TAPPICON
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Resolving Oversheeting in Tissue Converting

Wed. May 1, 2024; 10:30 – 11:30 AM HCC – Room 25A | T9

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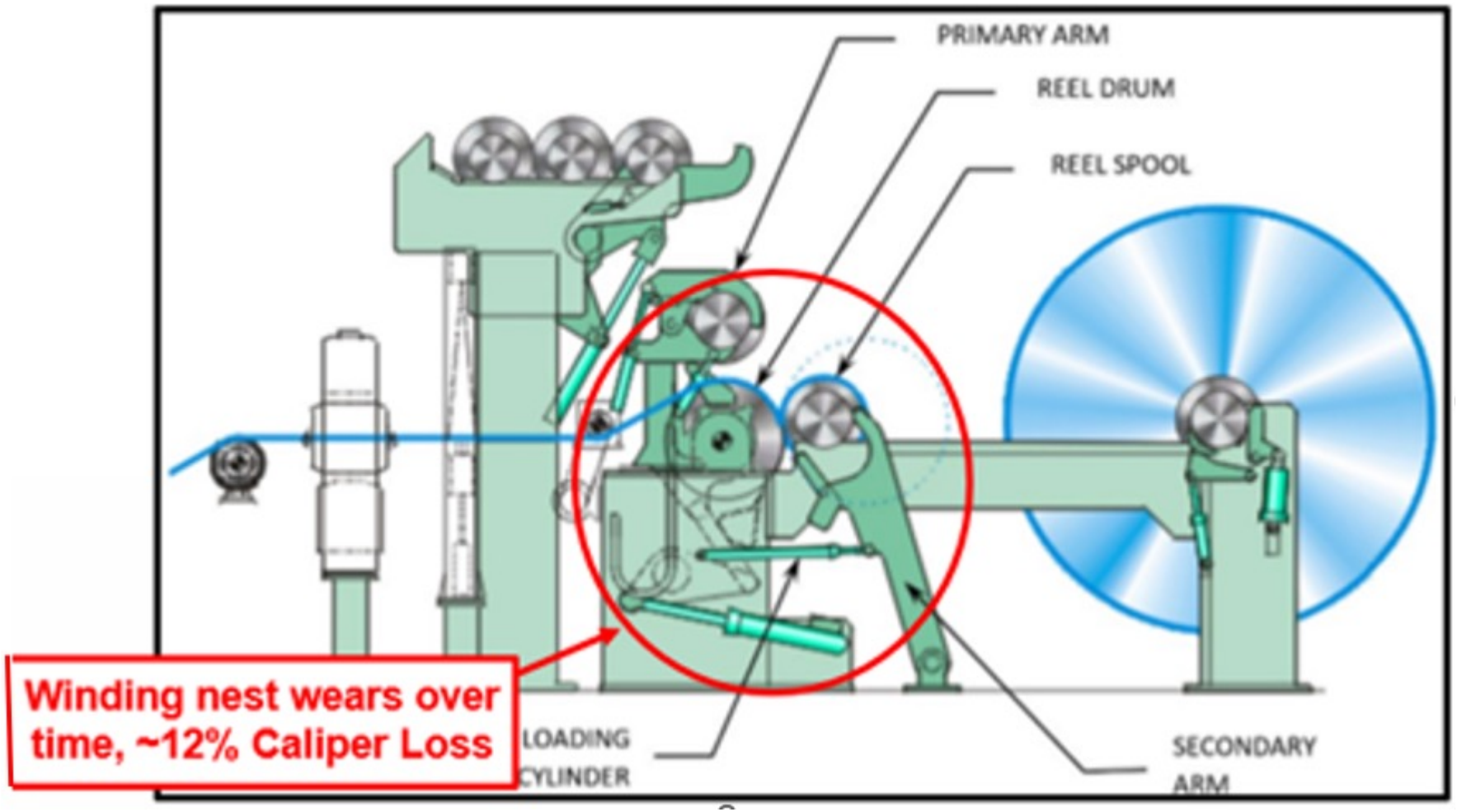
Abstract

Due to tissue products inherent high stretch, tissue is the most compressible of all paper products. Further, few mills recognize that oversheeting is occurring in converting. In most mills, it is common to see oversheeting costing between $2MM to $3MM per facility.

This paper will provide best practices on methods to monitor and control this within your process across pulping, paper machines, winders, and converting.

