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The Effect Of Varying Knitted Loop Length And Take-Down Tension On The Ease Of Processing Of Knitted Fabrics

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spreadsheet is *tdtens.xls*

Contents

Note:

Figure 3 is new for the Digital Version. The corresponding spread-sheet is *tdtens.xls*

Introduction

The effect of knitting machine take-down tension on the potential relaxation characteristics of knitted structures has been investigated in some detail by Black (1).

Although fabrics produced on a knitting machine from a standard yarn and at a constant knitted loop length have a fixed fully relaxed structure, the actual knitted structure can vary considerably due to the inconsistency in the operation of the take-down mechanism.

The purpose of this exercise was to examine whether these inconsistencies cause undue problems to the finisher, whose main consideration is one of trying to eliminate these distortions created by the knitting machine.

This was somewhat of a quick and crude investigation, aimed at giving an indication as to whether a problem does exist and whether a more detailed investigation is required.

The information was also required to clarify several points being made in a forthcoming paper on knitgoods finishing.

Outline Of Investigation

The aim was to monitor what actually happens to the knitted structure when it is subjected to the rigours of a winch treatment of up to 12 hours duration.

As the winch subjects the fabric to some degree of length tension, only the change in lengthways dimensions was considered in this investigation. To facilitate ease of measurement, fabrics were made with reference threads built into them. This was achieved by using coloured yarns on particular feeders: by measuring the change in distance between (a number of) the stripes, a fairly accurate indication as to changes in length dimension could be obtained.

This method of approach, rather than the measurement of course spacings had to be adopted since the measurements were being taken in the winch with the fabric at a temperature of around 90°C.

Fabric Variables

For this exercise, a 24 gauge single jersey fabric produced on the Monarch XL-JS machine was used.

Four lengths of fabric were made which covered two tightness factors, each knitted with high and low take-down tensions. Each variable was readily identifiable by means of an individual stripe and colour pattern.

The knitting specifications for the various fabrics are given in *Table 1* in the Appendix.

Procedure

The four lengths of fabric were sewn together to form a single rope which was loaded into the Leemetal winch. The winch contained water, with the addition of 2g/l Synperonic NX (detergent), sufficient to give a liquor to goods ratio of 20 : 1.

The speed of the fabric in the winch was set at 60 ypm. The temperature of the water was raised from cold to 90°C and maintained at this temperature throughout the investigation.

The changes in fabric dimensions were observed by stopping the machine at regular intervals and measuring the distance between five coloured stripes. An average of three measurements taken at different places throughout the individual pieces was used. The point at which the measurement was taken is indicated in *Figure 1*. This point was chosen because of ease of access and also because of the minimum of fabric handling which could cause some distortion to the structure.

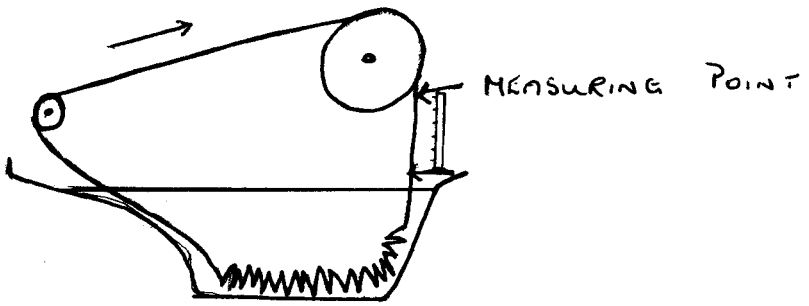

FIGURE 1

Measurements were taken at 15 minute intervals for the first hour and then every subsequent hour until the sixth hour. For the remaining six hours the measurements were taken every other hour.

The reason for a 12 hour cycle was that this kind of treatment is not uncommon particularly when fabrics have to be stripped and redyed.

After the 12 hours, the winch was stopped, the liquor dropped and fresh cold water added. The fabric was removed from the winch after a short rinse, hydro-extracted and carefully slit by hand. Drying was carried out on the Artos stenter, the width settings used corresponding to the fully relaxed widths which had previously been determined by washing and tumble drying.

