

Challenges in the use of Alternate Non-Wood Fibres for Tissue Production

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Agenda

- The use of non-wood fibres - specifically Bamboo pulp and Wheat straw in tissue manufacture
- Overview of problems presented by the use of non-wood pulps
- Comparison of Bamboo and Wheat straw with other commonly used pulps
- The importance of refining and controls in the process
- The impact on tissue manufacture and quality
- Available control tools
 - OnGuard™ VBX
 - OPTIX™ Applied Intelligence
- Case histories

Non-Wood Pulp Benefits

- Non-wood pulp is increasingly being used in the manufacture of tissue
- Viewed as environmentally-friendly and sustainable alternative to wood based pulps
- If farmed responsibly, benefits can include:
 - Faster growing and higher yields than wood-based pulp
 - Can help to reduce deforestation process
 - Captures more carbon dioxide and releases 30% more oxygen (Ref.Bamboo)
 - Lower maintenance overall during life-cycle, helps reduce or eliminate crop burning
 - Improved sustainability for the industry and end-users
 - Potential cost savings against traditional wood-based products

Non-Wood Pulp for Tissue Manufacture

- Non-wood can be adopted as suitable pulps for tissue production
- Typically used as a replacement for short fibre content.
- In China Bamboo is used as long fibre replacement
- Commercial products available with >90% of non-wood fibres
- Recent commercial bathroom products seen with 100% Bamboo
- Reuse of Wheat straw that would otherwise be burnt to control crops
- Reduction of carbon foot print and water volumes needed in pulping noted versus typical wood pulps
- Reuse of any waste materials as fertilisers and soil conditioners possible

Potential Problems With Non-Wood Pulps

- Wheat straw and Bamboo pulps typically contain higher levels of contaminants than pulp obtained from wood sources
 - High fines and extractives
 - Higher inorganics, particularly silica (bamboo)
- Contamination of the machine clothing and deposition
 - High fines causing deposition, drainage and retention problems
 - Shives imbedded in machine clothing
 - Increased chemical consumptions potential
- These can make the Yankee coating layer:
 - Harder coating
 - More dusty
 - More abrasive resulting in increased doctor blade wear
- Ultimately these will:
 - Lower machine runnability
 - Reduced doctor blade life
 - Reduce softness and handfeel

Pulp Comparison with Bamboo.

	BEK	Acacia	NBSK	Bamboo
Width (µm)	15.2	16.2	28.4	15.4
% Fines	4.1	4.8	3.5	13.7
Length (mm)	0.80	0.79	2.39	1.75
Coarseness	70	63	140	90
Ash (%)	0.08	0.07	0.11	2.15
Silica (%)	<0.05	<0.05	<0.05	0.75
Extractives (%)	<0.1	0.4	0.5	0.9

BEK – Bleached Eucalyptus Kraft
NBSK – Northern Bleached Softwood Kraft
 Testing carried out on dried pulp samples

- Bamboo is typically used as a replacement for long fibre in many mills in China.
- Bamboo between hardwood and softwood fibre length allowing mills to run a 50:50 HW to Bamboo furnish. Tensile strengths good with lower fibre width and coarseness offering good softness.
- The use of Bamboo in addition offers a potential cost saving and better sustainability profile.

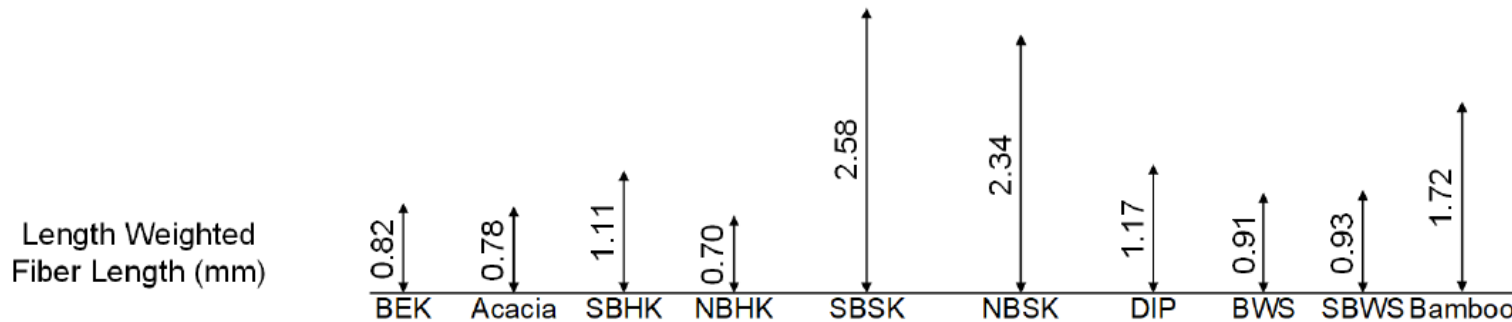
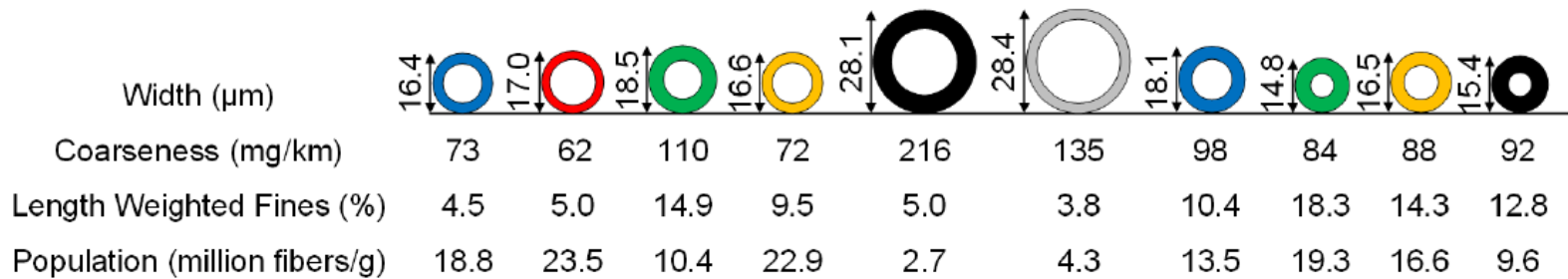
Note:

Higher fines, ash and silica levels typically found in Bamboo as highlighted in the table.

Fibre Morphology Comparisons Wood and Non-wood Fibres

Comparison table on the morphology of bleached and unbleached wheat straw pulp and Bamboo.

Wheat straw having similar properties to hard wood fibres and DIP, but with higher fines and Bamboo somewhere between hard wood and softwood.



BEK – Bleached Eucalyptus Kraft
 NBSK – Northern Bleached Softwood Kraft
 BWS – Bleached Wheat Straw

Wheat Straw Furnish use

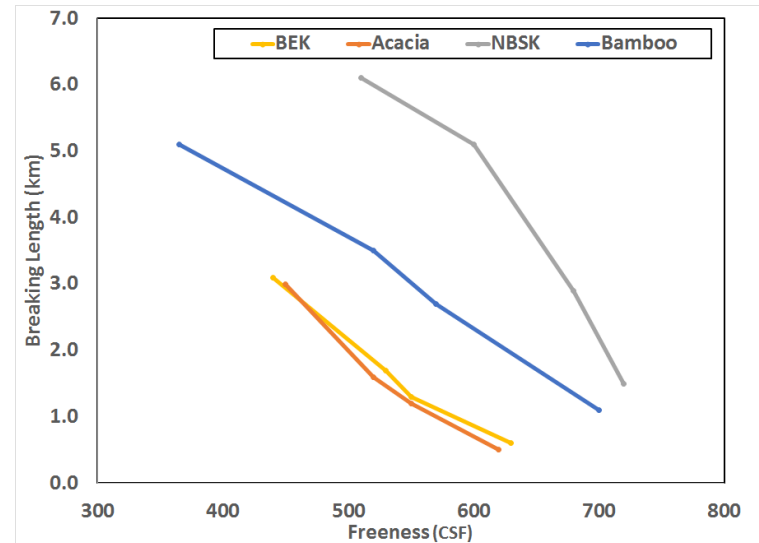
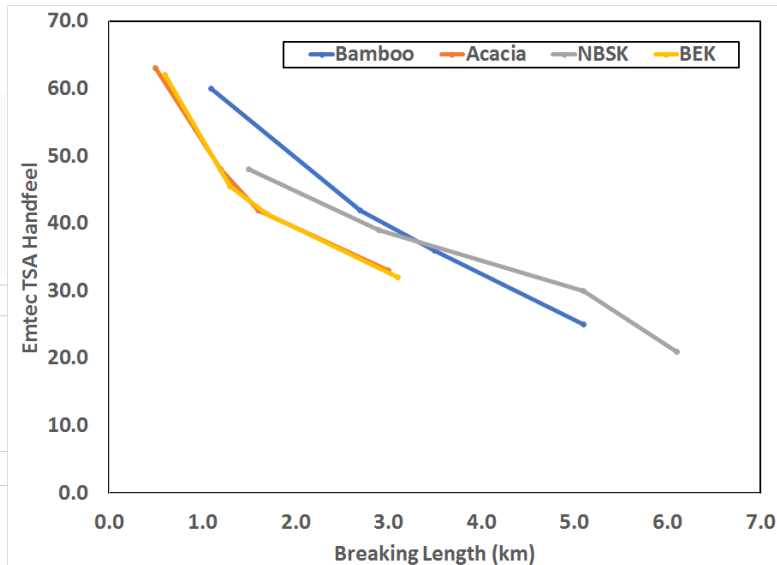
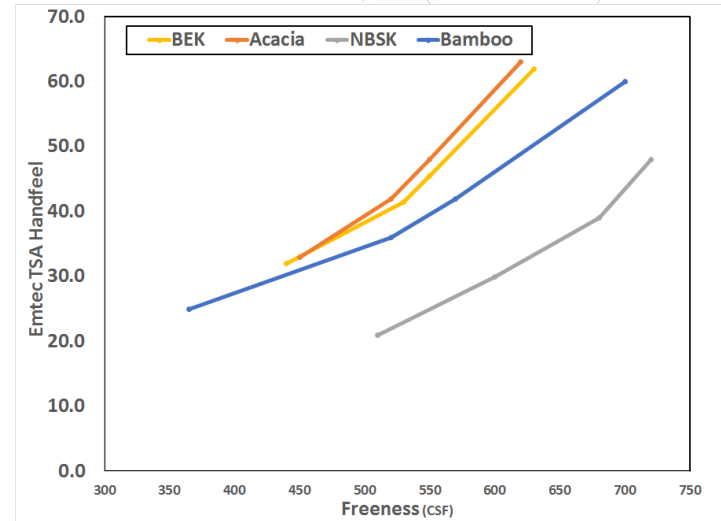
- Use of Wheat straw at various ratios of typical hard wood (HW) fibres and DIP.
- Wheat straw fibre up to 90% of the total furnish has been produced commercially for tissue products .
- Good management is needed for wet end, refining and Yankee coating to optimise fully.
- Use of Solenis' OnGuard™ VBX vibration unit on the crepe blade holder helps to manage the coating operating window, improve runnability and blade life.
- Generation of straw shives embedding in to the wire can cause holes, need careful management with a combination of chemical and mechanical controls.