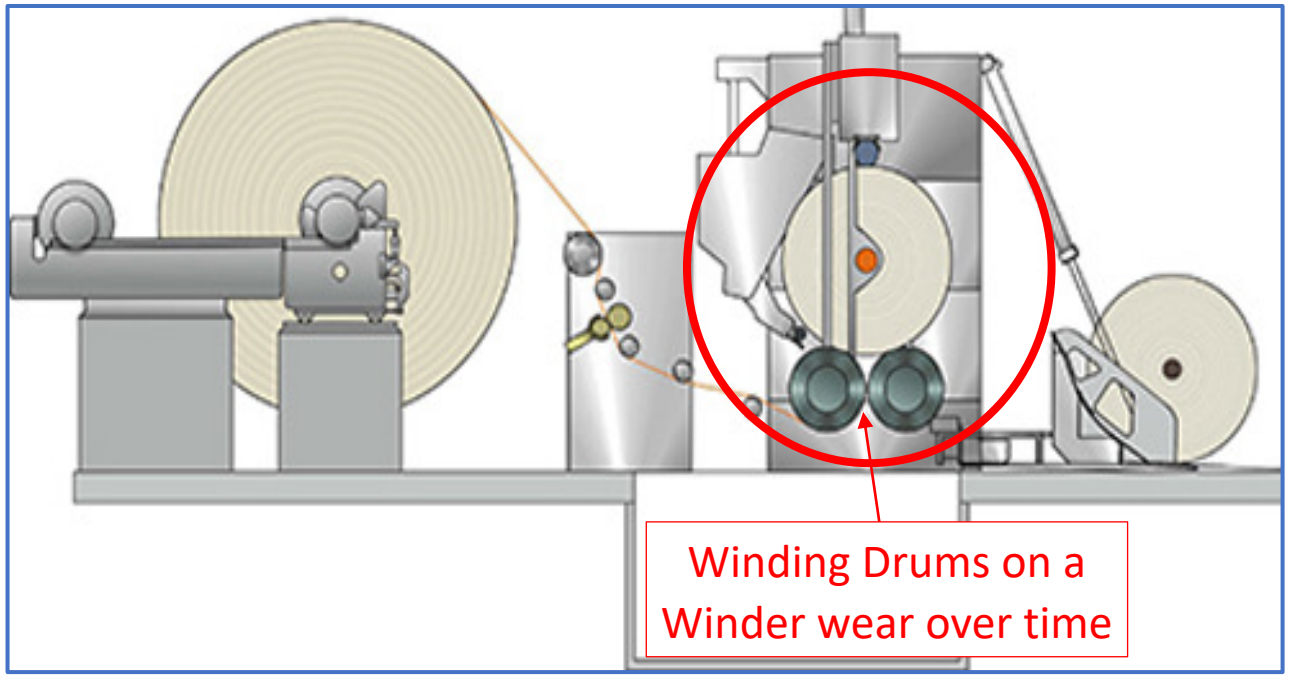
Percent Compression on *Parent Reels*



When asked what compression percentage is found on Tissue parent reels, "12%" is commonly stated.

- **"12%" is factory fresh**
- **After 1-year+, most are much higher, in the 18% to 22% range.**

Percent Compression on *Winders*

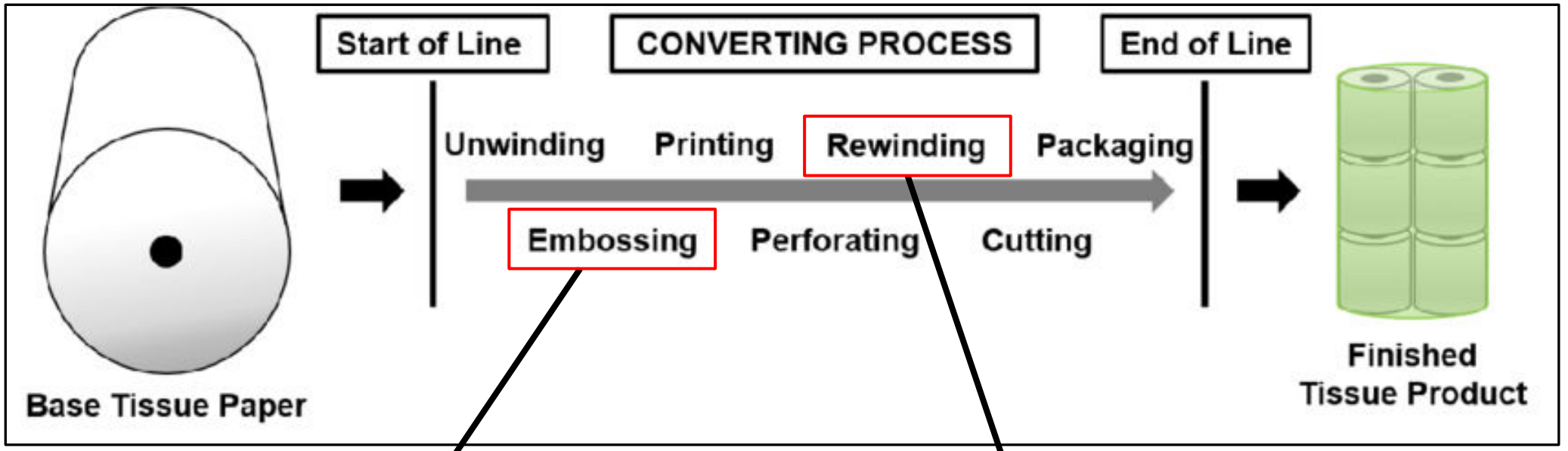


When asked what compression percentage is found on Tissue winders, “10%” is stated.

- ❑ “10%” is factory fresh
- ❑ **After 1-year+, most are much higher, in the 16% to 20% range.**
- ❑ Do you know how much each of your winder’s compress caliper?

Winders are used to slit parent reels down to needed widths. For tissue products, this would be used to slit parent rolls to fit converting unwinds, slit napkins to needed widths and to add plies to bath tissue or napkins for 2 or 3-ply napkin production. Generally, caliper loss is 10% on a winder when new. Caliper loss can jump to as high as 16% to 20% if not monitored & controlled.

