INVESTIGATION OF THE EFFECT OF SOFTENERS ON COTTON KNITTED FABRIC STIFFNESS

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ABSTRACT

Textile comfort of the fabrics is becoming very popular and soft touch is one of the prominent features. The main desired properties of cellulosic knits are their pleasant appearance, softness, absorbency, breathability, texture and comfort, which make them ideal for use in casual wear, sportswear, underwear, etc. Improving the performance and properties of cellulosic knits such as dimensional stability, smoothness, drapability, etc. through functional finishes is becoming necessary to cope with the demands of consumers and garment manufacturers. In this novel study 2 types of knitted structures (single jersey and pique) made of 100% cotton were used. Three different softening chemicals (macro silicone, micro silicone and seam facilitator) were used and acetic acid were used as a binding agent. According to the results, it was determined that macro silicone softener in single jersey knitted fabric and seam facilitator softener in pique knitted fabric gave more effective results in terms of hand feeling properties.

KEYWORDS

Comfort; Finishing; Hand feeling; Softener; Cotton.

INTRODUCTION

Comfort is a fundamental characteristic in the evaluation of clothing products, making it a key focus for textile manufacturers [1]. The literature reveals that softeners are the most commonly used method to enhance fabric comfort, as they play an essential role in improving the hand feel, smoothness, appearance, and usability of textiles. Softening treatments are typically applied after dye finishing as part of the finishing processes to ensure a soft touch and appealing look [2-4].

Textile materials are composed of various polymers, including natural cotton, cellulosic fibers, synthetic polyesters, and blends of these fibers. The combination of fibers directly influences the final quality and tactile feel of the fabric, which drives manufacturers to continuously improve fabric quality, smooth its surface, and enhance performance. In this regard, softeners are indispensable in textile production, with silicone-based softeners being especially common in enhancing fabric softness and tactile appeal [5].

There are studies about softener effects in the literature. Süpüren Mengüç, Dalbaşı, Özgüney & Özdil (2019), investigated the effects of various softeners on the hand-feeling properties and washing durability of cotton and bamboo knitted fabrics. They determined that the softening process did not have a successful performance in bamboo fabrics as in cotton fabrics. Hossain, Siddika & Islam (2019), examined the hand feel properties of single jersey fabric treated with three different types of cationic softener. They determined that aliphatic condensation softener gave the best results in terms of color fastness and hand feel properties of the fabric [6]. In another study; Illeez, Dalbaşı & Kayseri (2015), investigated the effects of parameters such as knitting structure, softener type and chemical concentration on sewability and seam shrinkage in ready-made clothing in cotton knitted fabrics. They found that softening treatments significantly improved sewability and seam shrinkage [7]. Silicone softeners are one of the most commonly used types of softeners in the textile industry. The use of silicone softeners is especially common in premium textile products and in areas that require high performance, such as sportswear and outerwear. These softeners are generally applied by the pad-dry-cure method and extend the life of textile products thanks to their long-term effects. These versatile advantages of silicone softeners make them a popular choice among textile manufacturers and consumers.

The aim of the study is to apply different types of softeners to fabrics with different knitted structures containing cotton and evaluate their findings. It is

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believed that the study will provide new data aimed at optimizing parameters such as overall user comfort. This study aims to provide scientific and practical information to textile manufacturers and researchers on the selection of softeners by examining in detail the effects of softeners on the hand feeling properties of fabrics.

EXPERIMENTAL

In the scope of the study, macro silicone, hydrophilic silicone and seam facilitating softeners were applied on cotton fabrics with different knitting type. Cotton was preferred in the study because it is one of the most widely used textile fibers in the world. For this purpose, single jersey and double pique fabrics were chosen for this study and treated with three types of softeners. Softener types were applied to the fabrics by pad-dry method. The concentration level applied was determined to be average, consistent with commercial practice. After the chemicals were applied, they were left to dry at 100 °C for half an hour. Then, stiffness test was performed and comparative analysis was carried out to evaluate the effect of different knitted structure. The bending strengths of the fabrics were determined with a digital pneumatic softness tester according to the ASTM (American Society for Testing and Materials) D 4032-08 circular bending test method. Details of the applied softeners are given in Table 1.

