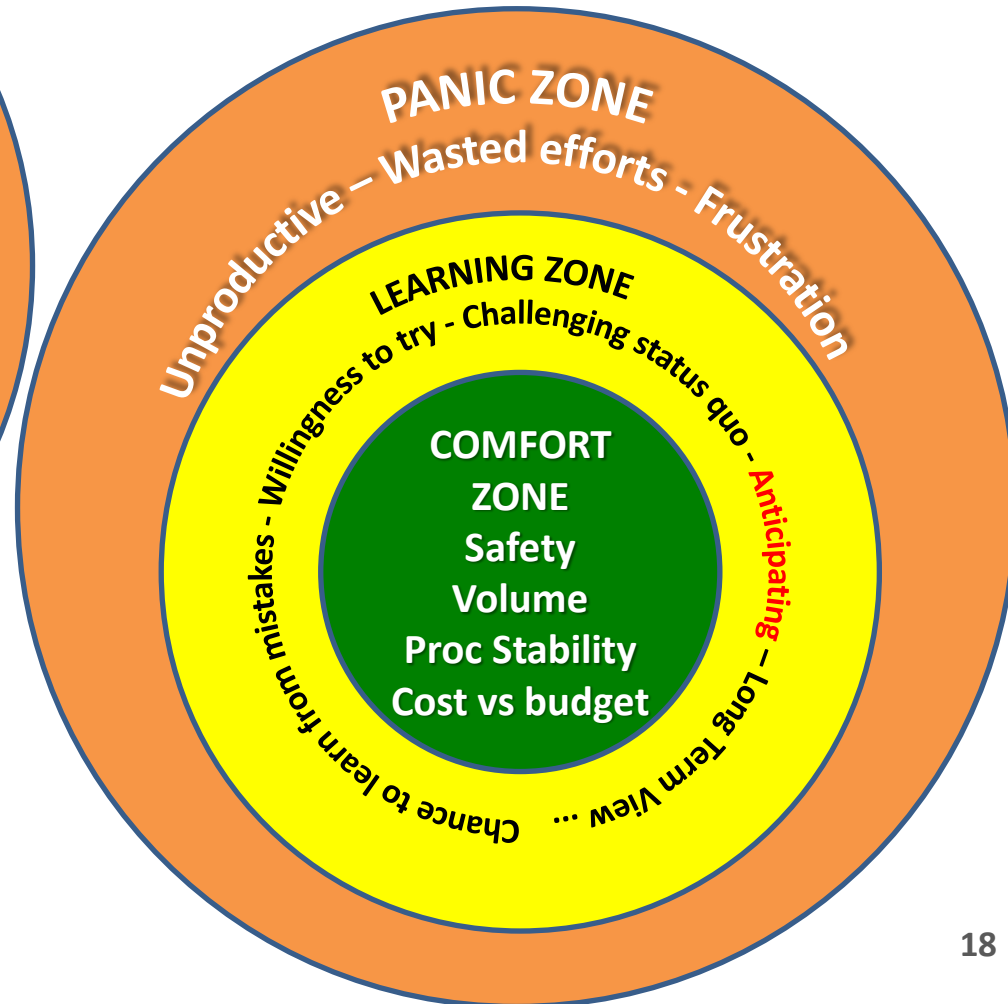
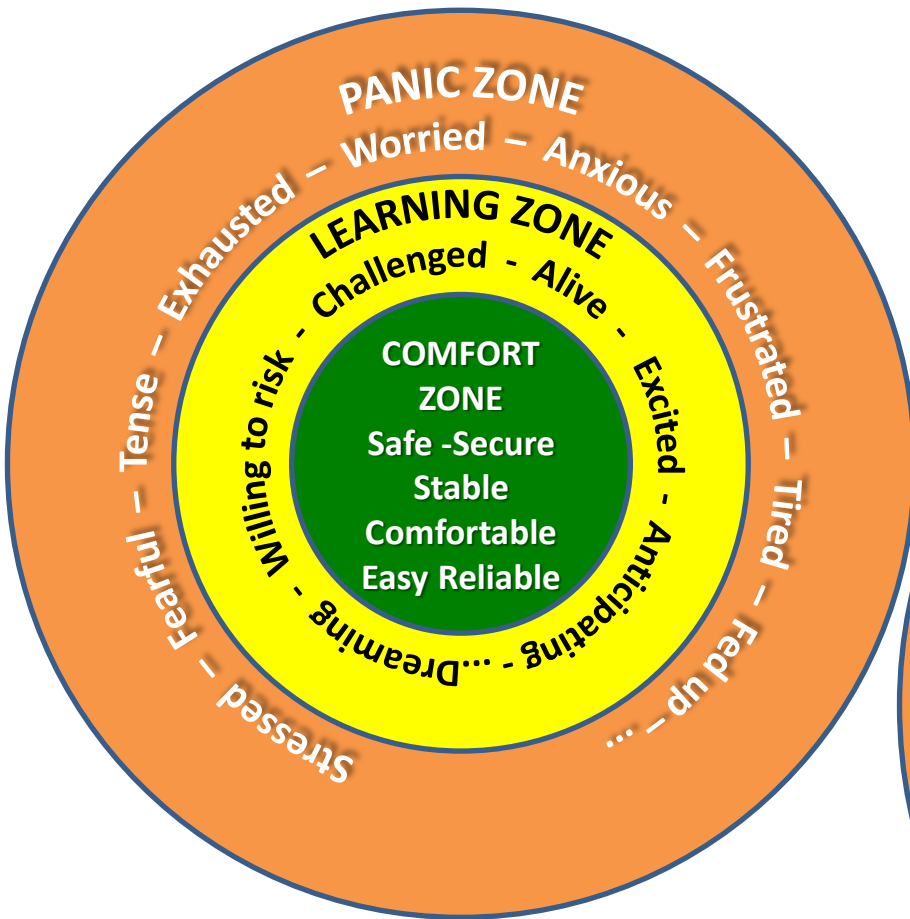
Sometimes, it
takes a painful
experience to
make us change

