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Changes in Absorbency and Drying Speed of a Quick-drying Knit Fabric by Repeated Laundering

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Abstract

This research evaluates the change of the water absorbency and drying speed of a quick-drying knit fabric by repeated laundering and laundering conditions and investigates the influence of laundering conditions on the functional properties of the knit fabric. Four factors of laundering conditions were studied: detergent, water hardness, water temperature, and frequency of rotation. Knit fabrics were washed for 25 laundering cycles in a drum-type washing machine with nine different laundering conditions derived from an orthogonal array. The properties of knit fabrics were measured with a drop absorption test, a strip test, and a drying time test. Relaxation shrinkage pointed to a change in the structural characteristics of the knit fabric. Wetting time was faster and wickability was greater in the knit fabrics that underwent 5 laundering cycles; in addition, there were no obvious changes in wetting time and wickability. The detergent was the most important factor in wetting time (40.4%) and wickability (60% or above). Water hardness, water temperature and RPM had less of an effect on wetting time and wickability. There were no significant differences between the levels of laundering conditions (except for detergent) on wetting time and wickability. Drying times with neutral and alkali were slower by repeated laundering; however, there was no obvious change in drying time. Hardness, water temperature and RPM had less of an impact on drying time.

Key words: Quick-drying knit fabric, Repeated laundering, Laundering condition, Water absorbency, Drying speed

I. Introduction

Based on the advance in science and technology, various functional outdoor garments have been developed. As new or combined function is introduced in the garments, the consumers enjoy the function. However, when it comes to laundering, they hesitate to choose laundry cycles in wash machine and/or detergents. This is because the high tech-high functional garments are very sensitive to laundering conditions in terms of maintaining its properties, but not enough information is provided yet and limited studies related to laundering are found in the literature (Cho & Ryu, 2000; Jeong & Choi, 1994; Leonas, 1998).

In our previous studies (Han et al., 2010; Roh et al., 2010), we chose functional outdoor garment fabrics, high-density and PU coated waterproof fabrics and have reported the changes of comfort-related properties by repeated laundering and laundering conditions. Residual detergent was the most influential factor.

Another high-tech functional fabrics for outdoor garment is quick drying fabric. The quick drying fabrics are more frequently washed than the waterproof fabrics as they are worn in contact to skin and pick up sweat. Effect of laundering or laundering condition may have completely different effect when compared to the waterproof fabric not just because of the

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difference in chemical composition but also because of the compact vs. loose structure of the fabrics.

Laundering involves mechanical force and chemical/physical reactions between the detergent and fibers, and heat which expedite the reaction. As most of the quick drying fabrics are composed of synthetic fibers, they exhibit excellent strength when wet; they are also resistant to alkali-based detergents. Absorption in quick-drying fabric is achieved via a capillary action that involves the micro pore structural differences that exist between the fibers. Little studies have been reported for the effect of laundering condition or repeated laundering on the changes of sweat absorption or drying properties except some studies about the material deformation (Kang et al., 1998; Onal & Candan, 2003; Quaynor et al., 1999). Therefore, the purpose of this study is to evaluate the changes of the water absorbency and drying speed of quick-drying knit fabric according to laundry condition and washing cycles, and to identify the influential factors.

II. Experimental

1. Specimen

Commercially available quick-drying knit fabric was used and its characteristics are described in <Table 1>.

2. Laundering

Four factors of laundering conditions were used (Roh et al., 2010): detergent, hardness, water temperature and frequency of rotation. Commercially available detergents were used.: alkali (Persil, Henkel KGaA, Germany), neutral (Wool shampoo for drum, Aekyung Ind., Korea), functional (Wool shampoo for outdoor, Aekyung Ind., Korea). Functional detergent is a neutral detergent for the use of functional clothing. According to manufacture, functional detergent can maintain the moisture permeability/waterproofness of outdoor fabric, water absorbency /quick-drying, and strong cleaning power on lipid composition of sweat ("Release a wool shampoo", 2008).

