EFFECT ON BENDING RIGIDITY OF TOWEL SAMPLES WITH DIFFERENT FIBER CONTENT

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ABSTRACT
Recently, there have been significant developments in investigating the quality perception and aesthetic behavior of the towel fabrics due to the developments in objective evaluation techniques in parallel with the technology. When bending properties are evaluated especially in terms of towel fabric comfort and towel quality perception, it is the main parameter that affects the selection of raw material, design and appearance of the textile material. In this study, towel samples with different fiber content (cotton, modal, bamboo, tencel, polyester etc.), yarn structure (carded, combed, open-end), yarn count, pile height, weight values were collected. By measuring the bending rigidity of towel samples, the effects of towel samples with different fiber content on both quality perception and bending rigidity were investigated.
Keywords: towel, towel comfort, towel quality, towel quality perception, bending rigidity.

Introduction

Today there is a growing interest in the interaction between textile materials and human beings. Mental as well as physical comfort has become much more important for the consumers in the past few years [1, 2]. Since fabric comfort and fabric quality perception are sensitively perceived by the human body, subjective evaluations should be made first and supported with objective measurements in order to produce similar fabrics in terms of their handle and ensure their continuity [3, 4, 5].

Although fabric comfort and fabric quality perception properties are generally evaluated according to subjective assessment methods, it has been proved in previous studies that there is a correlation between some physical properties of the fabric that can be measured objectively [6]-[12]. For this purpose; simple and advanced technology measurement systems (e.g. Kawabata Evaluation System) have been developed in which properties such as bending rigidity, smoothness, softness, stiffness and thickness can be measured with numerical values, which closely concern fabric comfort and quality [1],[6],[8],[12]-[17]. Due to the expense of the Kawabata equipment and maintenance difficulties, for determining the comfort and quality properties of fabrics, mostly in Turkey, bending length, devices measuring physical properties such as stiffness and fabric stiffness is used. The bending length is the deviation of the fabric fixed at one end by its own weight from the horizontal. Bending rigidity is the resistance of the fabric against bending. Fabric stiffness is the resistance of the fabric against bending like rigidity. The fact that these values are high indicates that the fabric has a hard handle and affects the fabric quality perception significantly [8].

The comfort and quality perception features of the fabrics are influenced by various factors such as fiber type, weight, yarn density and yarn count [8], [18]-[19]. It is known that the fibers form the yarns, that yarns also form the fabric, therefore the fiber properties have great importance in terms of fabric properties. Many fibers obtained naturally or chemically are being used in textile to obtain textile fabrics with different properties [19]. When it comes to towel fabrics, cotton, which is a natural fiber, comes first, followed by blends of cotton with fibers such as bamboo, modal and tencel.

In recent years, with the development of objective measurement techniques, the importance of quality and comfort of towel fabrics has increased. Bending rigidity is among the most important appearance and mechanical properties of towel fabric. Traditional methods, which are used for the measurement of these features and have not changed much since the 1930s, have contributed in parallel with the development of technology, especially in recent years [20]. As long as the perceptions of quality and comfort are reshaped over time, bending properties of towel fabrics will continue to attract researchers.

Denizli is one of the most important towel production location in the world. Different towel manufacturers have been visited in Denizli because it is very easy to access a wide variety of towel samples with a wide range of production parameters. In this study, physical test measurement results were used to evaluate the quality perception

features of towel fabrics with different fiber content, yarn structure, yarn count, pile height and weight values. By measuring the bending rigidity of the towel samples with physical testing, the effects of the towel samples with different fiber content on both quality perceptions and bending rigidity were investigated. The data obtained were interpreted in terms of parameters such as fiber type, yarn count, pile height and weight, which affect the quality and comfort. The results obtained from the study are thought to offer a new viewpoint for the innovative product development compatible with the needs of the consumer in the towel industry and in this context it is considered to be important in terms of the absence of a study on towel fabrics.

MATERIAL-METHOD

Material

The properties of 15 different towels for the analysis of towel fabrics are given in Table 1. The samples were cut on a laser machine 10x10 cm and 10x20 cm in size. Standart atmospheric conditioning was carried out for the towel samples for 24 h with temperature 20 ± 2 °C and relative humidity 65 ± 2% prior to the studies.

