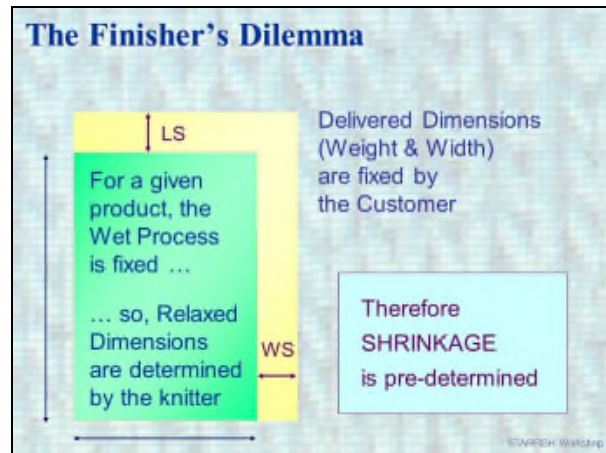


Management of Quality in Finishing

Part 1: Basic Principles



- ### The Finisher Needs Knowledge
- He must discover:
- For every fabric quality ...
 - > what are the Reference Dimensions?
 - For every customer specification ...
 - > is it attainable with the available equipment?
 - For every wet process route ...
 - > how does it affect the Reference Dimensions?

Check Customer Specification

Example:

Interlock: 38 Ne, 3.38 mm, 1500 needles

> Finished weight	165 gsm
> Finished width	60 cm
> Maximum shrinkage	12 %

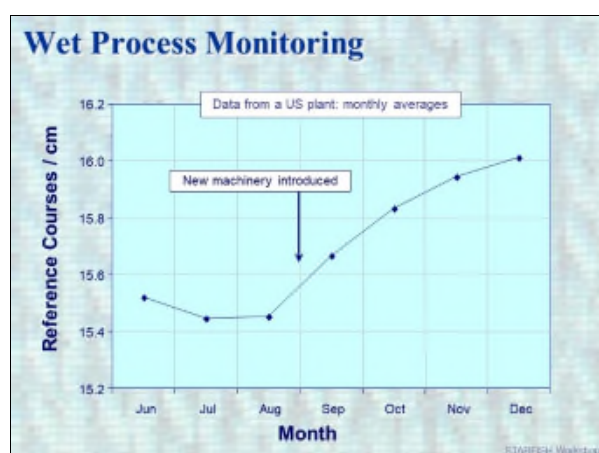
STARFISH predicts

> Length shrinkage	16 %
> Width shrinkage	13 %

- ### Know Your Fabrics
- Communication is vital
- * Ensure grey fabric properly specified
 - * Ensure conformity to specification
 - * Agree attainable finishing targets
 - * Keep informed about grey fabric changes

Know Your Process

Changing the Conditions of Wet Processing can Change the Reference Dimensions



Correct Finishing Targets

Finishing Control targets ... are Courses and Width (only)

If we can **QUANTIFY** ... the effect of the wet process

Then we can **CALCULATE** ... the correct Finishing Targets

Effect of Wet Processing

Can be determined by

- * STARFISH
- * CALIBRATION

STARFISH Workshop

STARFISH vs Measured Values

If *average* measured values do not correspond to STARFISH predictions, then ...

- * Grey fabric quality
- * Relaxation procedure
- * Wet process effect

are not as specified

STARFISH Workshop

Nevertheless There Should Be

A constant offset

... averaged over a period

Provided that

... basic conditions are constant

Therefore

... the process can be calibrated

STARFISH Workshop

Every Wet Process Route

Should be calibrated

... to check the level of agreement with STARFISH predictions

... to monitor process weight losses

... to be able to deal with fabrics not included in STARFISH

STARFISH Workshop

Basic Calibration Principle

- * Monitor Reference Dimensions
- * Set up Control Charts
- * Create a UDP for STARFISH

