



TAILORING EUCALYPTUS FIBRE FOR TISSUE PAPER PRODUCTION

5th International Colloquium on Eucalyptus Pulp
May 12, 2011
Porto Seguro – BA, Brazil

Paulo César Pavan



AGENDA

- **Some Pictures “From the Beginning”**
- **The way out of an “exotic commodity” to become a “specialty”**
- **The Consequences... Current Role of Eucalyptus Pulp**
- **The Future to Come. Room to Increase Market Leadership**
- **Final Remarks**

Some Pictures “From the Beginning”

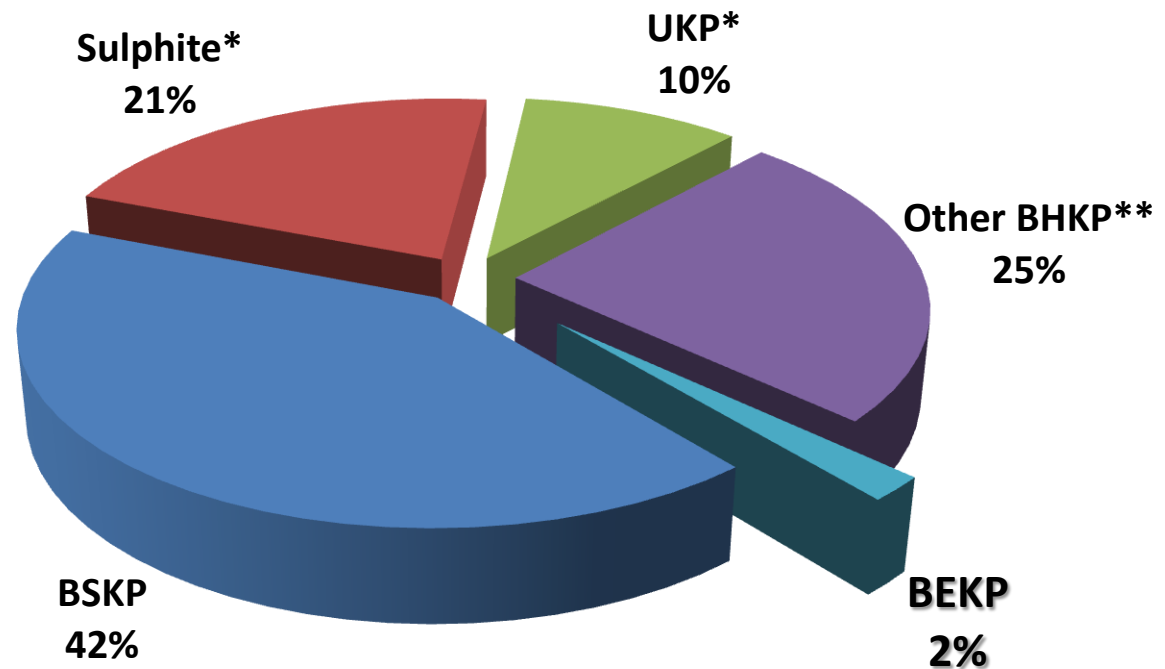
- 1950s and early 1960s: disbelief in hardwood pulp;
- 1960s: **understanding over the properties of hardwood pulps grew;**
- 1970s and early 1980s: birch still priced above eucalyptus;
- First internationally sold Brazilian BEKP from Riocell/Unicell targeting tissue.
- 1970s: birch substitution by BEKP for quality reasons in many paper segments.
- Late 1970s: two large BEKP market pulp mills built in Brazil: Aracruz and Cenibra.
- 1980s and 1990s: new players, Jari, Suzano, Votorantim, Arauco and CMPC.
- In summary: **Improved knowledge** and new paper machine technology allowed an increased share of BHKP in virtually all P&W, tissue, cartonboard and specialty papers. Strength was no longer *the* quality criterion. Bulk and opacity became predominant in printing papers. In tissue products, softness, along with bulk, became the key quality features, obtained by an increased use of BHKP.

Some Pictures “From the Beginning”

“Before the 60s, papermaking was considered an art. ... Softwood pulps were extensively used as the common denominator. ...Scandinavian birch, southern mixed hardwoods and northern hardwoods (all of them from native forests) completed the mixes”.

HILLMAN, D.C. *Single Species: The world’s preferred market pulp.*

World Fibre Consumption Year: 1974



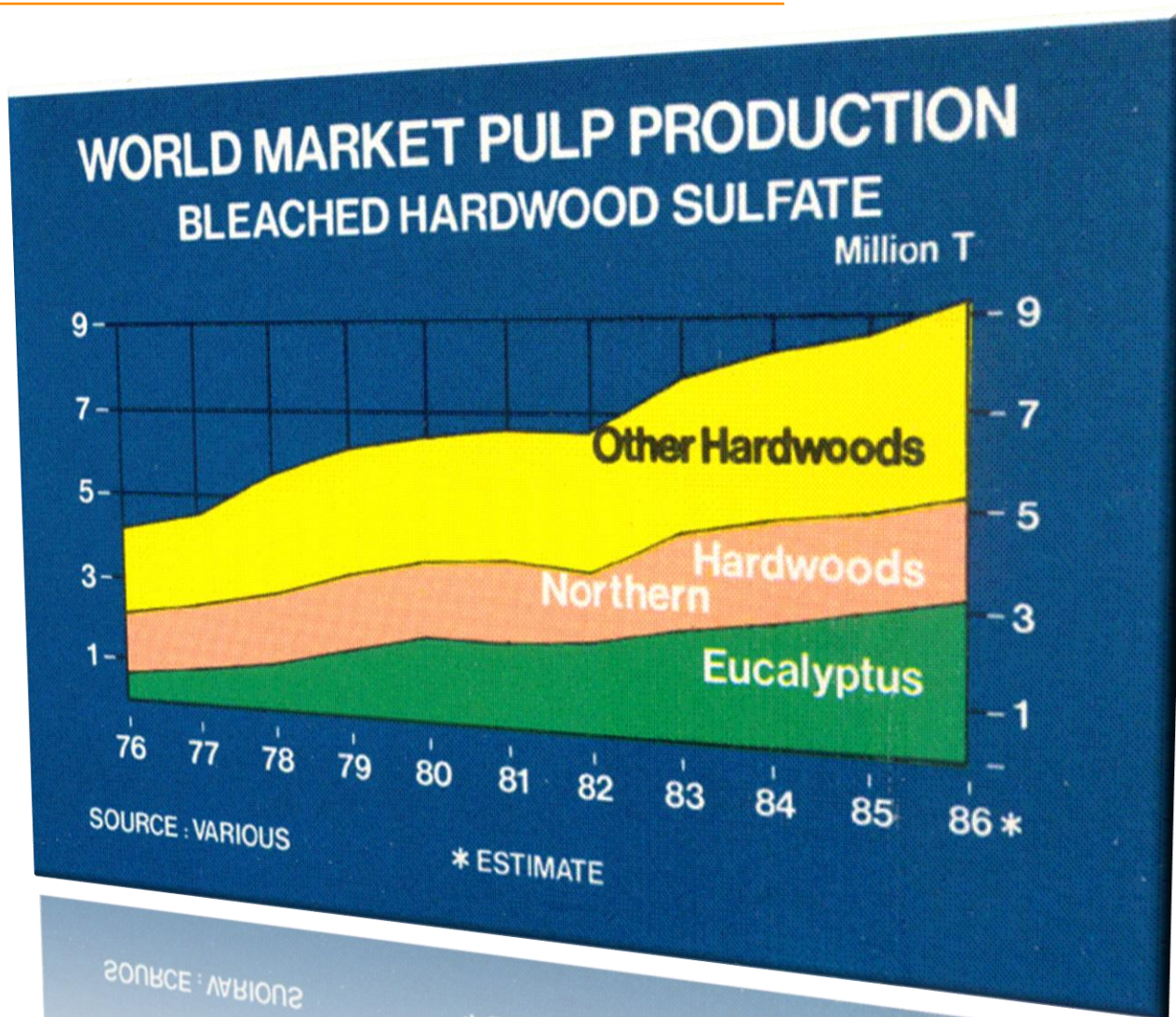
Total 18.3 MM ton

** Estimate*

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

Source: Hawkins Wright and Aracruz

Some Pictures "From the Beginning"



Some Pictures “From the Beginning”

Forests Implementation:

BEKP Scenario

- Introducing eucalyptus in large-scale forests dedicated to pulp production
- Less than 20 species were suitable for pulp production among more than 700 species adapted to a wide variety of soil and climate;
- Conventional forest technology planting using non-improved seeds;
- Initial adaptation problems, diseases, pests, and low productivity.

Some Pictures “From the Beginning”

Pulp and Tissue Production Technologies:

Pulp production

- Conventional pulping and bleaching technologies;
- Poor chip impregnation, selectivity and yield;
- Higher wood and chemical specific consumptions;

Tissue Paper production

- BEKP quality not known among papermakers;
- Conventional technologies, including refining – limited tools;

Some Pictures “From the Beginning”

From the BEKP supplier perspective **challenges** could be thus summarized as:

- Focusing in **high performance in cost and product quality** (fibre uniformity and physical properties);
- **Using planted forests** with high potential of sustainable growth;
- Overcome initial **forest adaptation problems**, as well as **diseases**;
- **Introducing a new pulp**, demanding knowledge and **dissemination of the advantages of BEKP** for tissue and papermaking in general

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







Why Eucalyptus appears ideal for fine and tissue papers?

- Fibre **length** is relatively short (about 0.65 mm), while European species such as birch, aspen, beech and oak are 15 – 40% longer;
- Fibre **coarseness** is the lowest of the traditional market pulp fibres.
- **Number of fibres per gram** is consequently high (in the range of 20 million).
- Eucalypt fibres **resist collapse**: not only are they slender but also their wall thickness is relatively high.
- Fibre wall **microfibrils have a low winding angle** with fibre axis when compared with other hardwoods.