The Importance of Correct Refining

- The correct refining is important for all pulps, but is particularly important for Wheat straw and Bamboo pulps
 - Over refining will further increase fines levels in the system
 - Need to balance refining to develop both strength, and softness of the sheet
- Fibre morphology is not the same as typical hardwood and softwood pulps so refining requirements will be different and should be optimised to suit
- Over refining will generate too high fines levels and poor quality fibres in terms of strength and softness produced
- Use of strength aids can help to manage the refining need and support the mill strength strategy

Effect Of Refining Paper Properties

- It is important to optimise refining for different pulps to get the correct balance between strength and softness
- This will also help to minimise fines formation through over refining
- Charts show some comparison curves against typical pulps and Bamboo for Tensile (Breaking length), softness and Freeness



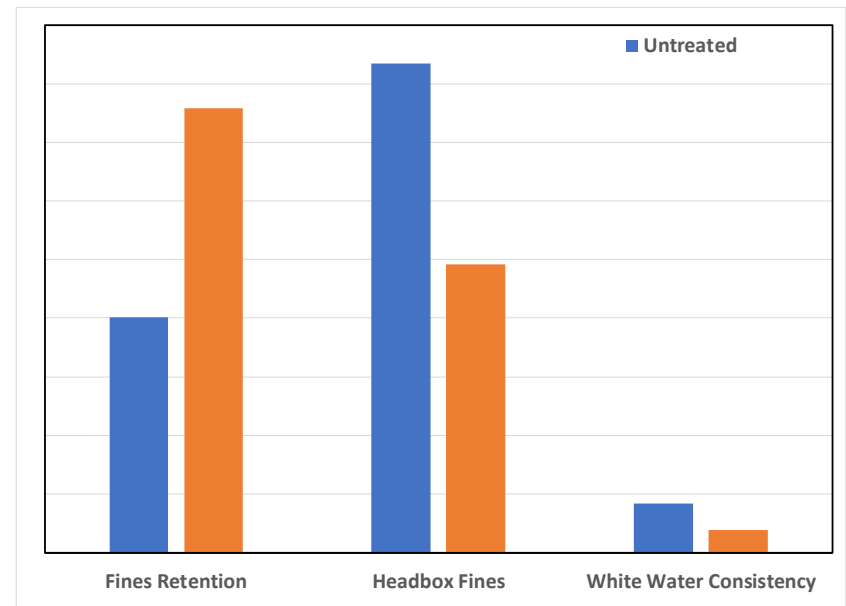
Refining Considerations and results Wheat Straw

- Comparison with Eucalyptus, the Wheat straw shows higher response to refining. Attributed mainly to the morphology and structural differences.
- The slower and lower strength development of Wheat straw is attributed to structural weak points in the fibre wall, producing higher fines generation and lower bonding sites.
- Wheat straw contains between 35 to 47% fines, giving higher SR numbers, but removal of the fines has benefits in drainage and sheet strength properties.
- It has been noted that fractionated Wheat straw can offer good sheet strength and drainage with limited refining, when replacing Eucalyptus and Short fibres.

Generation of High Fines Levels

- Tests to set refiner curves for the specific pulp to offer the best balance between strength, softness and fines generated
- Optimise fines retention on machine to remove fines from system
 - Typically fines retention is low on a tissue machine
 - A particle management programme will help control fines with no negative effects on tissue properties
 - Improve machine retentions
- Reduce loadings of fines in the Stock and White Whitewater offering many benefits, including
 - less deposition in the system
 - less issues with Yankee coating
 - more efficient chemical usage

Property	Mill 1	Mill 2
First Pass Retention	65.7%	68.9%
First Pass Ash Retention	16.7%	14.7%
Fines Retention	22.7%	21.8%



The Use of Non-Wood Pulps

- Potentially Bamboo and Wheat Straw can be used with no significant changes on machine, but for the best results need to optimise machine operations, for required Tissue quality.
- The most common problems include:
 - Hard Yankee coating
 - Reduced softness, low bulk and high dust
 - Increased potential for chatter marks on the Yankee
 - Increased consumption of other chemical additives
- High levels of extractives:
 - Increased fabric contamination and deposits
- High levels of silica
 - Increased potential for scale
 - Increased doctor blade wear

These can all be addressed through the use of correctly chosen chemical treatments

