

Comparative Analysis of Fabric Property Changes Processed by Two Different Brands of Stenter Machines: A Study on Drying and Finishing Effects in Textile Production

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Abstract

In this research, we are going to investigate and compare the key properties changes of dyed fabric by drying and finishing it using two different stenter machine brands. The stenter machines are crucial for improving fabric quality and appearance. It is a textile finishing machine that is used to heat set, dry, and apply finishing chemical treatments to fabrics in order to ensure their desired dimensions and properties. During this research, we will go through several laboratory tests of mechanical, dimensional, and aesthetic properties to analyze the impact of each stenter machine. The study findings will assist textile manufacturers in selecting machinery that ensures consistency, quality, efficiency, and energy to achieve the desired result.

Keywords

Stenter machine, fabric finishing, dimensional stability, GSM, fabric strength, colorfastness, textile machinery comparison

1.1 Introduction

The global textile industry continues to aim at improving fabric quality, production efficiency, and sustainability to evolve through technological advancements. The finishing process is one of the most critical stages in textile manufacturing, where fabrics are subjected to mechanical and chemical treatments to enhance their appearance, texture, and performance characteristics. During this process, the stenter machine plays a vital role among the other machinery (Choudhury 2017). Primarily, it is responsible for drying, heat-setting, and width control of fabrics, which significantly influences the final properties of the textile (DSRrey.2023). In fabric properties, the performance and technological configuration of different stenter machines can lead to varied outcomes, making it necessary to analyze

the comparative efficiency and effects of the machines on textile finishing.

In this research, two different brands of stenter machines Ehwha TEXTINNO and Yoantion were taken in the process, which focuses on appraising and comparing the fabric property changes resulting from. These two brands are well-recognized manufacturers in the textile machinery field, and each incorporates not unique designs but also process control mechanisms. The differences related to machine design, tension control, heat application systems, energy consumption, and air circulation can all contribute to disparities in fabric properties like dimensional stability, shrinkage, softness, colorfastness, GSM (grams per square meter), and mechanical strength (Gowda and Netravathi 2017).

Textile producers frequently run into the challenge of selecting the most proper stenter machine that aligns with their production requirements and fabric specifications in practical manufacturing environments. However, a shortage of empirical data exists comparing how different brands' performance changes under similar operational conditions. This research addresses that void by methodically analyzing fabric samples processed on both brands stenter machines under the standardized conditions, providing a clear understanding of their respective performance (Cay and Tarakcioglu and Hepbasli 2007). Furthermore, these insights are useful for both machineries purchasing decisions and contributing to optimizing textile finishing procedures for better energy efficiency and fabric quality.

In addition, this study carries larger implications for adherence to sustainable textile production. Also, it is crucial to determine which brands' stenter machine offers less fabric wastage and better energy efficiency, with growing emphasis on reducing carbon footprints and conserving resources, understanding and less fabric wastage becomes critically important. Thus, this research also reflects on optimal operational efficiency and sustainability considerations associated with each machine alongside fabric quality assessment (Purushothama 2004).

After carrying out a detailed comparative analysis, this study provides a practical reference for textile engineers, researchers, and manufacturers to make defensible decisions during machine selection and process optimization. In the end, the outcomes are expected to improve the understanding of how machinery selection influences fabric quality and production outcomes in current textile finishing (Shahriar 2019).

1.2 Objectives

- To determine the fabric's physical and aesthetic properties, the fabric was processed using two different brands of stenter machines.
- To assess variances in fabric strength, dimensional stability, GSM, colorfastness, and appearance.
- To provide suggestions for choosing machinery based on performance and quality outcomes.

2. Materials and Methodology

2.1 Fabric Details

▪ Fabric Name	: Plain Weave Cotton Shirting Fabric
▪ Weave Type	: Plain Weave (1/1)
▪ Yarn Details	: Warp - 40s Ne (Combed Cotton), Weft - 40s Ne (Combed Cotton), Ring Spun
▪ Thread Density	: Ends per Inch (EPI): 110, Picks per Inch (PPI): 90
▪ Dimensions	: Fabric Width (Greige): 64 inches, Fabric Width (Finished): 58 inches,
▪ Fabric Weight	: 120 GSM
▪ Additional Details	: Selvage: Leno Selvage or Tucked, Twist: S/Z twist,
▪ Processed State	: Dyed (before putting into the stenter machine)

2.2 Stenter Machine Details

2.3 Machine 1: Ehwha TEXTINNO Stenter Machine

• Manufacturer	: Ehwha Glotech Co., Ltd (South Korea)
• Model No	: TEXTINNO

- **Origin** : South Korea
- **Manufacturing Year** : 2011
- **Chambers** : 8
- **Heating System** : Oil-based
- **Width** : 2400

2.4 Features

- **Uniform Temperature Distribution-** The heat-spraying space and circulation space are divided with the help of a baffle plate, making the chamber design prevent radiant heat interference and offer an even temperature distribution.
- **Vertical Spraying Nozzle Technology-** Using a vertical-spraying mechanism that improves fabric quality by producing an air cushion effect, reducing fabric distortion.
- **Specialized Nozzles-** To fulfil different fabric processing requirements, it offers various nozzles as types, such as flat-type punching, slot-type, and M-type.
- **Optimized Temperature Control-** Outfitted with a and a high turn-down ratio (1:40) gas burner and PLC automation system, which enables reliable and energy-efficient temperature management.
- **Enhanced Insulation-** To decrease heat loss from the chamber, high-performance insulation materials are used.
- **Double-Screen Filter-** Here, A double-screen filter system is used that allows cleaning during the operation, also ensuring to minimize energy waste and downtime.
- **Precise Speed and Overfeed Control-** Here, to cope with an assortment of processing conditions, a non-slip IPM motor is used to provide precise speed control and deliver flexible overfeed control ranging between -10% to +80%.
- **Selvage Handling-** Selvage rolling is reduced, and ultra-precise pinning speed control is achieved by placing the selvage expanding texter pinning device close together.
- **Maximized Dewaterability-** Here, to improve dewatering efficiency, rubber components with differing hardness tailored to different textile types (natural, chemical, blend).

