

Effect of Cellulose Enzymes on Some Properties of Fibre Clothes

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Abstract

This study examined the effects of the enzyme cellulose on a few single jersey and interlock 100% flax t-shirts, two different styles of knit children's clothes that differ in both their chemical and mechanical characteristics. Clothing samples were dyed using reactive colours and then subjected to normal acid cellulose enzyme treatment procedures. We evaluated some physical and mechanical features before and after cellulose treatments, then compared these characteristics. Its cellulose enzymatic processing enhances some mechanical properties of fibre knitwear, such as pilling resistance and retention of water. Some characteristics of fibre-knitted clothing, such as fabric weight, fabric thickness, fabric burst resistance, and seam tensile strength of T-shirt side seams, are reduced by cellulose enzyme treatment at a manageable rate. Compared to single-jersey all-fiber children's T-shirts, interlocking 100% flax children's T-shirts have a better effect of the enzyme cellulose treatment on the majority of physical and mechanical attributes.

Keywords

Cellulose, Enzyme, Fiber, Clothes

1. Introduction

Knitted fabric uses cellulose to provide suppleness [1]. Cellulosic materials' surfaces can be modified with celluloses to make them seem cooler, smoother, and have brighter shading [2] [3]. Fiber's cellulose chains, which can be made up of crystalline and amorphous regions, make up its chemical makeup. The unstructured region is the cause of the fuzz and pilling on the surface of textiles [4] [5] [6]. Textile fibres may be biopolished by the operations of three cellulose components, including endo-glucanase, exo-glucanase, and glucosidases. This tech-

nique hydrolyzes the cotton-based substrate, releasing the final products [7]. The ability of cellulose, an enzyme, to remove fabric's fuzz fibres has recently drawn notice in the textile industry [8]. Modern denim outfits and jeans can now be designed using a variety of denim cleaning processes [9]. Weaving is the process of weaving yarn and needles into a web of connected loops to create fabric. Numerous styles of clothes are made from knit materials, because they are cosy [10]. Arguably the most significant ecological technology in the textile industry is the microbial treatment of clothing. Some enzymatic methods of treatment can be used to improve the trendy appearance of clothing [11].

The current research examined how two different types of children's T-shirt materials' physical and mechanical characteristics were impacted by the cellulose enzyme. This study examined the use of enzymatic textile wear treatment procedures on knit children's T-shirts. Since enzymes are safe for use on children's skin, this cellulose treatment gives children's T-shirts a trendy appearance, brittleness, and other good qualities.

The two types of knitted children's T-shirt fabrics used in this study (single jersey and interlock, both made of 100% flax fibre) were dyed with reactive dyes and then subjected to typical conditions of acid cellulose enzyme treatment. Before and after enzyme therapy, measurements of fabric its thickness, seam tension, shirt weight, burst resistance, pilling resistance, water resistance, and water absorbency were made. The outcomes were compared.

The aim of this study:

- Study the effect of the cellulose enzyme on some physical and mechanical properties of two kinds of children's T-shirt fabrics.
- Investigate the application of enzymatic treatment techniques to denim wear on knitted children's T-shirts.
- Study the effects of enzyme therapy on the water absorption and repulsion of two kinds of children's T-shirt fabrics.
- Investigate the breakthrough-resistant effects of enzymatic therapy on two kinds of children's T-shirt fabrics.
- Study the cellulose's effects on the seam tension strength of two kinds of children's T-shirt fabrics.

2. Materials and Methods

Samples of clothing

Two types of knitted children's T-shirts are shown here.

Three samples each of only one jersey 100% fibre flax T-shirt and an interlock 100% fibre flax T-shirt are provided.

Chemical dyeing

T-shirt samples were coloured using reactive dyes.

In the beginning samples had been scrubbed for twenty-five minutes at 100 degrees Celsius in the scrubbing bath described below using caustic soda, sodium hydroxide, and a wetting agent at a pH of 9 to 10.

Following scouring, neutralisation with acetic acid (1 g/l), and 500°C for 10 minutes.

Some Chemicals

Acid cellulase enzyme, Acetic acid, Sodium hydroxide, Sodium carbonate and Reactive dyes.

Adye bath

Each of the samples were coloured in the second step using the following types of dyes: Synozol blue HFG, 1% reactive dyes, 7.5 g/L bicarbonate of sodium (alkali), 1 g per litre of storage agent, 75 g/L glauber salt or typical salt (electrolyte), 1:10 liquid ratio, and sixty degrees Celsius temperature.

Following dyeing

The coloured samples were then subjected to the following treatments: a neutralisation step using 0.5 g/L acetic acid, a cold wash at fifty degrees Celsius for a period of ten minutes, and a hot wash at ninety-five degrees Celsius for 15 minutes.

Cellulose therapy in acid

Each type of T-shirt includes one untreated sample. Other t-shirt samples underwent typical settings of acid cellulase enzyme treatment. Acid cellulase enzyme 1%, acetic acid 1 g/l, 50°C, 25 min., and a 1:10 ratio of liquor make up the cellulase of the enzyme bath (**Table 1**).

3. Measurements

Fabric thickness

The goal of this test is to determine the samples' weight per square centimetre. The ASTM D 3776 Test Method for Measuring Mass per Unit Area (Weight) of Fabric was used for this test.