The overfeed was set at an arbitrary level and was not adjusted during the passage of the fabric.

Samples of the grey-state fabrics and also after stenter drying were submitted to the laboratory for testing. Results are given in *Table 3* and *Table 4*. *Table 2* gives the details of the measurements taken during the winch cycle. These are shown graphically in *Figure 2* and *Figure 3*.

Discussion Of Results

From the graphs, the following points are shown quite clearly.

1. Where a low take-down tension has been used, the fabric extends to a considerable degree, even after a short period in the winch. Where high take-down tension has been used, this additional extension is much less.
2. Any extension in the winch occurs within the first hour of treatment. Leaving the fabric in the winch for extended processing periods does not cause any additional extension.
3. The differences in grey-state structure brought about by variable take-down tensions are

easily eliminated once the fabric is wet treated in the winch.

4. Once the fabric is removed from the winch and hydroextracted, there is a considerable relaxation in the distortions which have occurred.

From this short study, the effect of varying take-down tension on the knitting machine does not pose any additional problems to the finisher.

Because fabrics of different tightness factors have been used in this trial, we have had the additional opportunity of observing how the knitted loop length affects the ease of processing.

Table 3 gives the comparative test data of the machine state fabrics: the differences in relaxation characteristics for the two tightness factors are very clear to see. What is also apparent is the effect the tightness factor has on spirality angle, particularly after relaxation.

Table 2 gives the measurements taken during the scouring operation. If the equilibrium measurements from the winch are compared with the relaxed-and-tumble-dried measurements, the degree of extension from the fully relaxed state is found to be as follows.

	Distance between 5 stripes, cm		
Tightness Factor	Fully Relaxed	In the Winch	Extension, %
16.42	15.3	17.7	15.7
13.41	19.6	25.7	31.1

The fabric with the higher tightness factor is therefore likely to be easier to finish than the fabric with the lower tightness factor.

Table 4 gives the test results obtained on the stenter dried fabrics and the difference is clear to see in the residual length shrinkage figures.

Conclusion

This has been a rather quick and crude evaluation, to attempt to obtain some quick answers. It has however produced some interesting results and a more detailed study ought to be undertaken. This should include a study of the effect on chemical treatments such as bleaching on the fully relaxed structure.

References

1. DH Black: AATCC Symposium Report - "*Knit Shrinkage, Cause, Effect and Control*", p69 (October 1973).

Table 1: Knitted Fabric Specifications

Machine:	Monarch XL-JS Single Jersey 24g, 26” Diameter, 60 feeds, 1920 Needles			
Yarn:	1/24 Ne HSP, 24.6 tex:			
Marker threads:	1/24 Ne - Orange		1/24 Ne - Brown	
Piece No	1	2	3	4
Tightness Factor, K	16.42	16.42	13.41	13.41
Stitch Length, cm	0.301	0.3021	0.3698	0.3698
Yarn Tension, g	3-5	3-5	3-5	3-5
Stretcher Board	constant	constant	constant	constant
Take-down Tension	Min: ½ weight	Max: 3½ weights	Min: ½ weight	Max: 3½ weights
Marker thread	1 feed Orange	2 feeds Orange	1 feed Brown	2 feeds Brown
On-machine CPI	48	41	29	27
On-machine WPI	27	29	27	28.5
Dist. between stripes, cm	3.2	3.8	5.2	5.8
Width at TD roller, cm*	~85	~81	83	80.5
Width on roll*	~85	~82	83	82

* Width measurements on pieces 1 & 2 are approximate due to creasing.