The fabrics were washed 1, 5, 10 and 25 times in a drum-type washing machine (SEW-HAR149AUW, Samsung Electronics, Korea) under nine different laundering conditions which were derived from orthogonal array by SPSS 12.0 (Table 2). Orthogonal arrays represent a special type of fractional factorial design that allows for the orthogonal estimation of all the main effect using the smallest number of combinations.

Table 1. Characteristics of specimen

Fiber contents (%)	Yarn number (Denier)	Weave type		Fabric count (wale×course/5cm)	Weight (g/m^2)	Thickness (mm)	Finish
PET 100%	75/72	Face	Single cross tuck stitch	76×128	150	0.64	Hydrophilic
		Back	Plain stitch	76×128			

Table 2. Laundering profiles

No.	Detergent	Hardness (ppm)	Temperature (°C)	RPM
1	Functional	250	40	30
2	Functional	70	15	40
3	Neutral	70	40	40
4	Neutral	70	30	30
5	Neutral	250	15	50
6	Alkali	70	40	50
7	Alkali	70	15	30
8	Functional	70	30	50
9	Alkali	250	30	40

3. Physical properties

1) Absorbency of Textiles

The drop-absorption test (AATCC test method 79-2007) was used to measure absorbency. Nine specimens with the different laundering conditions were tested, each 20×20cm. The specimens were mounted in an embroidery hoop so that the surface was taut. The hoop was placed 9.5±1.0 mm below the tip of the burette and one drop of distilled water was fallen on the specimens. The time was measured for the drop of water to lose its specular reflectance. As the knit fabric was very absorbent, 65% sugar water was used in the test. The results on wetting time were multiplied by a corrective coefficient of 0.023.

2) Wickability

The wickabilities in the wale and course direction of specimens was measured according to ISO 9073-6: 2000. One end of a strip (2.5×25cm) was clamped vertically with the dangling end and immersed to about 1cm in distilled water at 20±2°C. The height to which the water was transported along the strip was measured at 10 minute.

$$Wickability = \frac{M \times H}{100}$$

Where M (%) is the water absorptivity ((B-A)/A×100), A (g) is the fabric weight of drying, B (g) is the fabric weight of absorption, and H (cm) is height of liquid wicked by fabric strip.

3) Drying Speed

Drying time was measured according to KS K 0815. The specimen (40×40cm) was immersed in distilled water at 27±2°C and absorbed sufficiently. It was taken out of the water, and was hanged out on a drying rack under a standard atmosphere of 20°C, RH 65%. when water drop did not fell from the specimen. The drying time (min) was measured.

4. Statistical Analysis

Descriptive statistical analyses, t-test, ANOVA and conjoint analysis were performed with SPSS 12.0.

III. Results and Discussion

1. Structural Characteristics

In quick-drying knit fabrics, structural characteristics play a major role in the water transport properties. Therefore, changes in structural characteristics were evaluated in terms of fabric counts, thickness and weight after the repeated launderings (Table 3).

The fabric count in the wale direction increased after the first wash cycle but no subsequent change was observed. In the course direction, the knit fabric count increased gradually to 25 laundering cycles. The loop shapes in the laundered knit fabrics became more round <Fig. 1>, and the space between the fibers in the yarn became more compact than before it was laundered.

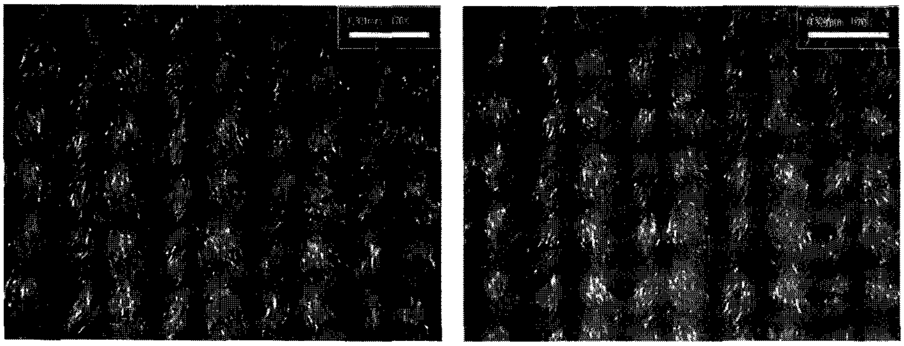
These observations indicate that repeated laundering resulted in relaxation shrinkage as was explained by Banerjee and Alaiban (1988) that when knit fabrics are washed, the material loses its tension, resulting in the long loops changing to short loops. The loops become round, because the knit length in the wale direction are shrunken, whereas those in the