2.5 Machine 2: Yoantion Stenter Machine

- **Manufacturer** : Yoantion (China)
- **Origin** : China
- **Model** : 2019
- **Year of Manufacture** : 2019
- **Heating System** : Steam Heated
- **Chambers** : 10
- **Working Width** : 2400 mm

2.6 Features

- **Chamber Configuration:** It has ten chambers, which ensures better drying quality and longer fabric processing.
- **Working Width:** This machine has a working width of 2400 mm, which allows a variety of fabric sizes.
- **Heating System:** This steam heating system provides consistent and flexible heat for fabric processing (Alam and M. G 2021).
- **Additional Features:** Some features, such as control systems, nozzle types, or fabric handling mechanisms, are not specified in detail here.

2.7 Process Parameters (Same for both machines)

- **Temperature:** 160°C
- **Moisture Content:** Standardized at inlet
- **Width Control:** 80 cm
- **Dwell Time:** 2 minutes
- **Overfeed:** 10%

2.8 Test Methods and Standards

Table 1: Testing Methods and Standards of Fabric

Property	Testing Standard	Equipment Used
Dimensional Stability (Shrinkage)	ISO 5077	Shrinkage Template + Scale
GSM (Fabric Weight)	ASTM D3776	GSM Cutter + Digital Scale
Tensile Strength	ISO 13934-1	Universal Testing Machine
Colorfastness to Wash	ISO 105-C06	Colorfastness Tester [10]
Surface Appearance (Pilling)	ISO 12945-2	Pilling Tester
Visual Appearance	AATCC EP9	Grey Scale Evaluation [9]

2.9 Sample Size:

Five pieces from each machine have been taken (10 samples in total).

3. Test Data Format

3.1 Dimensional Stability

Table 2: Dimensional Stability: Length and Width Shrinkage (%) of Fabrics Processed by Ehwha TEXTINNO and Yoantion Stenter Machines.

Sample ID	Machine Brand	Length Shrinkage (%)	Width Shrinkage (%)	Average Shrinkage (%)	Remarks
A1	Ehwha TEXTINNO	1.8	1.4	1.6	Stable
A2	Ehwha TEXTINNO	2.0	1.5	1.75	Within Limit
A3	Ehwha TEXTINNO	1.9	1.6	1.75	Acceptable
A4	Ehwha TEXTINNO	2.1	1.4	1.75	Good
A5	Ehwha TEXTINNO	1.7	1.3	1.5	Excellent
B1	Yoantion	2.5	1.9	2.2	Slightly Higher
B2	Yoantion	2.7	2.0	2.35	Acceptable
B3	Yoantion	2.6	2.1	2.35	Acceptable
B4	Yoantion	2.8	1.8	2.3	Borderline
B5	Yoantion	2.9	2.2	2.55	Moderate Shrinkage

In this data analysis, the performance difference between the two stenter machines is revealed [8]. According to dimensional stability, lower shrinkage was found for the Ehwha TEXTINNO samples with an average of 1.75% compared to Yoantion's machine, which is 2.35%. This suggests that improved tension and heat control are essential for reducing shrinkage in cotton fabrics.

