EFFECTS OF FABRICS STRUCTRAL PARAMETERS AND NUMBER OF NIPS ON AIR PERMEABILITY OF FABRICS KNITTED USING INTERMINGLED YARN

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ABSTRACT

Texturing technology has great importance in the textile industry. Texturing techniques are utilized in filaments to give properties such as bulky structure, good coverage, handle, and thermal insulation [1]. Fabrics' air permeability is an important thermal comfort parameter that closely related with surface structure. Air intermingling application affects yarn hairiness, surface porosity and thickness of fabric. Thus, intermingling causes the change on air permeability level of fabrics. The aim of this study is to investigate the effects of intermingling process on knitted fabrics' air permeability. Research results showed that intermingling process effects fabrics air permeability level significantly.

Key Words: *Air permeability, Knitted fabric, intermingling, POY*

1. INTRODUCTION

Texturing technology has great importance in the textile industry. Texturing techniques are utilized in filaments to give properties such as bulky structure, good coverage, handle, and thermal insulation [1]. Fabrics' air permeability is an important thermal comfort parameter that closely related with surface structure. Air intermingling application affects yarn hairiness, surface porosity and thickness of fabric. Thus, intermingling causes the change on air permeability level of fabrics.

The air intermingling technique is used to impart filament cohesion in flat and textured multifilament yarns (Figure 1). Friction is one of the most important factors that determine the behaviour of fibers in carding, drawing, and spinning processes and that of yarns during fabric formation. But yarns that consist of many filaments have no frictional force due to the parallel arrangement of filaments. Intermingling is the most common method used to impart the necessary cohesion to multifilament yarn using an air jet positioned in the path of the yarn. This creates nips in the yarn that significantly increase the interfilament cohesion [2].

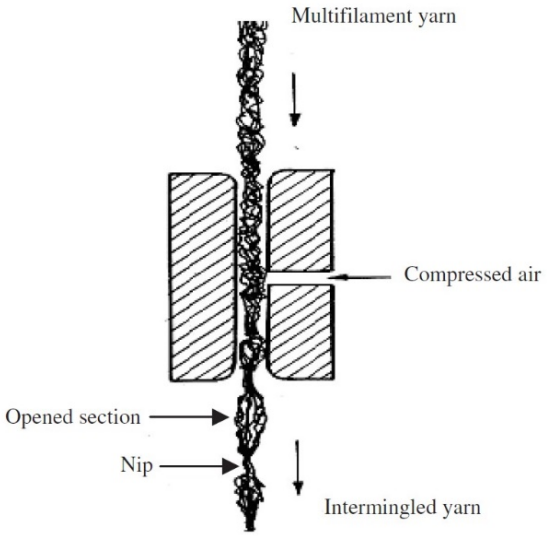


Figure 1. The principle of intermingling process [3]

There are various studies about the fabrics air permeability properties [4-12] but these studies are not include the effects of intermingling process on knitted fabrics' air permeability levels.

The aim of this study is to investigate the effects of intermingling process on knitted fabrics' air permeability levels. Hence, polyester POY yarns were intermingled by Hemaks HMX 114 model intermingling machine to impart filament cohesion with different nips level. Then POY yarn (as reference) and intermingled POY yarns were used as raw materials for single jersey sample knitted fabrics.

2. MATERIAL AND METHOD

Material

In this study, POY polyester yarns having 283 dtex linear density and 68 filaments in cross-section were used as raw material. All POY bobbins have round cross-section. The yarn properties are given in Table 1.

Table 1. Yarn properties

Yarns	Number of nips (number/m)	Linear density (dtex)	Filament number (number)
POY (Reference)	5,0	283	68
P1	47		
P2	67		
P3	77		
P4	80		

Methods

In this study, POY-polyester bobbins were intermingled with Hemaks HMX 114 model intermingling machine. Intermingling was performed in different speed and pressure levels. "TEMCO Y profile LD 22" air-jet was used in this process. Number of nips of intermingled yarns was tested using Itemat Lab TSI test device and each bobbin was tested 10 times.

Intermingled yarns were used for producing the single jersey knitted fabrics by sample type circular knitting machine. Knitting machine's specifications are given in Table 2.

Table 2. Laboratory type circular knitting machine's specifications

Knitted Roller	**3 ½-inch, single-head**
Speed (rpm)	0-400 rpm
Machine gauge (number of needles per inch)	18
Weave type	Single Jersey

Tests and standards applied to knitted fabric samples are given in Table 3.

