SCRAPLESS WINDING
OF THIN FILMS

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or

TAKING THE ART OUT of WINDING GOOD ROLLS *

*REFERENCE: PAPER BY R. DUANE SMITH, "THE ART OF WINDING GOOD ROLLS"
ROLL QUALITY

• All of us involved in making, processing or using films know of the critical importance of making good quality rolls and minimizing or eliminating scrap.
• Building rolls of good to excellent quality without waste is everyone’s goal.
• Scrap is costly – and not very pretty
• Environmentally unfriendly
TYPICALLY, A WEB THAT IS TO BE WOUND UP MUST HAVE CERTAIN CHARACTERISTICS:

- **PROPER TENSION**
- **NO WRINKLES**
- **GOOD PROFILE**
OUR DISCUSSIONS TODAY ARE CONCERNED PRIMARILY WITH WINDING OF THIN FILMS – LOOSELY DEFINED AS LESS THAN 3 MILS.
SCRAPLESS WINDING

THE FIRST STEP IN ACHIEVING SCRAPLESS WINDING IS TO MAKE GOOD ROLLS –

as my friend Duane Smith says,
SCRAPLESS WINDING

TO CONSISTENTLY WIND
DYNAMITE ROLLS YOU NEED:

TNT
TNT

T = TENSION

N = NIP

T = TORQUE
To illustrate TNT, let’s take the example of two drum winders as used in the paper industry:
• **T** - TENSION -- FIRST DRUM PULLING AGAINST THE UNWIND BRAKE

• **N** – NIP FORCE -- RIDER ROLL INITIALLY, AND AS THE WINDING ROLL BUILDS, BY THE WEIGHT OF THE ROLL ACTING ON THE DRUMS.

• **T** – TORQUE -- SECOND DRUM OVERSPEEDS, TIGHTENING ROLL
•THEREFORE, ALL THE PARAMETERS OF TNT ARE FULLY UTILIZED ON TWO-DRUM WINDERS
ELEMENTARY WINDING

- THE SIMPLEST FORM OF WINDING IS SURFACE WINDING WITH A SINGLE DRUM
- NIP PRESSURE IS THE DOMINANT PARAMETER

“POPE REEL” – SINGLE DRUM SURFACE WINDER

- TENSION
- NIP
- DRUM
- ROLL
COMPARE TWO DRUM WINDERS TO A SIMPLE CENTER WINDER

• WINDING TORQUE IS DEVELOPED BY DRIVING THE CENTER OF THE ROLL/CORE.

• TENSION IS DEVELOPED BY CONVERTING TORQUE TO A LINEAR FORCE AT THE OUTER WRAP OF THE ROLL AS THE WEB PULLS AGAINST A RETARDING FORCE
COMPARE TWO DRUM WINDERS TO A SIMPLE CENTER WINDER

- CENTER WINDING APPLIES TENSION ONLY
- A LAY-ON ROLL IS NOT USED
- NIP FORCE IS NOT AVAILABLE
CENTER WINDER

• CENTER WINDING WORKS OKAY
  ➢ WHEN WINDING SMALL ROLLS AT RELATIVELY SLOW SPEEDS.
  ➢ IF THE WEB INTERLAYER FRICTION IS RELATIVELY HIGH
  ➢ BUILD-UPS ARE SMALL (OD/ID)
CENTER WINDER WITH NIP

- CENTER WINDING WITH NIP, OR A LAYON ROLL, IMPROVES WINDING BY ADDING NIP FORCE FOR DENSITY CONTROL.

- AT HIGHER SPEEDS, THE NIP ROLL SQUEEZES SOME AIR OUT OF WINDING ROLL

- ONLY TWO PARAMETERS ARE USED: TENSION and NIP.

(AGAIN, TENSION CREATED BY CENTERWIND TORQUE)
CENTER WINDING WITH SURFACE ASSIST or SURFACE WINDING WITH CENTER ASSIST

• BY ADDING A DRIVEN NIP ROLL, THE WINDING PROCESS IS FURTHER IMPROVED.

