Troubleshooting Converting and Packaging Roll and Web Defects

Case Study-Winding

Presented by:
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Case Study - Winding
Based on a true Situation - Slightly Altered to Protect Confidentiality

**Problem Description:**

A manufacturer of the flexible packaging material used to form consumer fluid containers was have a roll defect called “Buckling”
Typical Coating, Laminating and Extrusion Coating Machine Line
<table>
<thead>
<tr>
<th>Material</th>
<th>Caliper</th>
<th>Thickness %</th>
<th>Tensile Modulus</th>
</tr>
</thead>
<tbody>
<tr>
<td>PET</td>
<td>.00048&quot;</td>
<td>10.4%</td>
<td>500,000 psi</td>
</tr>
<tr>
<td>Foil</td>
<td>.00035&quot;</td>
<td>7.6%</td>
<td>10,000,000 psi</td>
</tr>
<tr>
<td>PE</td>
<td>.0040&quot;</td>
<td>82.0%</td>
<td>25,000 psi</td>
</tr>
<tr>
<td>Structure</td>
<td>.00483&quot;</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

**Web Width** 42"
Problem Description:

The finished rolls look excellent right off the winder. However, after they have been stored for a day or longer, buckling wrinkles (pleat type fold overs across the web) show up in the first couple inches of material wound on the core. This material must be rejected as scrap at the printing operation which cause considerable scrap costs.
The composite structure is wound on 7" O.D. fiber cores to a diameter up to 36".

The rolls are being center wound without a nip at a constant tension of 80#.
BUCKLES

SYNONYMS
Also known as: Buckles Lanes (FEL-49), Wrinkles - Transverse Direction (TD), Corrugations - Transverse Direction (TD), Accordion Lines, Transverse Direction (WD-5), Wrinkles.

DEFECT DESCRIPTION
Buckle: An internal roll defect which is apparent from the edge of the roll and in which localized layers of the web are compressed to form a wave type pattern.

CAUSES OF BUCKLES
This defect is caused by loose winding and then winding tightly on top of the loose area. Common causes are:
1. Insufficient drum torque differential.
2. Loss of web tension, possibly at a splice.
3. Improper rider roll relief.
4. Stop and restart with loose web.
5. Automatic tension control not functional.
6. Quick speed changes.
7. Binding of core shafts.
8. Binding of rider roll slippage.
9. Low-caliper paper at the edges.
10. Too-rapid deceleration of a roll with center drive or braking.
**Problem Description:**

- The warm web wound into the roll is curing during storage. This causes the outer surfaces to contract and the inner wraps towards the core to be put under high compressive stresses.

- These high compressive stresses force any air that was wound into the roll to be compressed and/or to evaluate out the sides.

- The web is being center wound at a constant 80# tension without using a layon roll to nip the winding roll at the point the web enters the roll.
Suggested Tension for each Product Used in the Laminate from the TAPPI Web Tension Charts

<table>
<thead>
<tr>
<th>Material</th>
<th>Tension/Mil x Thickness x Width</th>
<th>Suggested Tension</th>
</tr>
</thead>
<tbody>
<tr>
<td>PET</td>
<td>0.5-1.5 pli/mil x 0.48 mil x 42&quot;</td>
<td>10-30#</td>
</tr>
<tr>
<td>Alum Foil</td>
<td>0.5-1.5 pli/mil x 0.35 mil x 42&quot;</td>
<td>7-21#</td>
</tr>
<tr>
<td>PE</td>
<td>0.25-0.3 pli/mil x 4.0 mil x 42&quot;</td>
<td>40-48#</td>
</tr>
</tbody>
</table>

Total Tension = 57# to 99#
ROLL HARDNESS PROFILE**

Roll Hardness vs. Diameter

** From Chapter #21 of TAPPI Film Ext. Manual – 2nd edition, 2005
This Laminated Flexible Pkg. product needs to be wound with a very tight start and then taper the roll's hardness as the roll builds. Due to the cooling or curing action of the material, we would suggest a 25% to 50% winding tension taper.
To obtain the req’d. tight start, it is suggested that winding tension at the start be about 100#. Then tapering the winding tension to 50# (50% taper) at a 36" dia.
Tension Principles of Winding**

**Taper Tension**

Reduce the tension smoothly as the roll diameter increases:

0 - 50% taper, 25% common

**Taper Tension reduces**:

- telescoping, end crowning,
- starring and buckling problems.

** From Chapter #21 of TAPPI Film Ext. Manual - 2nd edition, 2005**
This application should use the nip from a layon roll to build the desired roll hardness and to minimize air wound into the roll.

Suggested starting nip is 3 times the starting tension or $3 \times 100\# = 300\#$.

** From Chapter #21 of TAPPI Film Ext. Manual - 2nd edition, 2005
Nip Principles of Winding**

- Nip Load should be tapered as roll winds to prevent starring and telescoping.
- However, larger winding roll’s dia. drags more air and produces a Nip Taper Loading with a constant loading pressure.

** From Chapter #21 of TAPPI Film Ext. Manual – 2nd edition, 2005
Solution Summary: Buckling Problem

By increasing the Winding Tension to a 100# at the start and then tapering to 50# at a 36" diameter. Then by adding a nip roll which was used to supply a 300# Constant Nip to evacuate the air. The Buckling Problem as the roll cured was eliminated!
Typical Coating, Laminating and Extrusion Coating Machine Line
Case Study in Winding

Questions?
Case Study in Winding

Thank you !!!

