



PARASON || PRATISHTHAN

Mechatronic Division

Reengineering - Pope Reeling to Converting

IPPTA CONFERENCE

On

“Re-engineering and Best Maintenance Practices”

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Business Process Re- engineering

“Re-engineering – A Systematic starting over and reinventing the way a firm, or a business process, gets its work done to better support an organization's mission and reduce costs of operations. It is Fundamental rethinking and radical redesign of business process to achieve dramatic improvements in critical measures of performance such as cost, service, and speed”

Michael Hammer and James Champy

“Machine-reengineering not only creates new workflows, but a wholly a new model for thinking about work and processes. It has the potential to augment our thinking beyond cause and effect and allow us to understand, and then improve operations that are too complex for the human mind to manage, in some ways making the previously invisible visible. It will make processes far more agile, efficient and productive”

Dr. Keri E. Pearlson



Identify, Evaluate & Employ Technology improvements to

- ❖ Ensure implementation of total safety engineering
 - ❖ Reduce broke generation
- ❖ Ensure highest machine uptime availability
 - ❖ Achieve ROI within 6 months to 1 year
- ❖ Better run ability in final converting machines at Paper mill customers
 - in
 - * Pope Reeling * Slitting Winding * Sheeting

For small paper mills or paper mills without technically updated equipment



Pope Reel Automation retrofits & upgrades

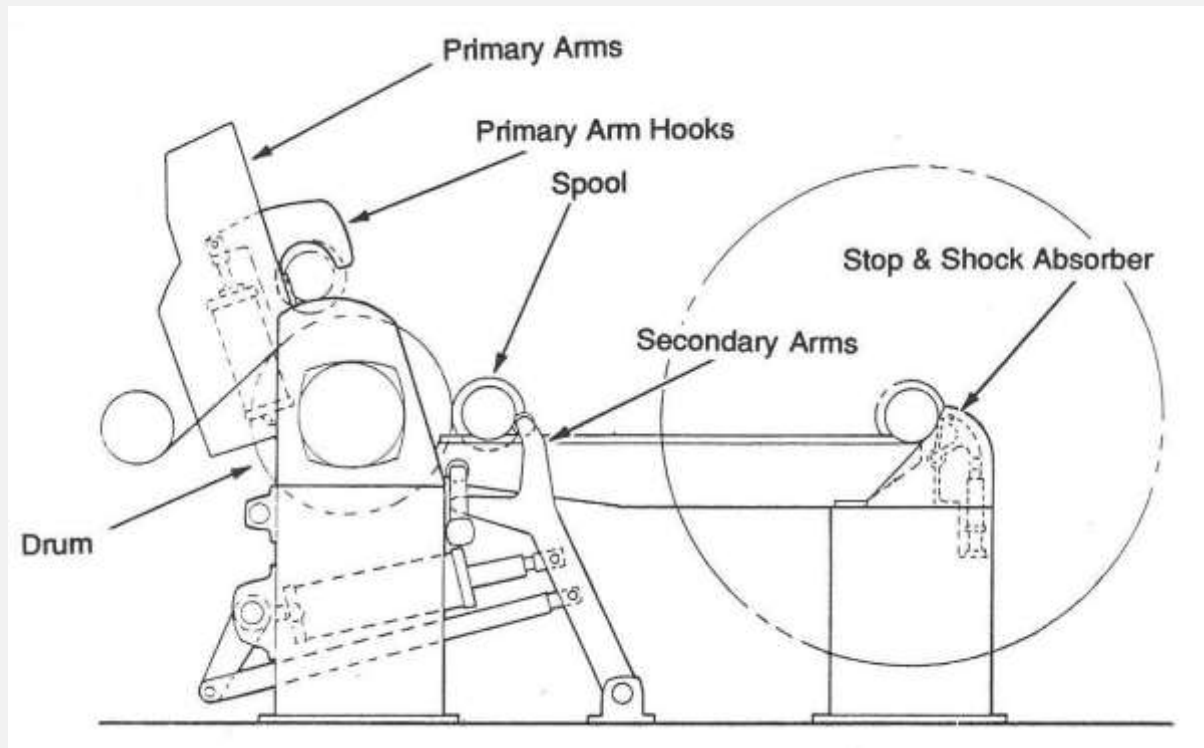
Target objectives:

- Reduced broke generation to reduce reconversion cost
- Increased production up time availability
- Assist improved productivity from subsequent process
- Retrofit / upgrade to be engineered for ROI within 6 months to 1 year

Envisaged Deployment benefits:

- Broke Reduction - Controlled Primary & Secondary arm reeling reducing broke from Tambour roll diameters to full roll diameter
- Break free Production - Seamless & Smooth cyclic turn up & TNT winding controls through optimally engineered pope reel automation
- Ensures improved winder/ sheeters performances due to better jumbo reels

