Management of Quality in Finishing Part 2: Practical Considerations

Define Objectives

It is important to distinguish between

- Performance Targets
- Finishing Control Targets

Performance Targets

Are what the customer demands

- Fabric weight per unit area
- Fabric width
- Maximum shrinkage levels

Finishing Control Targets

Are what the finisher has to control in order to guarantee performance

- as few as possible
- can be measured on-line

Not necessarily the same properties as the performance targets

Choice of Control Targets

Shrinkages can not be monitored directly

Weight is difficult to monitor accurately

Practical control targets are

- Fabric Length (course density)
- Fabric Width (wale density)

Rule One

It is not practical to control all of the performance targets at the same time

Select two fabric properties
- one for length and one for width -
and concentrate on them

Confirm Shrinkage Targets

Check customer's definition of shrinkage

- Average or maximum
- Line dry or Tumble dry
- Expected level of variation

Control can only be in terms of the average

To know the maximum, we need to know the Standard Deviation

Tubular or Open Width?

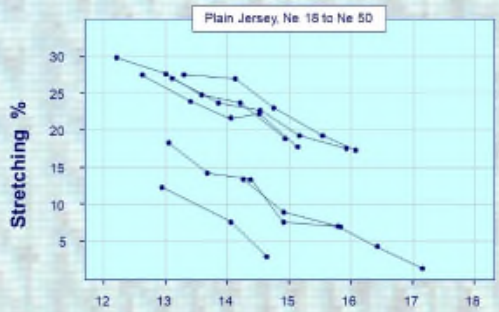
Experience shows that
TUBULAR processing
usually gives a better chance
of hitting finishing targets

Achieving the Targets

Drying and compacting
is where the
Finished Dimensions are achieved

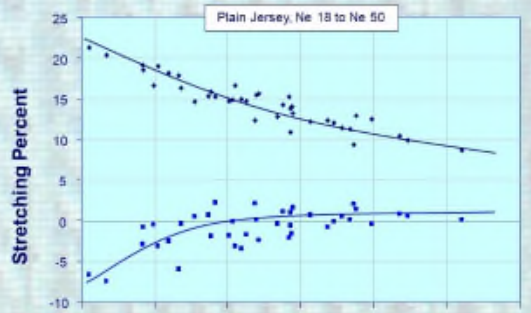
Machinery and Technique are decisive

Length Stretching During Knitting



Width Stretching During Knitting

Fabric Stretching During Preparation



Rule Two

After preparation and dyeing
the fabric will be highly stretched

Therefore
Equalize length and width tensions

Tubular Wet Spreading

Tubular Wet Spreading

Width stretched to greater than Target

- plain jersey: 15 – 25%
- 1 x 1 rib : ~ 40%

NB: - not close to a squeeze mangle
- preferably before a relax dryer

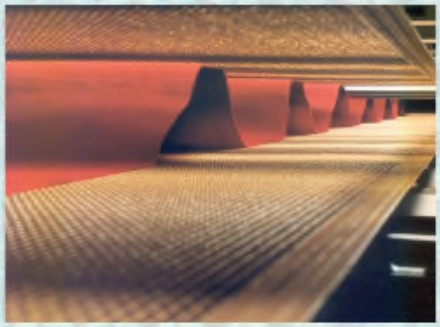
Relax Dryers

Attempt to imitate tumble drying

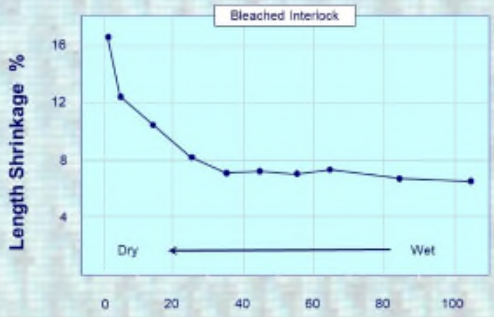
- vibrating carriers
- perforated drums
- staggered, opposed air jets

NB: proper overfeed and space between belts

Relax Dryer Interior



Shrinkage During Tumble Drying

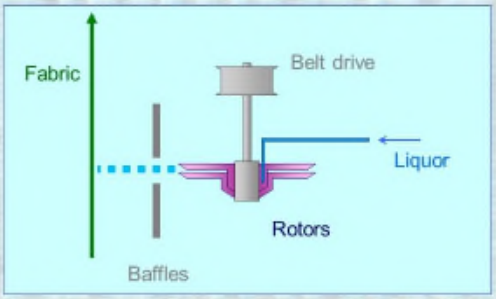


Rule Three

Mechanical action will induce relaxation only when the fabric contains less than about 35% moisture