Table 3. Changes in the structural characteristics of quick-drying knit fabric by repeated laundering

Characteristic		Laundering cycle					
		0	1	5	10	25	F-value
Fabric count	Wale/5cm	76.0 a	76.5 b	77.0 c	77.0 c	77.0 c	6.86**
	Course/5cm	127.0 a	129.5 ab	132.0 bc	132.5 bc	134.0 c	5.85**
Thickness (mm)		0.64 a	0.64 a	0.65 b	0.66 b	0.66 b	23.03**
Weight (g/m^2)		150 a	152 a	155 b	155 b	157 b	18.28**

**$p<.01$

a, b, c: Groups with significant differences according to Duncan's multiple range test were noted with different letters.



(a) No laundering (b) 25 laundering cycles

Fig. 1. Change in the loops of quick-drying knit fabric by repeated laundering.

course direction are stretched. This phenomenon is expected to change in the pore connectivity (Ji, 1989; Lee & Kim, 2001; Lee et al., 1997) or tortuosity. Changes in the weight and thickness of knit fabric followed a similar pattern to that observed in the fabric count. They increased slightly through 1 to 5 cycles but not much change is observed after 10 cycles. These results are also related to relaxation shrinkage (Kim & Kim, 2001) and can explain that the knit structure is more compact than before they are laundered.

2. Absorbency

1) Effect of Laundering Cycles

Absorbency of the knit fabric was measured by wetting time and the results are shown in <Table 4>. ANOVA and Duncan's multiple range test were carried out. The results revealed that the wetting time

Table 4. Changes in the wetting time of quick-drying knit fabric by repeated laundering

Laundering cycles	Wetting time (sec)
0	0.15 b
1	0.21 c
5	0.10 a
10	0.09 a
25	0.10 a
F-value	32.1***

***p<.001
a, b, c: Groups with significant differences according to Duncan's multiple range test were noted with different letters.

increased significantly after the first cycle. The increase after the first cycle is attributed to the removal of the hydrophilic finishing agent. Several methods have been employed to make quick-drying knit fabrics more hydrophilic. The application of hydrophilic finishing agents is one of the most simple ways of improving the absorbency of fabrics. These agents, however, were mostly removed by the first laundering cycle (Back, 1992).

After 5 cycles of laundering, the wetting time decreased and there was no significant difference in the subsequent washing cycles. Surfactant adsorption (Adler & Walsh, 1984; Wang & Yasuda, 1991) by residual detergent appeared to have the major effect on this phenomena. HLB (hydrophilic-lipophilic balance) of the surfactant for laundering is 13-15 which exhibits strong hydrophilic properties. As a result, the residual detergent can function as a hydrophilic finishing agent. Relaxation shrinkage seemed to have some effect on the wetting time; the intra- and inter-pore of the yarn being altered.

2) Effect of Laundering Condition

To analyze the impact of laundering on wetting times by the level of laundering condition, t-test and ANOVA were conducted (Table 5).