Typical Pope Reel concept views



Pope reel sequence of operations – Automated with manual override option



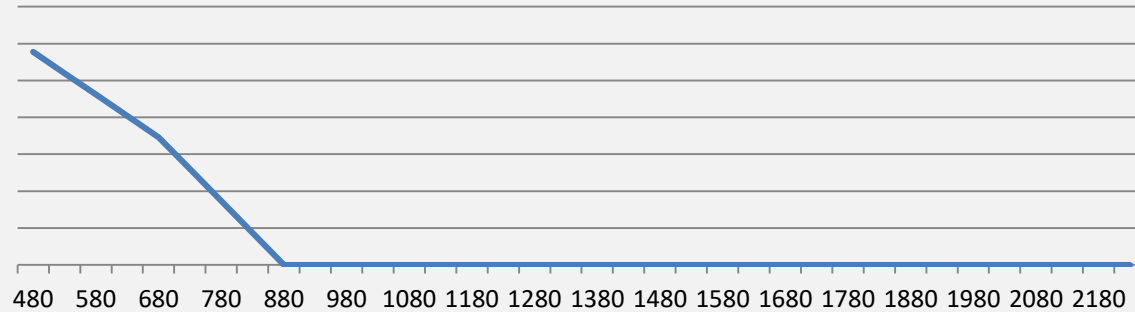
- Multiple reel spools stored in over head magazine
- Primary arm moved to parking home position
- Reel spool transfer arm transfers reel spool from Over head magazine to primary arm
- Primary hook arm closed to hold the reel spool
- Reel spool is rotated & speeded to reel spool surface speed equal to machine speed
- Primary arm rotated to Turn up position
- Goose neck / Tape turn up activated & Paper is transferred to empty reel spool
- Primary arm lowered to secondary rails
- Secondary arm is brought to reel spool position to take over reeling of paper
- Primary arm releases reeling control to secondary arm
- Primary arm is rotated back to home position
- Secondary arm completes the jumbo reeling
- The cycle repeats without a any break for second jumbo reeling



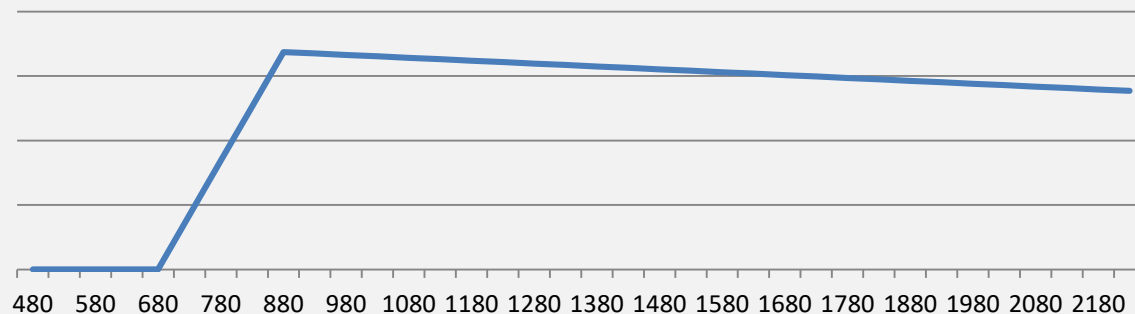
Tension - Nip - Torque winding parameters

Desired Primary, Secondary & Combined Net Nip Pressure profiles

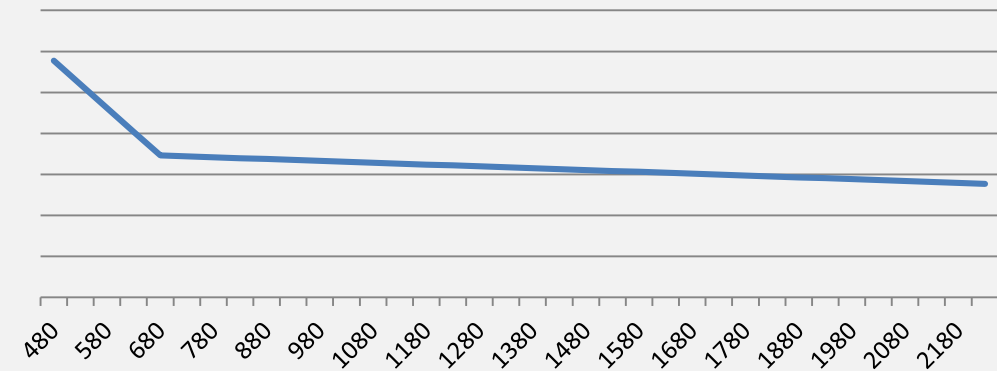
Primary Arm Nip Pressure vs. Inst. Reel dia



