Center Surface Winding

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Topics

- Principle of center surface winding
  - Tension, Nip and Torque winding
- Advantage and disadvantage
- Turret winding splice sequence
  - Possible Roll defects with turret winding mode
  - In-Line slitting requirements and benefits
- Center surface winding without turret
  - Surface Winder sequence
  - Roll quality and tension curves
  - Horizontal Winder
- Conclusion
Center-Surface Winders
Use Both Winding Methods

Center Winder
- Lay On Roll
- Roll
- Center Drive
- Tension control

Surface Winder
- Roll
- Loading Force
- Surface Drive
- Tension control
Center-Surface Type Winder

Web Tension is Independent Winding Principle from Winding Torque
Center-Surface Winders

- Can use all three TNT Winding principles
  - Tension, which is used for slitting and spreading, controlled by Surface Drive.
  - Nip is controlled by the lay-on roll loading.
  - Torque from spindle drive controls roll hardness independent from web Tension.
Tension Principle of Winding

Web Tension

- When winding elastic materials, web tension is the dominant principle of winding used to control roll hardness. The more tension is pulled and the more stretch is put on the web before winding, the harder the wound rolls will be at the end. Often it is not desirable to stretch the material.

- Example: Printed material needs to stay in the print repeat length restriction for further process.

- The web tension is often determined empirically. The maximum amount of web tension can be determined by using 10-25% of the materials tensile strength.
Tension Principle of Winding

When center surface winding,

• Web’s conveyance tension coming into the winder is normally held constant. This allows the web to be strained (stretched) equally from the start of the wind until the finished roll diameter.

• Also, since web spreading is a function of the web’s tension, constant web tension keeps the spreading action constant during the winding process.

• Winding tension is programmed to control the roll density. For proper roll hardness, the winding tension needs to taper smoothly as the roll diameter increases. The tension taper should be between 0 and 50%. A tension taper of 30% at full roll is common.
Nip Principle of Winding

Nip Loading

- When winding inelastic webs, nip is the dominant principle of winding used to control roll hardness. The nip controls the roll hardness by removing the boundary layer of air following the web into the winding roll. The rolling nip also induces in-wound tension into the roll.

- The harder the nip, the harder the winding roll will be. A programmed high nip load will result in a good hard start, then tapering the nip as a function of the winding roll's diameter will result in winding a progressively softer roll for the desired roll hardness profile.
Torque Principle of Winding

Torque applied through the center of the roll

• Center torque creates roll hardness by cinching or tightening of the wraps as the material is being wound. The resulting web tension from this torque is tapered as a function of the roll's diameter to produce the desired roll hardness profile.

• The surface drive will regenerate or pull negative (braking) torque (or current on AC drives) when the winding tension is greater than the incoming web tension. As the winding roll builds larger in diameter, the surface drive will gradually provide less braking until it reaches zero torque when the winding tension equals the web tension.

• If the winding tension is programmed to go below the incoming web tension, then the surface drive will pull positive torque at the larger roll diameter there is occurs.
Center Surface Winding

Advantage of center surface winding

• The winding roll hardness can be independently controlled by the web tension.
• Best winding method if inline slitting is desired in the converting machine
• For high tension applications, center-surface winders can share the tension horsepower requirements to allow small center drives.
• The disadvantage of center-surface winding is that the winding equipment is more expensive and more complex to operate
Turret Winder Splice Sequence

Air intrapments

- With the start of the indexing and splice sequence, winding roll looses contact with the main lay-on roll and air intrapments will occur, even with the use of a second helper contact roller

Web elongation

- During the indexing of the finished winding roll, the web length change will increase the web tension. Control or roll hardness and the straightness of the roll’s edge is difficult. This often resulting in winding scrap during the roll change process.
Turret Winder Splice Sequence

- Active Winding Shaft
- Empty Winding Shaft
- Contact
- Lay-On Roll
- Turret
Turret Winder Splice Sequence