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

Comparison among usual BHKP (weighted averages):

	Eucalypts <i>E. grandis</i> <i>E. urophylla</i> <i>E. saligna</i> <i>E. globulus</i> <i>E. camaldulensis</i>	Scandinavian Birch	NE American HW Maple Birch Aspen	Southern US HW Gums Oaks
Relative Sizes				
Width, μm	12 – 16	18 – 30	17 – 20	19 – 24
Wall Thickness, μm	2.0 – 3.0	2.5 – 4.0	2.5 – 3.0	4.0 – 6.0
Length, mm	0.65 – 0.75	0.80 – 1.30	0.60 – 1.10	0.85 – 1.00
Fibre Count, million/g	22 – 26	8 – 9	11 – 36	19 – 25
Coarseness, mg/100m	7 – 9	9 – 12	8 – 10	10 – 13
Fibre/Vessel ratio	130 – 150	40 – 50		

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

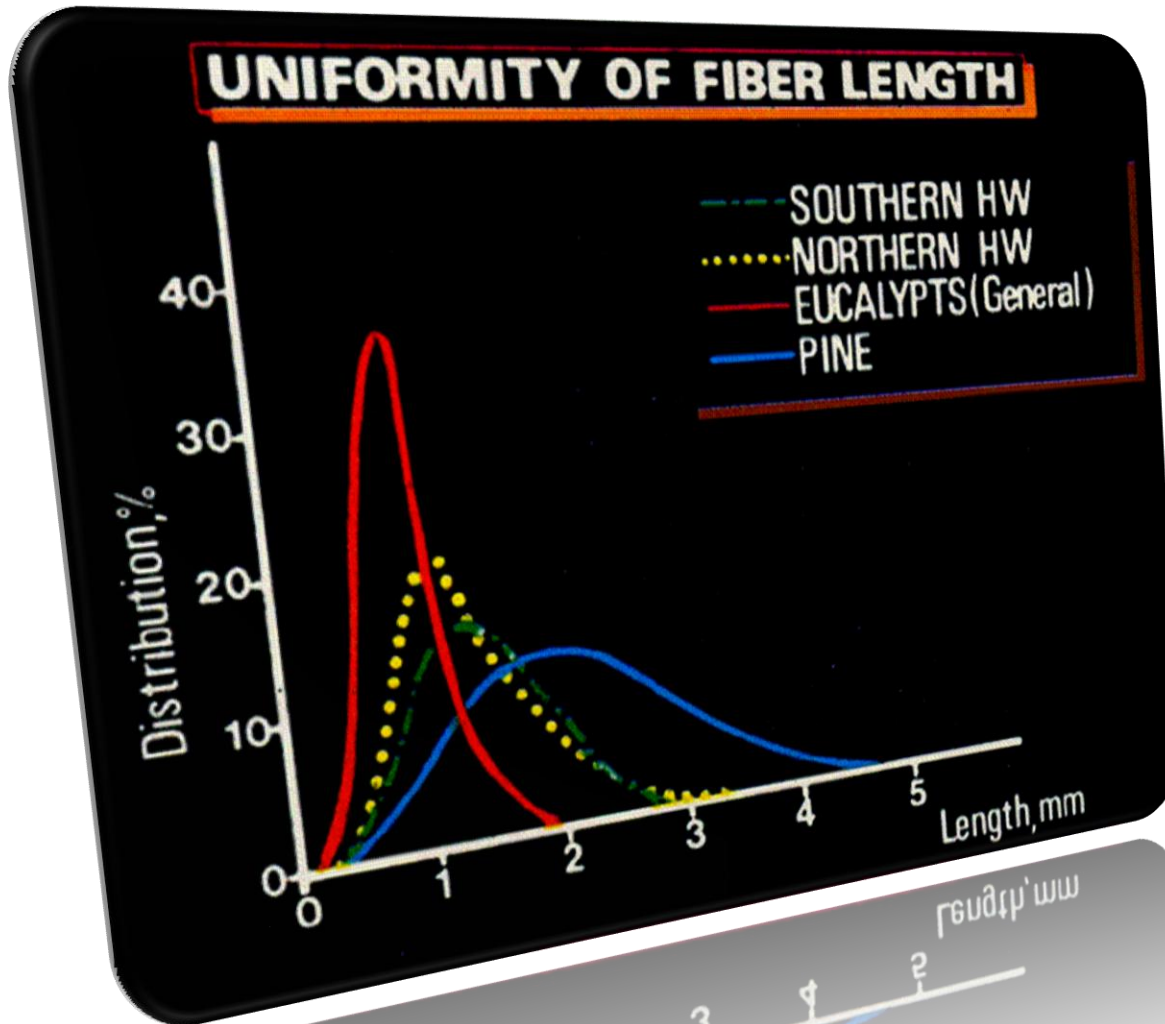


Why Eucalyptus appears ideal for fine and tissue papers?

Those distinguished morphological characteristics provide:

- **Uniform paper formation and high opacity:** important for all grades of fine papers. BEKP: high number of fibres per gram and short fibre 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 way out of an “exotic commodity” to become a “specialty”



“I believe firmly that in the future ... homogeneity of fibres will become increasingly important to the quality and efficiency of pulp and paper process, thus finally leading to lower costs.

Accordingly, planted forests apart from giving low costs wood will also lead to better quality at lower cost.

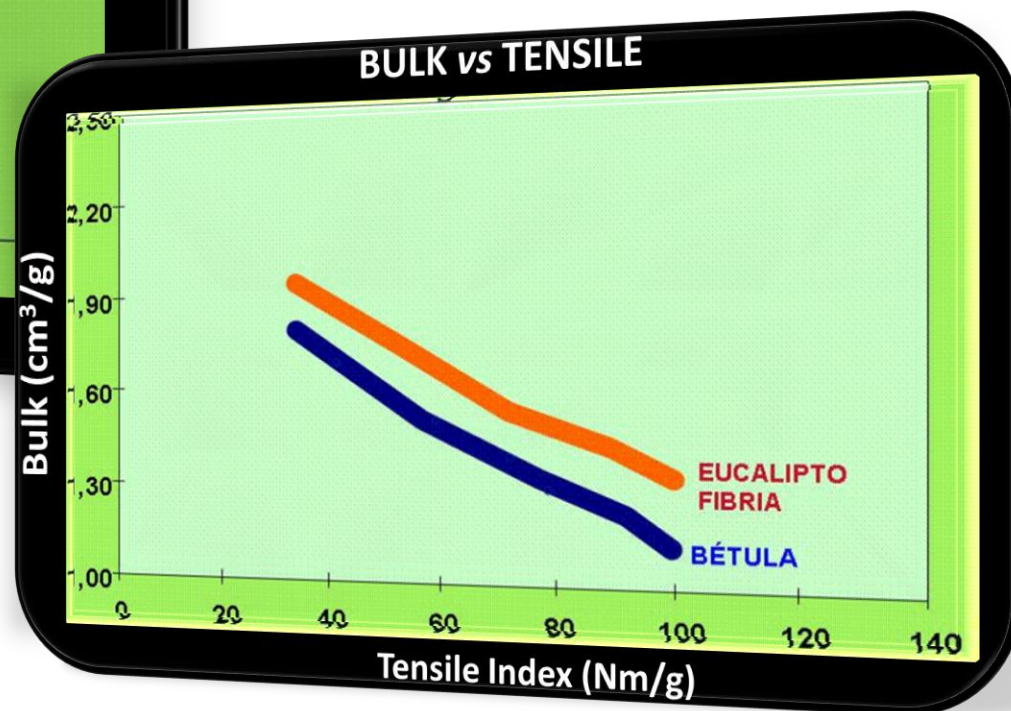
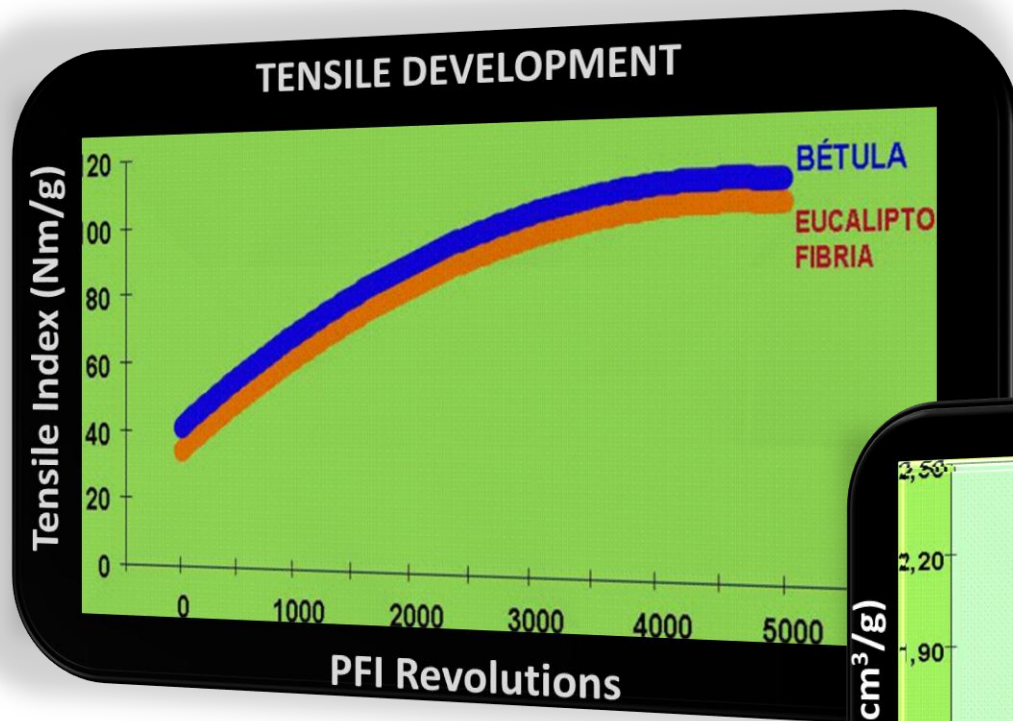
And through more uniform fibres homogeneity due to shorter rotations, these properties can in the future be even better designed ...”

CLAES HALL, 1987

HALL, C.G. *Competitively in the pulp & paper industry, with emphasis on Latin America versus the rest of the world.* Buenos Aires, Argentina, Sept. 1987. 9p.

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

Comparison between Eucalyptus and Birch:

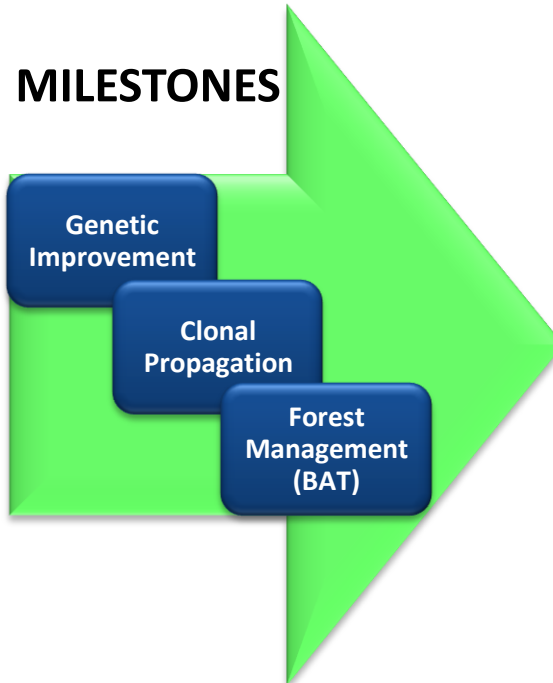
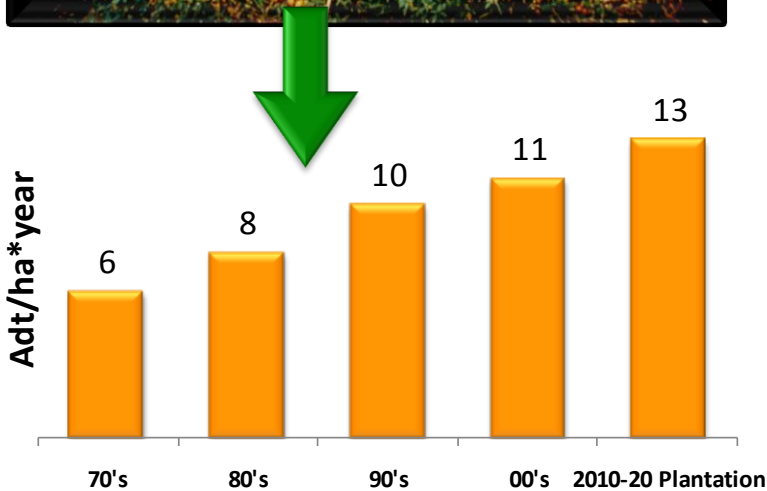
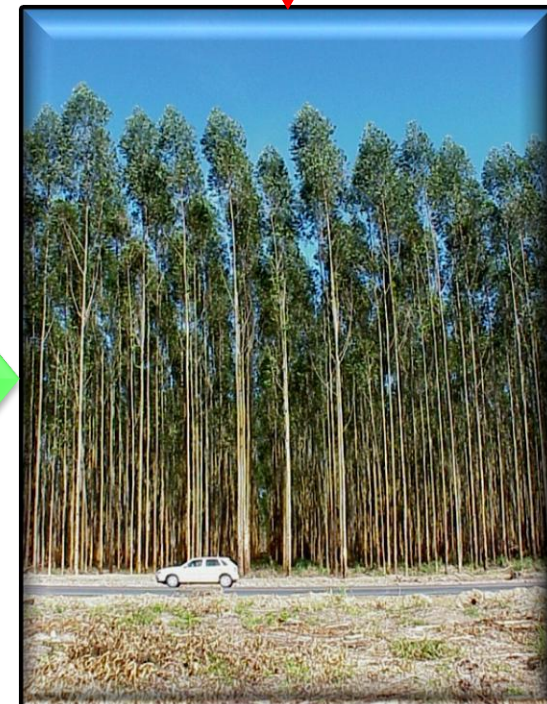


The way out of an “exotic commodity” to become a “specialty”

Forest Development/Improvement



Under the same climate conditions!



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

Evolution of Pulp Production Technologies

Fiberline - Continuous Cooking Process

• Conventional
cooking +
Cold blow

• CC +
High Heat

• CC +
Mod Cont
Cooking +
High heat +

• CC +
MCC +
Isothermal

• Black liquor
impregnation +
MCC +
ITC

• Compact
cooking G1
• Lo-Solids

• Compact
cooking G2
• Lo-Solids
Down Flow

Increasing Selectivity and Yield

1950

1960

1970

1980

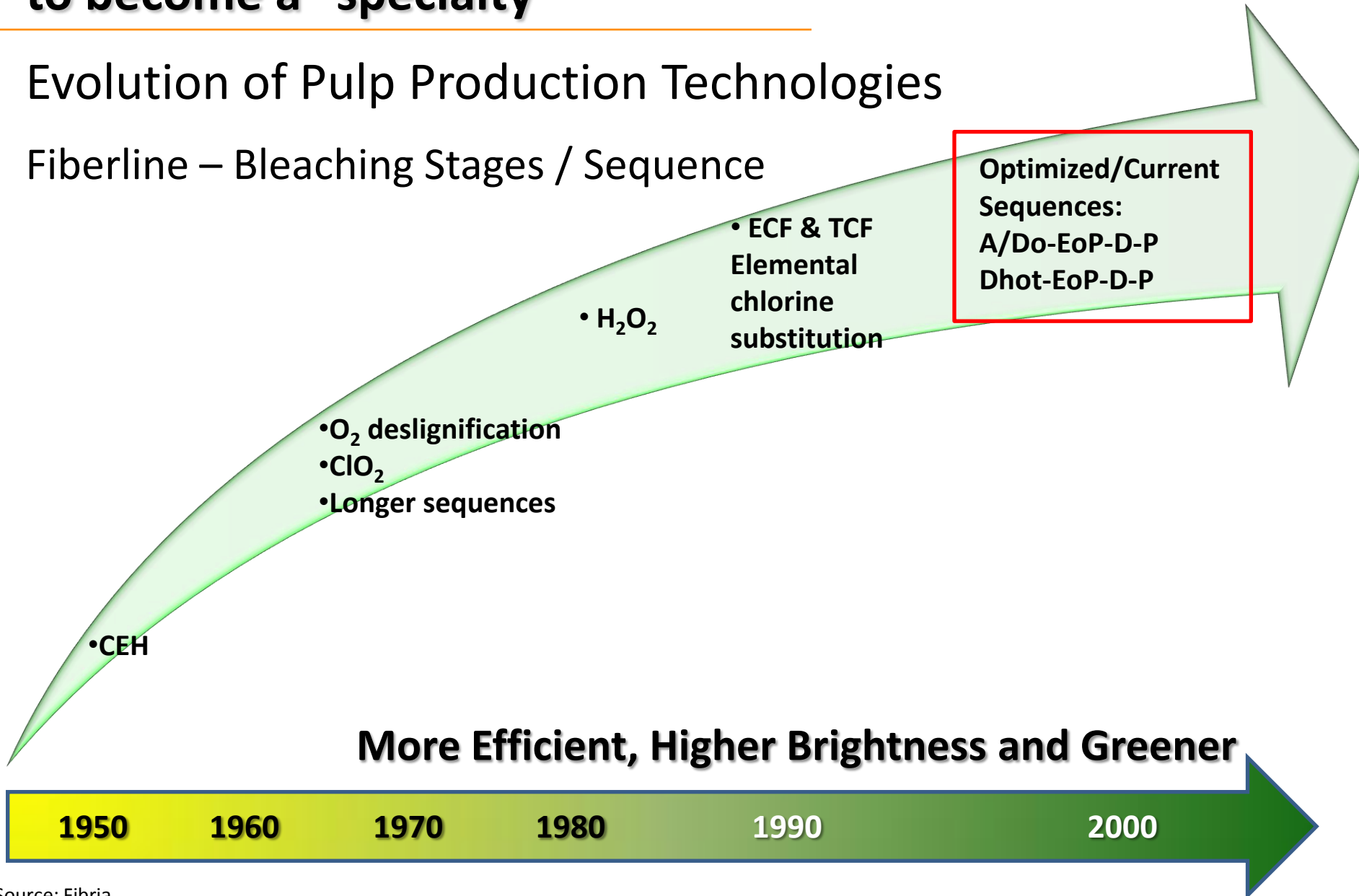
1990

2000

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

Evolution of Pulp Production Technologies

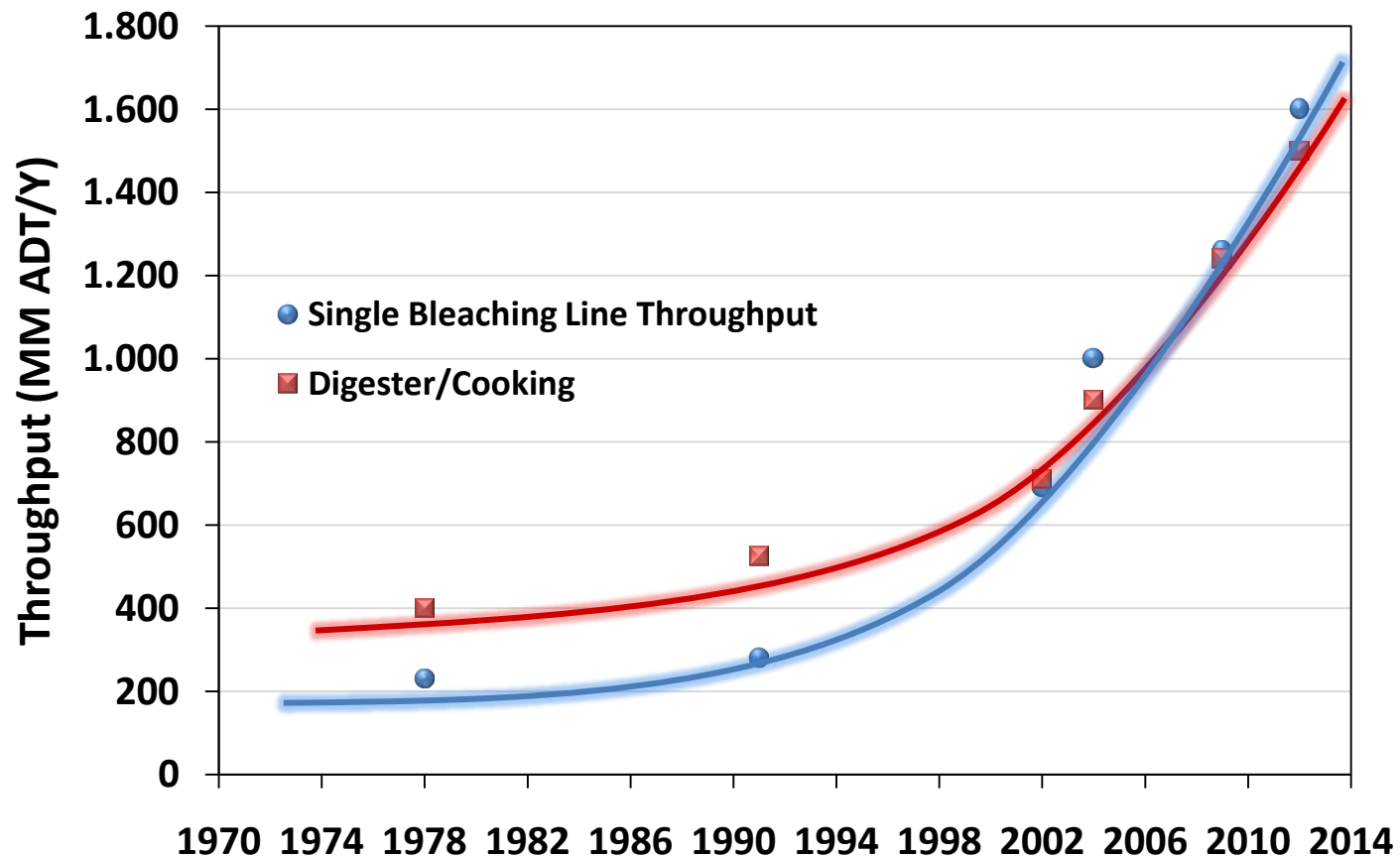
Fiberline – Bleaching Stages / Sequence



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

Evolution of Pulp Production Technologies

Fiberline - Capacity Evolution of Cooking and Bleaching Single Lines



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



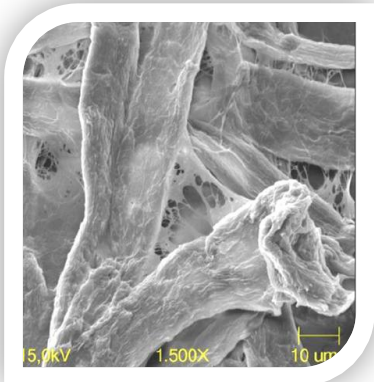
Evolution of Pulp Production Technologies