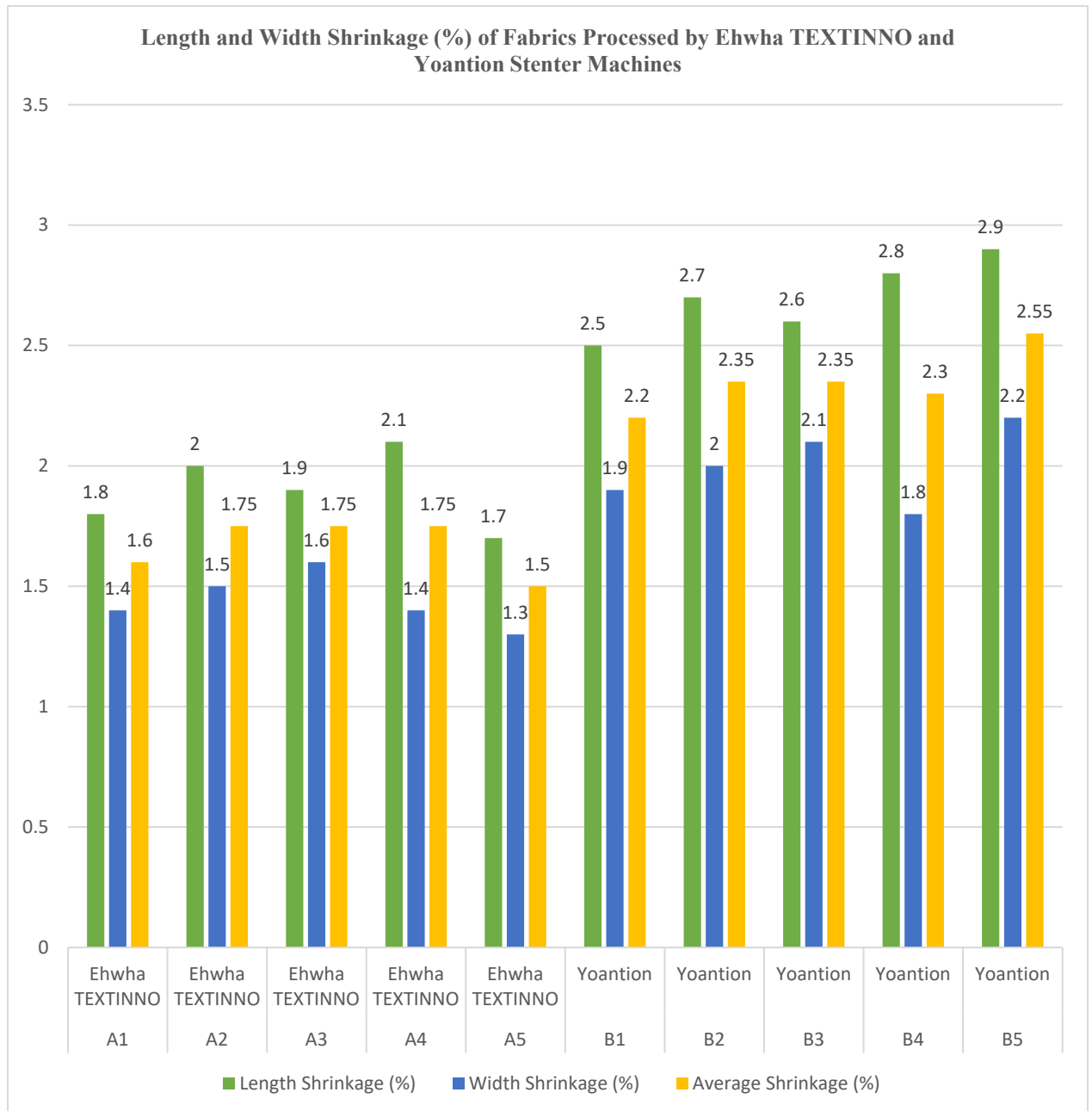


Figure 1. Comparison of Length and Width Shrinkage (%) in Fabrics Processed by Ehwha TEXTINNO and Yoantion Machines.

3.2 GSM (Fabric Weight)

In case of effective fabric compaction, the GSM increased in the Ehwha TEXTINNO group up to 3.33% whereas Yoantion samples showed a consistent weight loss, which may affect the durability and quality of finished fabric.

Table 3. Fabric Weight Analysis: GSM Changes Before and After Processing on Ehwha TEXTINNO and Yoantion Stenter Machines

Sample ID	Machine Brand	Initial GSM	Final GSM	GSM Change (%)	Remarks
A1	Ehwha TEXTINNO	120	122	+1.67	Slight Gain
A2	Ehwha TEXTINNO	120	123	+2.5	Good
A3	Ehwha TEXTINNO	120	121	+0.83	Consistent
A4	Ehwha TEXTINNO	120	122	+1.67	Stable
A5	Ehwha TEXTINNO	120	124	+3.33	Slightly High
B1	Yoantion	120	118	-1.67	Slight Drop
B2	Yoantion	120	117	-2.5	Noticeable
B3	Yoantion	120	119	-0.83	Minor
B4	Yoantion	120	118	-1.67	Consistent
B5	Yoantion	120	117	-2.5	Weight Loss