our ways

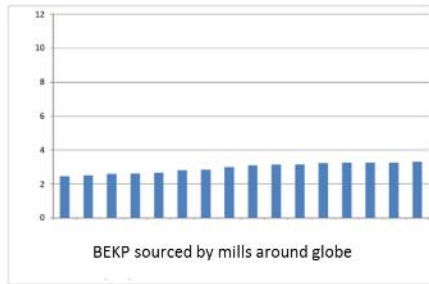
Proverbs 20:30

The Driving Forces for avoiding BEKP use

Papermaker Mind-sets

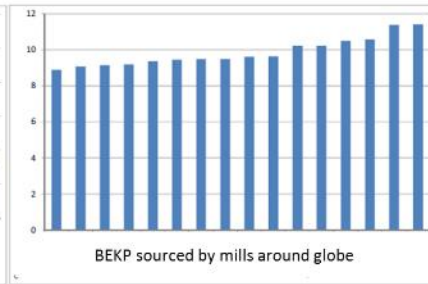


The Driving Forces for avoiding BEKP use Paper Strength / Papermaking Runnability



Unrefined pulps

Tear index : about 3 mN.m²/g



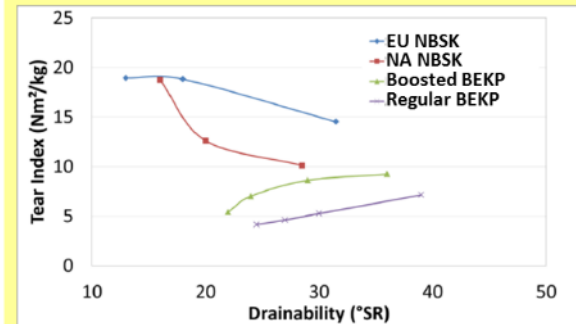
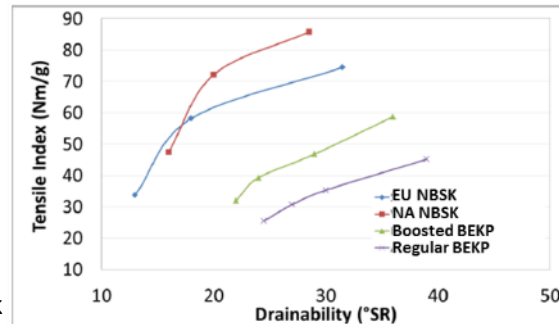
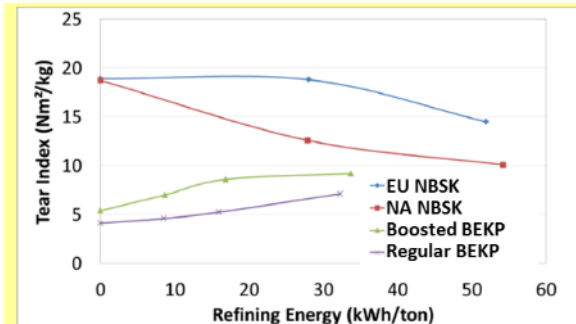
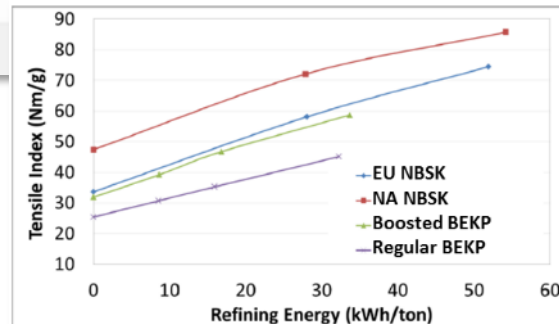
Refined pulps