Tablo 3. Standards and tests that applied to knitted fabric samples

Properties	**Standards**
Wale count per cm	TS EN 14971 Determination of number of stitches per unit length and unit area
Loop length	TS EN 14970 Determination of stitch length and yarn linear density in weft knitted fabrics
Mass Per Unit Area	TS 251 Determination of Mass Per Unit Length and Mass Per Unit Area of Woven Fabrics
Fabric thickness	TS 7128 EN ISO 5084 Determination of thickness of textiles and textile products
Air permeability (mm/sn)	TS 391 EN ISO 9237 Determination of permeability of fabrics to air

Obtained test data are compatible with the non-parametric test. Non-parametric tests provide a hypothesis test in question alone, with no additional assumptions such as probability distributions etc. [13]. Kruskal Wallis One Way ANOVA Test which is one of the non-parametric tests is used for evaluating hypothesis. Kruskal Wallis Test compares two or more independent samples to test the hypothesis. Kruskal Wallis test is also non-parametric equivalent of parametric one way ANOVA test. Pairwise comparisons are given for all samples which has significant differences between groups. IBM SPSS statistical software is used for building and testing the hypothesis. Moreover, statistical analyzes were supported with microscopy images.

3. RESULT AND DISCUSSION

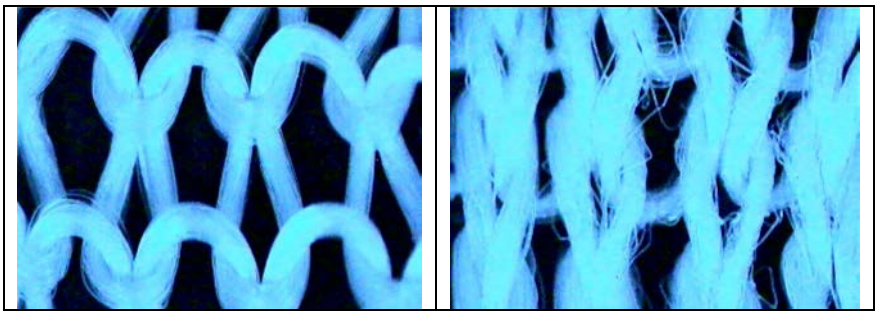
Kruskal Wallis test results are given as summary in Table 4.

Table 4. Kruskal Wallis Test Results

	Number of nips	**Air permeability**
Kruskal Wallis Test Results	Significance	Significance
Wale Count	0.000	0.000
Loop length	0.000	0.000
Mass Per Unit Area	0.000	0.000
Fabric thickness	0.000	0.000
Number of nips	-	0.000

Kruskal Wallis test results shows that difference in nips number has a significant effect on fabric structures parameters such as wale count, loop length, mass per unit area, fabric

thickness etc. Structural changes caused from difference in number of nips can be clearly seen in the microscopy images (Figure 2).



a b

Figure 2. Loop structure of knitted fabrics (**a.** with POY **b.** with high level intermingled yarn)

Intermingling process gives cohesion and bulkiness to filaments. Cohesion shows itself among loops and causes compact fabric structure. Furthermore, hairiness is increases with increasing in number of nips. When all interactions are evaluated together air permeability decreases with increasing in number of nips (Figure 3).

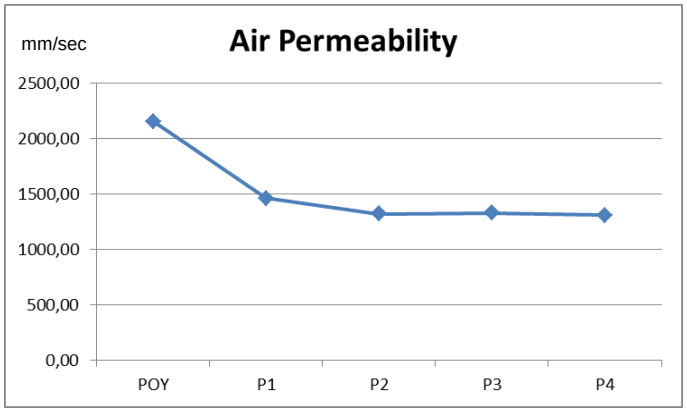


Figure 3. Interaction between number of nips and air permeability

As a conclusion, fabric weight, thickness, wale count, loop length and number of nips have significant effects on fabric's air permeability. Air permeability decreases when the fabrics' weight, thickness and wale count values increase. But it increases with increasing in loop length. These results are consistent with the literature [5, 6].

3. REFERENCES

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