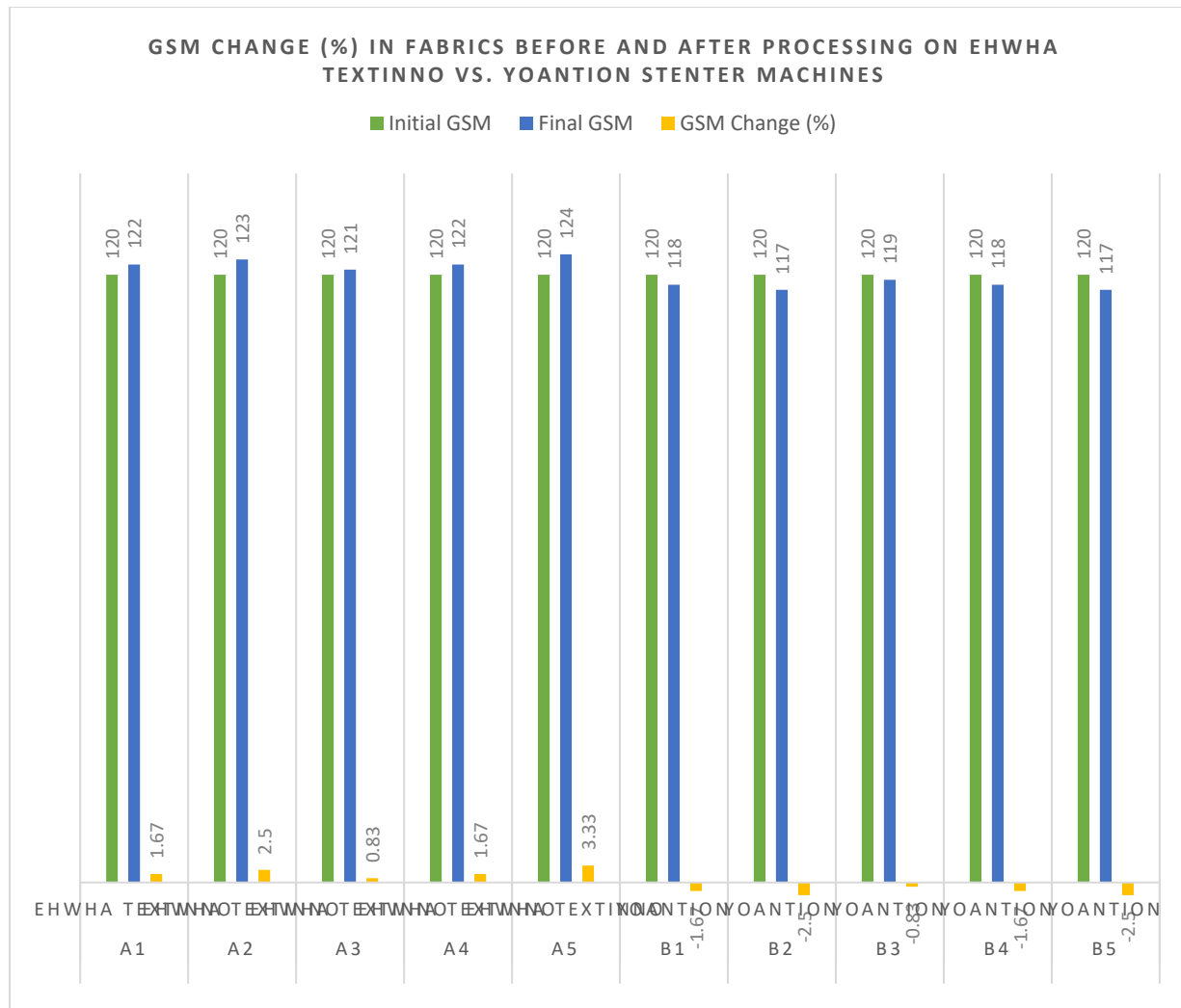


Figure 2. GSM Change (%) in Fabrics Before and After Processing on Ehwha TEXTINNO vs. Yoantion Stenter Machines.

3.3 Tensile Strength

Table 4: Tensile Strength Comparison of Fabrics Processed Using Ehwha TEXTINNO and Yoantion Stenter Machines

Sample ID	Machine Brand	Warp Strength (N)	Weft Strength (N)	Avg. Strength (N)	Remarks
A1	Ehwha TEXTINNO	310	295	302.5	Strong
A2	Ehwha TEXTINNO	315	290	302.5	Consistent
A3	Ehwha TEXTINNO	320	300	310	Very Good
A4	Ehwha TEXTINNO	312	289	300.5	Stable

A5	Ehwha TEXTINNO	318	297	307.5	Reliable
B1	Yoantion	280	270	275	Moderate
B2	Yoantion	278	268	273	Slightly Weak
B3	Yoantion	285	272	278.5	Acceptable
B4	Yoantion	279	270	274.5	Slightly Low
B5	Yoantion	277	268	272.5	Weak

While Tensile strength tests, fabrics processed by Ehwha TEXTINNO- were stronger, averaging above 300N, whereas in Yoantion, samples' strength was detected below 280N. In high-tension circumstances, such as suiting and shirting fabrics, this difference could result in longer garment life.

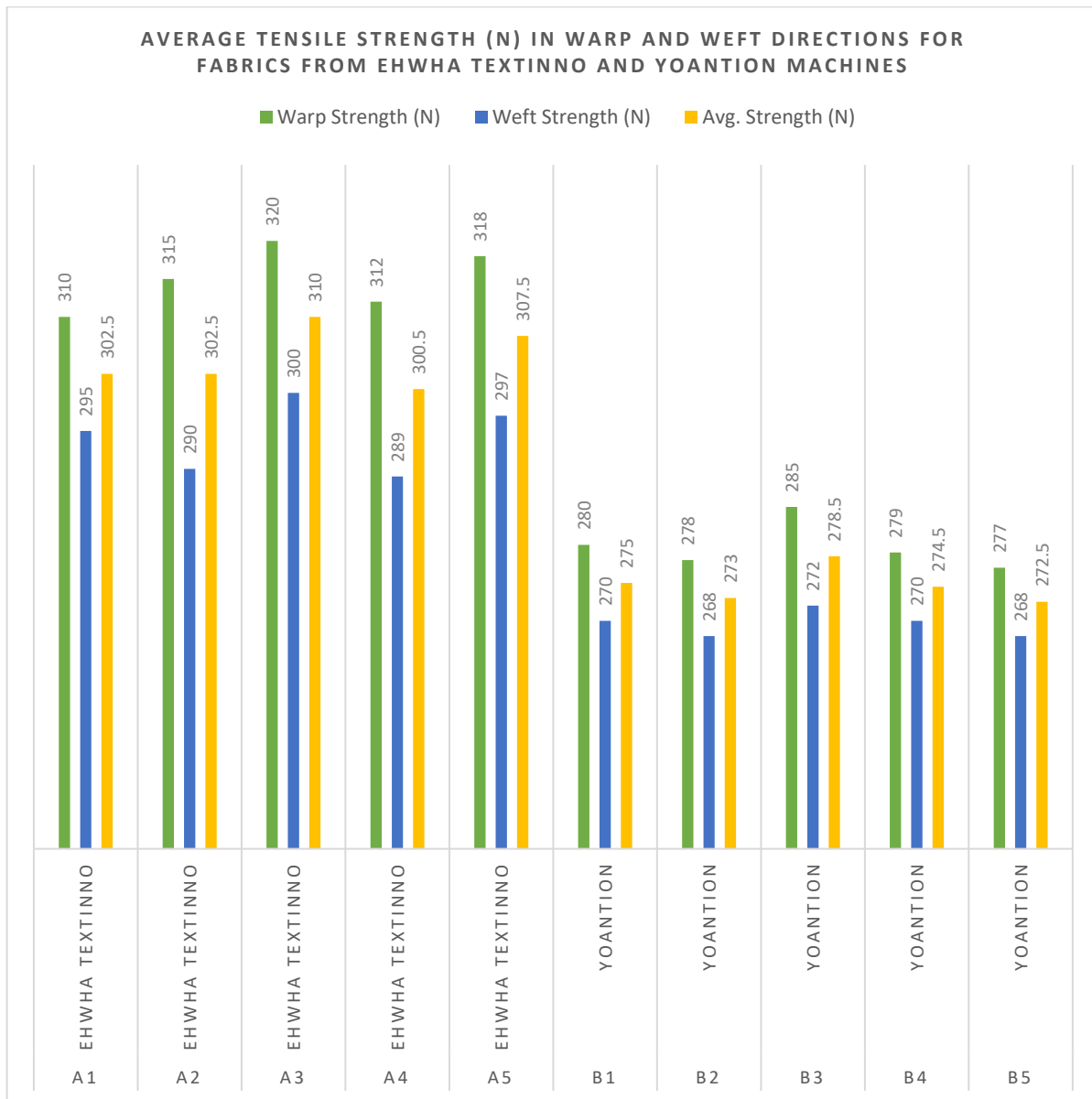


Figure 3. Average Tensile Strength (N) in Warp and Weft Directions for Fabrics from Ehwha TEXTINNO and Yoantion Machines.