Tear index : about 10 mN.m²/g

Tear index measured using Elmendorf apparatus,
(out-plane), on lab. samples (handsheets 72 g/m²)



Source: CTP, Eucaref project, 2013

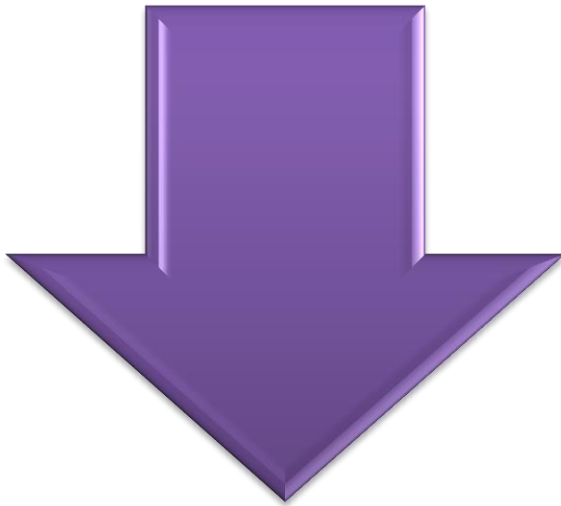


Source: Fibria proprietary databank

It may not be a matter of the strength itself... Or at least not only it!



Paper strength
Smoothness
Runnability



Absorbency
Drain/Dryability
Softness
Bulk ...

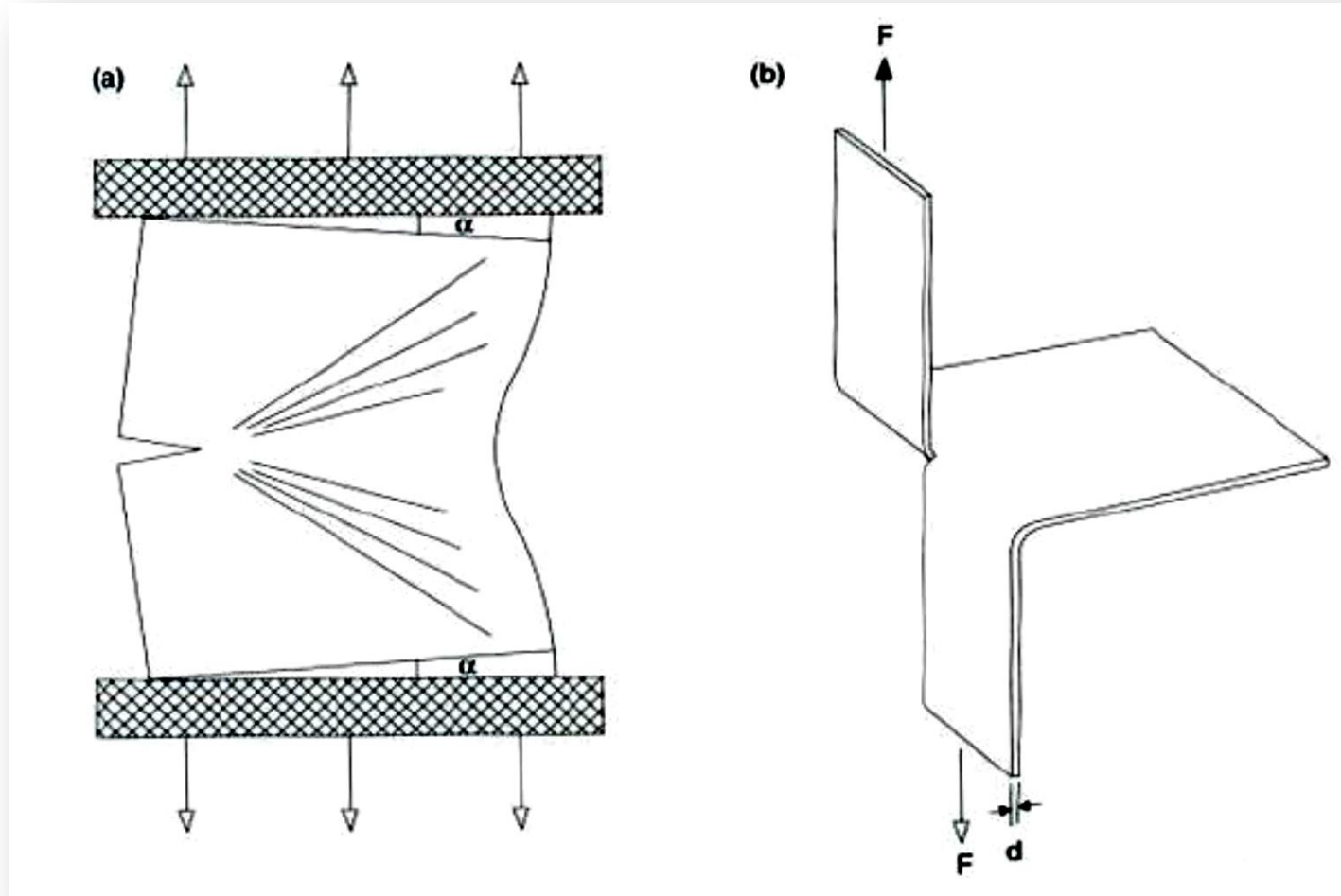
*“The Role of BEKP Strength on its
Market Share”*