Contracted Performance Assurance (actual numbers)

		1990s	2000s	2010s
Production Capacity	ADtB/day	1150	2400	3920
Chemical Consumption	kg act.Cl/ADtB	40.9		34.0
Effluent Generation (Bleaching)	m ³ /ADtB	18		15
Brightness Target	% ISO	90.8	92.0	92.0
Brightness Reversion	% ISO		< 2.0	1.6
Bleached Pulp Viscosity	dm ³ /kg	680	850	900

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

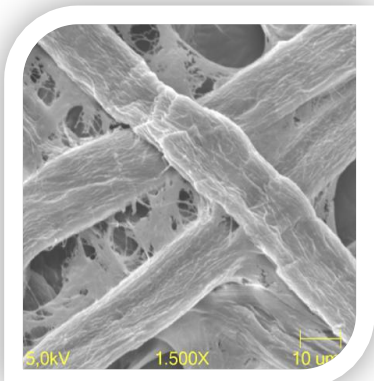
Evolution of Tissue Papermaking – Refining



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



3.0 x 3.0 / 15”
Cutting Length < 20 km/rev

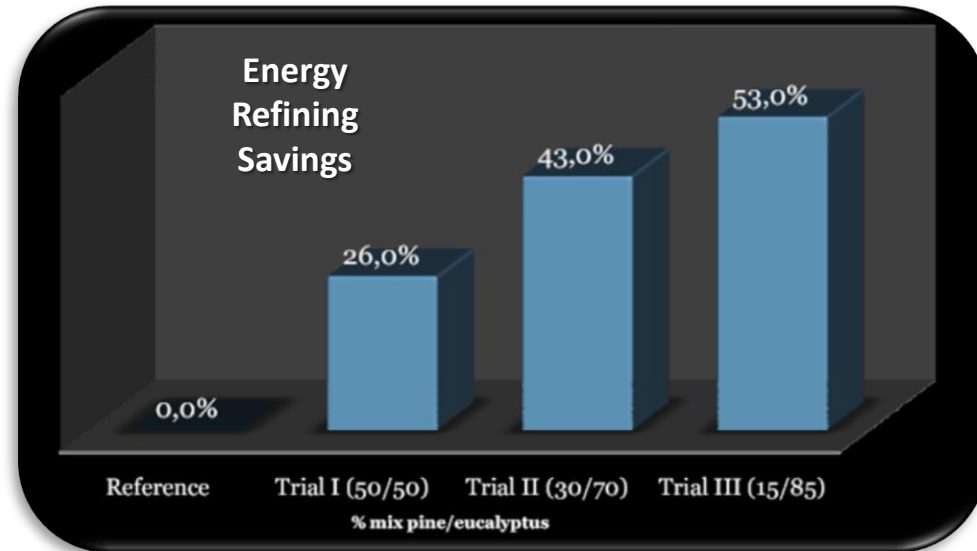


Fibres refined at 20 kWh/t
SEL 0.05 Ws/m



Finer Pattern 1.3 x 2.0 / 15”
Cutting Length > 62 km/rev

- Refining energy savings (over 50%)
- Reduction in the long fibres in the furnish. Figure shows an increase of BEKP/BSKP ratio from 50/50 to 85/15 with no loss in quality or runnability
- Better paper quality without jeopardizing the runnability.



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

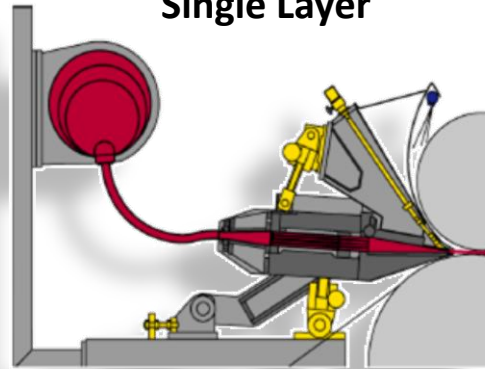
Evolution of Tissue Papermaking – Forming

Multi-layered Headboxes

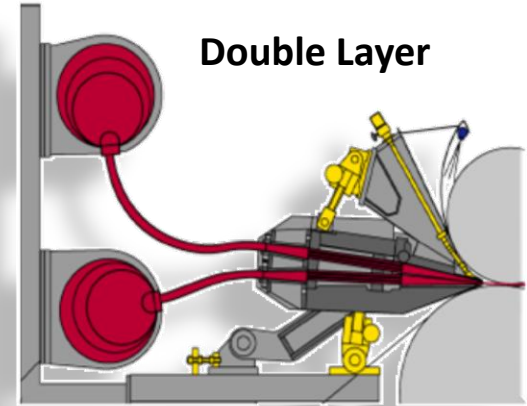
Developed in the 70s it is still today the best headbox concept for premium tissue.

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

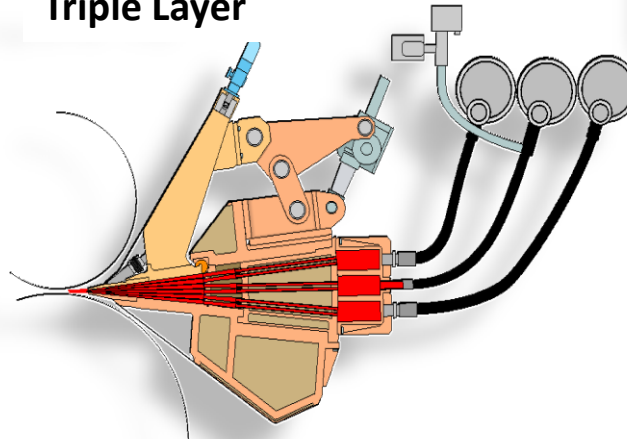
Single Layer



Double Layer



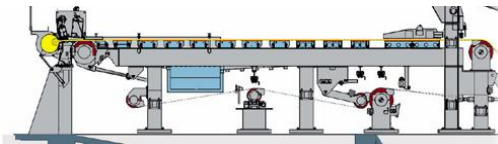
Triple Layer



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

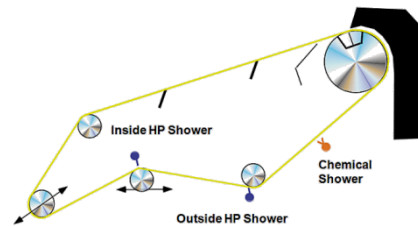
Evolution of Tissue Papermaking – Forming Concept

Fourdrinier:
*in the earlier times...
a survivor*



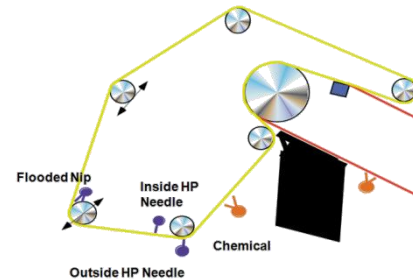
Max speed 1000m/min

Suction breast roll forming
*Used until late 1970s. The
fibre orientation could not
be adequately controlled at
high speeds.*



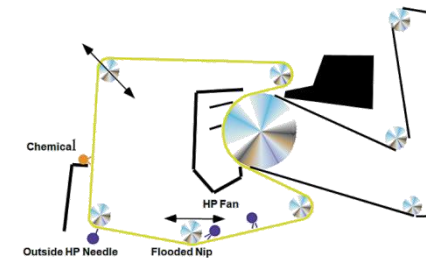
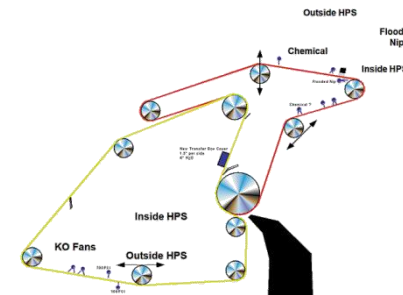
Max speed 1500m/min

Twin wire formers
*For better influence
on the MD/CD ratio,
C-wrap or S-wrap.*



Max speed 2000m/min

Crescent Former
*It uses a wire at the
drainage side and a
felt at the inside which
transfers the paper
web directly to the
drying cylinder and the
press nip. Still the most
used technology.*