Percent Compression in Converting: 6% to 12%



Embossing – Can add bulk and texture to sheet. Embossing types matter. Matched steel; Rubber to steel; 2-ply towel lamination and now 2-ply bath lamination

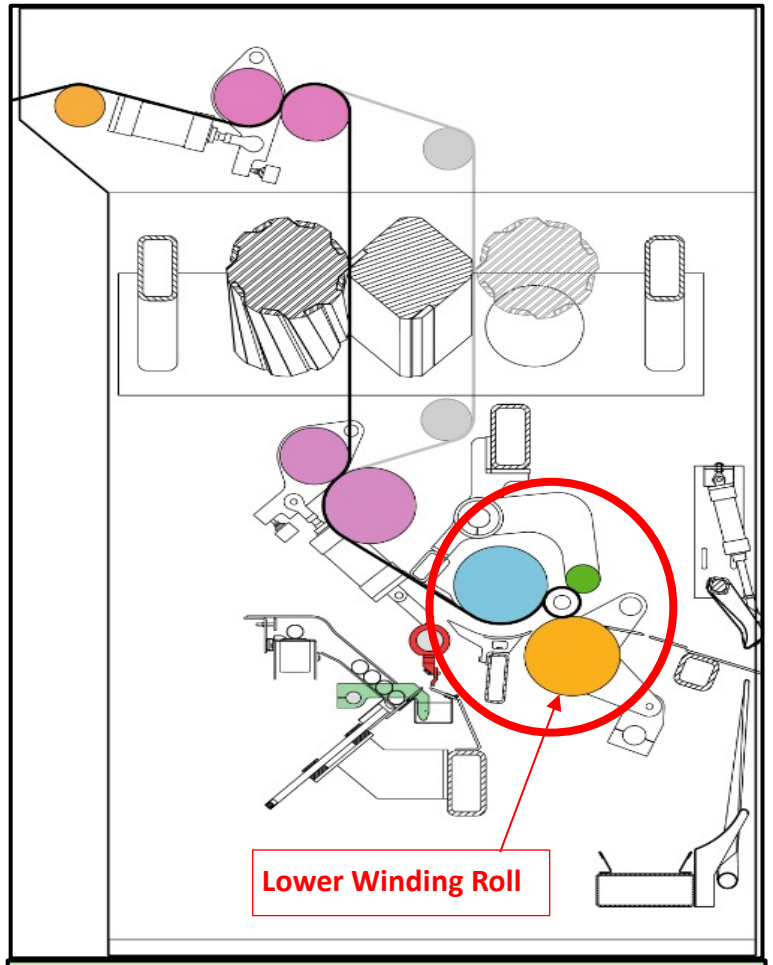
Rewinders – When roll products are soft / punky, rewinder operators nudge the count upwards to deal with low caliper paper. Also, wear on the lower winding roll can cause an additional 6% oversheeting.

Opportunities on Converting - Rewinders

Just as with a Paper Machine, Winder and a Converting Rewinder, all have a critically important 3-points of contact when winding a roll. Here is a typical surface rewinder to help understand this concept.

Over time, the lower winding roll, pictured in this schematic of a rewinder, wears from paper abrasion. If it is bright and shiny, it needs to be replaced!

In this example, the lower winding roll was replaced and immediately went from 850 LF to 800 LF.



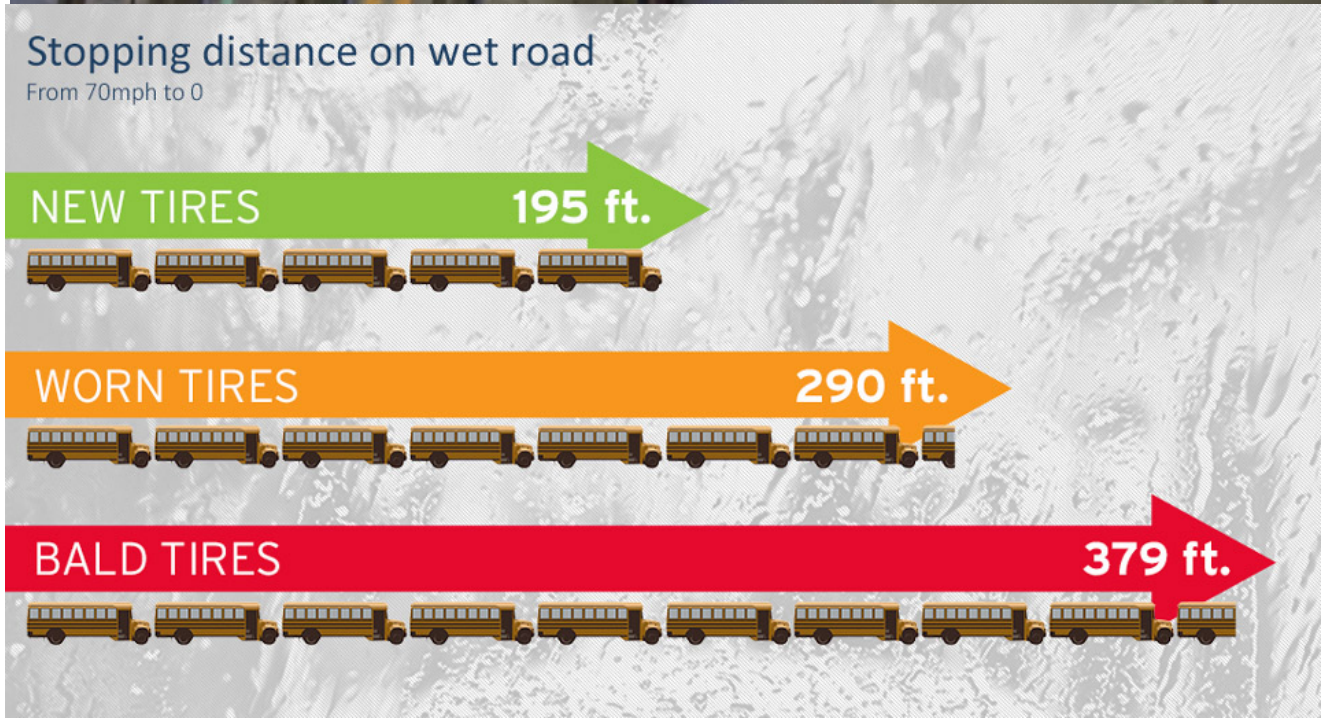
Picture of a Surface Rewinder. This is same winding nest that is present on parent reels and winders.