R. Duane Smith
Product Manager – Specialty Winding
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Fulton, NY

Please remember to turn in your evaluation sheet...
Case Study - Wrinkling

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Case Study in Wrinkling

The most costly defect in Web Handling Is:

WRINKLING
Case Study
Based on a true Situation - Slightly Altered to Protect Confidentiality

**Problem Description:**

A West Coast Company Was Losing $10Ks in Products due to Wrinkles.
Problem Description:

The company had accepted a contract to produce 55# High Gloss Ink Jet / Laser Photographic Printing Paper on their existing well used coating line.
Problem Description:

They had previously been successfully winding this produce at a narrower (60”) width.

But when they went to a wider (80”) web width, they got Wrinkling just before the nip of the Rider Roll on their Winder.
Description of Wrinkle

- **Wrinkle was only on one side of the web.**
- **Wrinkling was in the machine line direction (MD) and at a slight diagonal to the machine direction.**
- **Wrinkling was predominately on the Control Side of the winder.**
- **Wrinkling was evident on both spindles of this turret winder.**
ROLL AND WEB DEFECT TERMINOLOGY
2ND EDITION

R. Duane Smith

CHAPTER 4
ROLL AND WEB DEFECTS - WRINKLES

CHAPTER CHAMPION
DR. DAVID ROISUM
PRESIDENT
FINISHING TECHNOLOGIES, INC.
DIAGONAL SHEAR WRINKLE - ASYMMETRIC

SYNONYMS
Also known as: Wrinkles - Shear, Lightning Bolt Wrinkles.

DEFECT DESCRIPTION
Diagonal Shear Wrinkle - Asymmetric: Wrinkles are oriented at an angle with respect to the machine direction. The higher the angle, the greater the shear stresses. All wrinkles point to the same side and may favor that side. Wrinkle pattern tends to be evenly spaced. Wrinkles sometimes "walk" sideways. The common mechanisms for all subclasses are that something (e.g., roller or web) is "crooked."

CAUSES OF DIAGONAL SHEAR WRINKLE - ASYMMETRIC
1. Roller misalignment in the parallel (main) direction is the most common cause. Wrinkle points to the narrow side and walks to the wide side.
2. Roller diameter variation.
3. Roller nip pressure variation.
4. Uneven pull (e.g., from narrow drive rollers, edge trim tension or direction).
5. Uneven temperature film, foil or moisture (paper, nylon).
6. Baggy lane or web, tight lane.
7. Gauge or other web profile variation, whether inadvertently or by design.

REFERENCES
Diagonal Shear Wrinkles - **Something is Crooked**

Possible Causes: *Man/Machine/Materials*

- **Man** - Improper Settings
- **Machine** - Improper Alignment
- **Materials** - Gauge or other profile variations
Possible Causes: Man Problems?

Improper Tension Setting??

**Increasing Web Tension**
- They were running Maximum pressure on Dancer Roll Cyls. of 90 psi = Max Tension

**Decreasing Web Tension**
- Wrinkles did NOT improve.
- Wrinkles appeared to become more severe
Possible Causes: Machine Problems?

- **Web Handling Rolls’ Alignment?**
  Alignment of the Web Handling Rolls looked acceptable.

- **Rider Roll not square?** *(with the winder spindles)*
  Checked with pull tabs for equal lay-on roll loading on both sides of a Bare Core.

- **Machine Not Designed to pull sufficient Web Tension?**
Possible Causes:

Web Tension Problems?

- Winding Tension was controlled by a Dancer Feedback System.
- No readout of Web Tension.
- Lowering Web Tension made problem worse !!!
- Could not pull any greater web tension as already had 90 psi dancer roll loading cylinders.
- They ran the 60” wide product with the same 90 psi dancer roll loading pressure.
Possible Causes: Material Problems?

- **Easy to:**
  Align Web Handling Rollers to
  1 PART IN 10,000 (0.010” / 100”)

- **Difficult to:**
  Manufacture Webs to
  1 PART IN 100 (1% Across Sheet)
Web Handling Challenge

Pull Sufficient Tension to Convey Imperfect Web Materials Straight Through the Process WITHOUT Wrinkles

Suggested Amounts of Web Tension

“Rule of Thumb”

10 - 25% of Machine Direction Tensile Strength of Web Materials

** From Chapter #21 of TAPPI Film Ext. Manual – 2nd edition, 2005
Solution:

This 55# calendered grade had tensile strength of 37 #/ inch.

10% of tensile = 3.7% pli
minimum suggested tension.

90 psi on dancer = 210# tension /
80” web = 2.6 pli (3.5 pli on the 60” wide web.)
Solution:

Not pulling sufficient tension to pull out acceptable basic weight variations across sheet.

Winder Spindle Drive @ 50” dia - 210# = 60% FLC
(Plenty of Spindle Power to pull more Tension)
Solution Summary:

Solved Problem by: Moving the dancer roll closer to the pivot point (24” to 16”) to enabled pulling 315# tension or 3.9 pli on the 80” sheet.

This enabled pulling sufficient tension to pull sheet flat before nip and eliminating Wrinkles.
Case Study in Wrinkling

Questions?
Case Study in Wrinkling

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