A technique used with very difficult fabrics, such as brushed fleece, is to spray on 40% of water directly in front of a relax dryer

Weko Rotor Spray: Principle



Liquor delivery according to fabric weight and speed

Weko Rotor Spray: Implementation

Consolidation

Tumble drying can cause an increase in fabric THICKNESS of up to 40%

Low-shrink fabrics must have maximum thickness

Rule Four

Develop and Maintain Fabric Thickness

Effect of calenders is to reduce thickness and increase length

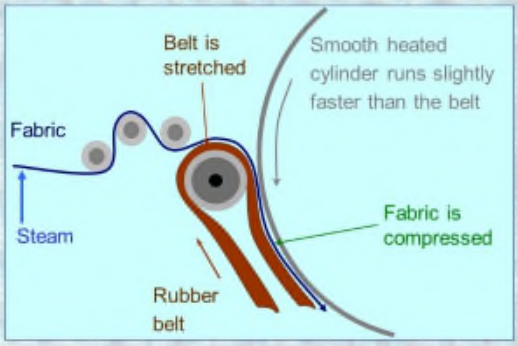
Compressive Shrinking

Compacting forcibly reduces fabric length

- rubber belts
- felt blankets
- polished steel shoe

Moisture and frictional conditions are important

Compressive Shrinking: Principle



Steam Condensation: Theory

Specific heat of dry cellulose ~ 0.3
Latent heat of steam 540 Cal /g

Heating 100 g of cotton from 20 to 100 °C
takes 100 * 0.3 * 80 / 540 = 4.4g steam

If the cotton contains 7% moisture, then
a further 1g of steam is condensed

Steam Condensation: Examples

Fabric starting condition		After steaming
Temp °C	Moisture %	Moisture %
20	7	12.4
50	2	4.5

Optimum moisture content for compacting
is 10 to 15 %

Rule Five

Steam will NOT condense
on a hot, dry fabric

Fabric must be cool
and have uniform moisture content
before the calender or compactor

Limitations of Compacting

Can change surface appearance
- polishing
- apparent colour depth
- surface irregularities

Does not develop proper consolidation
- easily pulled out

Problems are most apparent at
high levels of compaction

Rule Six

COMPACTORS
should be used to give only
small amounts of
compressive shrinking

Their primary function is
to deliver a precisely controlled
density of courses

Resin Finishing (Crosslinking)

Cell - OH + X – R – X + HO - Cell

↓

Cell - O – R – O - Cell

Effect of Resin Finish

On Reference Dimensions

- Usually significantly longer
- Usually slightly wider
- Usually lighter

- lower shrinkage at target weight
- slightly lower spirality

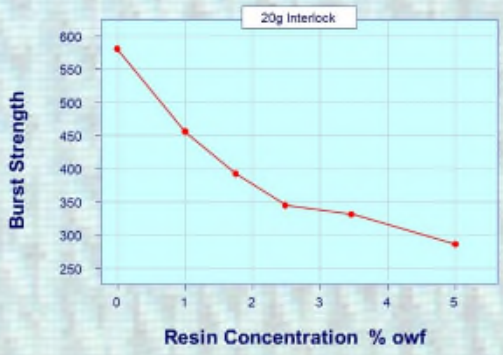
Resin Finishing: Advantages

- Lower shrinkage at the same weight
- Slightly lower spirality
- Better appearance retention
- Better easy care performance

Resin Finishing: Problems

- Change in Reference Dimensions
- Effect on colour and handle
- Free formaldehyde emission
- Strength and abrasion resistance
- Stitching damage and dusting

Effect of Resin on Bursting Strength



Rule Seven

Resin Finishing

needs considerable expertise

It should be avoided

if at all possible

On-line Measurements

- Moisture content at dryers
- Weight at stenters / compactors
- Course density at stenters / compactors

Moisture Content

For optimum drying cost and to ensure cool fabric for compacting

- control moisture at 8 – 10%

To develop maximum shrinkage and consolidation in relax dryers

- control moisture at 2 – 4%

Moisture meters must be very carefully calibrated

Fabric Weight

Monitoring weight for on-line process control is useful only if …

… moisture content and course density and width are also monitored …

… and included in the control software.

Course Density

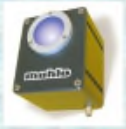
On-line monitoring of course density with feedback control for the overfeed …

… is the only way to guarantee delivery of the target fabric length

On-line Control of Course Density

Automation Partners

On-line Control of Course Density



Mahlo

Strandberg

Rule Eight

Variations in fabric weight and shrinkage due to …

- variations in grey yarn count
- differences in process weight loss
- almost all other random effects

… are minimized by delivering the fabric with constant width and course density

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