STARFISH Workshop

Basic Calibration Method

Sample a series of grey rolls

- Confirm knitting specification
- Normal dyeing and finishing

Sample the same rolls

- Reference Relaxation procedure
- Measure Courses, Wales, Weight

Repeat at regular intervals

STARFISH Workshop

Accurate Calibration Allows

- * Easier dialogue with customer
- * Better relationship with knitter
- * Accurate finishing targets
- * Better (simplified) process control
- * Reduced cost of quality control

STARFISH Workshop

Accurate Finishing Targets

For an average shrinkage of 5%

If Reference Courses are C

- Control Target Courses are $0.95 * C$

If Reference Wales are W

- Control Target Wales are $0.95 * W$

- Width = Needles / Wales

STARFISH Workshop

Better (Simplified) Process Control

It is not sensible to attempt to control weight and shrinkages independently

All of the random manufacturing variances are reflected in variation of weight and shrinkage

Random variation in the final product is minimised by tight control of *only* Courses and Width

©STARFISH Workshop

Reduced Cost of Quality Control

If the process is properly calibrated ...

it is not necessary to make routine tests for weight and shrinkage, because ...

If Courses and Width are held constant at the target level, then Weight and Shrinkage must be correct

©STARFISH Workshop

Reduced Cost of Quality Control

Example:

Computer print-outs of routine QC data were obtained from a large US manufacturer.

One quality is produced in a range of sizes.

A process calibration was deduced from the QC data for one of the sizes

For the other sizes, QC data were simulated using only the measured values for Courses and Width

©STARFISH Workshop

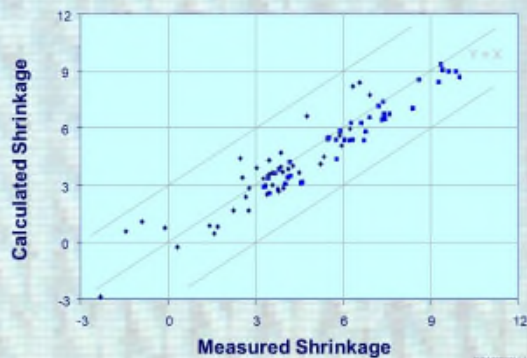
QC Data Simulation: Averages

Size	Len Shr. %		Wid Shr. %		Weight gsm	
	Meas	Calc	Meas	Calc	Meas	Calc
16	3.5	3.9	5.1	3.9	144	144
17	4.4	4.4	4.6	3.9	144	143
18	2.2	1.1	8.5	9.5	144	142
19	3.0	3.5	6.8	6.6	142	141
20*	3.0	2.5	6.9	7.4	142	141
21	5.1	4.5	5.8	5.9	141	140

* Measured Courses and Width data from 20 inch size used for calibration

©STARFISH Workshop

Simulated Shrinkage Data: Individuals



©STARFISH Workshop

Fabrics Outside STARFISH

Calibration also allows calculation of:

- Finishing Factors
- Calibration Ratios

Which can be used for some fabrics that are outside the scope of the STARFISH predictions

©STARFISH Workshop

Finishing Factors

For a given fabric quality, the ratio Grey Reference / Finished Reference will be more or less constant for both Courses and Wales

©STARFISH Workshop

Finishing Factors: Method

Sample a series of grey rolls

- Reference Relaxation procedure
- Measure Courses and Wales
- Normal dyeing and finishing

Sample the same rolls

- Reference Relaxation procedure
- Measure Courses and Wales

©STARFISH Workshop

Finishing Factors: Calculation

	Grey	Finished
Reference Courses	Cg	Cf
Reference Wales	Wg	Wf

$$FFc = Cf / Cg$$

$$FFw = Wf / Wg$$

STARFISH Workshop

Using Finishing Factors

Example:
Single piqué, 1/20 Ne, 3.00 mm

	Grey	Finished	FF
Reference CPI	80.2	71.9	0.896
Reference WPI	26.3	26.3	0.998

STARFISH Workshop

New Single Piqué Quality

Measured Grey Reference	CPI = 78.2 WPI = 25.5
Calculated Finished Reference	78.2 * 0.896 = 70.1 25.5 * 0.998 = 25.4
Finishing Targets (5% shrinkage)	70.1 * 0.95 = 66.6 25.4 * 0.95 = 24.1