Fabric weight

The purpose of this test is to gauge the specimen's thickness. The ASTM D 1777 Test Method for Measuring Fabric Thickness was used for this test.

Both water resistance and absorption

This test, also known as the "spray test", is used to evaluate a sample's water repellency.

Burst protection

The purpose of this test is to identify a sample's bursting resistance. The American Society of Testing and Materials 3786 Test Method for Measuring Burst Resistance of Fabric was used for this test.

Table 1. Details of T-shirt materials.

No.	Fabric type	Fabric weight (g/m ²)	Fabric thickness (mm)	Water repellency (%)	Burst resistance (kPa)	Seam tensile strength (kg)
1	Single jersey 100% fiber	181	0.47	92	11.6	31
2	Interlock 100% fiber	192	0.48	90	11.1	29

Tensile strength of seams

The goal of this test is to figure out how strong the side seams of the samples' seams are. The American Society of Testing and Materials 4632 Test Procedure for Measuring the Seam Tensile Strength of Garments was used for this test.

Medication resistance

This test is designed to determine the sample's pillaging resistance. This test was conducted in accordance with BS 5811, ICI Box Test Method for Evaluating Textile Pinning Sensitivity.

4. Results and Discussion

Cellulose's effects on fabric weight

Table 2 displays the findings from the evaluation of the fabric weight of fibre knit T-shirts. Results showed that after enzymatic treatment, weight loss in 100% fibre interlock fabric was slightly greater (2.4%) than weight loss in 100% fibre single jersey fabric (0.99). This reduction in weight results from the enzymatic hydrolysis of cellular fibres, particularly on the fabric surface, to soluble substances like glycogen [12]. A weight reduction of 3% - 6% is seen as acceptable commercially [13]. Therefore, the weight decrease of two different types of materials is reasonable (**Table 3**).

Effects of enzyme therapy on water absorption and repulsion

Table 4 displays the findings from the evaluation of the fiber knit T-shirts'

Table 2. Influence of cellulosic enzymes on various knit T-shirt fabrics in terms of weight.

Fabric type	Single jersey 100% fiber T-shirt (g/m ²)	Interlock 100% fiber T-shirt (g/m ²)
Before treatment	207	243
After treatment	204	235

Table 3. Effects of the cellulosic enzymatic on various crocheted T-shirt fabrics in terms of thicknesses.

Fabric type	Fully fibre single-jersey T-shirt (mm)	Interlock 100% fiber T-shirt (mm)
Before treatment	0.71	0.88
After treatment	0.68	0.87

Table 4. The impact of the cellulose enzyme on various crocheted T-Shirt materials' ability to attract water.

Fabric type	Single jersey 100% fiber T-shirt (%)	Interlock 100% fiber T-shirt (%)
Before treatment	76	73
After treatment	55	52

fabric water repellence. Results showed a 22% reduction in the water repellence of both materials.

After enzyme treatment, the water absorption of both textiles increased by 21%. This is because the natural decomposition of cellulosic fibres that protrude from the fabric surface improves the water absorption of knitted materials [5].

Breakthrough-resistant effects of enzymatic therapy

Table 5 displays the findings from testing the fabric burst resistance of fiber knit T-shirts. After enzymatic treatment, the burst resistance of singlets fell by 7.4% and that of interlocks by 4%. The interlock has a strong propensity to pill. Therefore, after being treated with the cellulose enzyme, interlock fabric suffered less of a decrease in burst resilience than single jersey. Due to the activity of an enzyme, the pills, fluff, and projecting fibres are hydrolyzed. Lessening the impact on the fabric's burst resistance. The likelihood of a single jersey pilling is low [11]. Therefore, the hydrolysis of pills, fuzz, and projecting cellulose fibres by the enzyme had a greater impact on the fabric's burst strength. 10% burst strength decrease is seen as appropriate [14].

Cellulose's effects on seam tension strength

Table 6 displays the findings from testing the seam tensile strength of a fiber knit T-shirt's front seam. After enzymatic treatment, the seam tensile strength of the side seam of a single jersey T-shirt decreased by 10.9%, whereas the seam strain strength of the side seam of an interlock T-shirt declined by 3.8%. The interlock has a strong propensity to pill. Therefore, after cellulose enzyme treatment, the interlock garment's loss of seam tensile strength was lower than that of the single jersey. This happens as a result of the pill's being hydrolysed by an enzyme.

5. Conclusion

Cellulase enzyme treatment improves the quality of interlock 100% fiber T-shirts, reducing burst resistance and seam tensile strength compared to

Table 5. Influence of the cell membrane protein on various crocheted T-shirt materials' bust tolerance.

Fabric type	Fully fibre single-jersey T-shirt (kPa)	Completely fibre mesh T-shirt (kPa)
Before treatment	10.9	10.3
After treatment	10	9.7

Table 6. Influence of the cellulose digestive enzyme on the side seams' seam tensile strength of various weave T-shirts.

Fabric type	Fully fibre single-jersey T-shirt (kPa)	Completely fibre mesh T-shirt (kPa)
Before treatment	29	29
After treatment	24	27

single-jersey T-shirts. The enzyme hydrolyzes pills, fluff, and projecting fibers without affecting seam tensile and burst resistance. Interlock T-shirts lose more weight after treatment, but the treatment has a better effect on most qualities. It is recommended for treating 100% fiber interlock children's clothing to enhance knitwear characteristics and prevent skin irritation.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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