**What are the levers to make it
easier?**

***(Paper) Books can still give us
important insights***

What's on the game?

Understanding the phenomena.



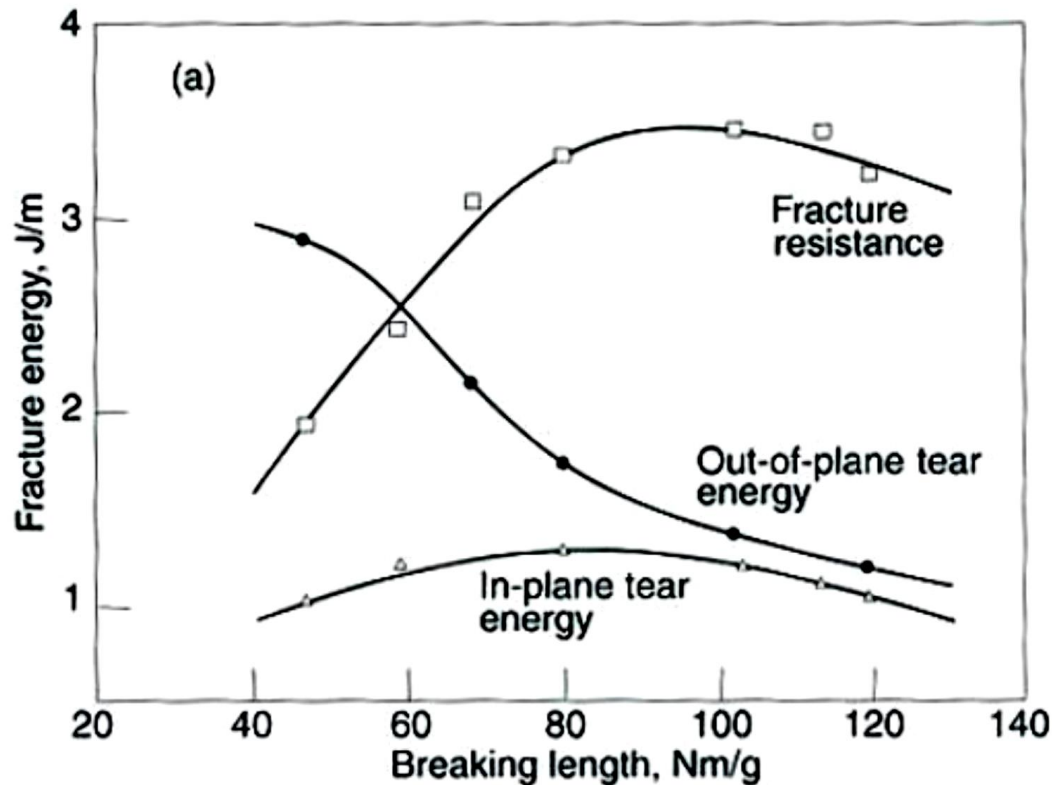
Tensile $\neq$ Tear

In Plane Tear $\neq$ Out of Plane Tear

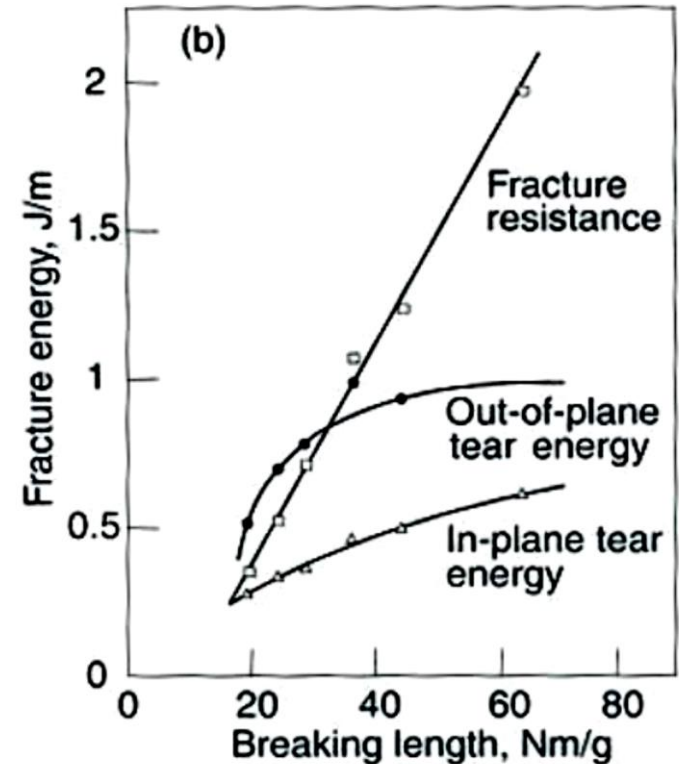