Remember Paper is Abrasive

Remember paper is abrasive. When OEMs design their equipment be that on a PM, Winder or Converting, they designed their equipment with a certain level of *texture or "grip"* to provide the needed traction to control the process. But this wears off over time and needs to be replaced.

It is critically important that you understand this concept. An analogy would be driving a car with slick, worn-out tires. There is little traction. This same principle applies throughout Paper Machines, Winders and Converting.

An Analogy: Bald Tires on a Car – No Traction!



These same principles apply to PMs, Winders and Converting.

Think of an analogy on new vs. bald tires:

- *Higher coefficient of friction (new) vs. bald tires (used.)*
- *High traction means less footage placed on a parent roll.*
- *Less traction means more footage packed on a parent roll.*

Raise Awareness

Another mindset: PM operators believe that by placing more paper on a roll:

- Benefits those running converting lines into finished product by having more paper on the roll.
- Fewer parent roll changes are needed in converting.
- Allows PM operators another ~5-minutes between roll turn-ups.
- This is costing you!

Troubleshooting: Start with Converting

- **Roll Products Are Primarily the Opportunity**
  - All rolled products have specific sheet counts that are expected to be adhered to, which includes an Outer Diameter (OD) when the product was developed.
  - Each product has a specific Outer Diameter (OD) and Sheet Count.
- **Key Learning - All rolled products center around a certain OD.**
  - All downstream equipment off the rewinder rely on a firm / consistent OD.
  - If OD is too small, log saw clamps can't clamp the log. This causes the expected 4.0" bath width to vary from say 4.25" to 3.75".
  - Wrappers don't work correctly along with case packer. If roll products are loose fitting in the case, this causes case handling, storage and crushed case concerns.

Troubleshooting (continued)

- **Current Fix:** *When the roll OD is too low / punky, rewinder operator adds sheets to firm it up. This doesn't get recorded and happens all the time.*
  - By firming up the roll, this typically resolves the punky roll that feeds the log saw, wrapper, case packer, or bundler.
  - Another request is to ask the PM crew to boost the basis weight and / or bulk for the grade.
  - Given that both oversheeting and adding basis weight to the base sheet occurs, be sure to note that when gathering finished product data.
  - As most are aware, variances occur from PM to finished product BsWt. Be sure to understand that, esp. as stretch is pulled out at the parent reel, winders and converting. This lowers caliper, BW and strength properties.

Best Practices in Manufacturing

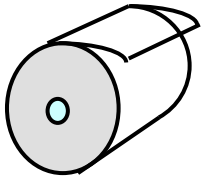
Best Practices – Best practice calls for each paper grade off a paper machine (and winder) to have targets for:

- ***Roll Footage;*** Outer Diameter; Inner Diameter; Bs Wt, MD Tensile, CD Tensile, Stretch, Water Absorbency, Trim Width, **Caliper, Bulk**, and depending on the grade, Softness Levels and Furnish (HW / SW / Broke)
- *Roll footage* was placed first to add emphasis to this discussion. Many firms do not measure this and as the adage goes, *what gets measured gets controlled*.
- Tendency is to run to a roll diameter and unless QC measures something out of spec, it is approved and sent into parent roll storage.

Bath Tissue Rolls – Converting & Parent Reel

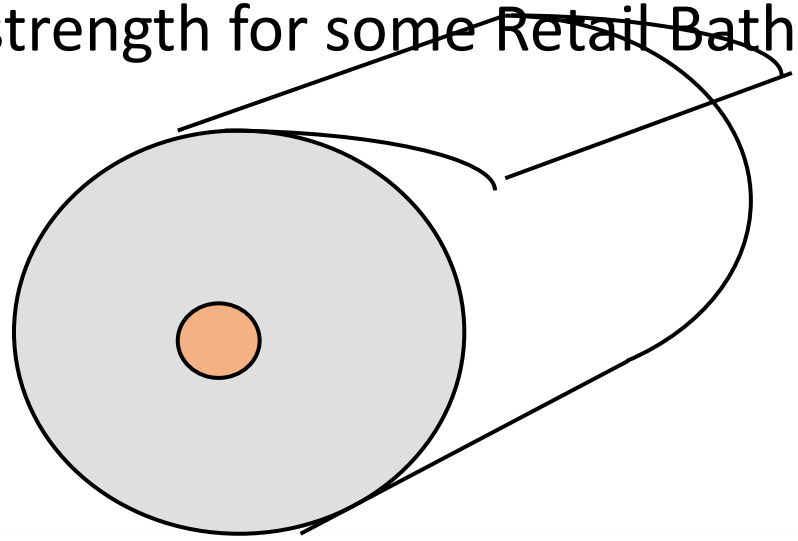
<u>Bath Tissue Roll (Converting)</u>: In Manufacturing, there is a known finished product spec for each SKU:

- Roll ID, OD, Width
- Bs Wt. / MD - CD Tensile / Stretch
- **Footage (Sheet Count)**
- Verify no wet strength (excludes temp. wet strength for some Retail Bath Grades)
- Verify perforations are good



<u>Parent Roll of Bath Tissue</u>: In Manufacturing standards, there is a known parent roll spec for each grade off each PM:

- Roll ID, OD, Trim Width
- Bs Wt. / MD - CD Tensile / Stretch /
- **Footage (Length)**
- Verify no wet strength (excludes temp. wet strength for some Retail Bath Grades)



Key Message – Managing Oversheeting Starts at PM

- **If you are not Measuring and Controlling Footage and Outer Roll Diameter at Parent Reels, *expect caliper loss*!**

- Each paper grade has specific targets for BW, MD & CD Tensile, Stretch, TEA, Water Absorbency, Trim Width and Outer Roll Diameter.