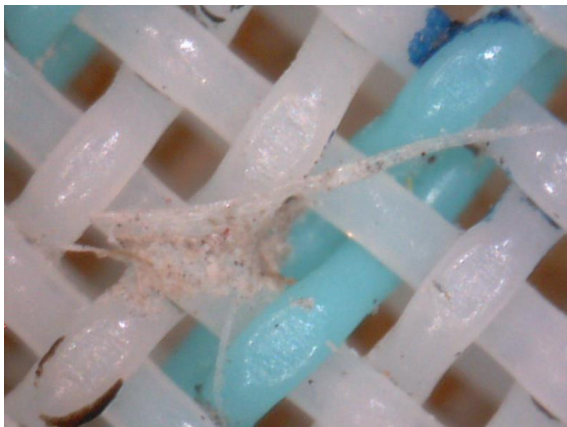
- To eliminate these problems Use designated Yankee coating
 - Former a softer coating layer on the Yankee
 - Have improved doctorability to improve crepe quality
 - Help the blade to penetrate into the coating layer removing it from the abrasive surface

Contaminant Controls

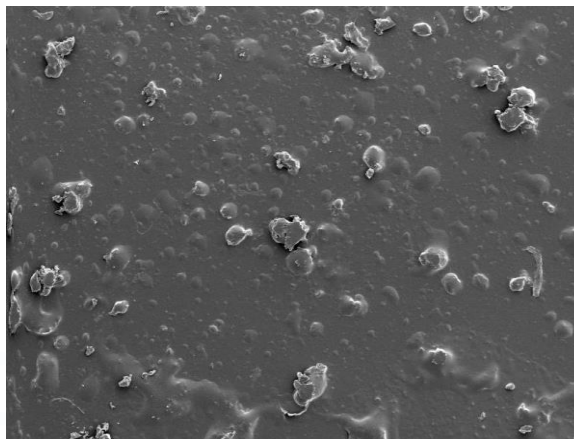
Use of contaminant control products to help prevent deposits and fabric contamination.

Developing new detackifiers to keep extractives well dispersed so they do not create deposit problems

Development of new fabric treatments to maintain cleanliness and performance during the life cycle.

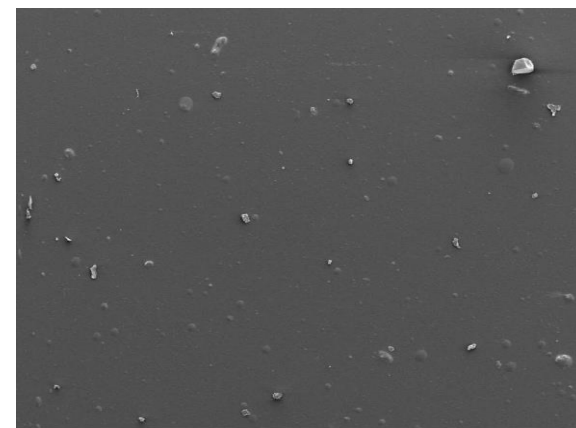


Untreated Extractive Particles In Filtered Stock



Larger particle size and higher number of particles per unit area leads to increased deposition

After 4ppm Treatment



100X Magnification

Smaller particle size and lower number of particles per unit area leads to less deposition

The Next Developmental Steps

- Development of new pulping chemicals to minimise fines and silica content of Bamboo and Wheat Straw pulps
 - Eliminate the root cause instead of solving problems on machine
 - Further improvements in quality, machine runnability and lower costs
- Further improvements in Yankee coating performance
 - Better control of increased natural coating seen
 - Increased doctor blade life
 - Les dusting
 - OnGuard™ VBX and OPTIX™ Applied Intelligence control measures adopted

Summary

- This data clearly highlights the source of the problems created by Bamboo and Wheat straw pulps
 - Fines levels are significantly higher
 - Higher levels of extractive materials
 - Increased ash levels particularly silica
 - Harder Yankee coating and more dust
 - Control of strength, softness parameters
- These can be controlled by the right chemical and control approaches
- OnGuard™ VBX and monitoring techniques
- OPTIX™ Applied Intelligence autonomous controls adopted



Case Histories



Case Histories

1. Controlling fines through particle management - PerForm™ SP Advanced Retention and Drainage Aids
2. Controlling extractives by preventing agglomeration - DeTac™ DC
3. Optimised Yankee coating using OnGuard™ VBX and OPTIX™ Applied Intelligence