3.4 Colorfastness to Washing

Table 5 Colorfastness to Washing: Color Change and Staining Grades of Fabrics Processed by Ehwha TEXTINNO and Yoantion Machines

Sample ID	Machine Brand	Color Change Grade (1–5)	Staining Grade (1–5)	Remarks
A1	Ehwha TEXTINNO	4.5	4.5	Excellent
A2	Ehwha TEXTINNO	4.5	4.0	Very Good
A3	Ehwha TEXTINNO	5.0	4.5	Excellent
A4	Ehwha TEXTINNO	4.0	4.0	Good
A5	Ehwha TEXTINNO	4.5	4.5	Very Good
B1	Yoantion	3.5	3.5	Fair
B2	Yoantion	4.0	3.5	Average
B3	Yoantion	3.5	3.0	Slightly Faded
B4	Yoantion	3.0	3.0	Poor
B5	Yoantion	3.5	3.0	Moderate

The Ehwha TEXTINNO machine was also chosen because of its colorfastness, which is a commercial and aesthetic priority. Maximum samples indicated less dye loss and improved fixation by scoring between 4.5–5.0. Pilling resistance and visual appearance further reinforced the machine’s superiority. Across these parameters, the Ehwha TEXTINNO often scored almost the top, which is between 4.5–5.0.

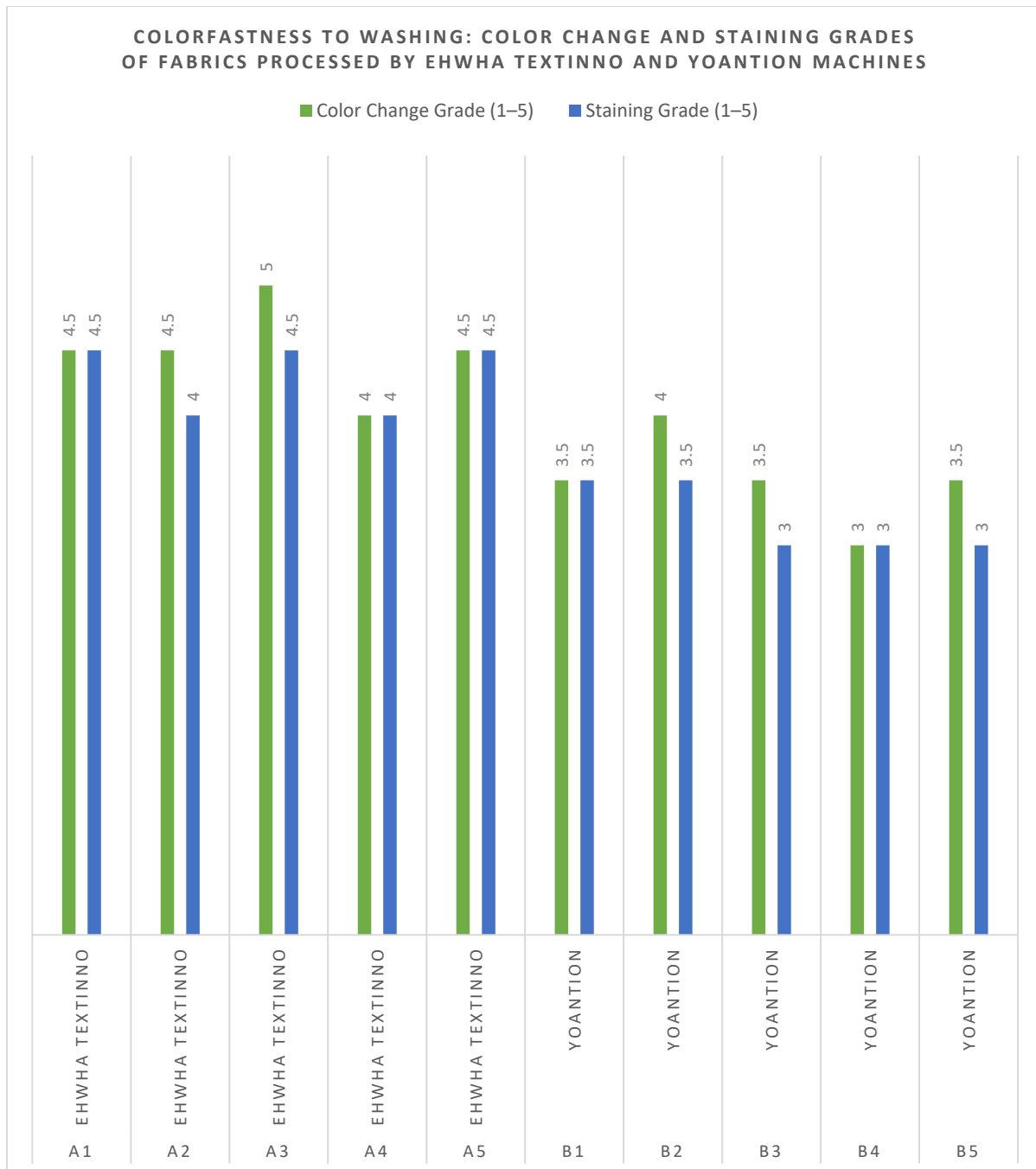


Figure 4. Colorfastness to Washing: Color Change and Staining Grades of Ehwah TEXTINNO vs. Yoantion Processed Fabrics