RESULTS AND DISCUSSION

Bending strength tests were carried out on test specimens of knitted fabrics of different structures before and after softening treatment. The fabric stiffness tester measures the force applied to a fabric under a standard pressure and the results are expressed in kgf. The results of the test specimens are given in Table 2.

It was observed that macro silicone softener decreased the stiffness (hardness) value by 5% in single jersey fabric, while hydrophilic softener increased the hardness by 63% and seam facilitator softener increased the hardness by 72%. It was determined that macro silicone softened the pique fabric by 11.5%, hydrophilic silicone by 43% and sewing facilitator softener by 60%.

According to the tests, it was found that all softeners applied gave effective results on pique fabric. It was observed that hydrophilic silicone and seam facilitator finish had a negative effect on single jersey knitted fabric at the applied concentration. While it was observed that seam facilitator softener was more effective in pique fabric, it was determined that macro silicone was more effective in single jersey fabric.

In the literature, it is known that softeners cause a decrease in bending properties due to the decrease in friction forces between yarns caused by the lubrication effect. However, fabric structure plays a decisive role on the effectiveness of the finish [8]. It has been determined that the knitting structure and surface characteristics of the fabric can affect the way softeners penetrate the fabric and show their effects.

Single jersey fabrics have a fine and dense knitting structure. This structure makes the fabric more flexible and lighter. Therefore, it can be easier for softeners to penetrate the fabric. However, softeners that provide a thinner and homogenous spread to increase the feeling of softness will be more effective in jersey. Pique fabric, which has a thicker and bulkier structure, is usually heavier and stiffer than single jersey. In this fabric, the effect of softeners should be able to penetrate deeper. The softeners used in pique fabric may need to have a more intense effect due to the volume and textural differences in the knitting structure. In addition, softeners work on the fabric by different mechanisms. Macro silicone-based softeners provide lubricity by adhering to the fiber surface and it is thought that such softeners can create a more pronounced effect on thinner fabrics (such as single jersey). Hydrophilic silicone softeners increase the water absorbency of the fabric and give softness to the fabric. This type of softener is considered to be more effective on thicker fabrics with high moisture retention capacity, such as pique. The seam facilitating finish has a hydrophobic structure and is thought to facilitate sewing operations by reducing friction between the fibers and making the fabric smoother.

As a result, even though they are produced from the same raw material, the fact that single jersey and pique fabrics have different structure and surface properties causes the effects of softeners on the fabric to vary. The thickness and texture of the fabric and the chemical structure of the softeners are the main factors determining which softener is more effective. It is thought that the hardening effect of hydrophilic and seam facilitating softeners on single jersey fabrics is related to the applied concentration. For this reason, it has been observed that optimum concentration settings of softeners are important. Determining the ideal concentrations for different fabric structures is critical to achieve the desired results.

Table 1. Details of softener application process.

Softener	pH	Concentration (g/L)	Pick up (%)
Macro silicone (polysiloxane)	5	40	80
Hydrophilic silicone	5	40	80
Seam facilitator (polyethylene emulsion)	5	40	80

Table 2. Test results.

Fabric	Stiffness [kgf]			
	Non-treated	Softener 1 (macro silicone)	Softener 2 (hydrophilic silicone)	Softener 3 (seam facilitator)
Single jersey	0.024	0.022	0.039	0.041
Pique	0.072	0.064	0.041	0.028

CONCLUSIONS

Within the scope of the study, the stiffness properties were analyzed by applying equal concentrations of macro silicone, hydrophilic silicone and seam facilitator (polyethylene emulsion) softening finishes to single jersey and pique fabrics containing 100% cotton. As a result, it was determined that macro silicone finish provided a low amount of softening in single jersey fabrics at the applied concentration, while other silicones made the fabric even stiffer. In pique fabrics, it was found that all softening chemicals provided softening, but the maximum softening was provided by the seam facilitator finish.

In conclusion, the investigation provides valuable insights into the role of softeners in modifying the stiffness of cotton knitted fabrics. The findings highlight that careful selection and application of softeners can significantly enhance the tactile properties of fabrics. Additionally, it contributes to the development of softer and more comfortable cotton garments. It is thought that by understanding the specific effects of different fabric softeners on fabric stiffness, manufacturers can make informed decisions about the types and concentrations of softeners to be used, and tailor their products to meet specific consumer preferences for softness and comfort. In the continuation of the study, it is aimed to apply softeners to fabrics at different concentrations and to perform tests and analyses.

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