Depending on the detergent used, there were significant differences in the wetting time of the knit fabric at 1 and 25 cycles. The wetting time of the knit fabric was faster in the order neutral, functional, alkali detergent; at 25 cycles, the time was in the order of

Table 5. Effect of laundering condition on the wetting time of quick-drying knit fabric

Factor	Level	Wetting time (sec) Laundering cycle				
		0	1	5	10	25
Detergent	Alkali	0.15	0.29 b	0.09	0.09	0.09 a
	Neutral	0.15	0.17 a	0.10	0.09	0.12 b
	Functional	0.15	0.22 ab	0.10	0.07	0.08 a
	F-value		6.89**	0.78	1.72	8.88***
Hardness (ppm)	70	0.15	0.25	0.11	0.09	0.10
	250	0.15	0.18	0.09	0.08	0.10
	F-value		2.49*	1.85	0.58	0.95
Temperature (°C)	15	0.15	0.21	0.10	0.09	0.11 b
	30	0.15	0.25	0.09	0.08	0.09 ab
	40	0.15	0.18	0.10	0.08	0.08 a
	F-value		1.31	0.03	2.07	4.84*
RPM	30	0.15	0.23	0.09 a	0.08 b	0.11
	40	0.15	0.24	0.13 b	0.10 a	0.09
	50	0.15	0.16	0.09 a	0.08 b	0.10
	F-value		2.87	9.74***	4.13*	2.36

*p<.05, **p<.01, ***p<.001
a, b: Groups with significant differences according to Duncan's multiple range test were noted with different letters.

functional=alkali>neutral detergent.

The results of the first cycle must be by the cleaning power and the results of the 25 cycles are by the residual detergents. Considering the composition of the detergent, powder-type alkali detergents contain builders that are added to soften hard water and to increase in pH; such detergents have, high efficiency of cleaning power. In contrast, liquid detergents with a neutral pH contain less builder and exhibit poor cleaning power. Therefore, more of the hydrophilic finishing agent was removed in the first cycle by the alkali detergents. The difference in wetting times after 25 cycles was attributed to the presence of residual detergent. The amount of the residual detergent is not analyzed in this study but assuming that there were similar amount, the alkali detergent have more hydrophilicity and showed quicker wetting time than the others.

Water hardness exerted a small difference on wetting times by the repeated laundering. No significant differences of wetting times were observed in response to water temperature. RPM showed significant differences in the wetting time at 5 and 10 cycles however, no significant differences were observed at 25 cycles.

Conjoint analysis was carried out using test results of 25 cycles to investigate whether the laundering conditions affected the wetting time. The importance of individual laundering conditions was calculated by examining the difference between the lowest and highest utilities across the levels of all the factors. The scores show the degree of effect on the wetting time. Higher scores suggest that the factor had a greater effect on the wetting time. As the utilities of laundering conditions on wetting time equaled the results of the changes in response to repeated laundering <Table 5>, the explanation on utilities of these data were omitted from the study. The relative importance of each factor in the wetting time, expressed as a percentage, is shown in <Table 6>.

Pearson's R and Kendall's tau statistics for this conjoint model were a good fit. Detergent was the most important factor in the wetting time, accounting for 40.4% of the variation, followed by water tem-

Table 6. Relative importance of laundering conditions on the wetting time of quick-drying knit fabrics

Factor	Level	Utility	Relative importance (%)
Detergent	Alkali	-0.007	40.41
	Neutral	0.021	
	Functional	-0.014	
Hardness (ppm)	70	0.003	7.54
	250	-0.003	
Temperature (°C)	15	0.013	28.99
	30	-0.002	
	40	-0.011	
RPM	30	0.012	23.06
	40	-0.008	
	50	-0.003	
Pearson's R		0.64**	
Kendall's tau		0.42*	

*p<.05,**p<.01

perature (29.0%), RPM (23.1%), and water hardness (7.5%). The results indicate that adsorption of residual detergent has the most impact on the wetting time when the physical properties of the fabric have been altered by repeated laundering. Alkali builder and neutral salt in detergent are dissolved and removed by rinsing; however, the removal efficiency of the surfactant is just 70.1% (Kim, 2000). Therefore surfactant type resulted in differences in the wetting time as a result of the adsorption of detergent with higher value of hydrophilic group.

3. Wickability

1) Effect of Laundering Cycles

Change in the wickability of the knit fabric by repeated laundering were assessed and differences in wickability in the wale (W) and course (C) direction of the knit fabric were evaluated (Table 7).