Secondary Arm Nip Pressure vs. Reel Inst. Dia



Reel winding Nip pressure vs inst. reel dia

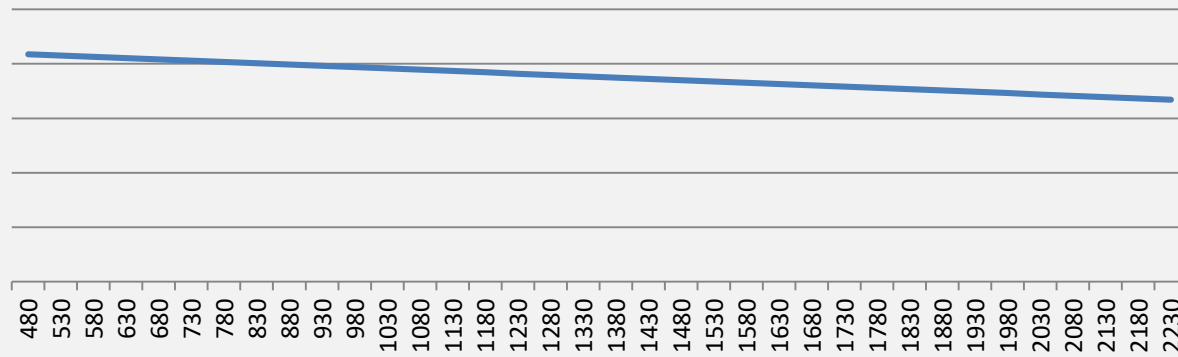




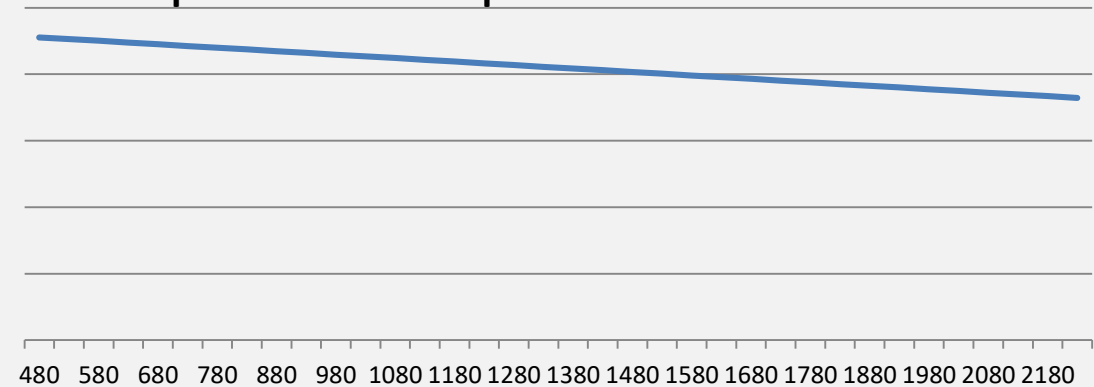
Tension - Nip - Torque winding parameters

Desired Tension & Torque limit profiles

Paper Tension vs. Inst. reel dia



Pope Reel Drive Torque Limit vs. Inst. reel dia





Benefits of adherence to desired profiles

- Avoids web wandering during primary arm reeling and during primary to secondary transfer
- The Jumbo is even, flush & tight from the beginning of every reel to full reel diameter
- Achievement of near break free Jumbo in the pope reeling operation
- Literally broke less Pope reeling operation
- Fast parameterization for paper grade changes in production
- Smooth run ability down till reel spool at Two drum winder/ Reel spool based sheeters
- Higher speeds & Non-stop operations at subsequent batch machines – Winders & Sheeters due to near perfect winding from Pope



Typical Refurbishments/ Retro fitments

Evaluated & Firmed up after preliminary detailed study

- Replacement of worn out/ missing mechanical parts & Realignment of mechanicals
- Centralized PLC control panel with or without DCS interface capability
- Control desk with Pushbutton controls for manual override & HMI for automatic operation
- Sectional pope drum drive system – If existing pope section is from line shafted system
- Hydraulic/ Pneumatic systems – Power packs/ Valves/ Regulators as applicable
- Integration of Tape Turn up/ Goose neck system as necessary
- Field sensors as necessary
- All the Safety interlocks as per standards

Pope reel upgrade – Methodology of exploration & implementation



- Present configuration – Pneumatic/Hydraulic & Primary – secondary / Single arm
- Existing electro-mechanical system & performing component detailing
- Present Performance – Broke per Jumbo & day & no. of paper breaks at Pope
- Set target objectives for broke per jumbo & no. of paper breaks due to pope reeling
- Configure the most optimum new solution