Case History 1

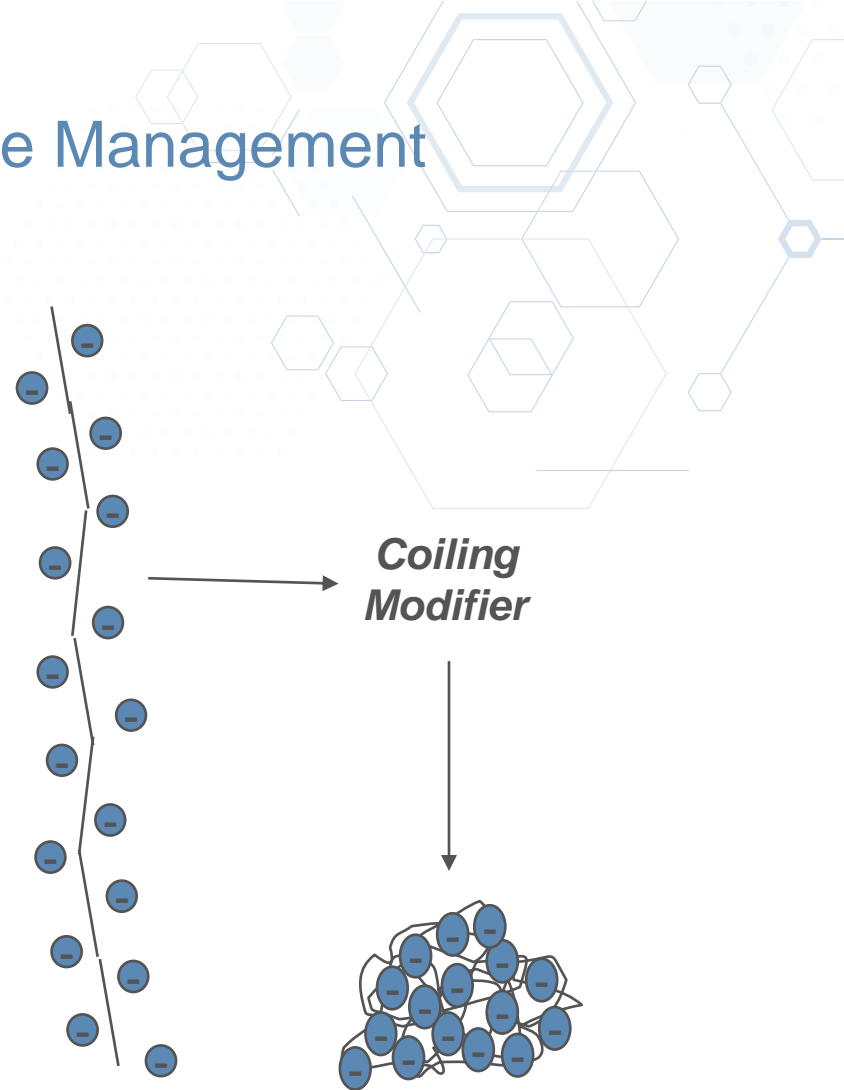
- **Machine Details**

- **Grade:** Major retail brand – facial tissue production
- **Machine Type:** Shoe press crescent former machine
- **Production :** Capacity – 100mt/day
- **Furnish:** Virgin fiber furnish containing 50% Bamboo
- **Wet end additives**
 - » Wet strength resin
 - » Softener
 - » Oxidizing biocide

Excessive Fines Control By Particle Management Technologies

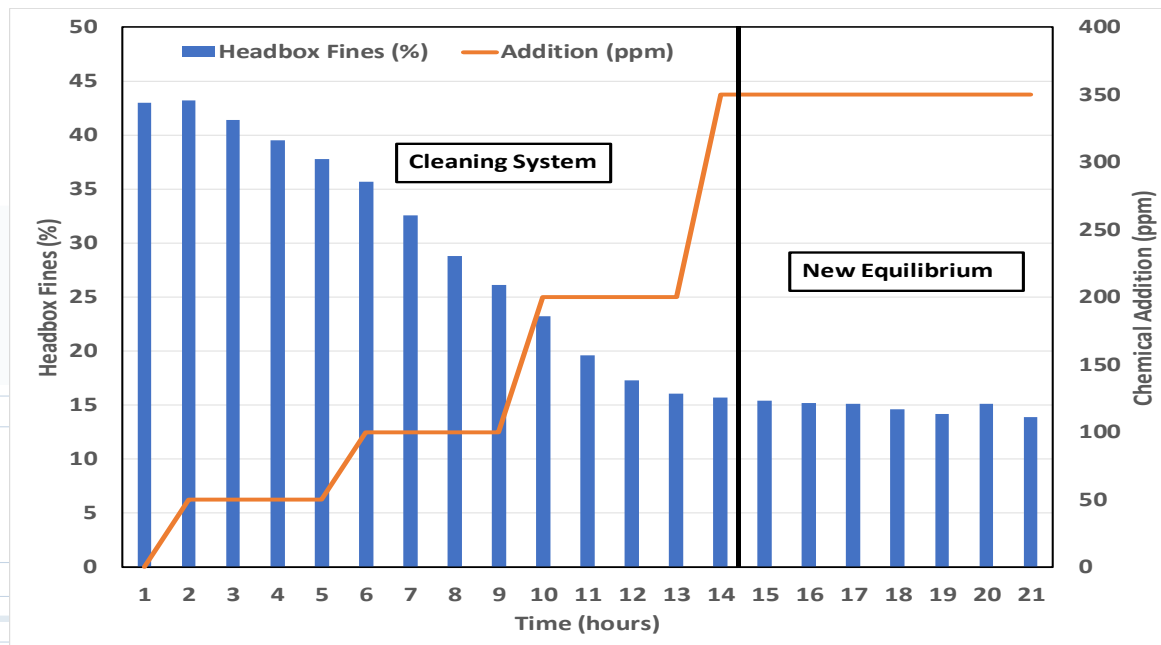
- Product used: PerForm™ SP Advanced Retention and Drainage Aids

- APAM based material with a specific MW and charge density that was picked for optimum performance.
 - Helps to improve fines retention to remove them from the system
 - Needs a cationic additive for best results
- » Ideal for use with wet strength grades, towel, wiper, napkin and facial tissues



Fines Control By Particle Management: PerForm™ SP Advanced Retention and Drainage Aids

- Chemical initially started low to control cleaning of system
- Cleaning too fast can create short term problems such as low softness
- New equilibrium reached after 15 hours use
- Customer benefits seen with improved Yankee coating performance, better softness and reduced dust.