3.5 Pilling Resistance

Table 6: Pilling Resistance Evaluation of Fabrics Processed by Ehwha TEXTINNO and Yoantion Stenter Machines

Sample ID	Machine Brand	Pilling Grade (1–5)	Surface Notes	Remarks
A1	Ehwha TEXTINNO	4.5	Smooth	Minimal Pilling
A2	Ehwha TEXTINNO	5.0	Very Smooth	No Pilling
A3	Ehwha TEXTINNO	4.5	Clean Surface	Good Resistance
A4	Ehwha TEXTINNO	4.0	Slight Fuzz	Acceptable
A5	Ehwha TEXTINNO	5.0	Smooth Finish	Excellent
B1	Yoantion	3.0	Moderate Pilling	Visible Pilling
B2	Yoantion	3.5	Slight Pilling	Moderate
B3	Yoantion	3.0	Uneven Surface	Moderate
B4	Yoantion	2.5	Rough Surface	Poor
B5	Yoantion	2.0	Fuzzy	Unacceptable

High pilling resistance test shows that the Ehwha TEXTINNO samples (A1–A5) score between 4.0 to 5.0. Here, maximum samples scored 4.5 or higher, which indicates excellent surface durability and minimal fabric wear. On the other hand, Yoantion samples (B1–B5) show moderate to poor performance, and the score was between 2.0 to 3.5. The lowest score was B5=2.0, indicating several fuzziness and unacceptable pilling. So, it is clear that the Ehwha TEXTINNO machine offers greater fabric integrity, due to its better technology or processing techniques.

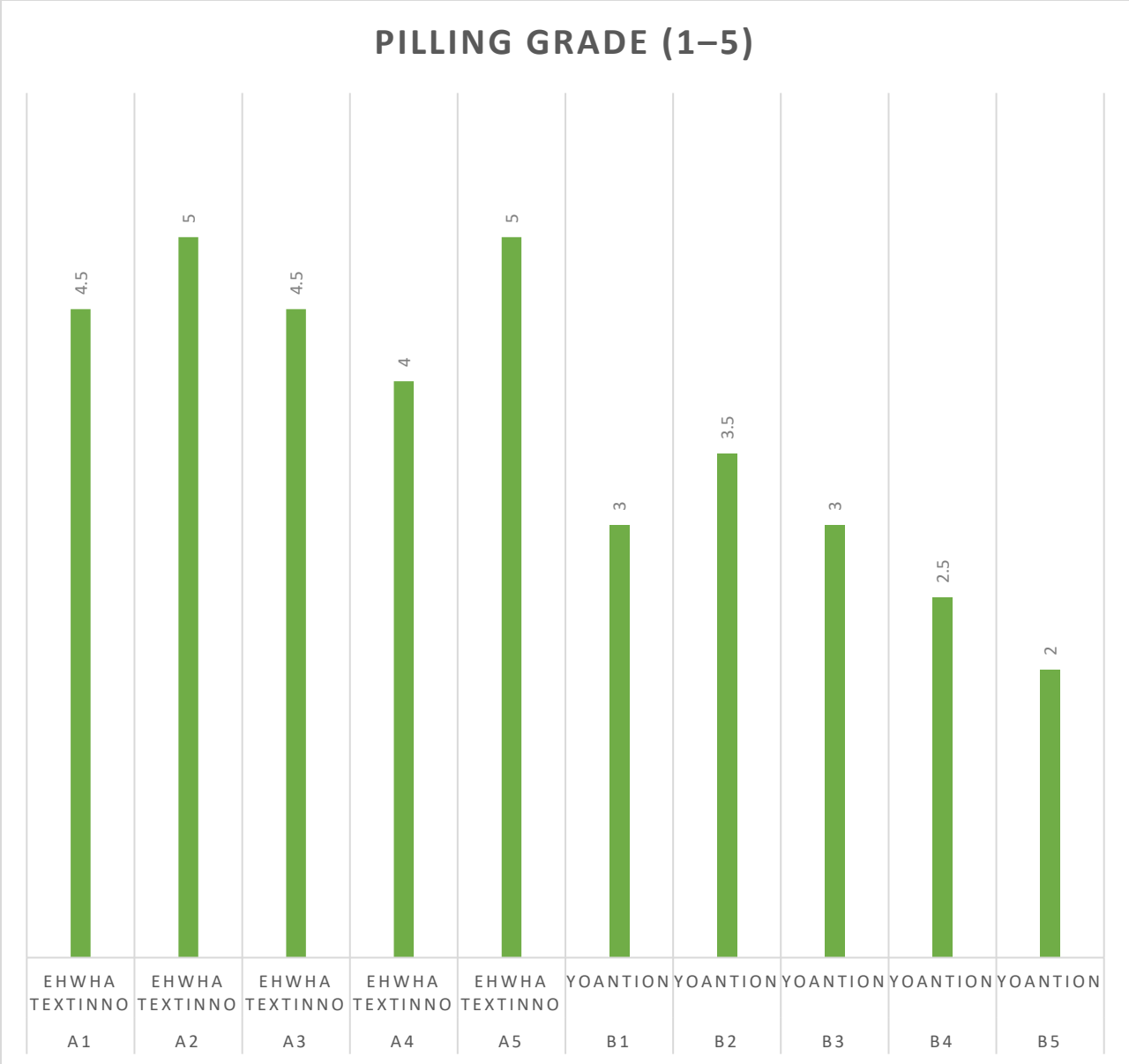


Figure 5. Pilling Resistance (Grade 1-5) of Fabrics Treated with Ehwha TEXTINNO and Yoantion Machines.