Active Winding Shaft

Contact Lay-On Roll

Air

Empty Winding Shaft

Turret
Turret Winder Splice Sequence

Active Winding Shaft

Contact Lay-On Roll

Air

Empty Winding Shaft

Turret
Turret Winder Splice Sequence

Active Winding Shaft

Empty Winding Shaft

Contact Lay-On Roll
Turret Winder Splice Sequence

Active Winding Shaft

Empty Winding Shaft

Turret

Contact Lay-On Roll
Turret Winder Splice Sequence

Active Winding Shaft

Turret

Empty Winding Shaft

Contact
Lay-On Roll
Turret Winder Splice Sequence

Active Winding Shaft

Empty Winding Shaft

Contact Lay-On Roll

Turret
Turret Winder Splice Sequence

Active Winding Shaft

Free web length

Turret

Empty Winding Shaft

Contact Lay-On Roll
Turret Winder Splice Sequence

Active Winding Shaft

Free web length

Contact Lay-On Roll

Empty Winding Shaft
Turret Winder Splice Sequence

Active Winding Shaft

Free web length

Empty Winding Shaft

Turret

Contact

Lay-On Roll
Turret Winder Splice Sequence

Active Winding Shaft

Free web length

Contact Lay-On Roll

Empty Winding Shaft
Turret Winder Possible Defects

- Possible winding defects:
  - Square Rolls
  - Telescoping of rolls
  - Neck-In
  - Oscillation
In-line Slitting

Winding shippable Slit Rolls on the Production Winder Requires:

- Center Surface Winding Capability for high control of inwound tension with proper roll hardness profile.
- Slitting system designed for the web material close to the winding position
- Adequate web spreading system
- Consistence transfer system regardless of operation speed with excellent clean start of the core
- Constant tension stability during winding cycle
- Adequate core stiffness in regards to the weight of the finished roll
In-line Slitting on Turret Winder

- Turret
- Spreader roll 1
- Spreader roll 2
- Nip
- Dancer roll
- Shear slitting station
In-Line Slitting

Benefits with In-Line Slitting:

- Less overall waste
- Save cost for the investment for a Slitter Rewinder
- Save human resources
- Short process
- **Disadvantage** are the limits of winding on small cores sizes and the set up in a continuous converting process
Center-Surface Winding Without Turret

Drum Type Surface Winder

- Drum Type Surface Winder with additional center drive w/o additional helper contact roller

Horizontal Winder

- Winding without turret – center drive and driven w/o driven lay on roll with constant contact from start to end of the winding process
Surface Drum Winder

Start new roll winding process

New shaft start winding process

Drum

Finished Winding Roll

Hydraulic cylinder
Surface Drum Winder

Lowering down primary arm
Surface Drum Winder

Lowering down primary arm
Surface Drum Winder

Reel turned over to the transportation carriage
Surface Drum Winder

Nip controlled winding via hydraulic force
Surface Drum Winder

New core and air shaft transferred into primary arm waiting position

- New shaft placed into primary arm
- Drum
- Winding Roll
- Hydraulic cylinder
Surface Drum Winder

Transfer sequence

- New shaft in wait position
- Drum
- Plow Knife
- Winding Roll
- Hydraulic cylinder
Surface Drum Winder

Finished transfer sequence

New shaft start winding process

Drum

Finished Winding Roll

Hydraulic cylinder
Tension through the reel without center drive and constant web tension

Tension through the reel with different constant web tension values

Negative Tension during reel start

Optimal tension curve through the reel with center drive and taper tension
Horizontal Winder
Horizontal Winder

Features & Benefits

• Gap or Controlled Contact Winding from start to the end of winding process
• Integrated Cross Cutting Transfer Knife “Stationary Knife” system
• Auto Roll and Core Handling System
• Optional multi Slitting device
• Splice without core preparation
• Single and Dual direction winding possible
• Operational Speed up to 1000 m/min
• Short cycle time < 1 minute
Conclusion

- Center surface winding is the most challenging winding system for sensitive web materials and laminates.
- The winding system has a lot of parameters to achieve the best winding results.
- Parameters are different, depending on the required roll and material behavior.
- Operation on center surface winding systems require trained and knowledgeable operators.
- Turret winders are the most common winding system, but prone to generate scrap during the roll change process.
- Drum type winders are prone to generate soft starts.
- New center surface winding systems, such as the horizontal winder, offer a more controlled winding process up to the finished reel diameter with elimination of scrap and better meet the requirements for inline slitting.
Thank You For Your Attention

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Thanks for Contributions from Duane Smith