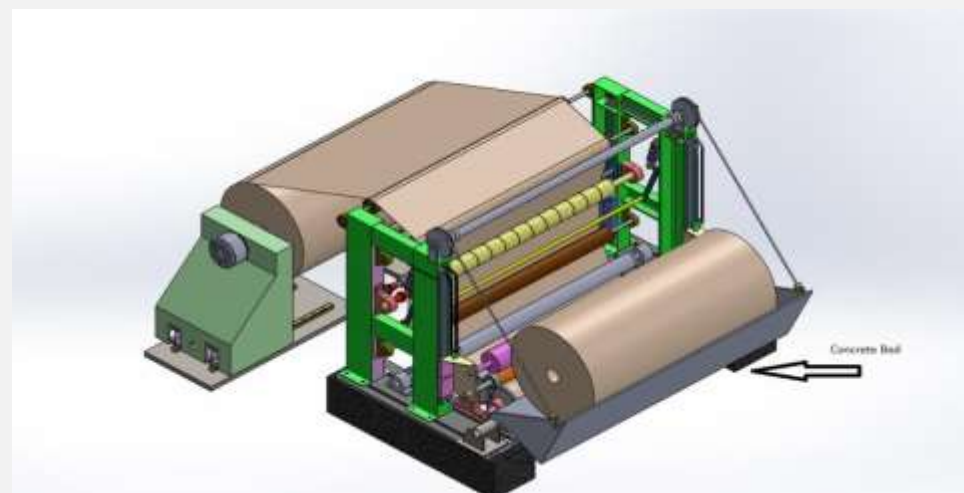
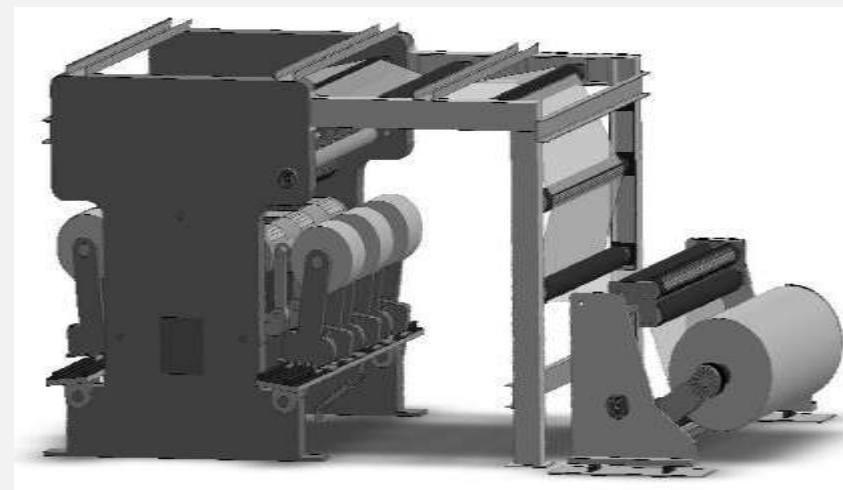
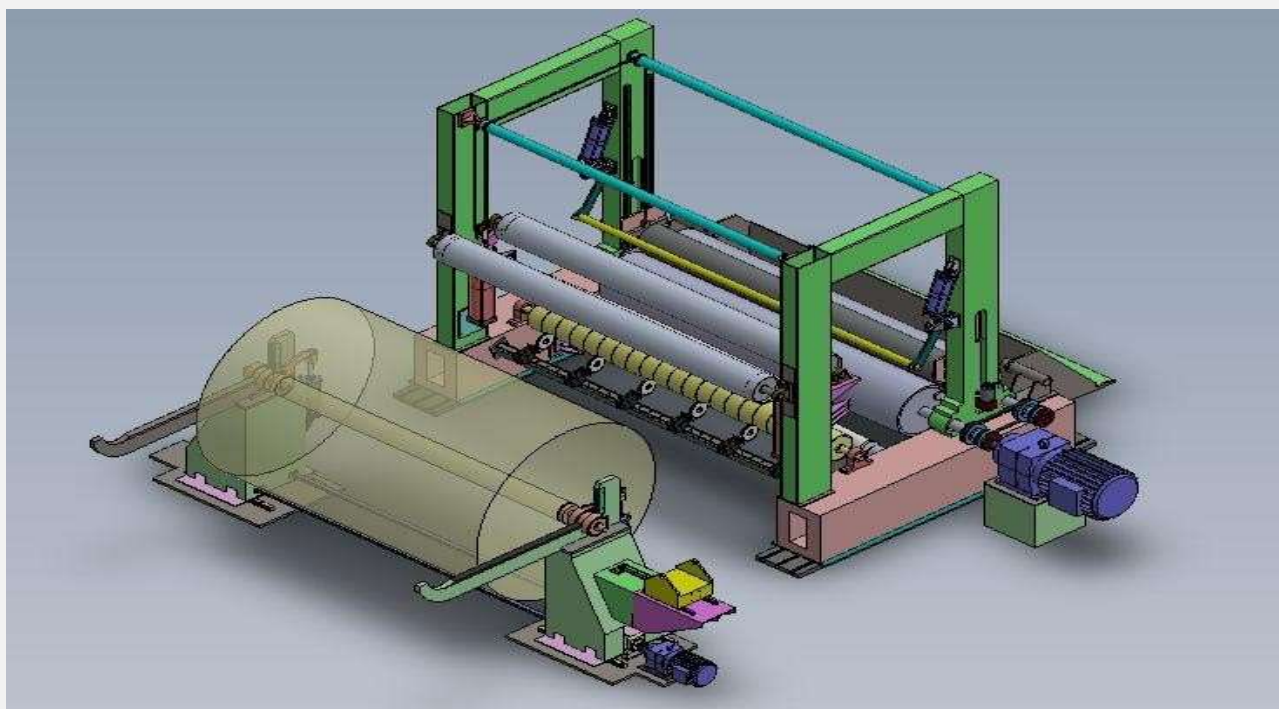
Pope reel upgrade economics & Return on Investment