Summary

PerForm™ SP Advanced Retention and Drainage Aids

CUSTOMER CHALLENGE

- Sustainable Bamboo fibers used to make Paper Towel increased chemical costs, reduced softness and generated dust, a fire hazard

SOLENIS SOLUTION

- PerForm SP improved fiber retention in the paper

RECORDED BENEFITS

- Enabled use of sustainable fiber source
- Lowered chemical costs
- Reduced dust generation, improving safety
- Improved softness
- Overall lower production cost



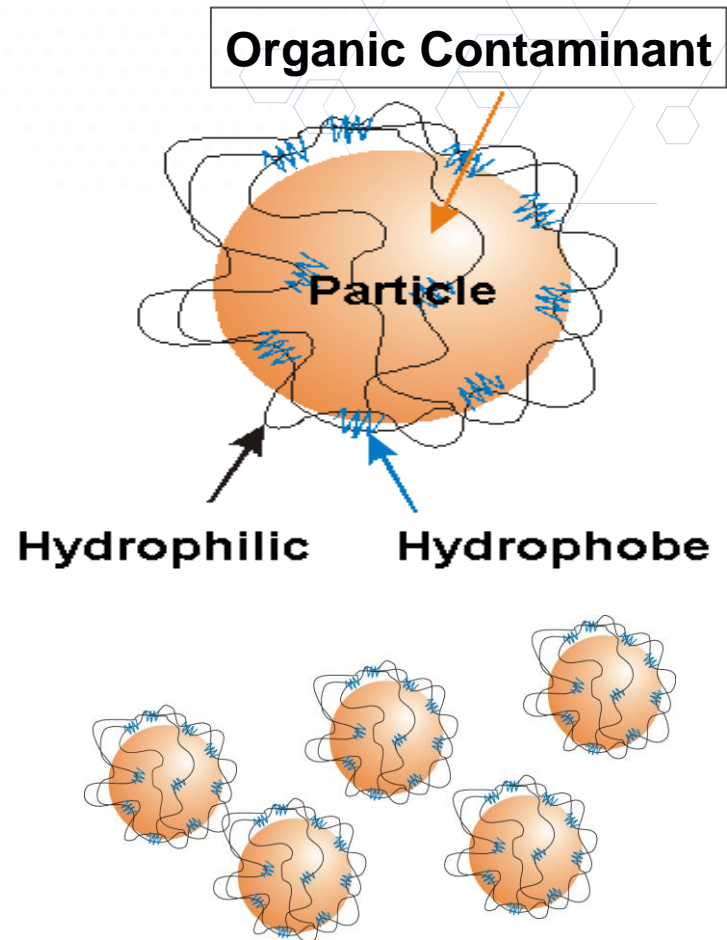
Case History 2

- Machine Details

- Grade: Premium facial tissue
- Machine Type: Shoe press crescent former machine
- Production : Capacity – 175mt/day
- Furnish : Virgin fiber furnish containing 45% Bamboo
- Wet end additives
 - » Wet strength resin
 - » Softener
 - » Oxidizing biocide

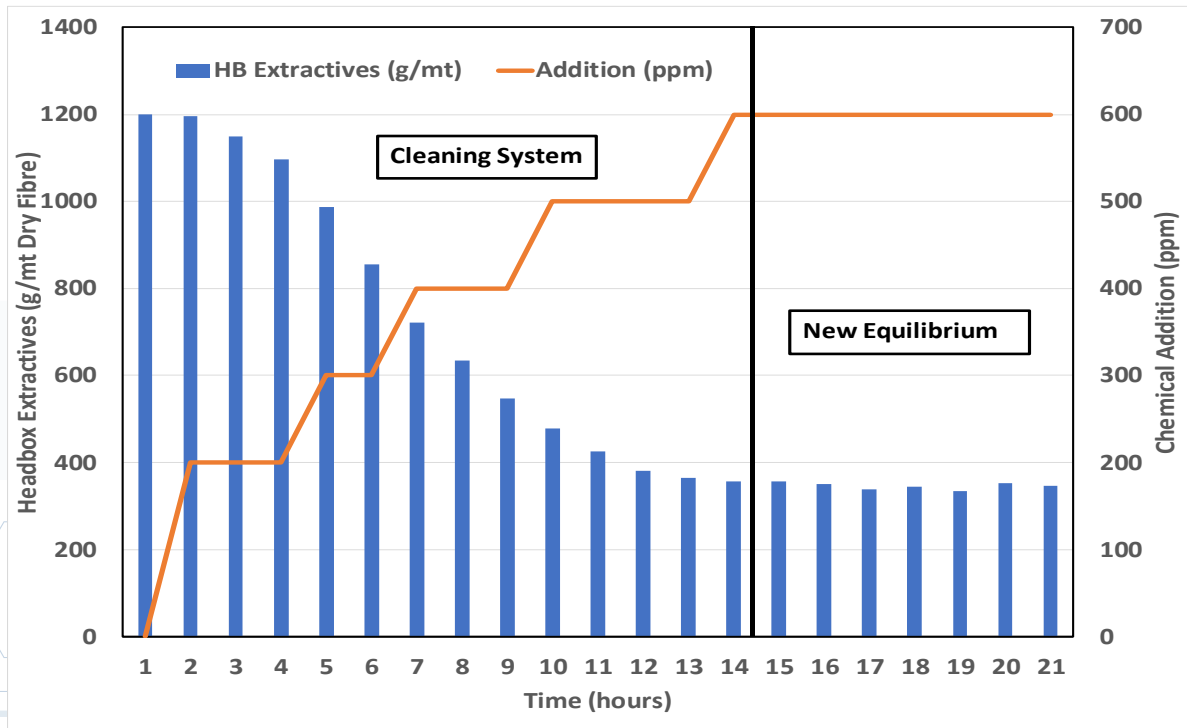
Control Of Extractives with Solenis' DeTac™ DC Technology