- Where is Roll Footage? It's available on every PM but seldom used!

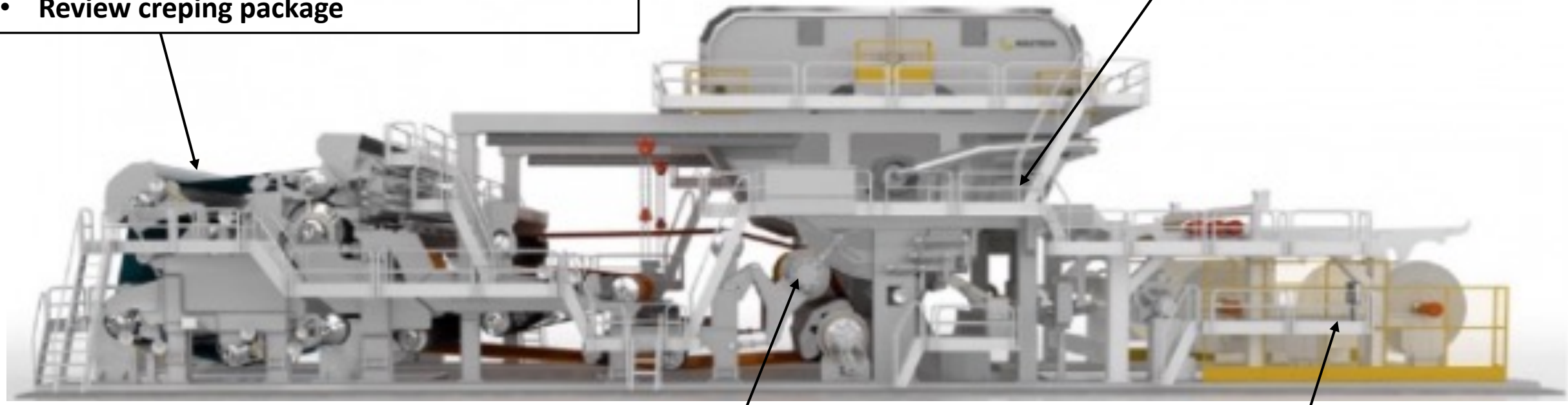
- At best, caliper loss is 12% at the parent reel. Worse case scenario, it is 20%+!

- **Unfortunately, this is rampant in the tissue industry, worldwide!**

Opportunities on Tissue PMs

- **Furnish** - Review HW/SW/Broke content going to Head Box. Use of Aspen HW helps dusting w/o sacrificing softness or absorption.
- **Review creping package**

Consider adding a spray boom to add steam directly before the doctor blade.



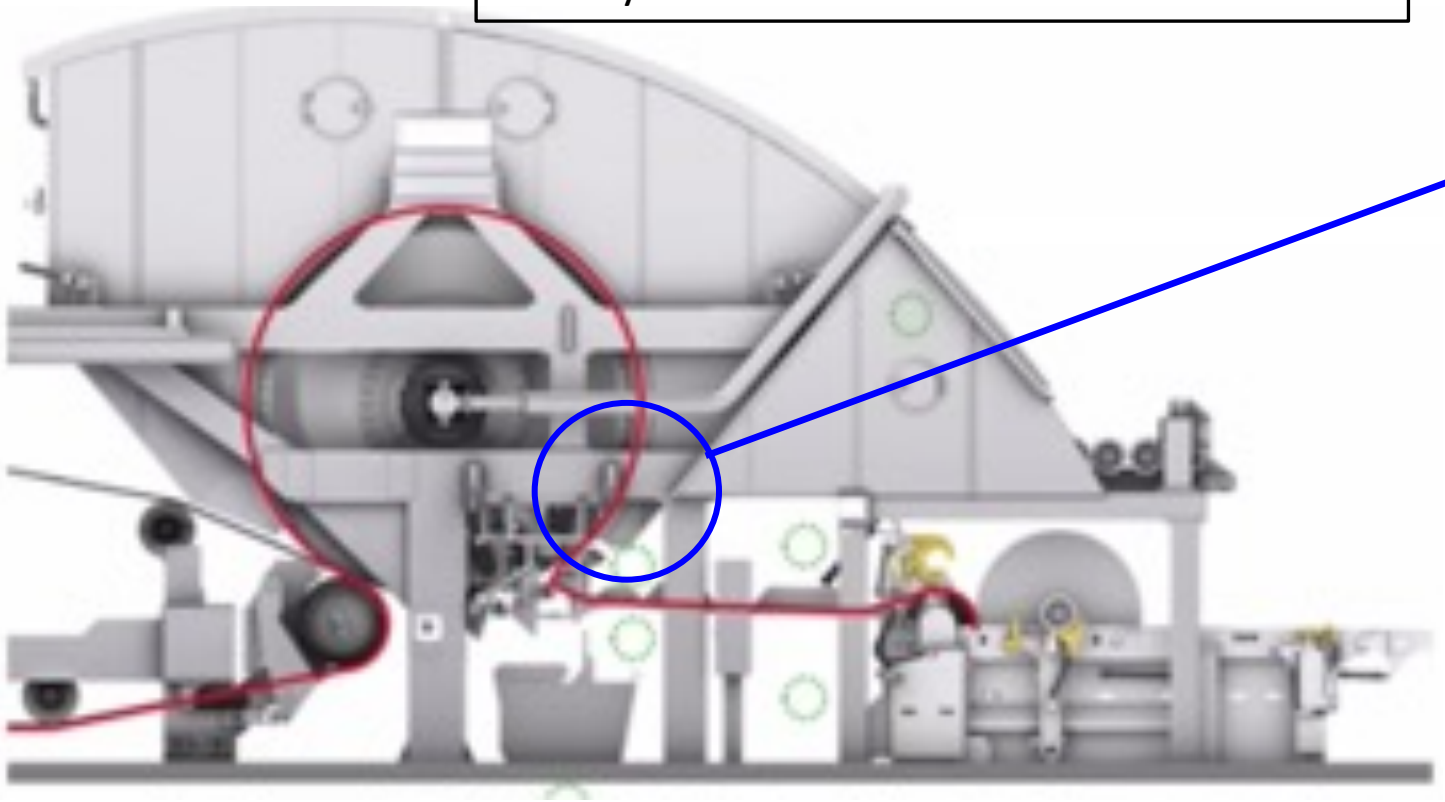
In stock prep: Use new refining technology to add kink, curl and bulk plus increase tensiles and lower Bs. Wt.

