Research Article

An Innovative Approach to Technical Textiles: Assessing the Performance of Olefin-Based Outdoor Fabrics

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Abstract

In recent years, consumer preferences have undergone significant transformations driven by socio-cultural, economic, and demographic factors, resulting in a growing demand for innovative and sustainable textile products. The intensifying competition in the global market, along with evolving consumer expectations, necessitates that firms within the textile industry not only adapt to technological advancements but also develop sustainable solutions. Within this framework, Menderes Tekstil has emerged as a pioneer in the field of outdoor technical textiles by introducing an innovative production process through the utilization of olefin yarns. Compared to acrylic and polyester yarns, olefin-based fabrics demonstrate superior mechanical performance, offering twice

the tensile strength of acrylic and approximately 30% greater strength than polyester. In addition, these fabrics exhibit water- and oil-repellency, ultraviolet resistance, mold resistance, and stain resistance, thereby ensuring durability and suitability for outdoor applications. The recyclability of olefin yarns further reinforces an environmentally responsible production approach, contributing to broader sustainability objectives. Specifically developed for demanding applications such as garden furniture, umbrellas, awnings, and marine textiles, these products not only address a critical gap in the textile market but also enhance the competitive capacity of the firm by combining innovative features, environmental advantages, and high added value.

Keywords: Olefin yarn; Acrylic yarn; Technical textiles; Outdoor textiles; UV resistance; Water repellency

1. Introduction

Outdoor fabrics are technical textiles developed to withstand harsh weather and environmental conditions, designed for applications such as garden seating sets, boat upholstery, umbrellas, awnings, and similar uses. These fabrics are produced using specialized fibers and surface treatments to provide resistance against sunlight (UV), water and moisture, mold, stains, abrasion, and fading.

Material Preferences

- **Synthetic Fibers:** The most common choice for outdoor applications is synthetic fibers. Polyester, acrylic, and polypropylene provide stronger, more water- and UV-resistant alternatives compared to natural fibers.
- **Polyester:** Offers high strength and good performance against UV exposure. Since its natural water repellency is weak, it is often enhanced with coatings.
- **Acrylic:** Highly resistant to sunlight and color fading; frequently preferred in outdoor upholstery.
- **Polypropylene:** Demonstrates strong resistance to moisture and mold; a lightweight, durable, and cost-effective option.

Functional Coatings

Coatings applied to fabrics enhance their protective and durability properties:

- **Waterproofing:** Polyurethane (PU), polyvinyl chloride (PVC), or silicone-based coatings create a barrier against water.
- **UV Protection:** Coatings with UV stabilizers help delay color fading and material fatigue, making them essential in applications with high sun exposure.
- **Mold/Bacteria Prevention:** Used in humid climates to limit the growth of microorganisms.

Production Methods

- **Weaving:** Tight weave structures enhance the mechanical strength of the fabric and reduce water and dirt retention. A denser weave also improves abrasion resistance and gives the fabric a more compact structure**.**
- **Coating Applications:** Post-production surface treatments are applied to impart water repellency, waterproofing, or UV resistance. Through lamination, multi-layered structures are created to improve properties such as waterproofing and tear resistance.

Performance Evaluations

- **Weather Resistance:** Tests are conducted to assess durability against sunlight, humidity, precipitation, and temperature fluctuations.
- **UV Resistance:** Color fading and structural degradation under prolonged sun exposure are measured.
- **Waterproofing:** Barrier performance against water is verified through methods such as pressurized water spray tests.
- **Abrasion Resistance:** Durability against friction and wear encountered in outdoor use is evaluated**.**

Sustainability Approaches

- **Recycling:** To reduce environmental impact, recycled synthetic fibers—particularly recycled polyester derived from PET bottles—are increasingly being utilized.
- **Eco-Friendly Coatings:** Coating systems with a lower environmental footprint are preferred as alternatives to conventional chemicals.

Standards and Testing Protocols

- **ISO 4892-2:** Used to evaluate the performance of textiles under UV exposure.
- **ISO 105-B02:** Focuses on the measurement of color fastness and resistance to fading.
- **AATCC 22 Test Method:** Developed by the American Association of Textile Chemists and Colorists to assess the water repellency of fabrics**.**

Design and Aesthetics

- Appearance is also a critical criterion in outdoor fabrics. Vibrant colors, patterns, and textures complement furniture design.
- Resistance to color fading and staining are key determinants in aesthetic choices.