Conservative basis for ROI calculations – A broad perspective

- Broke generated/ jumbo approximately - 60 kgs
- No. of Jumbo/ day - 25 nos/ day
- Total broke per day - 1.5 tons/ day
- No. of days/ year - 335 – 340
- Total yearly broke generated & recycled - 500 tons
- Reconversion cost - INR 10,000/ Ton
- Total reconversion cost per year - INR 50,00,000
- Typical retrofit/ upgrade cost - INR 40,00,000 – 50,00,000

Winders & Salvage Winders



Winder section - Points of importance for efficient performances



- Mechanical rigidity of the machine for speeds & paper grades
- Constant Tension controls on paper by Unwind brake controls
- Nip Pressure controls through controlled Rider roll nip relieving
- Differential Torque controls on the two drums
- Power saving through Regenerative systems
- Bow roll designs & configurations – For avoiding wrinkles & interleaving
- Apt paper traction by two drums by suitable coatings
- Ease of Paper threading for every break
- Ease of Loading parent rolls & Unloading empty reel spools and daughter reels
- Introduction of Salvage winder for small & narrow width slits



Typical Refurbishments/ Retro fitments

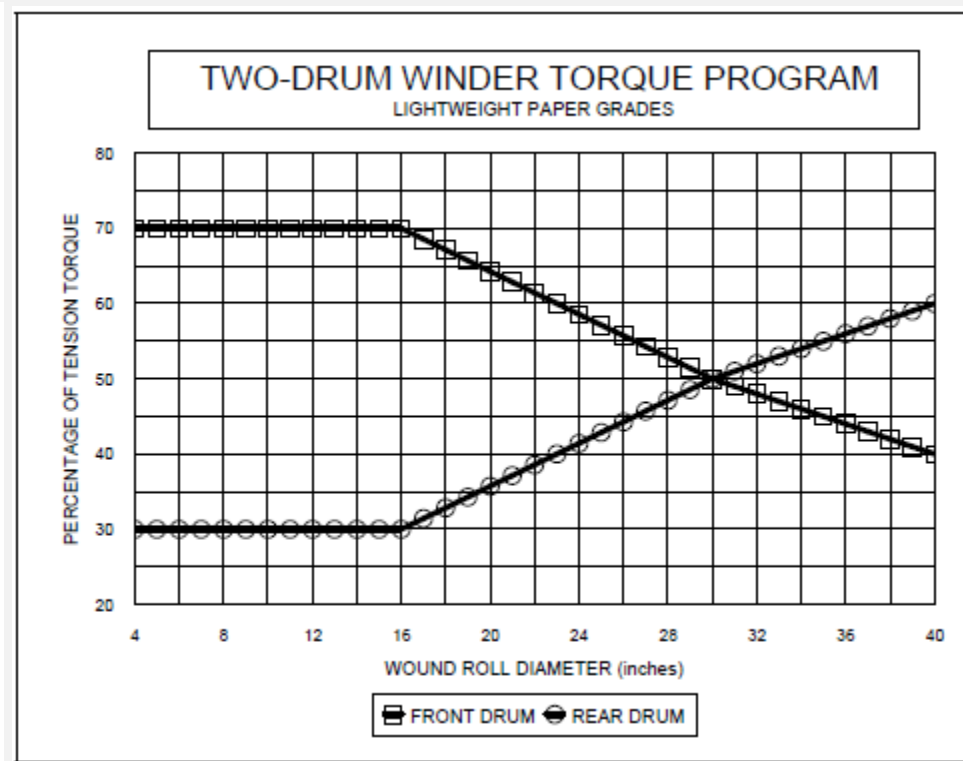
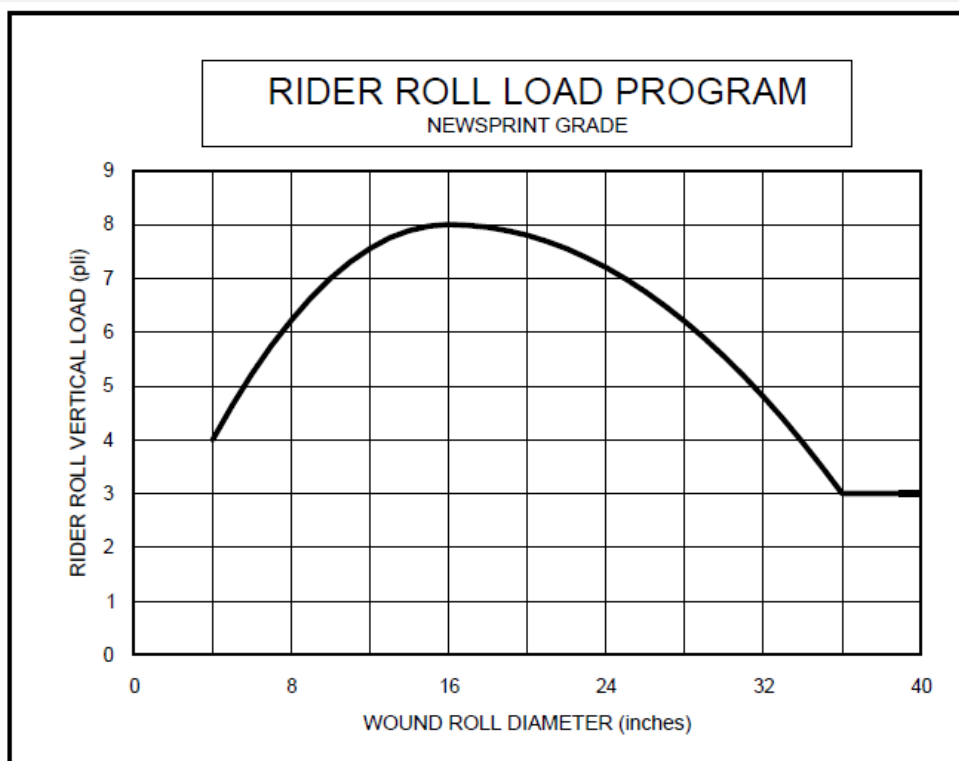
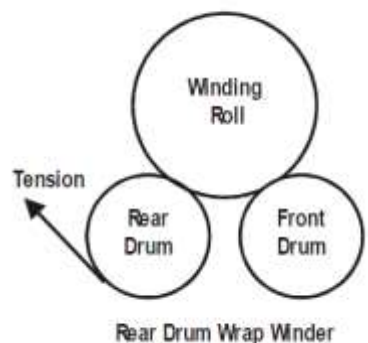
Evaluated & Firmed up after preliminary detailed study

- Replacement of worn out/ missing mechanical parts & Realignment of machine
- Unwind tension control system – Regenerative or Pneumatic drum brake based
- Two drum AC drive system with daughter reel diameter based differential torque controls
- Centralized PLC control panel with or without DCS interface capability
- Control desk with Pushbutton controls for manual override & HMI for automatic operation
- Field sensors as necessary
- Hydraulic/ Pneumatic systems – Power packs/ Valves/ Regulators as applicable