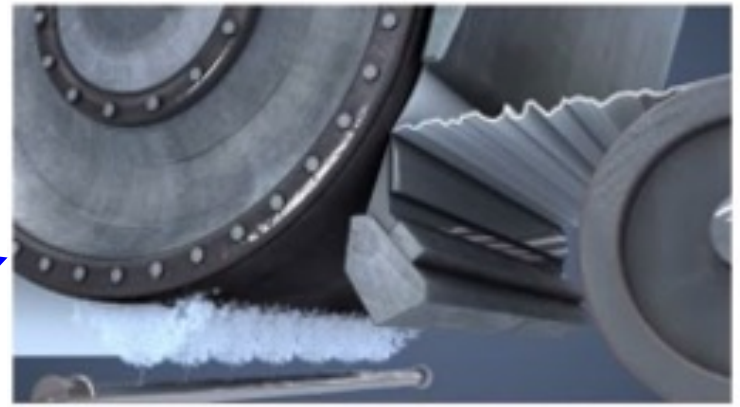
Press Roll Settings – Review current settings. Long term, consider a larger diameter on the Suction Press Roll to decrease loading pressure

Reel Section: Review primary, secondary and rider roll settings to prevent excessive caliper loss

Opportunities on Tissue PMs

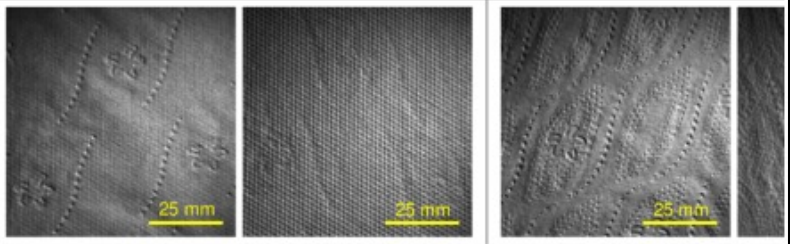
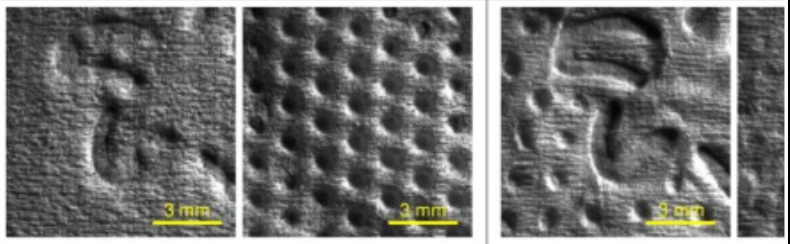
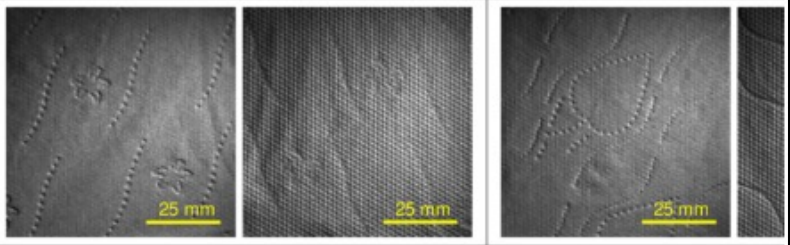
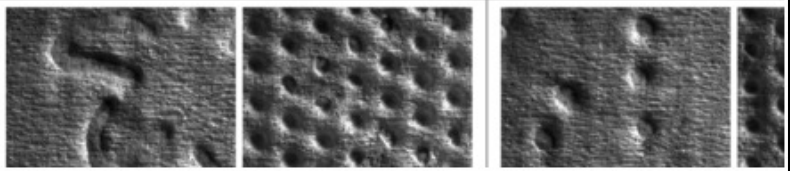
Consider adding a spray boom to add steam directly before the doctor blade.