The differences between the wickabilities of the knit fabrics by repeated laundering were significant. Wickability increased up to 5 cycles and then slowly declined in the wale and course direction. There were significant difference between the wickabilities in the wale and course direction of the knit fabric. Uçar et al. (2007) reported that pore size and connectivity of

Table 7. Changes in the wickability of quick-drying knit fabric by repeated laundering

Laundering cycles	Wickability		t-value
	Wale	Course	
0	7.4 a	11.2 a	-3.63*
1	12.8 b	13.8 b	-1.78
5	17.5 c	19.6 c	-5.92***
10	18.4 c	20.5 c	-6.88***
25	17.3 c	19.5 c	-4.07***
F-value	61.2***	70.4***	

*p<.05, ***p<.001

a, b, c: Groups with significant differences according to Duncan's multiple range test were noted with different letters.

the knit fabric affected wickability. They attributed this finding to differences in the density of the fabric in the wale or course direction caused by repeated laundering. The change in the wickability according to the direction is due to the structural changes in the pore size and connectivity. As mentioned previously, repeated laundering resulted in relaxation shrinkage of the knit fabric in the course direction.

The change in wickaility differed from one's wetting time in the drop-absorption test, particularly by the first cycle. Back et al. (2009) evaluated the absorption behavior of quick-drying knit fabric; they reported that the excellent wetting properties of knit fabric did not agree with their finding for wickability. They attributed their results to the difference in the direction of the capillary phenomenon and to the difference in the structure of knit fabric. However, they only measured the wetting time associated with the capillary phenomenon in the thickness direction of the knit fabric. In this study, a double weave knit fabric was used; the back of the knit fabric was jersey and the front was composed of a single cross tuck stitch. This type of structure facilitates moisture absorption and diffusion in the direction of knit fabric thickness. However, it resulted in differences in the wetting time and the wickability of the knit fabric in our study.

2) Effect of Laundering Condition

The difference in the wickability in response to laundering conditions was analyzed (Table 8). In the

Table 8. Effect of laundering condition on the wickability of quick-drying knit fabrics in wale and course direction

Factor	Level	Wickability									
		Laundering cycles									
		Wale					Course				
		0	1	5	10	25	0	1	5	10	25
Detergent	Alkali	7.4	12.3	18.2	19.1	21.1 c	11.2	14.8 b	20.5 b	22.1 c	24.0 c
	Neutral	7.4	13.7	17.2	18.0	15.4 a	11.2	14.5 b	19.6 ab	19.5 a	16.9 a
	Functional	7.4	11.5	17.5	18.4	17.5 b	11.2	11.5 a	18.7 a	20.8 b	20.5 b
	F-value		2.89	1.41	2.51	60.03***		6.09**	3.22*	19.33***	142.23***
Hardness (ppm)	70	7.4	13.5	17.0	18.5	17.9	11.2	13.3	19.6	20.6	19.7
	250	7.4	12.1	18.0	18.2	16.8	11.2	14.4	19.6	20.4	19.4
	t-value		1.62	-2.04*	0.63	1.49		-1.32	0.09	0.53	0.37
Temperauter (°C)	15	7.4	12.1 a	17.0 a	17.5 a	16.9	11.2	14.0	18.7 a	19.7 a	18.8
	30	7.4	11.6 a	17.2 a	19.0 b	17.5	11.2	14.3	20.0 b	21.5 b	20.1
	40	7.4	15.4 b	18.7 b	19.6 b	17.9	11.2	13.2	20.9 b	21.1 b	20.5
	F-value		8.64***	4.90*	14.53***	0.67		0.50	8.12**	8.90***	1.82
RPM	30	7.4	13.1 b	17.9 b	18.2 a	17.72	11.2	14.1 b	20.4 b	20.4	19.8
	40	7.4	10.5 a	16.3 a	17.3 a	16.39	11.2	11.6 a	17.3 a	20.0	19.9
	50	7.4	14.5 b	17.9 b	19.8 b	17.49	11.2	15.5 b	20.3 b	21.0	18.8
	F-value		7.46**	4.87*	11.59***	1.19		6.65**	21.26**	1.32	0.59