Nip - Torque profiles for ideal performances

Desired Rider roll Nip & Differential Torque profiles

Figure 1 – Rear and Front Drum Winders



Unwind Tension for optimizing machine performance

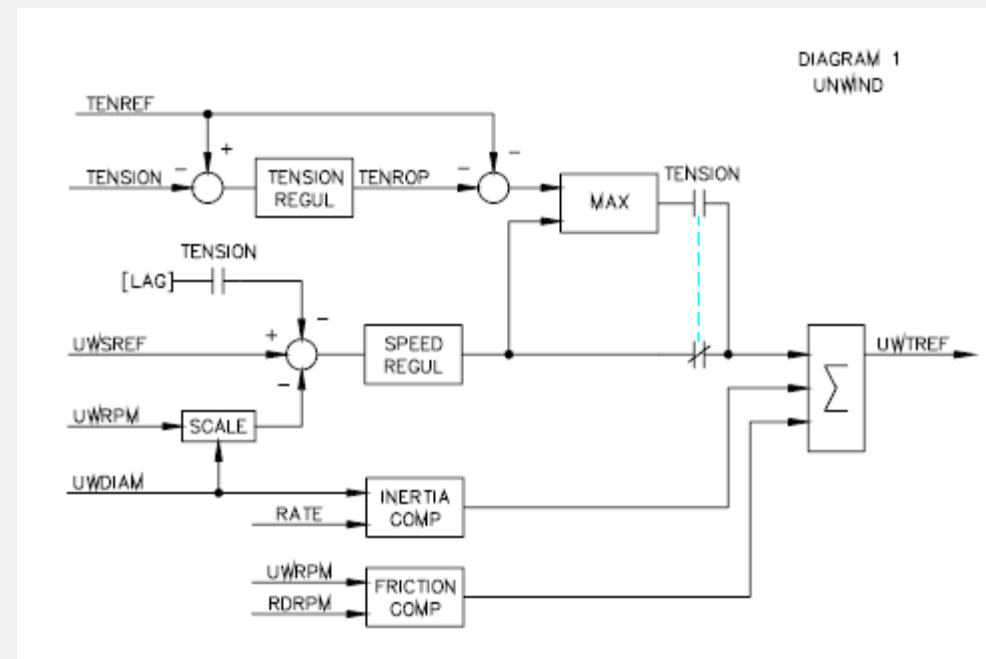
Unwind Tension control characteristics

- Tension stability (percentage of maximum) should be better than the following:

	Accel/Decel	Steady state	Rounding
	%	%	%
Typical	2.0	1.0	4.0

- Friction compensation for high line speeds & unwind rpm
- Windage compensation controls