• TENSION IS PROVIDED BY THE DRIVEN LAY-ON ROLL (PULLING AGAINST AN UPSTREAM NIP OR BRAKE)

• NIP IS PROVIDED BY THE LAY-ON ROLL

• TORQUE IS PROVIDED BY CENTER WINDING
ACHIEVING TNT IN WINDING OF THIN FILMS

- CENTER WINDING – TORQUE
- SURFACE ASSIST - TENSION
- LAYON PRESSURE - NIP
THROUGH **TNT** WE HAVE THE TOOLS TO ENABLE BUILDING ROLLS OF EXCELLENT QUALITY BY

- ROLL DENSITY CONTROL AND THEREFORE, ROLL HARDNESS
- “WOUND-IN” TENSION CONTROL

(Too much center torque needed for adequate tension)
**TNT**

- CONTROLLING THE THREE PARAMETERS....
- ALLOWS THE PROCESSOR TO BUILD A "PERFECT" ROLL
EXAMPLE OF A TURRET WINDER WITH A LAYON ROLLER

Lay-on Roller
Non driven
FOR THIN FILMS:

• CENTER-SURFACE - or
• SURFACE-CENTER WINDING
• WITH NIP PRESSURE
• UTILIZING **TNT** PARAMETERS
• “PROGRAMMED CONTROL” OF **TNT** TOOLS ENABLES THE BEST IN WINDING.

CAN WIND **NEARLY** “SCRAPLESS”.
OTHER FACTORS NEED TO BE CONSIDERED TO ACHIEVE SCRAPLESS WINDING:

• NO “FOLD-BACK” AT THE CORE
• ELIMINATION OF POORLY WOUND OUTER WRAPS
FOLD BACK AT ROLL CHANGE OR TRANSFER—CAUSES:

1. OLDER ROLL CHANGE OR CUTOVER TECHNIQUES:
   - BUMP AND CUT
   - PLUNGE KNIFE
   - CORE ENVELOPER

HISTORICALLY, THESE METHODS HAD FOLD BACK REMNANTS AS A SIDE-EFFECT.
AN EXAMPLE OF A PLUNGE KNIFE CAUSING FOLD BACK ON A TURRET WINDER ROLL CHANGE
FOLD BACK CAN CAUSE BAD STARTS ON A CORE, IN SOME CASES CREATING WASTED MATERIAL YARDS OUT FROM THE CORE

A LOT OF DEVELOPMENT EFFORT AND THE CREATION OF SOME NOTABLE PATENTS HAVE GONE INTO ELIMINATING OR MINIMIZING FOLD BACK
THE “STATIONARY KNIFE” DESIGN – PATENT NO. 4,422,586, by Tetro, WAS A MAJOR IMPROVEMENT OVER THE PREVIOUSLY CITED ROLL CHANGE METHODS.

STATIONARY KNIFE ROLL CHANGE PATENT

- FOLD BACK AT ANY SPEED IS NEARLY ELIMINATED

- ORIGINAL DESIGN HAS BEEN IMPROVED UPON

- CUTTING BLADE
PATENT NO. 5,791,587, by Pasquale, PRESENTS ANOTHER METHOD OF CUTTING THE WEB AND TRANSFERRING THE LEADING EDGE TO A NEW CORE ON A TURRET WINDING APPARATUS.

Cut the web prior to core contact using a traversing knife mounted on a rotary web transport device
ANOTHER PATENT OFFERED A DIFFERENT APPROACH TO ELIMINATING FOLD BACK

• CUT THE WEB PRIOR TO THE CORE CONTACT
• GAPPED KNIFE – “TAB-CUT” TRANSFERS THE WEB TO THE CORE

US Patent #5,368,253 Nov. 29, 1994, Hartley
Gapped Knife; Tab-Cut
A SUBSEQUENT DESIGN UTILIZED A STATIC CHARGE TO PIN THE WEB TO THE LAYON ROLL TO TRANSFER WITH A CLEAN STRAIGHT CD CUT

Static Tacking (complete cut)
THESE DESIGNS ARE A SIGNIFICANT DEPARTURE FROM PRIOR TECHNOLOGY - IN SUMMARY

- OLD
  - THE WEB IS SEVERED AT A POINT BETWEEN THE CORE AND THE WINDING ROLL
  - THE CUT TAKES PLACE AFTER THE WEB HAS CONTACTED THE INCOMING CORE.

- NEW
  - WEB IS CUT BEFORE IT ARRIVES AT CORE
NEW IN THE LATTER DESIGNS:

TWO METHODS ARE EMPLOYED TO CONTROL AND DIRECT THE LEADING YET SEVERED EDGE OF THE WEB TO THE DOWNSTREAM CORE.

1. THE FIRST IS TO LEAVE SMALL, UNCUT "TABS" IN THE WEB, WHICH SUBSEQUENTLY BREAK AS THE WEB ARRIVES AT THE PRE-TAPED CORE.