3.6 Visual Appearance (Grey Scale Assessment)

Table 7. Visual Appearance Assessment (Grey Scale) of Fabrics Processed by Ehwha TEXTINNO and Yoantion Machines.

Sample ID	Machine Brand	Visual Score (1–5)	Appearance Observations	Remarks
A1	Ehwha TEXTINNO	5.0	Uniform	Excellent
A2	Ehwha TEXTINNO	4.5	Clean	Very Good
A3	Ehwha TEXTINNO	5.0	Smooth	Excellent
A4	Ehwha TEXTINNO	4.0	Minor Issues	Good
A5	Ehwha TEXTINNO	5.0	Perfect	Outstanding
B1	Yoantion	3.5	Uneven Texture	Acceptable
B2	Yoantion	3.0	Slight Marks	Moderate
B3	Yoantion	2.5	Faded Lines	Weak
B4	Yoantion	3.0	Patchy	Fair
B5	Yoantion	2.5	Wrinkled	Poor

Lastly, we can say, with Visual Scores ranging between 4.0 to 5.0, Ehwha TEXTINNO performs much better than Yoantion in visual appearance. Ehwha TEXTINNO samples are smoother, uniform, and perfect, which reflects a higher quality. Whereas Yoantion samples range between 2.5 to 3.5, they show mentions of issues such as faded lines, wrinkles, and uneven texture, which display uneven finish and potential faults happen in production.

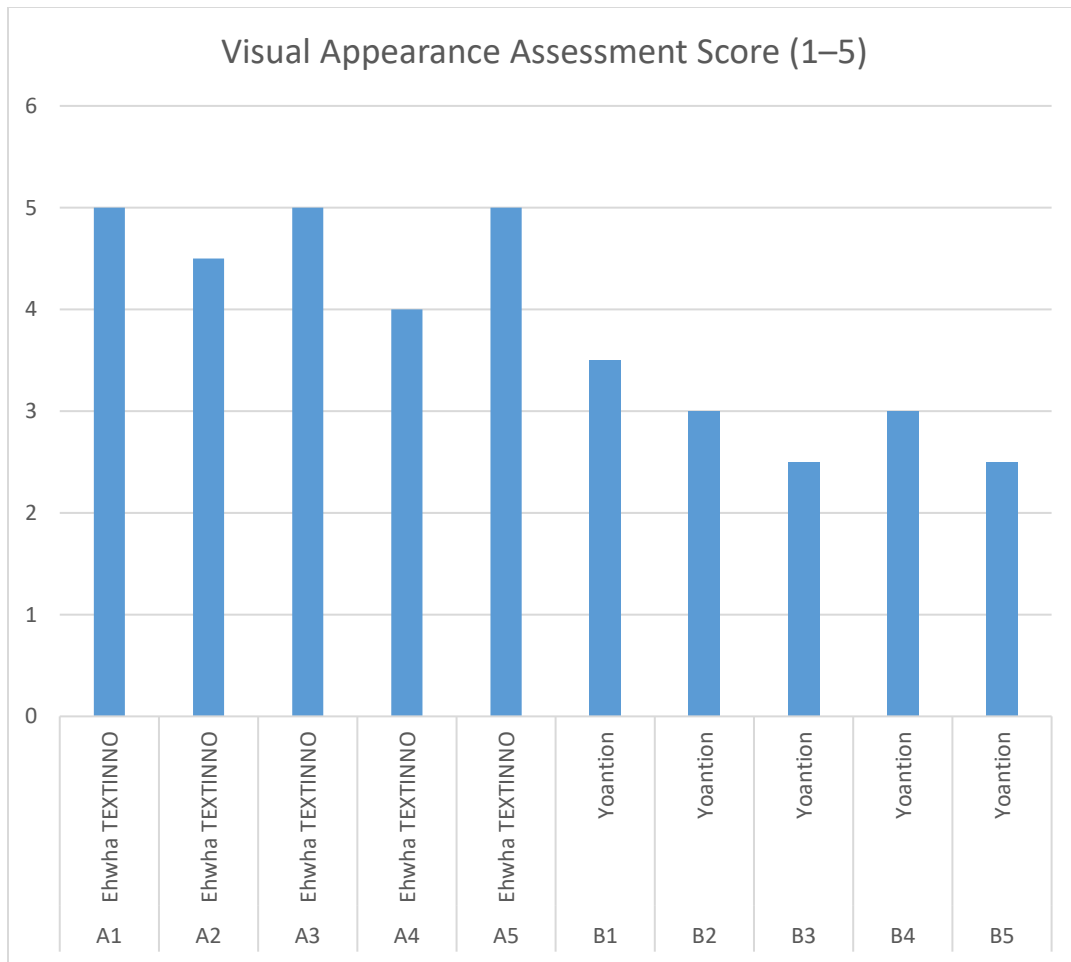


Figure 6. Visual Appearance Scores (Grey Scale Assessment) of Fabrics Processed by Ehwha TEXTINNO and Yoantion Machines.