Typical Tension Control algorithm

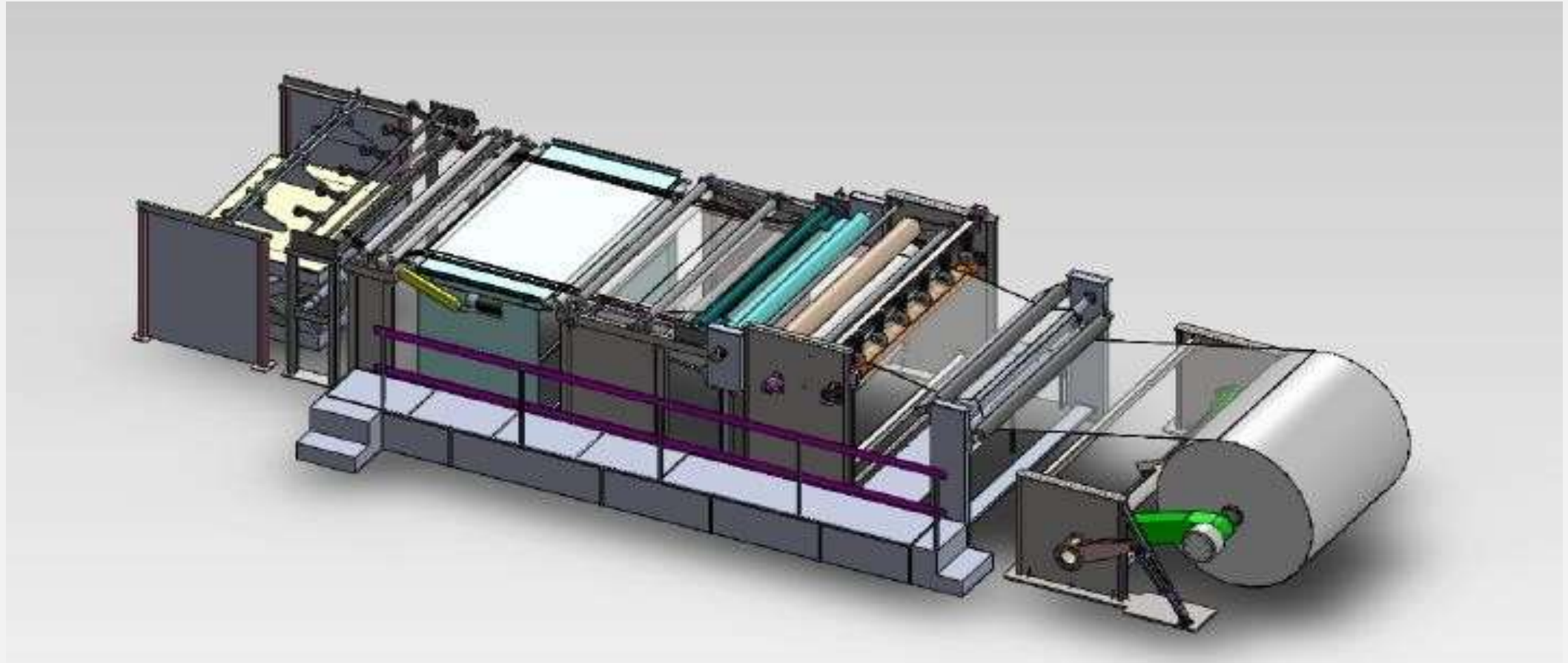




Tangible benefits - Two drum winder refurbishments & retrofits

- Higher speeds attainability
- Increased productivity
- Lowered machine stoppages during change overs
- Flush, Desirably hard roll, Near break free daughter reel production
- Power saving of more than 40 – 50%
- Least manual interventions
- Highest MTBF & least MTTR
- Lowered winder output rejections and lesser broke generated
- Ease of roll handling and hence lowered roll handling damages
- Better run ability of winder output reels in subsequent converting processes.

Roll to Sheet Converting Lines





Technology upgrade venues

- Low cost Unwind tension controls through Computed Radius Monitoring system
- Automatic parent roll diameter based de-curling stations
- Direct servo drive systems at cutter sections replacing complex, wearing out & maintenance demanding special mechanical transmissions (Double drag link)
- Introduction of Splice detection & Reject gate application
- Dual rotating knife cutter section replacements for stationary bed knife sections
- Introduction of Sheet counting & Tag Insertion
- Automatic overlapping, stack change over & lowering systems

Machine performance requirements



- Cut length accuracies within ± 0.5 mm
- Cross cut accuracies within ± 0.5 mm
- Bur free cutting
- Automatic Sheet counting with tag insertion for reducing FH manual efforts
- Ready to dispatch stack dressings
- Increased productivity & machine speeds



Tangible benefits of Sheeter refurbishments & retrofits

- Cut length & diagonal accuracies within ± 0.5 mm
- Fastest cut length setting, maintaining cutting accuracies during machine transients
- Extended range of cut lengths
- Stack change overs without machine stoppage
- Increased productivity, Higher speeds attainability & short runs without increasing broke
- Lowered machine stoppages during frequent change overs
- Highest MTBF & MTTF & least MTTR
- Lowered customer rejections and lesser broke generated
- Better run ability of stacks in subsequent converting processes - Offset printing/ Box making



Case study – Synchro – Fly sheeters upgrade

- Sheeter upgraded – 3.2 mtr, Duplex Synchro-Fly, Jagenburg of 1960 origin