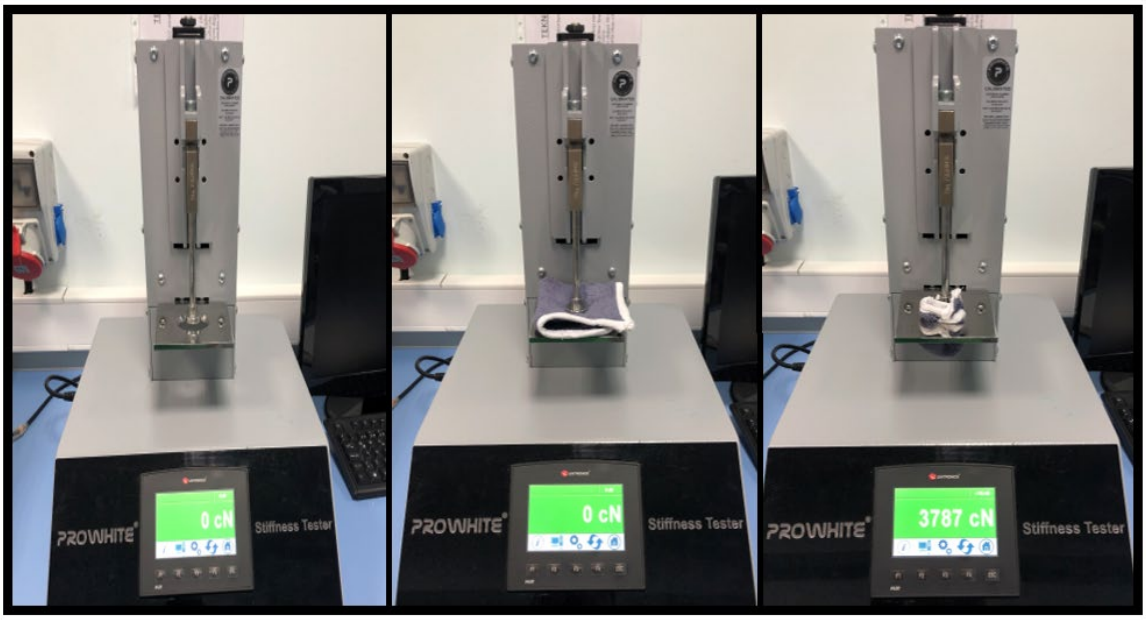
Table 1. The properties of the towel samples

Sample number	Fiber content	Yarn count (Ne)	Pile height (mm)	Weight (gr/m^2)
1	100% Cotton	Pile: 20/2 Carded yarn Ground: 24/2 Carded yarn Weft: 16/1 Carded yarn	5.1	550
2	100% Cotton	Pile: 20/2 Carded yarn Ground: 24/2 Carded yarn Weft: 16/1 Carded yarn	6.25	550
3	100% Cotton	Pile: 20/2 Carded yarn Ground: 24/2 Carded yarn Weft: 16/1 Carded yarn	5.25	550
4	21% Modal - 79% Cotton	Pile: 12/1 Combed yarn Ground: 20/2 Combed yarn Weft: 14/1 Combed yarn	8.1	700
5	75% Cotton - 25% Modal	Pile: 16/1 Cotton-Modal Ground: 20/2 Carded yarn Weft: 16/1 Carded yarn	9.75	650
6	95% Cotton - 5% Silk	Pile: 13/1 Cotton-Silk Ground: 20/2 Carded yarn Weft: 16/1 Carded yarn	6.9	725
7	95% Cotton - %5 Cashmere	Pile: 14/1 Cotton-Cashmere Ground: 20/2 Carded yarn Weft: 16/1 Carded yarn	8.22	635
8	50% Modal - 50%Cotton	Pile: 16/1 Modal-Cotton Ground: 20/2 Open end Weft: 20/2+16/1 Carded yarn	7.6	600
9	34% Modal - 66% Cotton	Pile: 12/1 Combed yarn Ground: 20/2 Combed yarn Weft: 12/1 Combed yarn	8	650
10	60% Bamboo - 40% Cotton	Pile: 16/1 Bamboo-Cotton Ground: 20/2 Carded yarn Weft: 16/1 Carded yarn	7.4	550
11	70% Modal - 30% Cotton	Pile: 16/1 Modal-Cotton Ground: 20/2 Carded yarn Weft: 16/1 Open end	8.25	544
12	60% Cotton - 40% Bamboo	Pile: 16/1 Cotton-Bamboo Ground: 20/2 Carded yarn Weft: 16/1 Carded yarn	8.7	580
13	85% PES - 15% Cotton	Hav: Ne 20/2 (%85 PES - %15 Cotton) Zemin: Ne 18/2 (%100 PES staple fiber) Atkı: Ne 18/2 (%100 PES staple fiber)	8.1	564
14	50% Cotton - 50% Tencel	Pile: 16/1 (50% Combed Cotton-50% Tencel) Ground: 20/2 Carded yarn Weft: 16/1 Carded yarn	6.8	550