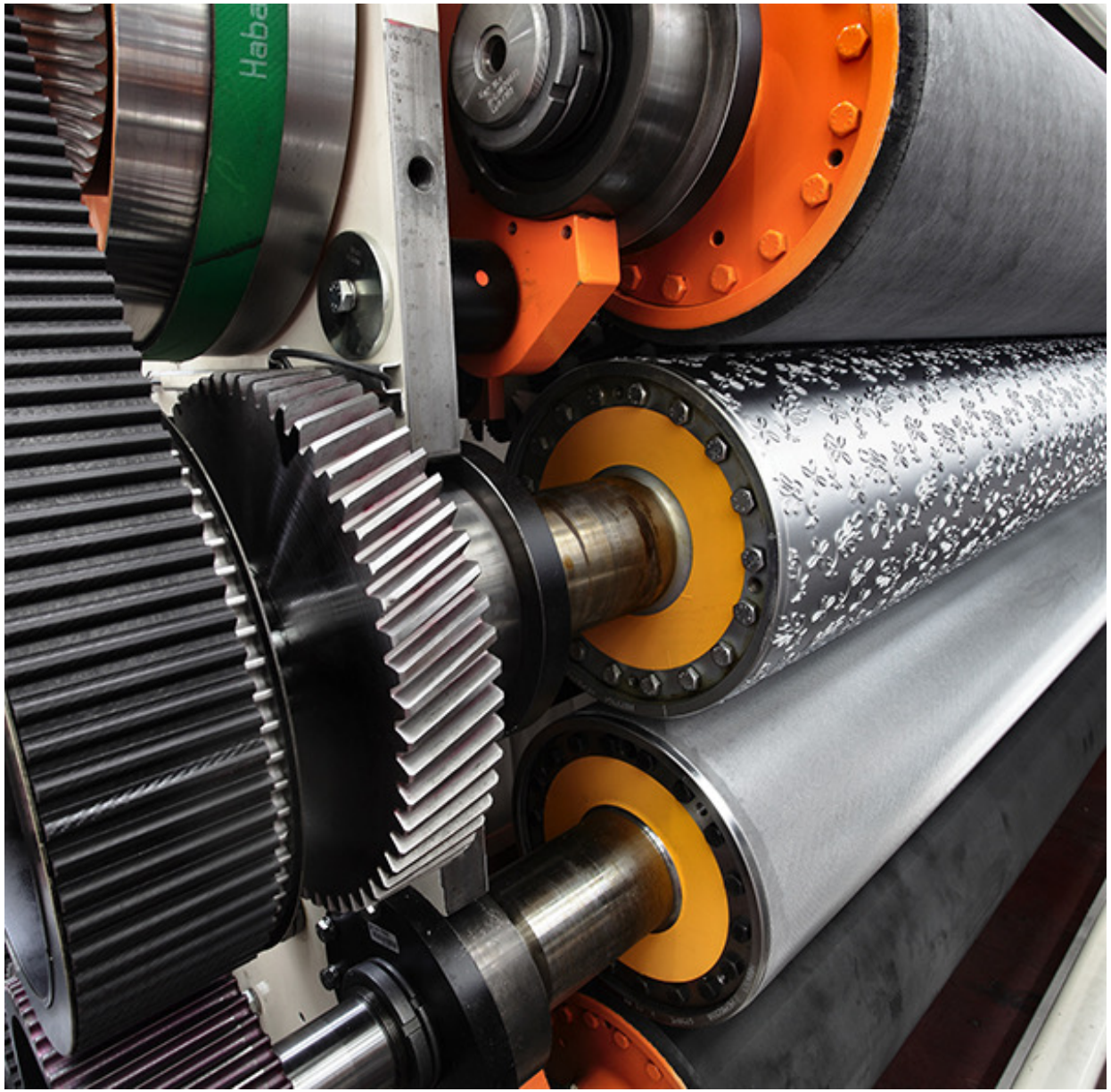


- Use a spray boom with fan nozzles to distribute steam across the web
- Approximately 10” to 12” before the doctor blade
- Use 30 to 40 PSI steam
- Adds heat and moisture to the fibers and will explode the fibers giving:
  - Increased kink
  - Increased curl
  - Increased caliper
  - Expect to see decreases in MD and CD Tensiles

Opportunities on Converting – Embossers

Mother-reel	A1+A2	B1+B2
2-ply Paper	A	B
Global View of Paper Service (Deco / Micro)		
Magnified View of Embossing (Deco / Micro)		
Mother-reel	C1 + C2	C1 + C2
2-ply Paper	C	D
Global View of Paper Service (Deco / Micro)		
Magnified View of Embossing (Deco / Micro)		

Sample Organization and Images of the Paper Services and Embossed Patterns (Size of Global Views ≈ 77 × 77 mm 2 , Magnified Views ≈ 10 × 10 mm 2)



Best Practices - Calculating Footage and Caliper

For reference, Roll Footage and Caliper Compression for both Parent Reels and Winders can be calculated

INSTRUCTIONS: Fill in the BLUE cells and the calculated values will appear in the GREEN cells.
You can just type over old data.