- Upgrade details
 - a) Revitalizing Load cell- Pneumatic drum brake based tension control at unwind
 - b) Replacing 2 nos. 37kw Servo motor with gear head cutter drives with 2 Nos 180 kw Low speed state of art AC servo motor direct drives.
 - c) Introduction of two drive system & mechanicals for sheet gapping & overlapping
 - d) Introduction of Automatic sheet counting with Tag insertion
 - e) Automatic stack lowering with pile height sensors
 - f) PLC based total machine automation
 - g) Remote system diagnostics through internet

Performance comparison – Pre & Post Refurbishment



Cut Size (in mm)	Before Modification			After Modification			
	Speed (In MPM)	Cross Cut (in mm)	Size Variation (in mm)	Speed (In MPM)	Cross Cut (in mm)	Size Variation (in mm)	Increase/Decr ease speed %
600	40	± 0.5 to 1	± 1.5 to 2	56	± 0.5	± 0.5	40%
650	40	± 0.5 to 1	± 1.5 to 2	60	± 0.5	± 0.5	50%
700	60	± 0.5 to 1	± 1.5 to 2	66	± 0.5	± 0.5	10%
750	64	± 0.5 to 1	± 1.5 to 2	77	± 0.5	± 0.5	20%
800	75	± 0.5 to 1	± 1.5 to 2	90	± 0.5	± 0.5	20%
825	75	± 0.5 to 1	± 1.5 to 2	90	± 0.5	± 0.5	20%
925 to 1325	100	± 0.5 to 1	± 1.5 to 2	100	± 0.5	± 0.5	0%

It was not possible to cut 500 to 600 mm size before modification. Now it is possible successfully



Present State of Art Field sensors, Communication & Data Acquisition technologies upgrades for operational multi fold benefits

1. Real Time data acquisition system with reporting at multi level – Leads to Routine, Preventive & Predictive maintenance highly efficient
2. Low cost – High speed computing controls make the machines faster responsive, more reliable, repetitive & robust
3. Machine & Self diagnostic systems pose very high advantage of reducing machine stoppages, malfunctioning & MTTR
4. Remote diagnostics by way of web enabled systems or multi remote viewer soft wares assist system manufacturers to enter in to end user system conveniently & provide prompt back up service
5. Present day Feed forward algorithms assist the machines to better perform
6. The remotely available MIS for decision making highly pre - validated



Above Total Mechatronic Solutions under one roof & single point responsibility



References

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