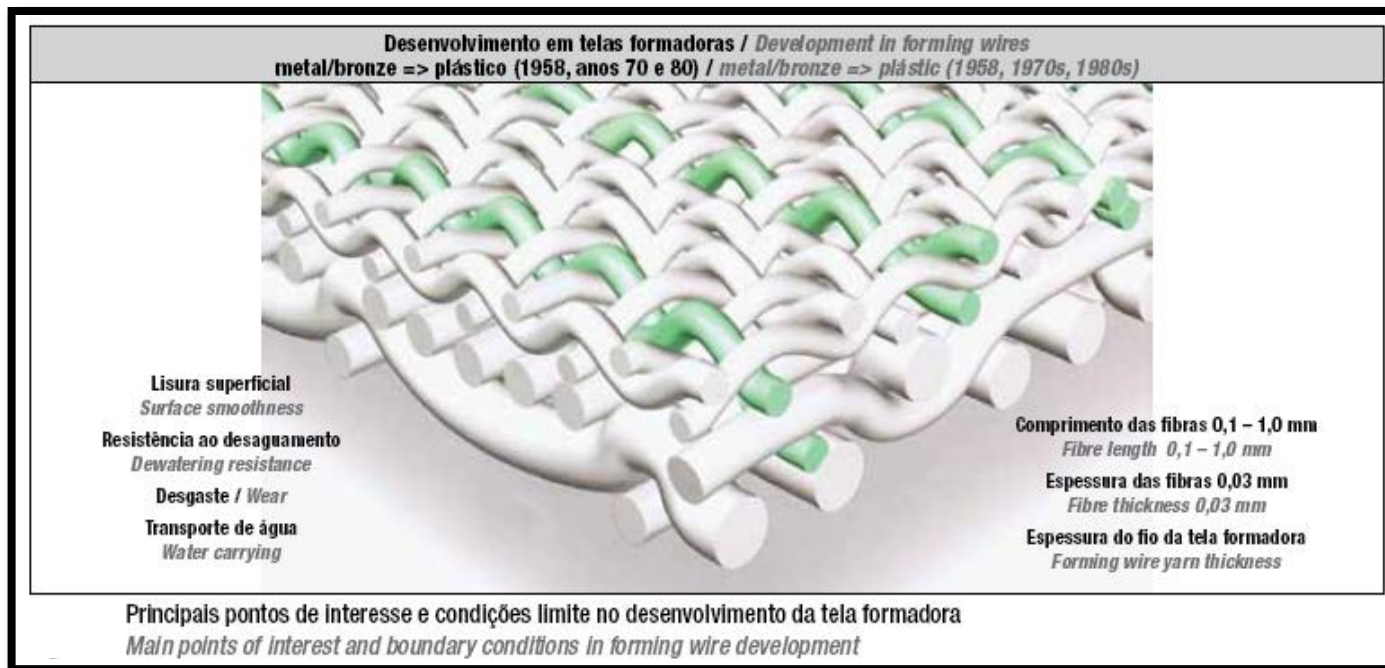
Max speed 2400m/min

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

Evolution of Tissue Papermaking – Forming Wires

1958: plastic wire started to replace the (single layer) bronze wires

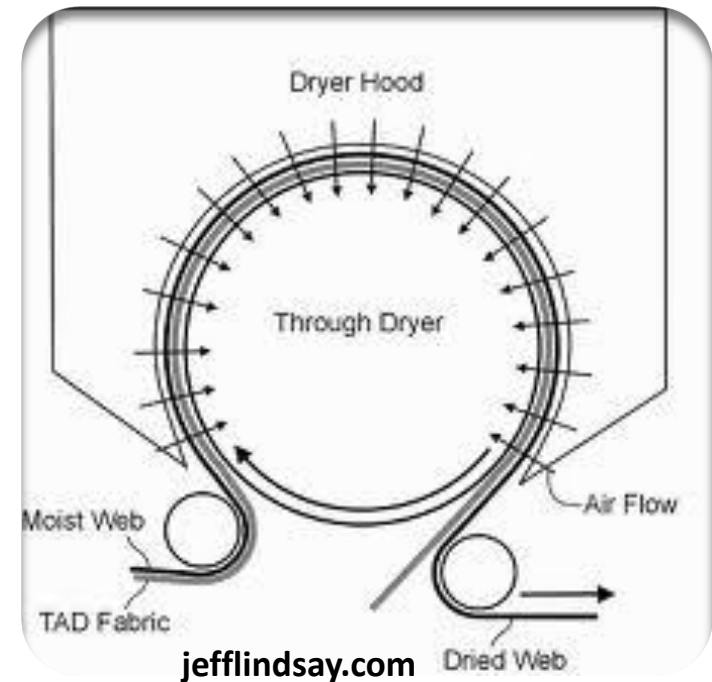
During the 1970s and 1980s: polyethylene or polyamide wires optimized with 2 - 3 layers and different yarn dimensions at the paper and the running side. This resulted in a smoother paper surface and better fibre support (retention).



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

Evolution of Tissue Papermaking – Drying

- Contact drying: Cylinders (Yankee) from 3.6 m diameter to 5.5 m currently.
- High efficiency drying hoods operate at air velocities of up to 210 m/s and air temperatures up to 700°C. Since the 1980s sectioned hoods for control of moisture CD profile were more frequently used.
- **Through air drying (TAD):** Used since the 1960s (P&G patent). The formed sheet is not pressed; the water is evaporated by hot air sucked (or blew) through the web up to a dry content of about 70%. Final drying and creping occur on a (small) Yankee dryer. ***The disadvantage is high energy consumption.*** Accounts for 10% of the world tissue capacity (2008).



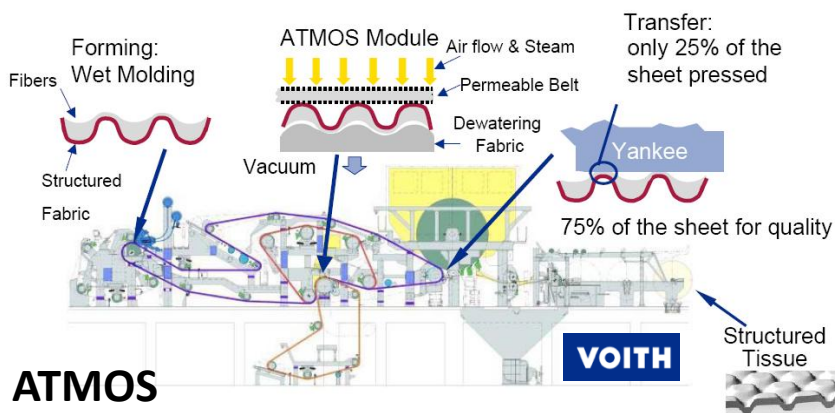
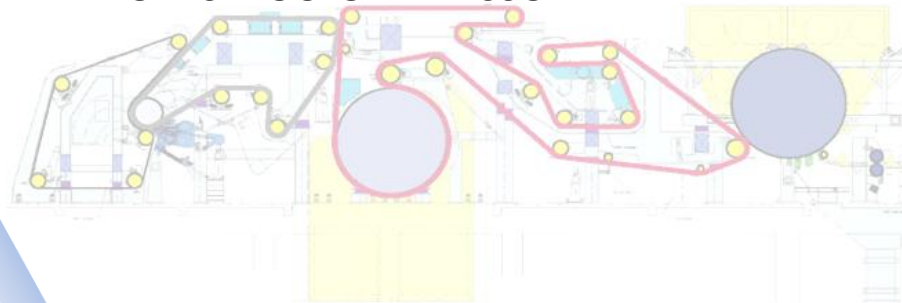
The way out of an “exotic commodity” to become a “specialty”

Evolution of Tissue Papermaking – State of the Art

CONVENTIONAL TISSUE – DC/DCT



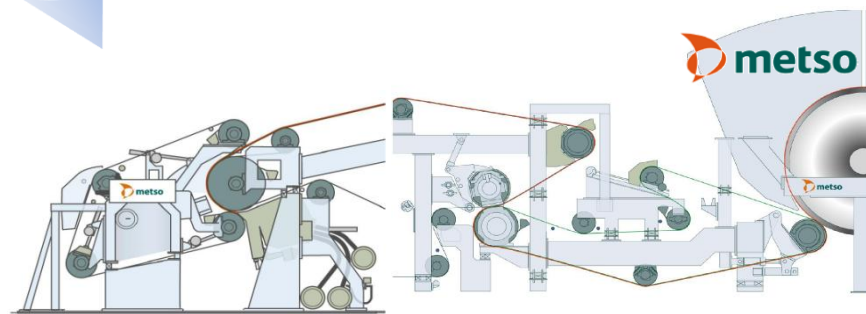
PREMIUM STRUCTURED TISSUE – TAD



ATMOS

Easy swing: DC to/from ATMOS

Up to 55% energy savings versus TAD



NTT Technology

Swing capability between textured and DCT

Investment cost about 10% higher than for DCT tissue line running on virgin fibre

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

“Tailoring the tailored pulp” – illustrative efforts

There is no single fibre which would provide the best solution for all the requirements: softness / smoothness / absorption / fluffiness / bulk / strength.

Alternatives:

- A) FURNISH: **Use a very diverse combination of raw materials** - *desired product properties, availability and cost, are the main drivers to decide the blend; and/or*
- B) PROCESS: Minimal or no BHKP refining, creping, embossing, etc.

Drawbacks: Technical problems of mixing typically raises the cost of production.

BHKP in general - and BEKP in particular - fulfils well most of the key quality demands.

The use of BHKP in tissue can be further enhanced through:

- wood supply management, with the selection of most suitable species or combinations
- differentiate cooking
- tricks to manage fines or fibre deformation.
- genetic improvement, specifically BEKP. This is a slow and costly process but can in the long term lead to an improved generation of BEKP.

However, most producers make just one product, considering too costly to differentiate.

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



Recognition – The very special fibre for Tissue application

- Latin American BEKP is especially suitable and **fine tuned for tissue**.
- BEKP **increases especially tissue softness**.
- Many tissue producers and BEKP producers have **strong partnerships**.
- Latin American pulp producers are **well positioned** to supply the global tissue industry.
- Developments of the paper fibre furnish are used to fight for the margins. Increasing share of short fibre pulp has an impact due to both **lower fibre and refining energy costs**.

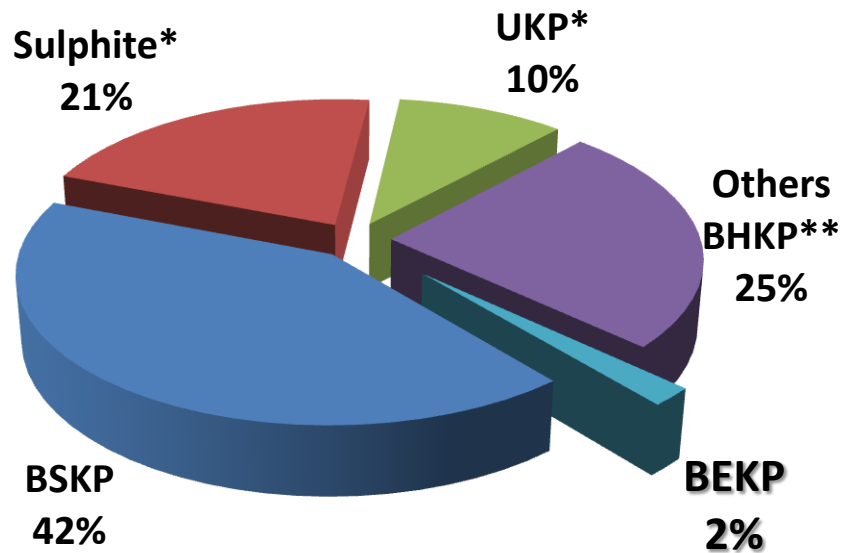
**This strategic positioning complements and is
part of the technology to BEKP tailoring**

The Consequences...