	Parent Roll 1	Parent Roll 2	Parent Roll 3	Parent Roll 4	Parent Roll 5	Parent Roll 6	Parent Roll 7	Units
Grade Description of known variable	2-Ply Bath (after parent reel)	2-ply bath (After Rewinder)	3-Ply Bath	3-Ply Bath	2-Ply Twl TAD	2-Ply Twl TAD	2-Ply Twl TAD	
Basis Weight (lbs/3000sf)	12.4	10.89	11.5	11.5	18	18	18	lbs/3000 sf
Lab Bulk of Paper (8 Ply) mils	46.00	34.75	43.00	43.00	118.00	118.00	119.00	mils per 8 ply
Caliper UNCOMPRESSED .001"	0.0058	0.0043	0.0054	0.0054	0.0148	0.0148	0.0149	inches per 1 ply
Outer Diam, OD (in)	84.0	82.0	80.0	90.0	120.0	112.6	112.5	inches
Core Diameter (OD) (in)	17.0	11.3	13.0	13.0	17.5	17.5	17.5	inches
Core Diameter (ID) (in)	16.0	10.0	12.0	12.0	16.0	16.0	16.0	inches
Roll TRIM Width (in)	129.0	131.5	138.0	138.0	105.0	101.0	101.0	inches
Roll Weight w/ Core (lbs) =	4,280	5,588	4,800	6,100	3,750	3,515	3,520	lbs
Roll Weight w/ Core (Tons) =	2.14	2.79	2.40	3.05	1.88	1.76	1.76	
Roll FT (FPMx Min/Turn-up)						68,454	68,343	ft
Density of Core (#/cf)	42.0	42.0	42.0	42.0	42.0	42.0	42.0	lbs/ cu ft
Calculated Values								
Est. Core Weight (lbs)	81	67	66	66	101	97	97	lbs.
Est. Parent Roll Footage	94,496	138,802	107,391	136,881	69,518	67,686	67,785	ft.
Est. Caliper COMPRESSED	0.0047	0.0031	0.0038	0.0038	0.0133	0.0120	0.0119	inches per 1 ply
% Compression	81.5%	71.6%	70.6%	70.5%	89.9%	81.1%	80.1%	%
Avg Parent Roll Density	10.6	14.0	12.1	12.1	5.4	6.0	6.0	lbs/ cu ft
Footage Error (%)					1.6%	-1.1%	-0.8%	

Roll Wt (lb) = Roll Length * Roll Width * Bs Wt = 3.14*(OD^2 - ID^2)/(4 * lbs/3000 sq ft)* 1 sq ft/144 sq in

General Formulas Used In Calculations:

- Area = Length x thickness = 3.14 x ($OD^2 - ID^2$)/4
- Est. Core Weight (LBS)= (3.14/4) x (Core OD^2 – Core ID^2) x (Trim Width) x (Core Density) (Core density = 42#/CF)
- Est. Parent Roll Footage, L for Length (FT) = (Roll Wt. w/ core – Core Wt.) (12”/ft x 3000 sf)/ (Bs Wt. x Trim Width)
- Est. Caliper COMPRESSED (inches) = (3.14) (Core OD^2 – Core ID^2) / (4 * Est. Roll Footage x 12)

Variables:

- OD = Outer Diameter, inches
- ID = Inner Diameter, inches (add core thickness; looking for the OD of the core.)
- L = Length of Roll, Feet
- t = Thickness or Avg. Wound Caliper, inches

Understand Legal Requirements

Tissue products sold in the United States fall under the Fair Packaging and Labeling Act: (eCFR :: 16 CFR Part 500 — Regulations Under Section 4 of the Fair Packaging and Labeling Act)

Purpose of the Act:

- Designed to facilitate value comparisons and to prevent unfair or deceptive packaging and labeling of many household "consumer commodities."
- **The key point is that Tissue Products must comply with a + / – 3% on content on an individual product and that when viewed as a unit sold to the public (e.g., case or bundle) it must meet the declared content.**

Conclusions

- Oversheeting in tissue has been and continues to be significant challenge worldwide.
- Most in management will be hard pressed to understand or believe this is occurring. That is, until actual data is presented.
- On average, this costs *each mill* roughly $2MM to $3MM / year.
- This also occurs at remote converting sites where paper is shipped to a converter.
- Call us to provide support in this endeavor to lay out a program, form teams, and provide technical guidance from start to finish.

Thank you.

Questions?

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Appendix

These next slides are presented as a simple walk through of forming a team, analyzing the data, using Pareto charts, etc.

Highlights of Oversheeting

Objective – Learn to recognize oversheeting in your facility.

Step I – Form a team to gather the data

Step II – Analyze the Data

Step III – Develop Pareto Charts. Start with worst offenders, likely $$$

Step IV – Troubleshoot the issue. This will require a skillset that can be taught

Step V – Implement the plan in stages.

- Start with Converting: There may be some straightforward resolutions then move to the PM room
- Quick wins will help boost confidence in the team
- Learn Best Practices

Step VI – Understand Legal Requirements

Step VII – Conclusions

Step I – Form a team

- Team members should include QC, Accounting, Engineering, IT & Corporate to coordinate activities across mills
- Have QC gather actual test data by line & compare this to “Spec”
- Surprisingly, gathering data is hard to do! Typically, the QC data is recorded on paper, sometimes on an Excel spreadsheet. Long term, use Seeq (e.g. Software to gather QC data) to automatically record this data (e.g., Automates collection of QC then compares to “spec” data.)
- *Don’t shoot the messenger!* – The first time this was uncovered by Quality Control, it sent a shock wave thru the system and felt like management was ready to shoot the messenger.

Step II – Analyze the Data

❖Step II – Analyze the Data

A. There will be data that has been reported by QC on several products that have been oversheeted for months, if not years.

B. Where will the likely candidates be? Surprisingly, this occurs in both Retail and Away-from-Home products roll products, almost equally.

- Retail Bath – Both high and low count bath
- Retail Towel – Both high and low count toweling
- AfH – Jumbo Roll Bath, 9” OD (1,000 LF) and 12” OD (2,000 LF)
- AfH - Hard Wound Towels 400 LF, 600 LF, 800 LF, 1000 LF
- AfH – Single roll, wrapped and unwrapped bath with varying sheet counts

Step III – Develop Pareto Charts

Develop Pareto Diagrams

- Once ‘spec’ vs actual data has been analyzed in Step II, recommend plotting this in Pareto diagrams. Simple Excel Spreadsheet will do initially.

- Requires Financial / Accounting feedback on value that each SKU will be assessed. Conventional vs TAD paper, profitability per SKU etc., play a role in determining appropriate value.