STARFISH Workshop

Limitations of Finishing Factors

Finishing Factors can be applied

- > Only to closely similar fabrics
- > Because of proportioning errors

STARFISH Workshop

Calibration Ratios

For a given fabric quality, the ratio
STARFISH Prediction / Finished Reference
will be more or less constant
for both
Courses and Wales

STARFISH Workshop

Calibration Ratios: Calculation

	Finished	STARFISH
Reference Courses	Cf	Cs
Reference Wales	Wf	Ws

$$CRc = Cf / Cs$$

$$CRw = Wf / Ws$$

STARFISH Workshop

Using Calibration Ratios

Example:
Three-thread fleece from Plain Single Jersey

	Measured (3TF)	STARFISH (PSJ*)	CR
Reference C/cm	14.9	14.3	1.04
Reference W/cm	10.0	10.4	0.96

*NB: PSJ prediction is made using sum of 3TF ground and tie Yarn Tex and mean of 3TF ground and tie Stitch Length

STARFISH Workshop

New Fleece Fabric Quality

Predictions for Finishing Targets (PSJ*)

Courses /cm = 15.0
Tubular width = 72 cm

Actual Finishing Targets (3TF)

C /cm = 15 * 1.04 = 15.6
Width = 72 / 0.96 = 75.0

*NB 1: PSJ prediction is made using sum of 3TF ground and tie Yarn Tex and mean of 3TF ground and tie Stitch Length
*NB 2: A weight correction will be required (see text)

STARFISH Workshop

Versatility of Calibration Ratios

Calibration Ratios can be applied

- Across a wide range of qualities
- Across certain fabric types
- Across processing routes

Because proportioning errors are small

STARFISH Workshop

Process Weight Loss

Cotton fabrics lose weight during scouring and bleaching

Cotton fabrics gain weight during dyeing and finishing

The net result is Process Weight Loss

STARFISH Workshop

Process Weight Loss

If good Calibration records are kept ...

Process Weight Loss can be calculated from the average weight per loop in grey and finished fabrics

STARFISH Workshop

Average Weight per Loop

$$\text{Fab Wt} = C * W * \text{tex} * \text{loop length} * F$$

number of loops
weight per loop
scaling factor

Grey fabric

$$\text{Loop Wt (g)} = \text{tex} * \text{loop length}$$

Finished fabric

$$\text{Loop Wt (f)} = \text{Fab Wt} / (C * W * F)$$

STARFISH Workshop

Net Weight Change Percent

$$100 * \frac{(\text{Loop Wt (g)} - \text{Loop Wt (f)})}{\text{Loop Wt (g)}}$$

Requires good data for accurate results

STARFISH Workshop

Process Weight Loss: Example

Interlock: Ne 38, SL 3.38 mm – Continuous bleach
Grey Fabric: Ne 37.65, 3.382 mm, Loop Wt = 0.530

Bleached	C /3cm	W /3cm	Wt/gsm	Loop Wt	Loss %	Run Mean
1	37.3	35.9	150	0.504	5.03	5.03
2	38.3	34.3	143	0.490	7.56	6.29
3	38.2	36.4	159	0.514	3.07	5.22
4	37.2	35.6	155	0.511	3.68	4.84
5	38.1	36.0	158	0.517	2.60	4.39
6	39.0	36.2	156	0.498	6.09	4.67
7	37.7	38.5	162	0.504	5.07	4.73
8	39.3	38.2	173	0.518	2.38	4.44
9	37.8	37.0	157	0.505	4.87	4.48
10	33.4	38.2	146	0.513	3.21	4.36
11	38.7	38.9	167	0.498	6.11	4.52
12	40.3	36.9	165	0.499	5.96	4.64
13	38.4	38.5	170	0.516	2.71	4.89
14	40.2	34.6	159	0.515	3.00	4.38

STARFISH Workshop