Current Role of Eucalyptus Pulp

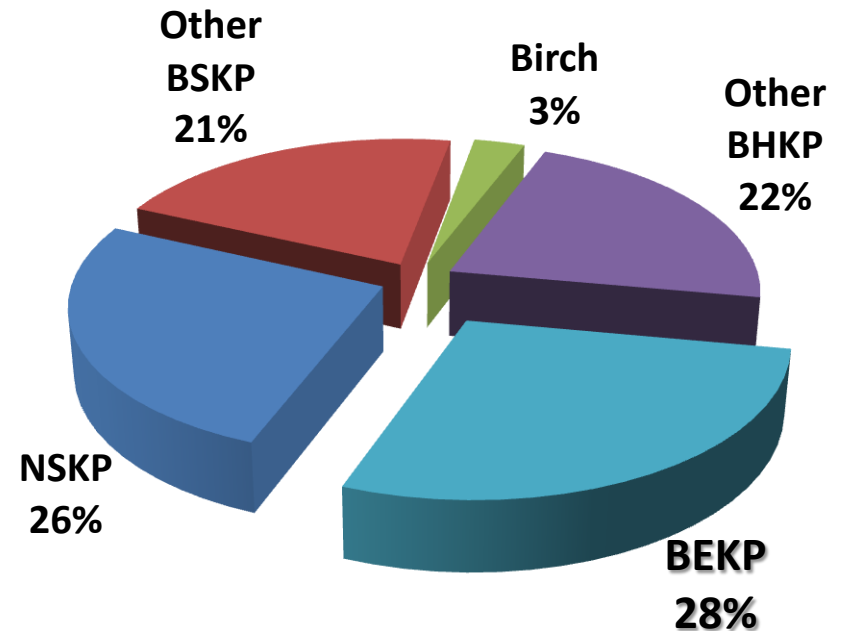
World Market Pulp Consumption

Year: 1974



Total 18.3 MM ton

Year: 2008



Total 40.5 MM ton

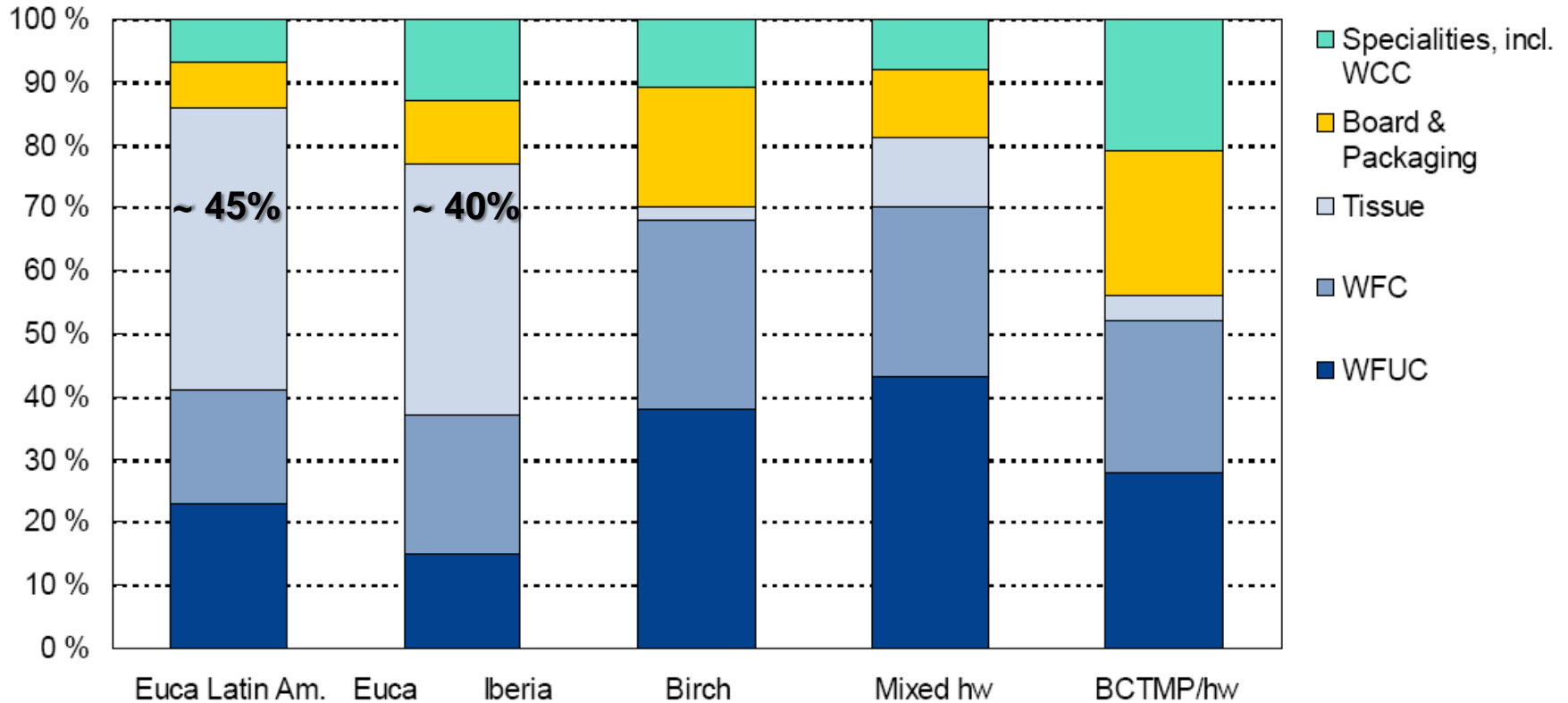
* Estimate

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

The Consequences...

Current Role of Eucalyptus Pulp

Destination of the most common HWKP
 ... where they have been used

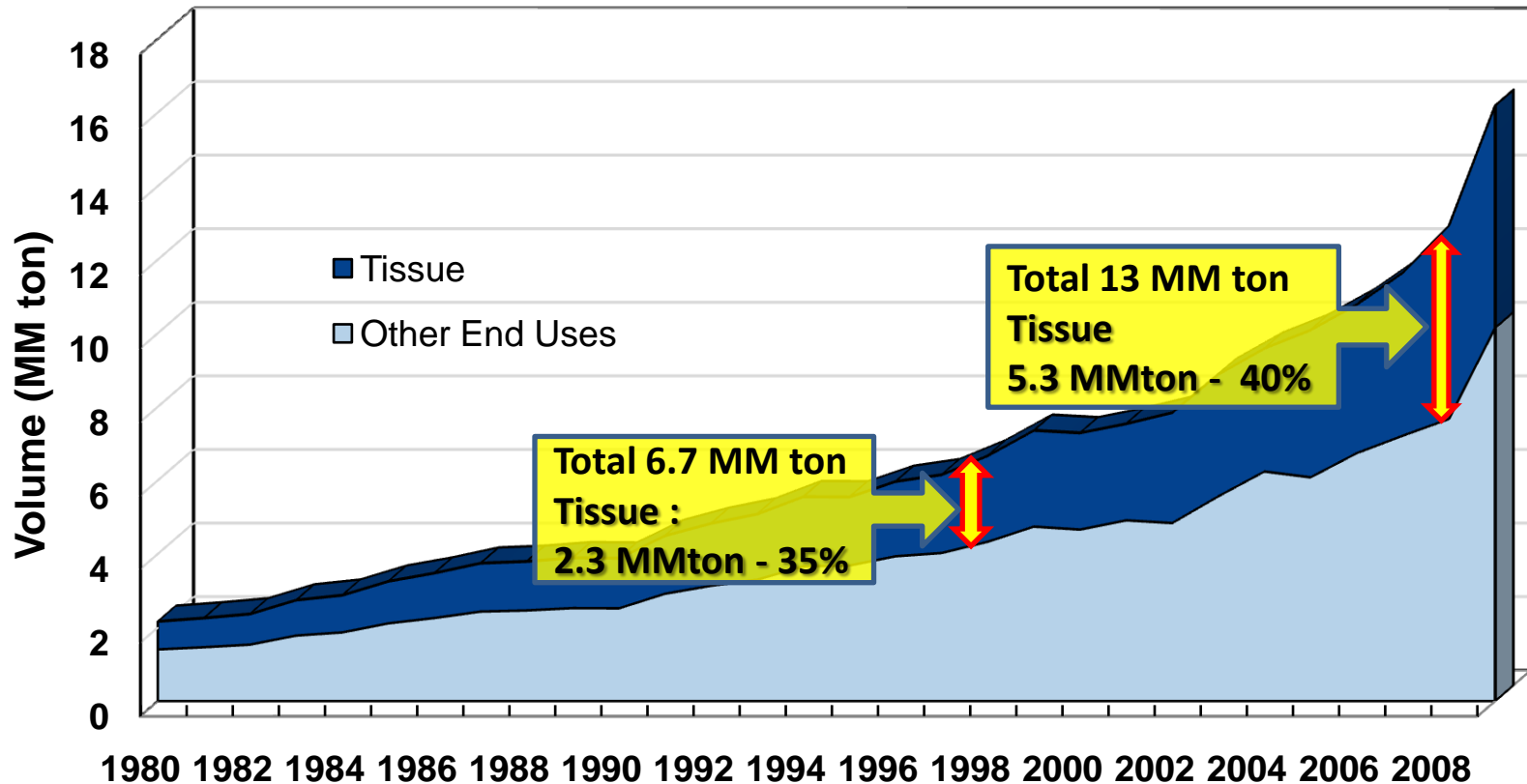


Latin Am. Euca concentrated in Tissue Application

The Consequences...

Current Role of Eucalyptus Pulp

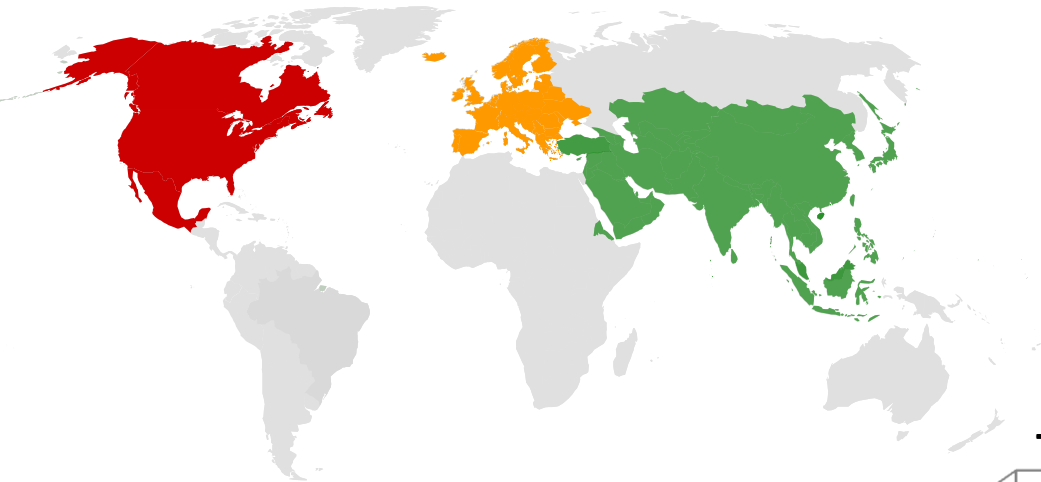
Market BEKP Consumption for Tissue Applications



**World Operacional Tissue Capacity in 2008 (3068 Machines) = 29,5 MMton/year
COMPRISING AN AVERAGE OF 17,6% OF BEKP IN THE FURNISH.**

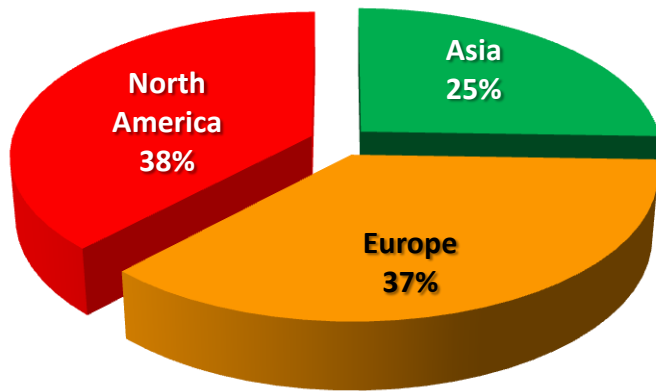
The Consequences...