4. Results and Discussion

a. Dimensional Stability

The Dimensional stability test results show that fabrics processed using the Ehwha TEXTINNO machine exhibited superior control over shrinkage. For Yoantion samples, the average shrinkage across length and width averaged 2.35% whereas Ehwha TEXTINNO samples averaged 1.75%. This shrinkage difference between them displays that the Ehwha TEXTINNO machine offers better heat control and tension during processing, which is important in order to maintain fabric dimensions after wash, especially in cotton textiles, where shrinkage is the key for quality parameters.

b. GSM (Fabric Weight)

The GSM (grams per square meter) result score made the performance difference clearer. The Ehwha TEXTINNO machine samples exhibited that fabric weight increased up to +3.33%, which shows effective fabric compaction. On the other hand, Yoantion samples show weight loss up to -2.5%, which may negatively affect the tactile feel and long-term durability of the fabric. These differences display that the Ehwha TEXTINNO machine retains fabric density and ensures better mechanical control.

c. Tensile Strength

The samples of the Ehwha TEXTINNO machine performed higher average strength, which was 300.5–310N. On the other hand, the Yoantion machine samples tensile strength was below 280 N. This suggests stronger fiber alignment and integrity resulting from better thermal and mechanical settings in the Ehwha machine. For end-use applications such as shirting and suiting materials that require robust fabric performance, higher tensile strength is important.

d. Colorfastness to Washing

During colorfastness testing (color change and staining), the Ehwha TEXTINNO machine samples scored between 4.0 and 5.0, whereas Yoantion scores ranged from 3.0 to 4.0. These results show that Ehwha-processed fabrics have improved dye fixation and washing durability in contrast with Yoantion. This is an important commercial factor because we know that higher colorfastness reduces the chances of customer complaints and returns due to color fading or dye transfer during laundry.

e. Pilling Resistance

The Ehwha TEXTINNO machine samples scored between 4.0 and 5.0 during the pilling resistance test, which indicates less surface fuzziness and entanglement of the fiber. On the other hand, Yoantion machine samples scored between 2.0 to 3.5, with more surface imperfections and visible pilling. This indicates that Ehwha's processing results show better surface integrity than Yoantion machine samples, which are crucial for premium fabric applications.

f. Visual Appearance (Grey Scale Assessment)

Visual appearance scores again favored, with maximum samples scoring between 4.0 and 5.0; the Ehwha TEXTINNO machine sample won the visual appearance test by displaying unformed, smooth, and perfect fabric samples. In contrast, Yoantion samples were scored between 2.5 and 3.5, which were noted as wrinkled, patchy, or uneven. So it can be said, due to more precise heat setting and fabric tension management, Ehwha TEXTINNO machine samples display greater uniformity and fabric refinement .

g. Summary of Comparative Performance

Table 8: Summary of Comparative Performance Processed by Ehwha TEXTINNO and Yoantion

Parameter	Ehwha TEXTINNO	Yoantion	Result
Dimensional Stability	Avg. Shrinkage: 1.75%	Avg. Shrinkage: 2.35%	Ehwha Superior
GSM Change	+0.83% to +3.33%	-0.83% to -2.5%	Ehwha Superior
Tensile Strength (Avg.)	>300 N	<280 N	Ehwha Superior
Colorfastness to Washing	4.0–5.0 (Both grades)	3.0–4.0	Ehwha Superior
Pilling Resistance	4.0–5.0	2.0–3.5	Ehwha Superior
Visual Appearance	4.0–5.0	2.5–3.5	Ehwha Superior

5. Conclusion & Recommendations:

In practically all fabric quality aspects, the Ehwha TEXTINNO stenter machine performed better than Yoantion in accordance with the comparative inquiries. It displayed greater GSM retention, dimensional stability, colorfastness, pilling resistance, tensile strength, and visual appeal. The Ehwha TEXTINNO is the perfect choice for manufacturers who emphasize premium fabric quality and consistency. We can say, further studies may consider energy efficiency and lifetime durability of machinery.

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References

- Abdulla, A., Rokonuzzaman, M., Bashar, M. M., & Siddiquee, M. A. B. Effect of mechanical finishing on dimensional stability of cotton knitted fabric. *Academia.edu*, 2019.
- Alam, S. M. M., & Kibria, M. G. Sustainable heat-setting process in stenter for textile industry. *Materials Today: Proceedings*, 2021.
- American Association of Textile Chemists and Colorists, *AATCC EP9: Evaluation procedure 9: Visual assessment of color difference of textiles*, 2015.
- ASTM International. *STM D3776/D3776M-20: Standard test methods for mass per unit area (weight) of Fabric*, 2020.
- Cay, A., Tarakcioglu, I., & Hepbasli, A. Exergetic performance assessment of a stenter system in a textile finishing mill. *International Journal of Energy Research*, 31(14), 1251–1265, 2007.
- Choudhury, A. K. R. *Textile finishing*. Woodhead Publishing, 2017.
- Christie, R. M. *Textile processing and properties*. Elsevier, 2015.
- DSRrey. Revolutionizing fabric finishing: The role of heat setting stenter machines in textile production, 2023.
- Gowda, R. V., & Netravathi, M. A review on the influence of finishing process on the performance characteristics of textile fabrics. *International Journal of Textile and Fashion Technology*, 7(4), 1–10, 2017.
- Hong, G. B., Su, T. L., Lee, J. D., Hsu, T. C., & Chen, H. W. Heat recovery for a textile stenter: CFD analysis of air curtain benefits. *Energies*, 12(3), 482, 2019.
- Khan, M. A., & Rahman, M. A. Influence of stenter machine parameters on dimensional stability of cotton fabric. *Journal of Textile and Apparel Technology and Management*, 8(1), 45–52, 2014.
- Kumar, R., & Rajendrakumar, P. S. Analysis of process parameters on GSM and shrinkage in stenter process. *International Journal of Engineering Research and Technology*, 3(10), 1123–1127, 2014.
- Lomas, C. *Fabric testing*. Textile Institute, 2009.
- Purushothama, B. *Fabric inspection and grading*. New Age International Publishers, 2004.

- Shahriar, A. Physical change of various knitted fabrics by stentering & compacting. *International Journal of Textile Science*, 8(2), 31–37, 2019.
- Sinclair, R. *Textiles and fashion: Materials, design and technology*. Woodhead Publishing, 2015.
- Xu, Y., & Li, M. Study on the influence of stenter parameters on cotton fabric properties. *Textile Asia*, 41(8), 32–36, 2010.

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