In summary, research on outdoor fabrics extends from the selection of appropriate fibers and production techniques to functional coatings and comprehensive performance testing. Advances in sustainable materials and eco-friendly finishes aim to ensure that these fabrics meet both durability and aesthetic expectations in a long

lasting manner. Production processes and applied technologies are continuously being refined to enhance their adaptability to outdoor conditions.

- In a study conducted by Prescott [4], key performance characteristics of high-tech fabrics developed for outdoor apparel were examined, including moisture management, climate control, and comfort under both hot and cold weather conditions. The article also addressed the specific requirements of military textiles, such as durability, moisture regulation, and the need for protection and comfort across diverse environmental conditions. Lightweight fabrics were highlighted as a critical factor for moisture transport, breathability, and overall comfort, while the use of material combinations was presented as an effective approach to support these advantages.
- A review article [1] presents a comprehensive analysis of outdoor textiles. The study discusses in detail fiber types, fabric structures, finishing techniques, and the performance characteristics required in outdoor applications. Key factors influencing the end-user experience in outdoor environments—such as comfort, protection, and durability—are emphasized, highlighting the need to balance these features in material selection. Furthermore, the article underscores the critical importance of fabric types and finishing methods (e.g., waterproofing, UV resistance, abrasion tolerance) in open-air conditions such as hiking and camping. By evaluating both technical and application-oriented criteria, the review provides valuable guidance for manufacturers and designers alike.
- In a study conducted by Tayyar and Alan [5], performance analyses were carried out on cotton, polyester, and cotton/polyester blend woven fabrics treated with TiO_2 (titanium dioxide) nano-pigment for outdoor applications. The fabrics were dyed using the pad-dry-cure method, and key parameters such as UV resistance, dry/wet rubbing fastness, color fastness, and tensile strength were evaluated. The results indicated that all treated fabrics exhibited high resistance to UV radiation and abrasion. The application of TiO_2 pigment was found to enhance both UV and abrasion resistance while also improving the tensile strength of the fabrics.
- Matusiak [3] investigated quilted fabrics, an example of textile layering technology, produced in two- or three-layered structures. Comfort-related properties such as thermal resistance, thermal conductivity, heat absorption, water vapor resistance, and air permeability were examined. Five different variants of quilted fabrics were tested, and their comfort performance was evaluated in relation to structural differences.

- In their study, Graham and Ruppenicker [2] developed outdoor fabrics by incorporating a glass fiber core into cotton yarns. Fabrics woven from yarns containing 17–57% glass fiber demonstrated suitability and durability for applications such as awnings and tarpaulins. Through commercial finishing treatments, the fabrics were endowed with water repellency and enhanced durability. Compared to pure cotton fabrics, the glass fiber–reinforced fabrics exhibited greater strength, improved weather resistance, and superior fire resistance.

In outdoor fabrics, properties such as water and oil repellency as well as resistance to mold are generally expected. These fabrics are typically produced using acrylic or polyester yarns. Through our project, however, a first will be achieved by utilizing olefin yarns instead of acrylic and polyester.

Olefin is a synthetic fiber produced from polyolefin molecules such as polypropylene or polyethylene. Since different molecular types can be used in fiber production, olefin may exhibit several molecular structures, including those derived from ethylene, propylene, or other olefins.