Current Role of Eucalyptus Pulp

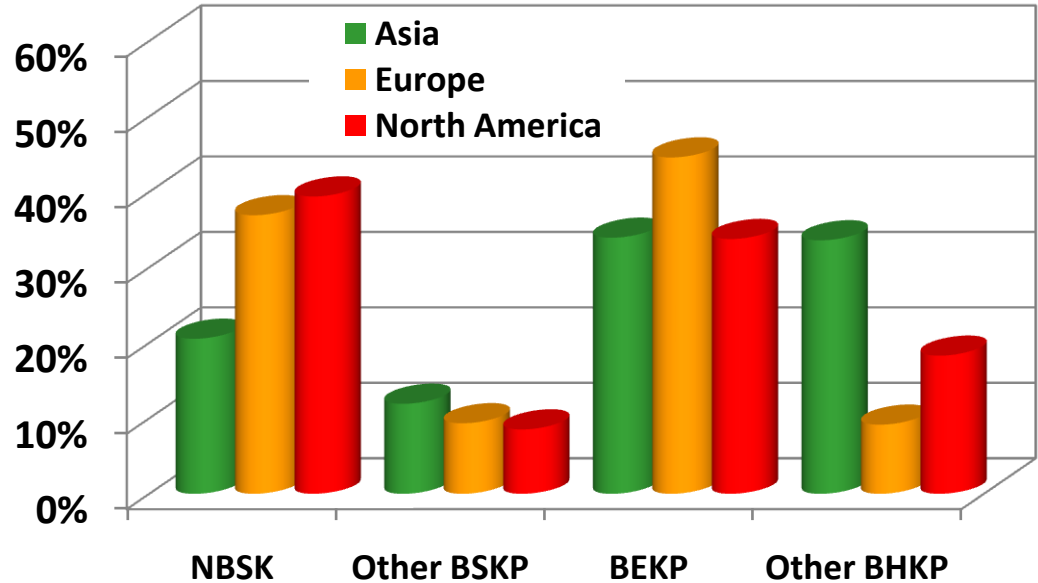


Tissue Furnish: Market Pulp, a 2008 Picture

**MARKET PULP FOR TISSUE
2008 - 10.2 MM ton**



TISSUE FURNISH - 2008 PICTURE



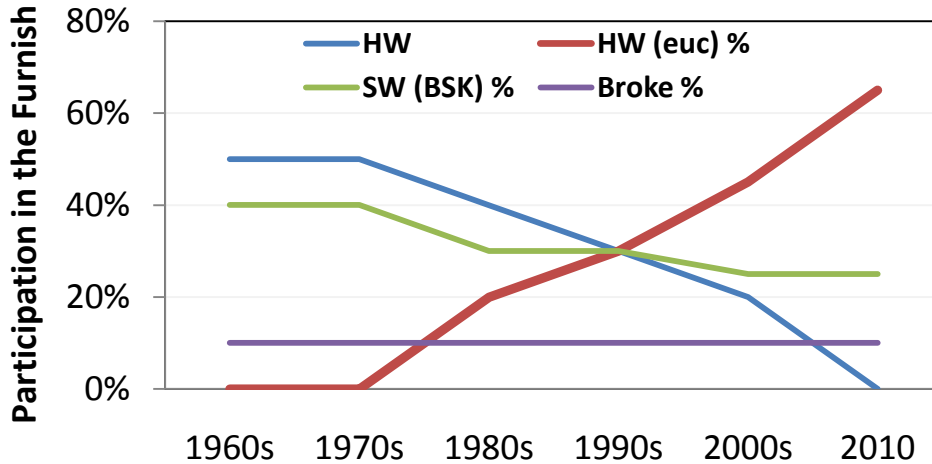
“Other BHKP” includes European birch, Indonesian acacia, and mixed hardwoods from Northern hemisphere

The Consequences...

Current Role of Eucalyptus Pulp



Premium Bath 2-Ply

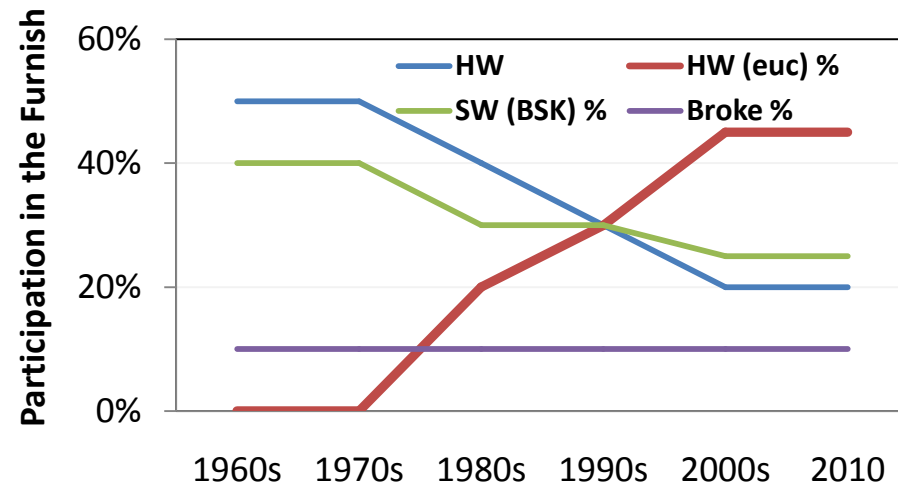


Tissue Furnish over the last 50 years on the North American premium tissue market*

* Average for all companies for consumer products in NA.

Survey accounts for 70% of the premium NA tissue market

Premium Bath 1-Ply



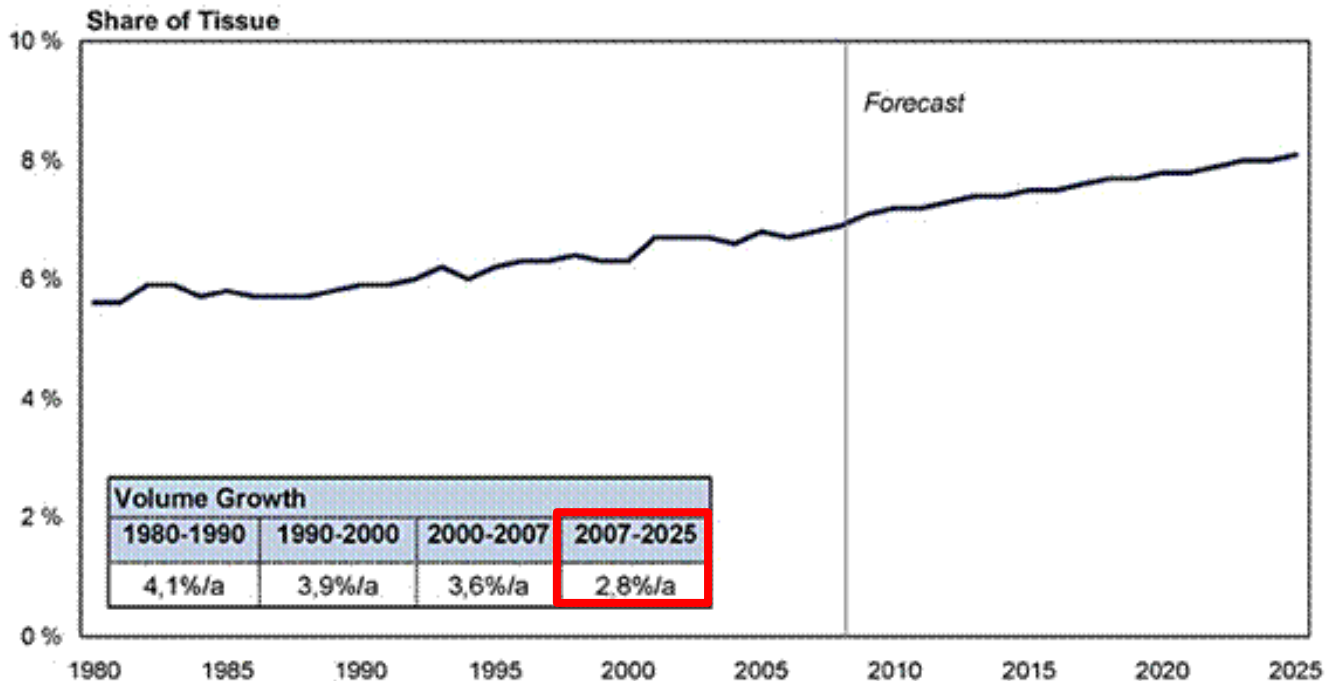
The Future to Come

Room to Increase Market Leadership

Tissue market has been consistently growing, and shall still grow in importance inside the overall paper market!

Share of Tissue of Total Paper and Paperboard Consumption

The share of tissue of the total paper and paperboard consumption has gradually grown from averaging 6% in the 1980's and 1990's to 7% in 2000's and on to 8% projected in 2010's. The tissue volumes have grown steadily, at nearly 4%/a.



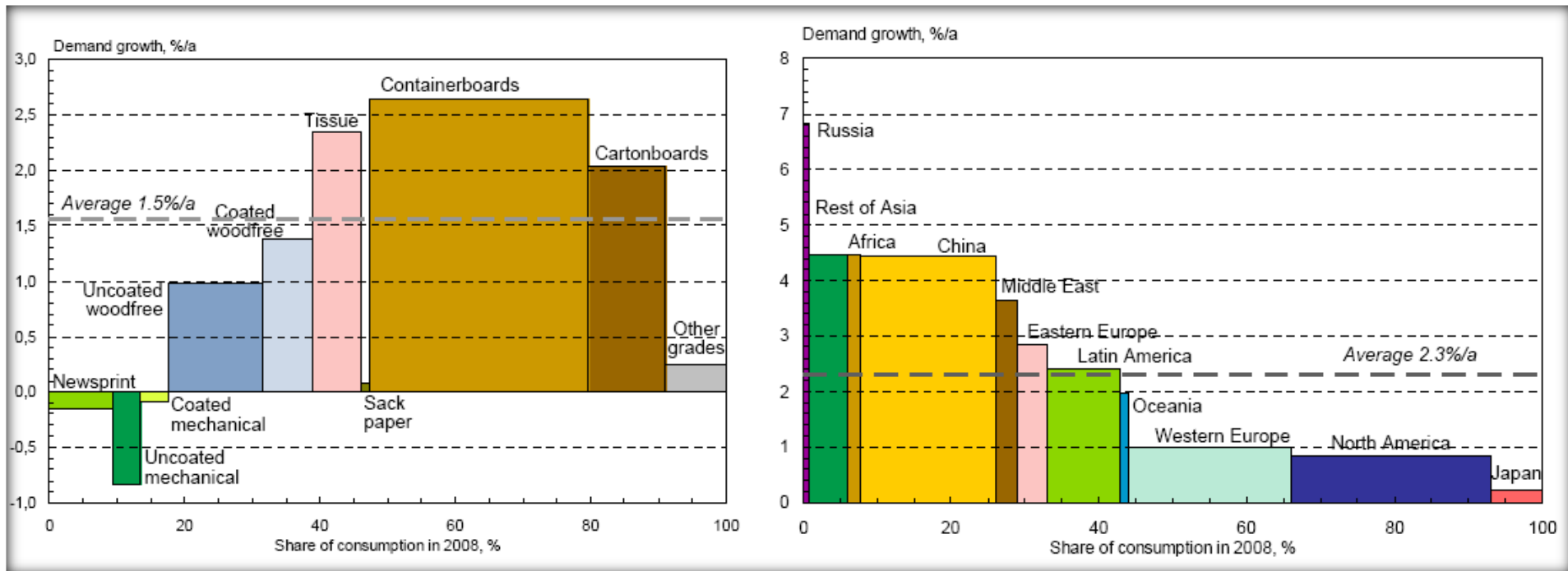
The Future to Come

Room to Increase Market Leadership



Long Term Forecast (2008-2025) – BRIC Effect

Best figures for Russia and Asia (> 4%/year)!