What's on the game?

Understanding the phenomena.

Softwood



Hardwood



Source: Fibria internal report from Innventia, 2013

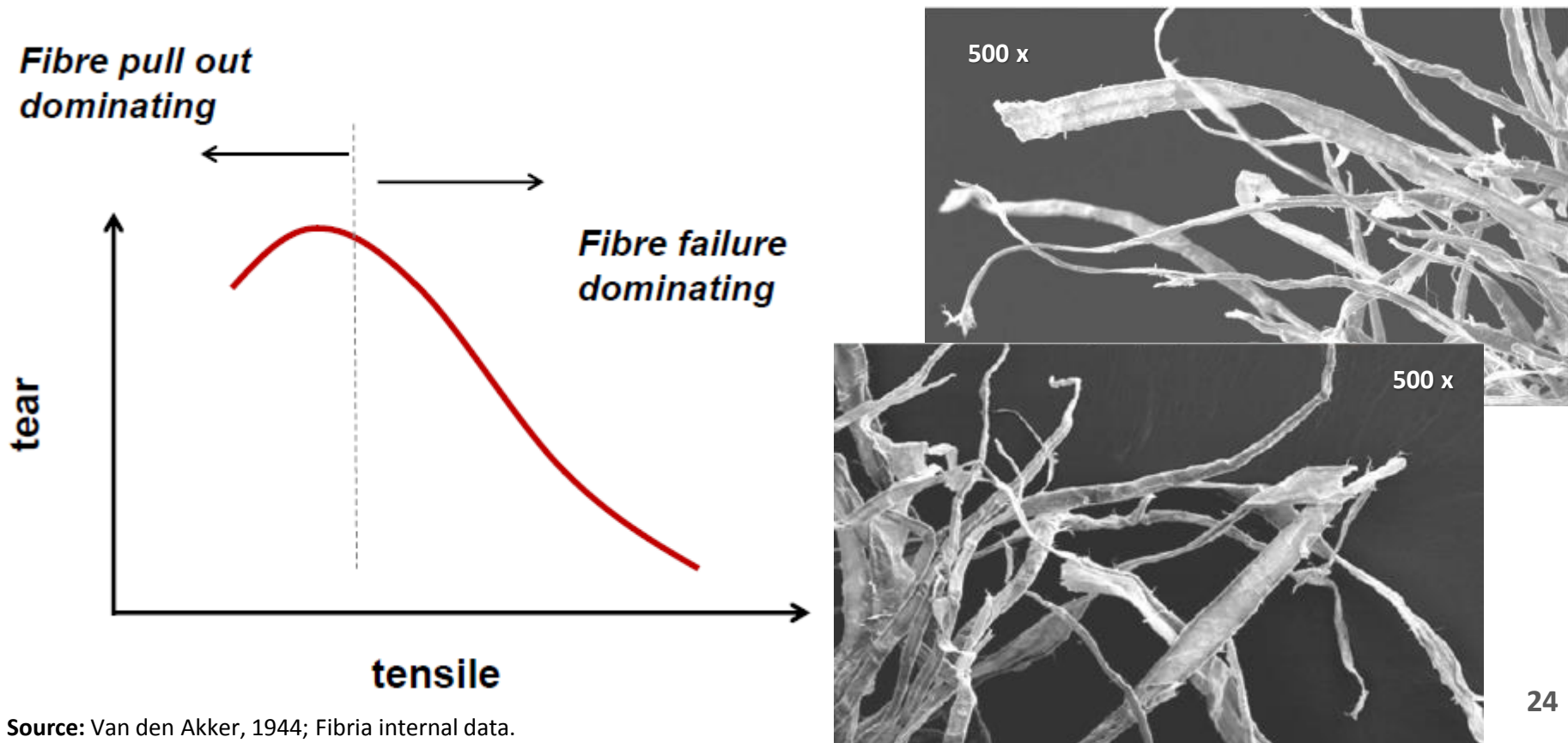
Behavior of a softwood based paper under stress is different of that from a hardwood based paper