Table 2: Measurements Taken

Measuring Point		Tightness Factor 16·42		Tightness Factor 13·41	
		Low Tension	High Tension	Low Tension	High Tension
After Knitting Dry Relaxed)		14·5	16·4	23·7	25·7
Winch	15 mins	16·7	17·4	23·0	25 0
	30 mins	17·7	18·1	25·8	26·2
	45 mins	17·7	17·9	25·6	26·3
	60 mins	17·7	17·9	25·4	25·5
	2 hours	17·4	17·8	25·5	25·5
	3 hours	17·4	17·8	25·3	25·6
	4 hours	17·5	17·8	25·4	25·8
	5 hours	17 6	17·6	25·5	25·9
	6 hours	17 6	17·7	25·5	25·7
	8 hours	17·8	17·7	25·5	26·1
	10 hours	17·8	17·8	25·8	26·1
	12 hours	17·7	17·7	25·6	25·8
After Hydro Extracting.		17·0	17·0	23·2	23·2
After Drying Dry Relaxed)					
After Relaxing and Tumble Drying.		15·3	15·4	19·6	19·6

NOTE Figures given relate to the distance - cms between five single feeder stripes or 5x 60 courses = 300 courses.

Table 3: Grey-State Test Data

INTERNATIONAL INSTITUTE FOR COTTON. KNITTING REF. LAB. REF. SUBMITTED BY: DATE: 7

TESTS REQUIRED		TIGHTNESS FACTOR 16.42					SAMPLE TIGHTNESS FACTOR 13.41				
	✓	MINIMUM TENSION	95%CL	MAXIMUM TENSION	95%CL		95%CL	MINIMUM TENSION	95%CL	MAXIMUM TENSION	95%CL
% SHRINKAGE length		4.4%+		4.97%				14.86%		19.46%	
width		26.0%		23.1%				11.29%		10.85%	
FABRIC WEIGHT BW		166.7	5.15	156.2	7.62			134.7	6.38	119	4.30
AW		210	4.64	203.4	5.09			174.6	5.73	175.2	5.85
C/3 ~~CM~~ INCH BW		54.6	0.35	49.8	0.70			35.7	0.43	33.7	0.44
AW		51.9	0.46	52.1	0.22			40.5	0.36	40.8	0.55
W/3 ~~CM~~ INCH BW		27.2	0.31	27.1	0.31			27.6	0.25	27.2	0.41
AW		36.4	0.31	36.2	0.30			31.6	0.31	31.7	0.33
STITCH LENGTH BW		2.94	0.009	2.93	0.011			3.59	0.021	3.59	0.051
mm AW		2.93	0.016	2.89	0.031			3.60	0.023	3.51	0.036
BURST STRENGTH BW											
AW											
SPIRALITY ANGLES BW		13.18	0.85	13.50	1.41			13.7	1.24	15.2	0.87
AW		14.15	1.06	14.85	1.08			23.02	1.22	22.8	1.15

COMMENTS:

GREY STATE TEST RESULTS

FABRIC DETAILS:

Table 4: Finished Fabric Test Data

INTERNATIONAL INSTITUTE FOR COTTON. KNITTING REF. LAB. REF. SUBMITTED BY: DATE

TESTS REQUIRED		TIGHTNESS FACTOR 16.42 .						SAMPLE TIGHTNESS FACTOR 13.41			
	✓	MINIMUM TENSION	95%CL	MAXIMUM TENSION	95%CL		95%CL	MINIMUM TENSION	95%CL	MAXIMUM TENSION	95%CL
% SHRINKAGE length		13.75		15.97				21.5		23.13	
width		1.8		2.45				1.06		1.19	
FABRIC WEIGHT BW											
AW		198		198				169.4		166.6	
C/~~3 CM~~ INCH BW		43.5		42				31.9		29.3	
AW		50.2		49.8				39.5		39.6	
W/~~3 CM~~ INCH BW		36.3		36.1				31.7		32.3	
AW		37		36.6				31.1		30.9	
STITCH LENGTH BW											
m.m AW		2.83		2.91				3.54		3.51	
BURST STRENGTH BW											
AW											
SPIRALITY ANGLES BW											
AW											
cc YARN COUNT AN		24.7		24.3				23.9		23.9	

COMMENTS:

FINISHED TEST RESULTS

FABRIC DETAILS:

Figure 2: Graphical Representation of Measurements

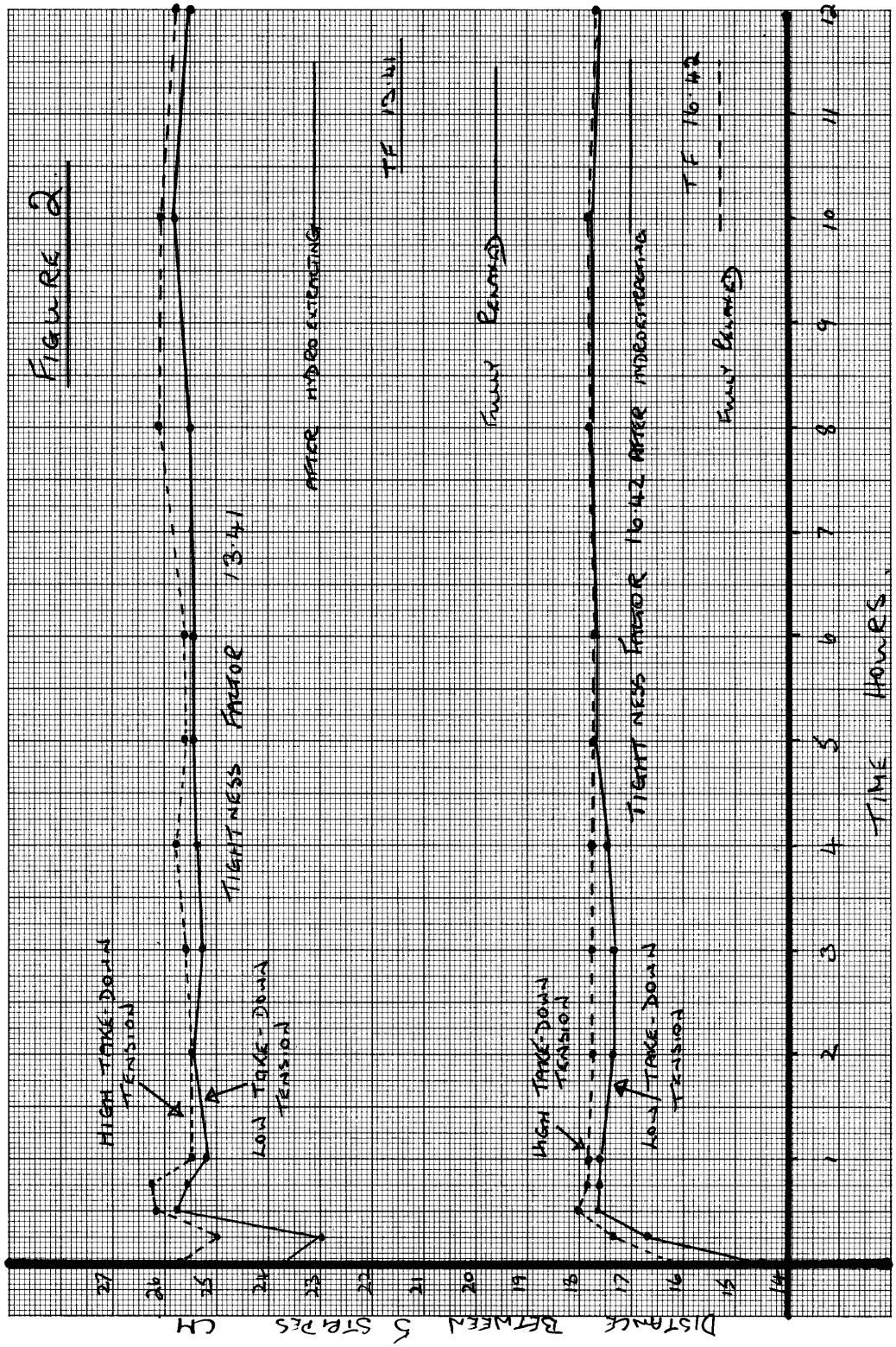

Figure 3: Calculated Course Density