Source: PÖYRY, october 2010.

The Future to Come

Room to Increase Market Leadership



Tissue growth in China demands the equivalent of a new pulp mill every 2 years!

<i>thousand t/y</i>	Location	Province	2010	2011
Tissue				
Longjing Paper	Fengdu	Chongqing	+25	-
Wei Er Mei	Tongnan city	Chongqing	+25	-
HengAn Holding Co	Jinjiang city	Fujian	+60	-
Max Fortune Paper	Fuzhou	Fujian	-	+60
Zhongshun	Jiangmen	Guangdong	+25	-
Donguan Yongchang Paper	Dongguan	Guangdong	+20	-
Jiangmen Renke Luzhou	Jiangmen	Guangdong	+45	-
Fook Woo Group	Huizhou city	Guangdong	-	+30
Nanning Jiada	Binyang county	Guangxi	+25	-
Nanning Phoenix	Nanning	Guangxi	-	+40
Guangdong Zhongshun	Tangshan city	Hebei	-	+25
Henan Yuzhou Shengxuan	Luohe city	Henan	+15	+60
Henan Ying Industrial	Yuzhou	Henan	+15	+60
Vinda Household Paper	Xiaogan	Hubei	+25	-
Zhongshun	Xiaogan city	Hubei	+10	-
APP Gold Hongye	Xiaogan city	Hubei	-	+60
HengAn Holding Co	Changde	Hunan	+60	-
APP Gold Hongye	Suzhou	Jiangsu	+60	+60
Hubei Jiangsu Zhiyin Paper	Gong'an	Jiangsu	+10	-
Hwagain Paper co.	Ganzhou	Jiangsu	-	+60
Vinda Paper	Anshan	Liaoning	+25	+30
APP Xinmin	Xinmin city	Liaoning	-	+60
Ningxia Zijinghua Paper	Yinchuan city	Ningxia	+15	+25
HengAn Holding Co	Weifang	Shandong	+60	-
Shandong Weifang Hengxin	Weifang	Shandong	+60	-
Shandong Dongping Zhongshun	Dongping	Shandong	+45	+20
Shandong Chenming	Shouguang/Qihe	Shandong	-	+60
Shanghai Orient Dongguan	Pu dong	Shanghai	-	+70
Chongqing Longjing Paper	Fengdu city	Sichuan	+25	-
Chongqing Wei Er Mei Paper	Tongnan city	Sichuan	+25	-
APP Jinan Pulp & Paper	Ya'an	Sichuan	-	+70
Yunnan Jiangchuan Cuifeng	Yuxi	Yunnan	+10	-
Shanghai Welfare Group	Shaoying	Zhejiang	+25	+10
Sub total - Tissue			+710	+800

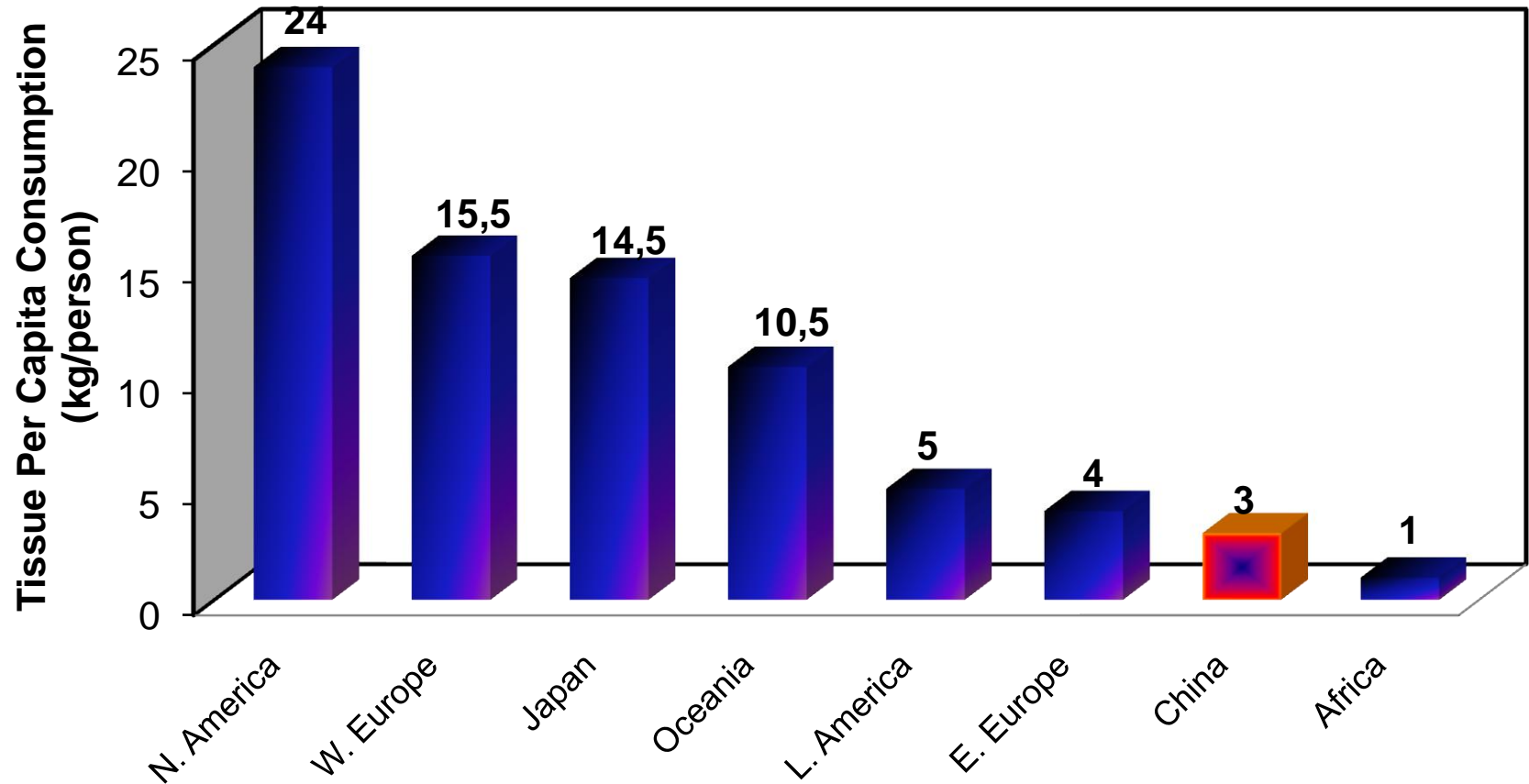
2010
710 kton

2011
800 kton

The Future to Come

Room to Increase Market Leadership

Still much room to be occupied!
Per Capita Consumption of Tissue by World Region 2007



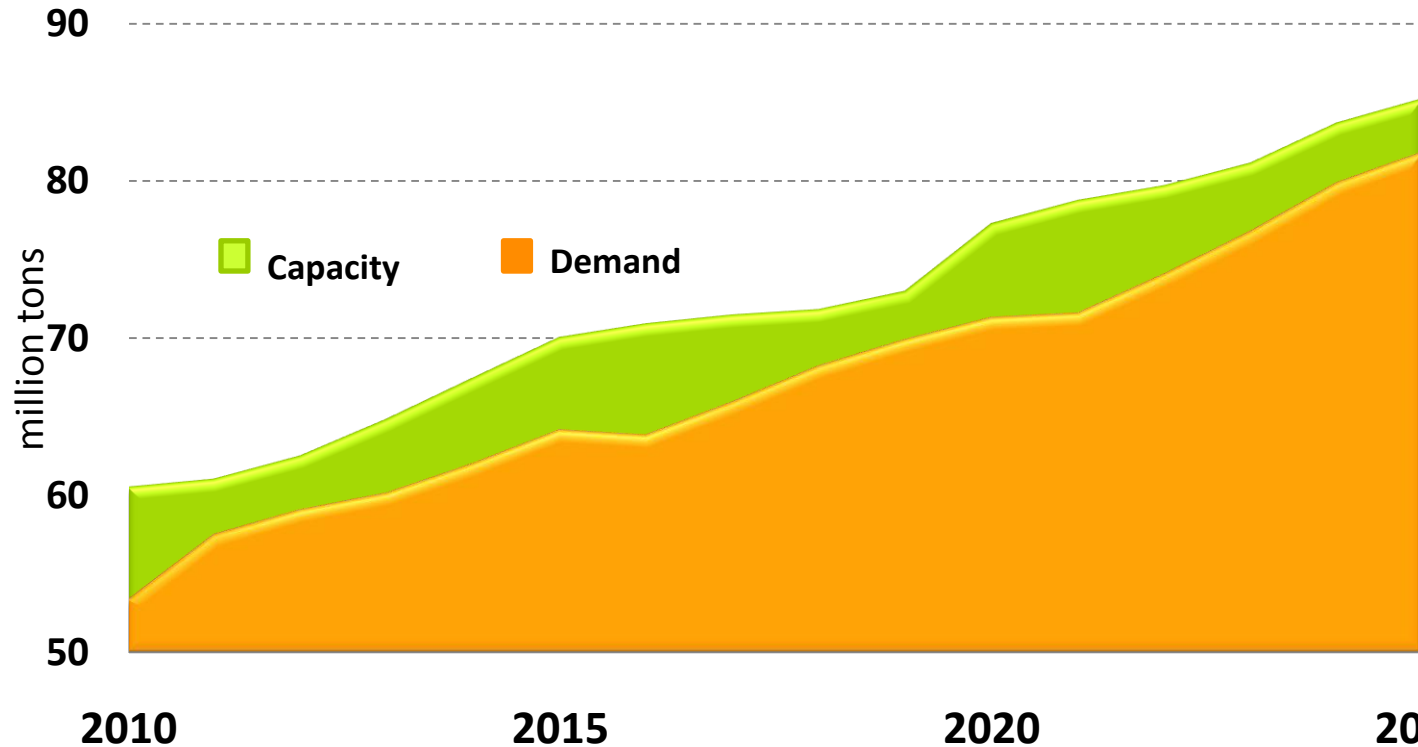
The Future to Come

Room to Increase Market Leadership



Major Capacity Expansions

Market Pulp Supply and Demand (2010-2025)



DEMAND GROWTH:
+2,5% /y or
1,8MM tons/y

Final Remarks

Developing, improving and applying knowledge and technology on what and how to plant, how to pulp, and how to apply BEKP in tissue making, is a consistent and successful “tailoring route”.

Or, as Timo Teras had acutely stated :

“Eucalyptus market pulp and tissue paper production met in the late 1960s. They engaged in the early 1970s and got married soon thereafter. It took a few years to really get to know each other in mutual recognition, respect and commitment. This is a happy and long-lasting marriage with no risk of a divorce in sight.”

... a growing, consistent, knowledge and technology-based relationship.

Acknowledgements



For the kind and special attention special thanks to:

YOU