What's on the game?

Understanding the phenomena.

One of the most used theories is Van den Akker's:

Tear strength related to fibre pull out as well as fiber fracture; initially mostly fiber pull out then more and more fiber fracture.



What's on the game?

Understanding the phenomena.

Tearing work - Kärenlampi



- Well bonded sheet
 - $W_{\text{paper}} \sim (\text{cell wall strength})^2/E$
- Middle range some fibres break
 - $W_{\text{paper}} \sim \{(RBA \cdot \text{fibre length} / \text{fibre width})(G_f/E_f)(\text{cell wall strength})^2\}/E$
- Loosely bonded sheet
 - $W_{\text{paper}} \sim RBA \cdot \text{fibre length} \cdot (\text{specific shear bond strength})^2 \cdot (\text{fibre width})^3 / \{E \cdot (\text{coarseness})^2\}$

Fiber strength and
Fiber-Fiber bonding
shall be taken into
account as within a
given and specific
matrix

What's on the game?

Understanding the phenomena.

- Seth and Page (1988) & Page (1994): *for paper with low bonding between fibers:*

$$\text{TEAR} = f(\text{FIBER LENGTH})$$

- Paltakari (2011):

$$\text{TEAR} = f(\text{FIBER LENGTH})^{3/2}$$

- Giertz & Helle, 1960 and Page, 1994: *for paper with low bonding between fibers:*

$$\text{TEAR} = f(\text{FIBER STRENGTH})^2 \text{ (fiber strength measured by Zero-Span)}$$

- Kärenlampi *for loosely bonded sheets (eg tissue):*

$$W_{\text{paper}} \sim \frac{RBA * \text{fiber length} * (\text{specific shear bond strength})^2 (\text{fiber width})^2}{(E * (\text{coarseness})^2)}$$

Source: Demuner, B.; Fibria internal report, 2013

Aha! It seems that there are ways to work on paper tear not only through the use of longer or coarser fibers also in literature!!

What's on the game?

Understanding the phenomena – What matters?



Summary:

For SWKP:

Fiber strength (and length) is the most relevant for TEAR mechanism. Bonding-ability also contributes;

For HWKP:

Bonding-ability (*and bond strength!*) is the most relevant attribute.

Source: Demuner, B.; Fibria internal report, 2013

What's on the game?

Understanding the phenomena – The knobs



FIBER (PRIMARY) FACTORS

1. MORFOLOGY

- Length / Coarseness
- Diameter / Wall thickness

2. STRENGTH

- Damages

3. FORM

- Curl / Kinks

4. BONDING ABILITY

- Sheet density /WRV / Carboxyl groups
- Specific Surface Area / Collapsability

FURTHER PAPER/PAPERMAKING RELATED FACTORS

FIBER LOAD BEARING ABILITY

- Fiber Stiffness/Activation
 - ✓ Fiber shrinkage/curl
- Effective fiber length
 - ✓ Length / coarseness / kink
- Fiber strength
 - ✓ Tensile/Shear strength
- Sheet uniformity

FIBER BONDING/COHESION

- Fiber contact area
 - ✓ Fiber collapse / twist / flexibility
 - ✓ Fibrillation
 - ✓ Fines
- Specific bond strength
 - ✓ Surface chemistry
 - ✓ Polymer entanglement

Technology allows higher BEKP participation in paper furnish balancing trade-offs

The way out of an “exotic commodity” to become a “specialty”



Evolution of Tissue Papermaking – Refining



Fibres refined at 65 kWh/t
SEL 0.70 Ws/m



3.0 x 3.0 /
Cutting Length <



Fibres refined at 20 kWh/t
SEL 0.05 Ws/m



Finer Pattern 1.3 /
Cutting Length >

The way out of an “exotic commodity” to become a “specialty”

Evolution of Tissue Papermaking – Forming

Multi-layered Headboxes

Developed in the 70s it is still today the best headbox concept for premium tissue.