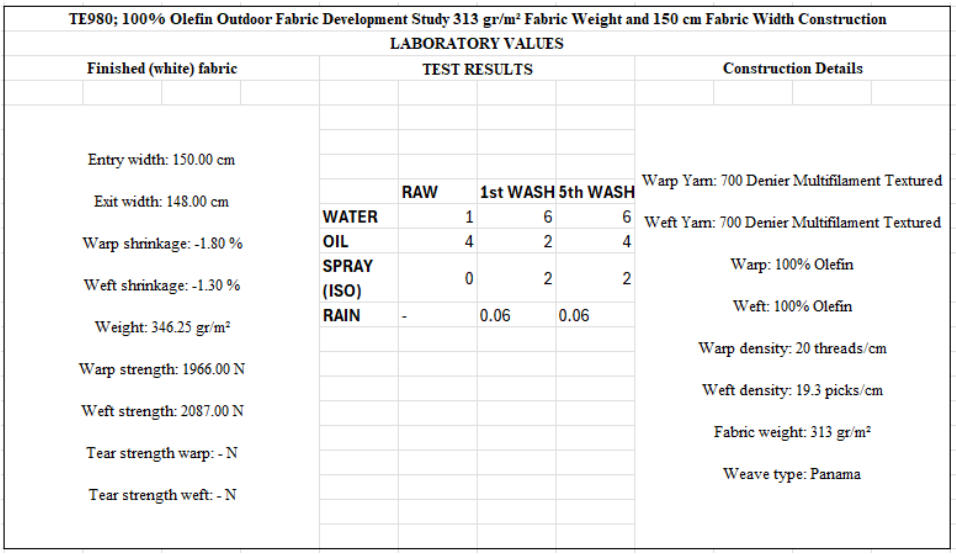
2. Materials and Methods

In the initial phase of our project, following a preliminary meeting at Turktex Company in Bursa, sample yarn colors were selected from the solution-dyed olefin yarn color catalog.

Figure 1.Yarn color catalog

To ensure compatibility with our own sectional warping machines, sample yarn orders were placed for air-textured and high-twist yarn production. A specific construction was defined, and to facilitate the monitoring of sample production within the facility, the process was carried out under the code TE980.

TE980 (700*700 denier, 150 cm width, 300 g/m², Panama weave, 75 m).



TE980; 100% Olefin Outdoor Fabric Development Study 313 gr/m² Fabric Weight and 150 cm Fabric Width Construction

LABORATORY VALUES

Finished (white) fabric	TEST RESULTS			Construction Details
Entry width: 150.00 cm				
Exit width: 148.00 cm		RAW	1st WASH	5th WASH	Warp Yarn: 700 Denier Multifilament Textured
Warp shrinkage: -1.80 %	WATER	1	6	6	Weft Yarn: 700 Denier Multifilament Textured
Weft shrinkage: -1.30 %	OIL	4	2	4	Warp: 100% Olefin
Weight: 346.25 gr/m²	SPRAY (ISO)	0	2	2	Weft: 100% Olefin
Warp strength: 1966.00 N	RAIN	-	0.06	0.06	Warp density: 20 threads/cm
Weft strength: 2087.00 N					Weft density: 19.3 picks/cm
Tear strength warp: - N					Fabric weight: 313 gr/m²
Tear strength weft: - N					Weave type: Panama

Figure 2.TE980 construction details

A total of 43 distinct fabric samples were woven using various combinations derived from the 22 selected yarn colors.

Table 1.Sample production table

TE980 (HIGH LINE) 700*700 Denye	
PRODUCTION CODE – WARP ECRU + COLORED WEFT	**PRODUCTION CODE – WARP & WEFT SAME COLOR**
DM752 Ecru + Beige	**DM701** Ecru
DM753 Ecru + Light Beige	**DM702** Beige
DM754 Ecru + Milky Brown	**DM703** Light Beige
DM755 Ecru + Gray	**DM704** Milky Brown
DM756 Ecru + Light Gray	**DM705** Gray
DM757 Ecru + Anthracite	**DM706** Light Gray
DM758 Ecru + Olive	**DM707** Anthracite
DM759 Ecru + Dark Brown	**DM708** Olive
DM760 Ecru + Copper	**DM709** Dark Brown
DM761 Ecru + Lemon Mold (yellow-green tone)	**DM710** Copper
DM762 Ecru + Yellow	**DM711** Lemon Mold (yellow-green tone)
DM763 Ecru + Orange	**DM712** Yellow
DM764 Ecru + Red	**DM713** Orange
DM765 Ecru + Bordeaux	**DM714** Red
DM766 Ecru + Turquoise	**DM715** Bordeaux

DM767 Ecru + Petrol Green	**DM716** Turquoise
DM768 Ecru + Blue	**DM717** Petrol Green
DM769 Ecru + Amazon (green shade)	**DM718** Blue
DM770 Ecru + Purple	**DM719** Amazon (green shade)
DM771 Ecru + Navy Blue	**DM720** Purple
DM772 Ecru + Black	**DM721** Navy Blue
	DM722 Black

As the yarns were dope-dyed, the finishing stage consisted only of special finishing treatments and quality control.