- Contains a unique, patented polymer that adsorbs onto the hydrophobic surface of organic contaminants
- Polymer creates a stabilization barrier around contaminant particles
 - Prevents hydrophobic particles from agglomerating into larger, problem particles
 - Reduces the tackiness of the particles
 - Reduces potential for deposition
 - Helps to remove particles with the sheet



Control Of Extractives using DeTac™ DC technology.

- Adding DeTac DC reduced levels of extractives in the system, a new, lower, equilibrium level is maintained, after several hours.
- Customer benefits of improved sheet uniformity, less breaks and washing times needed and improved machine runnability



Summary

- Extractives can be effectively controlled by the use of DeTac DC
- Reduction is not immediate, it takes time to clean up the wet end system
 - This can take several hours depending on the system and level of contamination
- After this the system reaches a new equilibrium with lower extractives levels results shown include;
 - Increased sheet uniformity
 - Less breaks and need for washing machine clothing
 - Better machine runnability

Case History 3

OnGuard™ VBX Vibration Monitoring System

- Asset Protection
- Coating Optimization
- Blade Life Optimization

Computer or laptop running
MSI Blade Monitor software



Data Acquisition (DAQ)
box resides machine-side



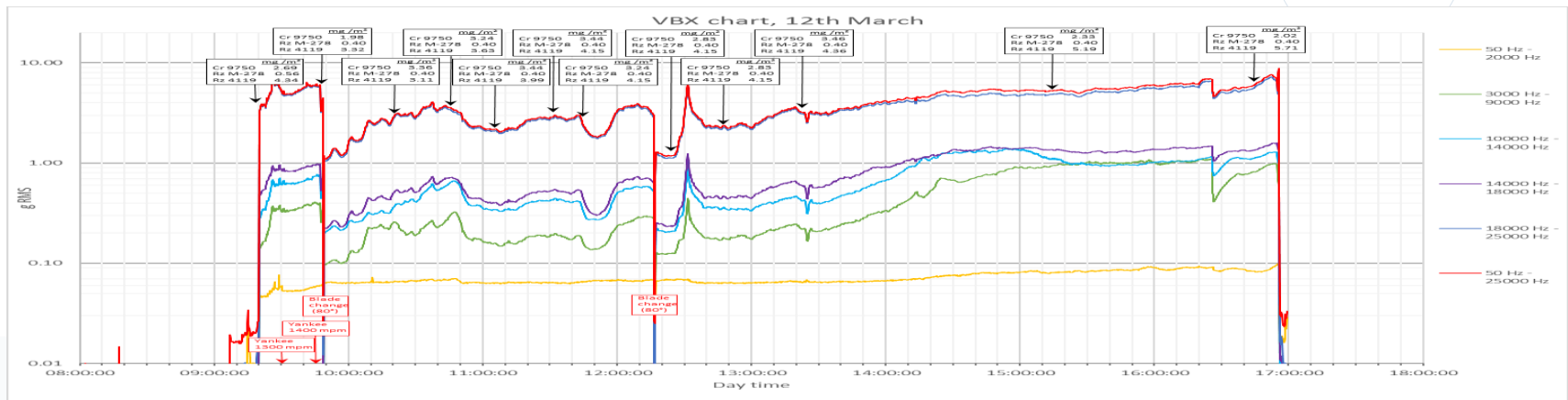
Accelerometer with integral
armored cable mounts to
doctor holder



Ethernet cable connects
DAQ box to computer or
laptop up to 300' away

OnGuard™ VBX data helps to monitor blade vibrations and coating performance

- Solenis OnGuard™ VBX Vibration Analysis system was employed to monitor creping blade vibrations. This allowed for careful monitoring to ensure a suitable and robust coating was managed at all times.