With the appropriate allocation of BEKP and BSKP the process/product get the benefit of runnability and handfeel simultaneously.

The way out of an “exotic commodity” to become a “specialty”

Evolution of Tissue Papermaking – Forming Wires

1958: plastic wire started to replace

During the 1970s and 1980s: polyethylene different yarn dimensions at the paper surface and better fibre support (retention)



The way out of an “exotic commodity” to become a “specialty”

Evolution of Tissue Papermaking – State of the Art

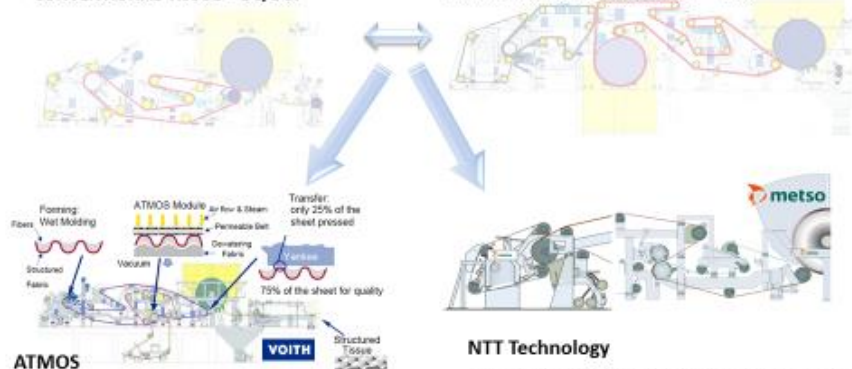
Source of the Pictures: Voith Paper and Metso Paper

Source: Holik, H. Faster, wider, better – progress in paper making



CONVENTIONAL TISSUE – DC/DCT

PREMIUM STRUCTURED TISSUE – TAD



ATMOS

Easy swing: DC to/from ATMOS

Up to 55% energy savings versus TAD

Source: Voith and Metso

NTT Technology

Swing capability between textured and DCT
Investment cost about 10% higher than for DCT tissue line running on virgin fibre

.... among others

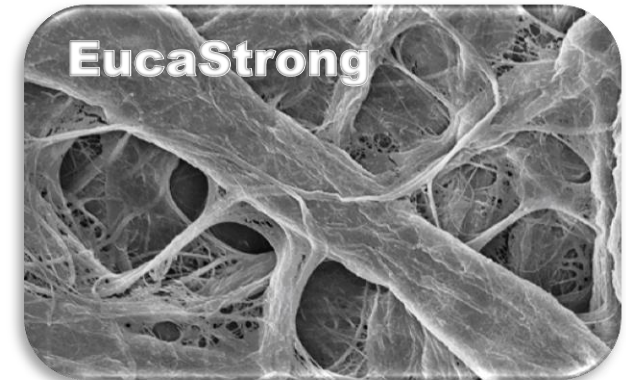
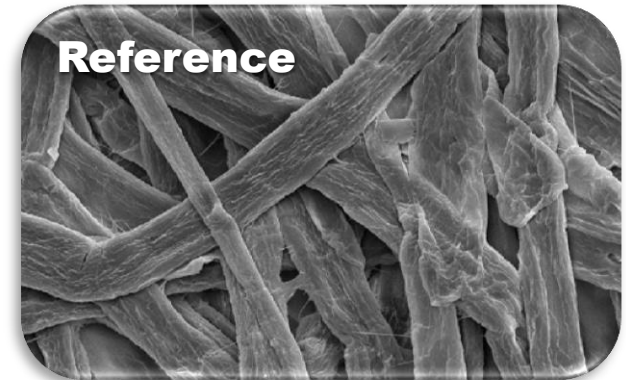
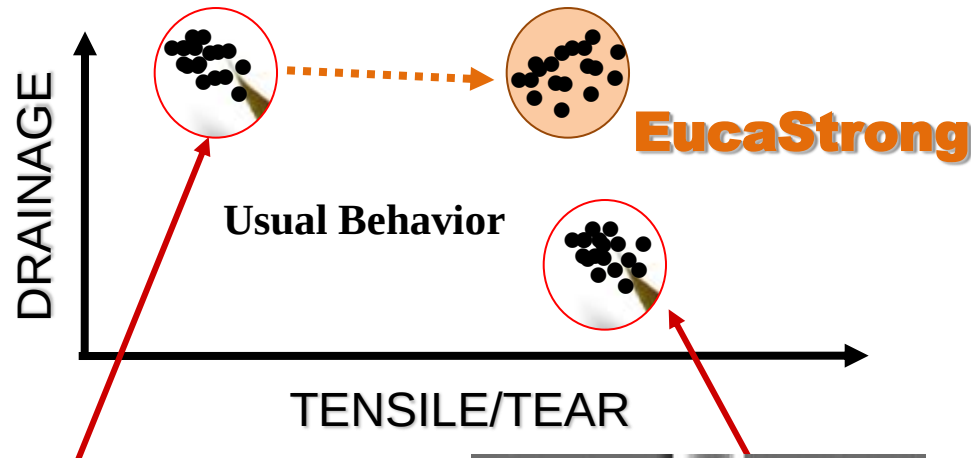
Technology allows higher BEKP participation in paper furnish