*$p<.05$, **$p<.01$, ***$p<.001$

a, b, c: Groups with significant differences according to Duncan's multiple range test were noted with different letters.

case of detergent, there was significant difference between the wickabilities in the wale direction after 25 cycles. No significant differences in the wale at 1, 5 and 10 cycles. There were significant differences in the wickability in the course direction at 1, 5, 10 and 25 cycles. The wickability of at 25 cycles was greater in the order of alkali> functional> neutral detergent.

The difference between the wickabilities at 70ppm and 250ppm in both direction were not significant through 25 cycles. Up to 10 cycles, the wickability was significantly higher in water temperatures of 40°C compared with 15°C. However, wickability was not significantly different at 25 cycles. Up to 5 and 10 cycles, there were significant differences in the wickability based on RPM. However the wickability did not show a tendency to according to RPM, and it was not significantly different at 25 cycles. Overall, water hardness, water temperature, and RPM had no effect on the wickability of the fabric. These results show that the relaxation shrinkage affected wickabiltiy up to 10 cycles. After 10 cycles, the relaxation shrinkage was minimized and the adsorption of surfactant was the major factor to affect the wickablility.

As seen in <Table 9>, detergent was the most important factor in wickability, accounting for 62.7% in the wale direction and 69.5% in the course direction at 25 cycles. Detergent was more than four times as important as the other factors in wickability. When compared with the results of wetting time, detergent had a great deal of influence on wickability. This mean that detergent affected absorption evaluation with several minute than with several second.

4. Drying Time

1) Effect of Laundering Cycles

Changes in the drying time of the knit fabric by repeated laundering are shown in <Table 10>.

No significant differences were observed in the drying times of the fabric in response to repeated laun-

Table 9. Relative importance of laundering conditions on the wickability of quick-drying knit fabrics

Factor	Level	Utility		Relative importance (%)	
		Wale	Course	wale	course
Detergent	Alkali	3.084	3.542	62.73	69.48
	Neutral	-2.561	-3.566		
	Functional	-0.523	0.025		
Hardness (ppm)	70	0.525	0.151	11.67	2.95
	250	-0.525	-0.151		
Temperature (°C)	15	-0.517	1.010	10.91	16.75
	30	0.053	0.307		
	40	0.464	0.704		
RPM	30	0.518	0.291	14.70	10.82
	40	-0.805	0.408		
	50	0.288	-0.699		
Pearson's R		0.88***	0.96***		
Kendall's tau		0.75***	0.85***		

***$p<.001$

Table 10. Changes in the drying times of quick-drying knit fabric by repeated laundering

Laundering cycles	Drying time (min)
0	75.0
1	88.3
5	87.3
10	88.7
25	91.2
F-value	0.45

dering. The drying time may include a wide margin of error because the drying time test was lengthy. However, the drying time by the first cycle was 10 minutes longer compared with no laundering. There were no subsequent changes in drying times. This result attributed to the rearrangement of pore sizes and connectivity brought about by structural changes after the first cycle and the hydrophilicity of the fabrics.

2) *Effect of Laundering Condition*

<Table 11> shows the difference in the drying time depending on laundering conditions. The differences between the drying times by detergent were significant at 1, 5, 10 and 25 cycles. It was interesting to notice that the drying time of fabrics with functional detergent was shorter than with neutral and alkali detergent. We need further study to identify this result analyzing the components of the detergents. As the structural characteristics will be mostly affected by the mechanical action and it is assumed that there would be not much difference by chemical reaction during the laundering. The drying times of fabrics exposed to 70 ppm were longer than those exposed to 250 ppm. However, except for the first cycle, the difference in the drying time was not significant. There were no differences between the drying times based on water temperature and RPM. Although laundering resulted in the rearrangement of pore size and connectivity, this had no effect on drying time. This finding is explained by the larger pore size of knit fabrics compared with woven fabric; the change in the pore size was also not large enough to affect the drying time.