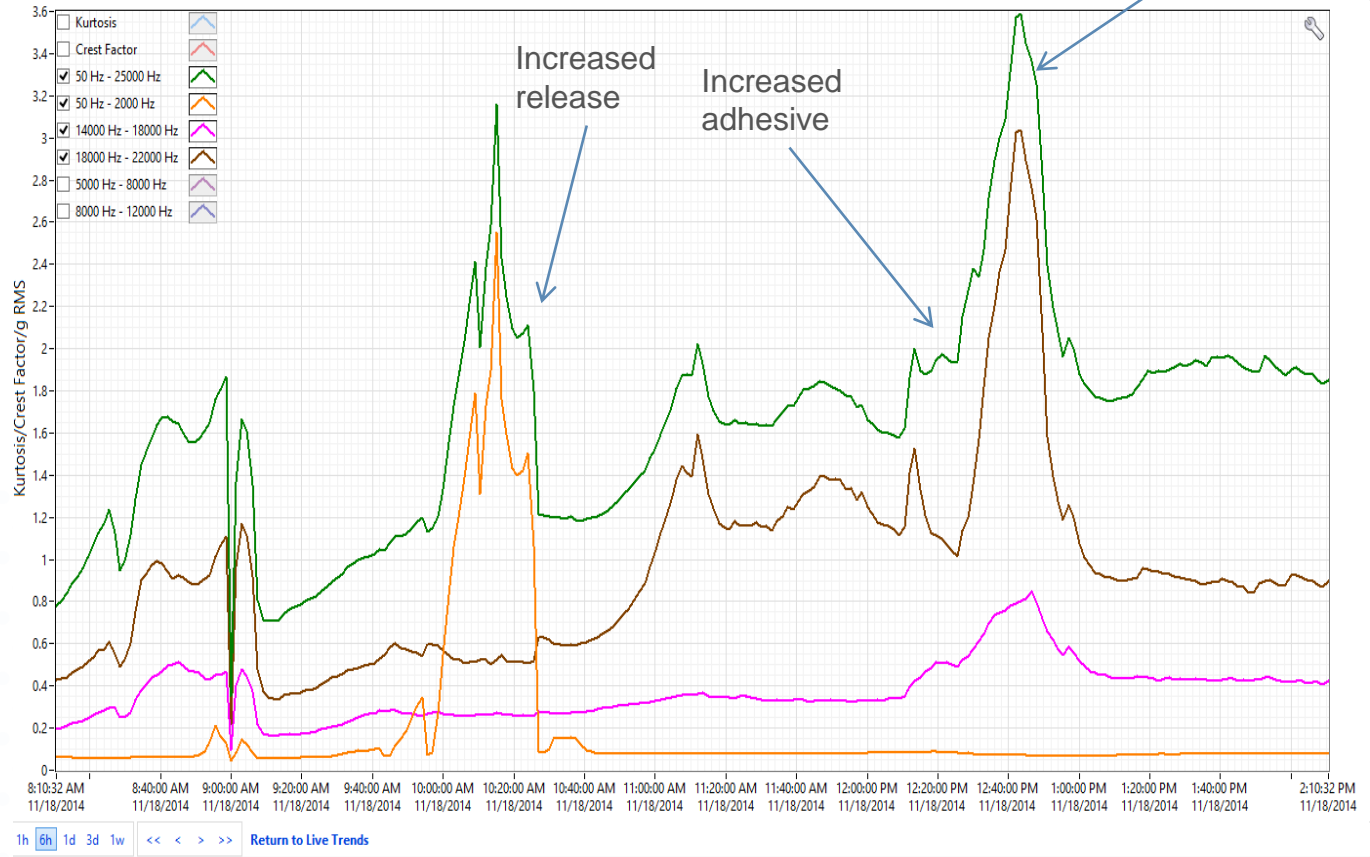
Coating changes were managed to achieve and maintain the range 3.0 – 4.0 for the gRMS in the overall frequency range, seen to offer the best crepe performance in this case.

Coating Optimization: Utilizing OnGuard™ VBX

LDC machine
Bath Tissue grade

“Stair-stepping”
adhesive and
release for
improved
operations and
softness.
Controlled by
VBX real time
data analysis.

Condition Indicator Trends (Average of All Channels)



Future Considerations – AI Predictive Analytics for Autonomous Control of Chemistries and VBX Vibration



Summary

OPTIX™ Applied Intelligence

CUSTOMER CHALLENGE

- Paper towel strength varied versus the performance target, resulting in inconsistent quality and higher costs

SOLENIS SOLUTION

- OPTIX provides real-time prediction of wet strength quality test results and autonomously controls chemical feed, reducing strength variation

RECORDED BENEFITS

- Lower wet strength program cost (\$140K)
- Reduction in quality variation (33%)
- Improvement in strength target adherence (98%)



Key Reference sources:

bioresources.com

Comparison of Wood and Non-Wood Market Pulps for Tissue Paper Application

Tiago de Assis,^a Joel Pawlak,^a Lokendra Pal,^a Hasan Jameel,^a Richard Venditti,^a
Lee W. Reisinger,^b Dale Kavalew,^c and Ronalds W. Gonzalez^{a,*}



<https://www.bamboobotanicals.ca/html/about-bamboo/bamboo-facts.html>

Notes:

Data in the slide 6 and refining date slide 10 was sourced by Rekha Bharti, who was Solenis Marketing Manager for pulp now retired. Ref. Bioresources.com Comparison of Wood and non-Wood Market Pulps for Tissue paper Application.

The table comparison table slide 7 from the references above, and paper titled Bamboo for Tissue