2. THE SECOND IS TO SEVER THE WEB COMPLETELY BUT TO TRANSPORT THE WEB FROM THE CUT POINT TO THE NEW CORE BY ATTACHING IT TO A RUBBER TRANSPORTING ROLL UTILIZING A MOMENTARY CHARGE OF STATIC ELECTRICITY.
MOST OF THE PREVIOUS DESIGNS DEPEND ON A **TURRET** TO MOVE THE NEW CORE INTO POSITION FOR THE TRANSFER:

- **TURRET ROTATION** CAUSES THE WINDING ROLL TO LEAVE THE HOME POSITION AND LOSE CONTACT WITH THE LAYON ROLL

- **LOSS OF NIP** occurs
  - WINDING WEB MAY EXPERIENCE CHANGES
    - TENSION UPSET
    - WEB MISALIGNMENT
    - BOUNDARY LAYER AIR ENTERS BETWEEN WRAPS

(ALL OF WHICH ARE BAD!!)
CUTTING THE WEB COMPLETELY PRIOR TO ITS ARRIVAL AT THE CORE AND TRANSPORTING THE CUT WEB TO THE CORE HAS ALLOWED SOME NEW CONCEPTS IN WINDING

• ELIMINATE THE NEED FOR A TURRET
• ALLOW APPLICATION OF CONTINUOUS LAYON ROLL FOR CONSTANT NIP
An apparatus and method of winding a continuously moving web, and for splicing and transferring the web from a first core to a second core with no-fold-back or wrinkling of the web material during the splice. The web is fed through a first nip point and thereby applied to a lay-on roll, the lay-on roll further applying the web material onto first and second cores alternatively. An electrostatic charging bar positioned downstream from the nip point emits an electrostatic charge onto the web to temporarily adhere the web to the lay-on roll. A rotatable cutting knife cooperatively engageable with the lay-on roll cuts the web at a point downstream from the electrostatic charging bar but upstream from the first and second cores to produce a tail and new leading edge. The tail continues to be wound about the first roll, and the new leading edge is affixed to the second roll and the web is thereafter wound about the second core. The first and second cores are each independently movable toward and away from the lay-on roll so the web may be spliced and transferred from the first core to the second core, and alternatively from the second core to the first core.
“SCRAPLESS” WINDING

• TACK THE WEB TO THE DRUM WITH STATIC
• CLEANLY SEVER THE WEB WITH ROTARY KNIFE
• LEADING EDGE TRAVELS ON SURFACE DRUM TO NEW CORE
• WEB IS PRESSED ONTO TAPE AT NEW CORE
• NEW ROLL WINDS CONTINUOUSLY WITH NIP
• SURFACE DRUM WINDS IN TENSION
• SPINDLE WINDS IN ADJUSTABLE TORQUE

• WIND WITH TNT TO THE VERY END OF THE ROLL!!!
A SCRAPLESS WINDING SYSTEM

- NIP ROLL
- STATIC CHARGING BAR
- ROTARY KNIFE
- SURFACE DRUM/LAYON ROLL
- SPINDLES

FIG. 7
SCRAPLESS WINDING
AN EXAMPLE OF A WINDER DESIGN WITH:

• CONTINUOUS LAYON NIP
• CENTER WINDING W/ SURFACE ASSIST
SCRAPLESS WINDING
PILOT WINDER
AN EXAMPLE OF A WINDER DESIGN WITH:
• CONTINUOUS LAYON NIP
• CENTER WINDING W/ SURFACE ASSIST
SCRAPLESS WINDING

KEYS TO DESIGN

• NO TURRET
• ROTARY KNIFE
  ➢ SERVO DRIVE
• CONTINUOUS LAYON ROLL
  ➢ SERVO DRIVE
• SURFACE AND CENTER WINDING
“SCRAPLESS” WINDING

New application of the time-tested TNT principle gives the processor:

- ability to lay-down a wrinkle free core start
- ability to wind to the last wrap in contact with the lay-on roll
- success in winding films that have proved troublesome or impossible for conventional turret winders
- superior roll quality and structure providing a desirable hard start and transitioning to a desirable finish.
- rolls that do not telescope or dish, do not suffer from starring and have no waste.
- in-line slitting to the extent not previously thought possible on a continuous type winder.
SCRAPLESS WINDING - A REALITY!!
Thank you very much
CLICK TO RETURN TO LIST OF PAPERS AND PRESENTATIONS