<Table 12> shows the relative importance of laundering conditions on drying time. Detergent (48.1%) was the most important factor in drying time, followed by RPM, water hardness, and water temperature. Detergent was more than twice as important as the other factors.

Table 11. Effect of laundering condition on the drying time of quick-drying knit fabrics

Factor	Level	Drying time (min)				
		Laundering cycles				
		0	1	5	10	25
Detergent	Alkali	75.0	82.0 a	92.0 b	91.3 b	97.0 b
	Neutral	75.0	100.8 b	95.0 b	98.5 b	99.8 b
	Functional	75.0	69.1 a	67.1 a	66.6 a	68.2 a
	F-value		12.95***	7.56**	11.86***	10.38***
Hardness (ppm)	70	75.0	96.0	93.8	94.6	97.8
	250	75.0	80.9	80.7	82.8	84.5
	F-value		2.41*	1.98	1.85	1.99
Temperature (°C)	15	75.0	88.5	89.5	90.8	93.5
	30	75.0	86.5	84.3	86.6	90.3
	40	75.0	89.6	85.8	86.7	87.4
	F-value		0.06	0.22	0.20	0.26
RPM	30	75.0	95.1	90.4	93.2	95.7
	40	75.0	83.6	90.1	89.1	92.4
	50	75.0	78.8	78.1	79.3	80.9
	F-value		2.58	1.22	1.55	1.57

*p<.05, **p<.01, ***p<.001

a, b: Groups with significant differences according to Duncan's multiple range test were noted with different letters.

Table 12. Relative importance of laundering conditions on drying time of quick-drying knit fabrics

Factor	Level	Utility	Relative importance (%)
Detergent	Alkali	8.694	48.07
	Neutral	11.444	
	Functional	-20.139	
Hardness (ppm)	70	6.667	20.29
	250	-6.667	
Temperature (°C)	15	3.056	9.19
	30	-0.069	
	40	-2.986	
RPM	30	6.000	22.45
	40	2.750	
	50	-8.750	
Pearson's R		0.64**	
Kendall's tau		0.42**	

**p<.01

IV. Conclusions

Mechanical force and chemical reactions involving water, detergent, and heat, that occur during laundering produce changes in the dimensions, stability, and performance of fabrics; they also might have had an important influence on the absorption and drying of quick-drying fabrics. The absorbency and drying properties of the quick-drying knit fabric in response to laundering cycles and conditions are discussed.

The knit fabric count, weight, and thickness increased in response to the number of laundering cycles as a result of relaxation shrinkage.

At the first cycle, the wetting time of the knit fabric was increased. After 5 cycles, the wetting time decreased. No significant difference was observed until 25 cycles. At 1 and 25 cycles, there were significant differences in the wetting time by detergents. There was no significant difference in the wetting time in response to the other cycles. Detergent was the most important factor in the wetting time, accounting for 40.4% of the variation, followed by water temperature, RPM, and water hardness.

The differences between the wickabilities of the knit fabrics by repeated laundering were significant.

Wickability increased rapidly up to 5 cycles and then slowly declined. Significant difference of the wickabilities by detergent appeared, the wickability was greater in the order of alkali>functional>neutral detergent. Hardness has no effect on wickability, and water temperature and RPM had no effect on wickability. Detergent was more than four times as influential as the other factors.

The drying time with the functional detergent showed was shorter than with neutral and alkali detergents. The other factors did not affect the drying time.

As mentioned above, detergent is the most influential factor for the absorbency and drying properties of the quick-drying fabric and water hardness, water temperature, and RPM don't exert a large effect. This finding implies that selecting an appropriate detergent is very important when laundering quick-drying knit fabric. In general, not much thought has been given to the washing requirements of textiles composed of synthetic fibers. Repeated laundering resulted in chemical and mechanical changes in quick-drying knit fabric, and these changes affected water absorbency and quick drying properties. Additional quantitative evaluations of the individual components of the detergents and the ratio of the surfactants are needed for further study.

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