15	85% PES - 15% Cotton	Hav: Ne 20/2 (%85 PES - %15 Cotton) Zemin: Ne 18/2 (%100 PES staple fiber) Atkı: Ne 18/2 (%100 PES staple fiber)	8.55	587

Method

Samples cut in 10x20 cm dimensions were folded in half and measured in the Prowhite Stiffness Tester Unitronics device. The measurement device, the placement of the sample in the device and its image at the time of measurement are given in Figure 1.



Şekil 1. Bending rigidity test measuring device

Samples cut in 10x10 cm dimensions were used to determine the pile height. Pile height values of the samples were determined according to TS 629. 10 yarns were drawn from the warp direction of each towel sample of 10x10 cm size. The value obtained by dividing the sum of the corrected lengths of the yarns removed from the fabric by 100 is defined as the pile height of that towel.

Results And Discussion

The bending rigidity test results measured on the Prowhite Stiffness Tester Unitronics are shown in Table 2. Measurements were made 5 times for each sample and their average values were calculated.

Tablo 2. Bending rigidity test results of towel samples

Sample number	Fiber content	Bending rigidity (CN)
1	100% Cotton	3708
2	100% Cotton	5192
3	100% Cotton	3536.2
4	21% Modal - 79% Cotton	5300.8
5	75% Cotton - 25% Modal	4525.4
6	95% Cotton - 5% Silk	4129
7	95% Cotton - %5 Cashmere	3805.2
8	50%Modal - 50%Cotton	3579.4
9	34% Modal - 66% Cotton	3001
10	60% Bamboo - 40% Cotton	1906.4
11	70% Modal - 30% Cotton	1786.4
12	60% Cotton - 40% Bamboo	1721

13	85% PES - 15% Cotton	1564.4
14	50% Cotton - 50% Tencel	1278.6
15	85% PES - 15% Cotton	1070.2

While the bending rigidity values generally increase as the grammage and pile height value increase, when examined in terms of yarn count factor, is observed that the resistance against bending in thinner numbers decreases. When analyzed also as fiber content, it can be stated that as the use of regenerated and synthetic fiber increases, the samples tend to have a soft handle than others. The high bending rigidity values indicate that the towel sample has a hard handle. Singh, Behera and Matsudaire (2014) point out the perception of softness ın the description of the quality perception of good towel fabric.

Conclusion

In this study; by measuring the bending rigidity of towel samples with different fiber content, yarn structure, yarn count, pile height and weight values, the effect of towel samples with different fiber content on both quality perceptions and bending rigidity was investigated. In the results obtained from the study, high bending rigidity values indicate that the towel sample has a hard handle. As one of the towel properties that best expresses the towel quality perception is the softness parameter, it was observed that the ratio of regenerated and synthetic fibers increased in samples with low bending rigidity.

As a doctoral thesis, with this study, which is a part of the research conducted within the scope of ‘’Determination and Development of Objective/Subjective Evaluation Criteria of Quality Perception in Towel Structures’’; it is expected that by comparing the production parameters that affect the quality and comfort characteristics by determining the bending rigidity of towel fabrics, which is one of the physical test methods, it is expected to provide benefits to towel fabric manufacturers in determining how different production parameters affect consumer preferences and directing their product development activities within the framework of these parameters.

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