On pulp side we can mention:

- Pulping/bleaching set ups
 - ✓ Cooking/Kappa ; Bleaching sequence; pH management; Drying Technologies*...
- Forestry differentiation
 - ✓ Different hibrids; Spacing; Sorting; Ages*...
- Pulp additivation / surface functionalization
 - ✓ A brave new world

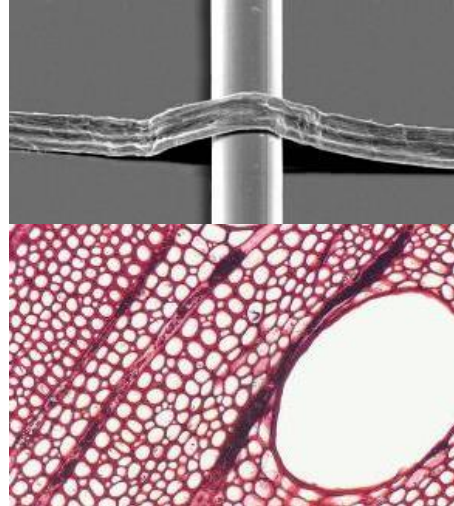
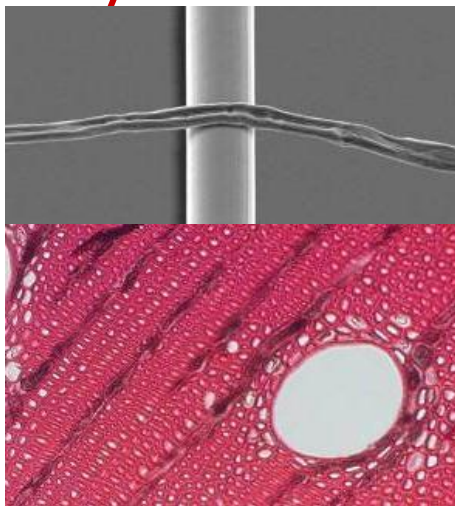
And one could expect many new or combined strategies to succeed...

Technology allows higher BEKP participation in paper furnish – A real example



Fiber

Wood



Better strength/drainage relationship

- ✓ Refining Energy
- ✓ Machine Throughput
- ✓ Additives – DSA

Furnish Optimization

- ✓ BEKP increase

*“The Role of BEKP Strength on its
Market Share”*

**Why being ahead of competition
on BEKP usage?**

Recap...

- Open-minded teams to make BEKP work and keep sheet winding on the reel will be rewarded with:
 - Unique and cheaper furnish;
 - Less demanding refining;
 - Paper opacity; smoothness; softness...
 - Drainage and balanced tear/tensile;
 - Secure and sustainable source of fibers;
 - **Opportunity to get the lead in**
 - **Eco-labeling;**
 - **C footprint;**
 - **Customer preference on the shelf;**
 - **Reel cost**

*“The Role of BEKP Strength on its
Market Share”*

Final Remarks

Final Remarks

There is a slow but increasing demand for a higher BEKP strength, dependent on the paper grade.

✓ *The more you use the higher the challenge*

BEKP producers and customers (papermakers) may obtain relative competitive advantage with this movement.

✓ *Quality / Cost / Eco-friendly*

There are several different ways to provide that.

✓ *Forest pulp functionalization and Refinishing as examples*

The trend of increasing BEKP use does not appear to be dependent on this strength increase

✓ *Strong rate of market share accumulation along the years*

Acknowledgements

For the great opportunity we thank:

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And...



**For your kind attention:
THANK YOU!**



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