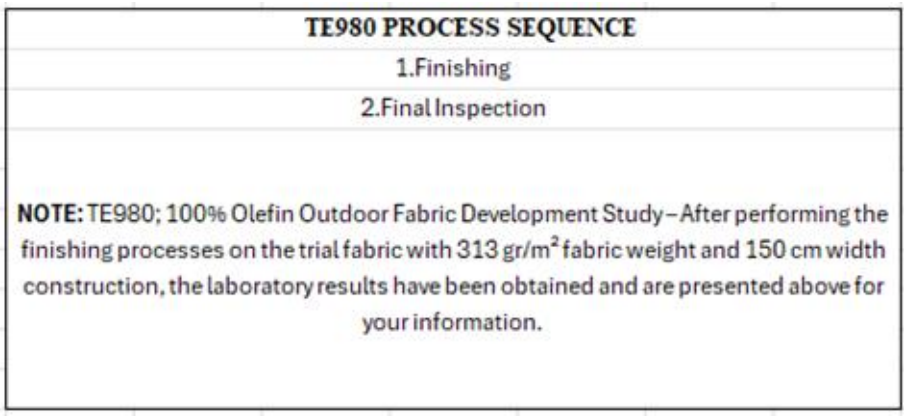


Figure 3.Finishing process steps

Through a special collaboration with the chemical company Rudolf Duraner, a customized finishing treatment was developed and applied to the fabric surface, designed to impart water- and oil-repellent as well as anti-mold properties.

Table 2.Finishing formulation

RECIPE NO	REÇ47			
PATTERN / CUSTOMER	OLEFIN FINISHING RECIPE			
1.APRE 90300084670				
CHEMİCALS	**GR/LT**			
RUCOBAC ZPY	15			
RUCOGAL ENE	5			
1st Pass Conditions	Temperature: 128 °C	Speed: Drying speed	Pad Pressure:3 bar	Pickup:80%
2.APRE 90300085027				
RUCOSTAR TEE6	150			
RUCOGAL ENE	3			

2st Pass Conditions	Temperature:128 °C	Speed: 13 m/min	Pad Pressure: 1.5–2 bar	Pickup: 65–70%

3. Results and Discussion

Outdoor fabrics are expected to possess water/oil repellency and anti-mildew properties. They are generally produced from acrylic or polyester yarns. In our project, for the first time, olefin yarn was used instead of acrylic and polyester. Olefin is a fiber synthetically produced from polyolefin molecules such as polypropylene or polyethylene. When outdoor textile products are manufactured using olefin yarn, their strength is twice that of acrylic and 30% higher than polyester. Below is a comparison of these two yarn types according to various criteria.

Durability and Strength

- **Acrylic:** Acrylic yarns are highly durable and suitable for long-term use. They exhibit resistance to wear and abrasion, making them a long-lasting option for outdoor furniture.
- **Olefin:** Olefin yarns are also durable and demonstrate excellent resistance to abrasion. They generally possess a dense and strong structure, which makes them highly suitable for outdoor applications

UV Resistance and Colorfastness

- **Acrylic:** One of the major advantages of acrylic yarns is their very high resistance to UV radiation. As a result, acrylic fabrics do not fade easily and maintain their color even after prolonged exposure to sunlight.
- **Olefin:** Olefin yarns are also resistant to UV radiation, although not as effectively as acrylic. Nevertheless, they provide good protection and are widely used in outdoor fabrics.

Water and Moisture Resistance

- **Acrylic:** Acrylic yarns are resistant to water and possess quick-drying properties. They also show resistance to mold and mildew formation, which makes them advantageous for outdoor use.
- **Olefin:** Olefin exhibits exceptional resistance to water, to the extent that it can be considered nearly waterproof. This property makes olefin yarns particularly preferred in outdoor fabrics. They are also highly resistant to mold and mildew formation.

Breathability

- **Acrylic:** Acrylic yarns offer a breathable structure and are generally preferred for seating comfort. By allowing air circulation, they help reduce perspiration in hot weather.

- **Olefin:** Olefin yarns are also breathable, though slightly more limited compared to acrylic. Nevertheless, they provide a good level of comfort.

Softness and Texture

- **Acrylic:** Fabrics made from acrylic yarns have a soft and natural feel. For this reason, they are often preferred in outdoor furniture for enhanced comfort.
- **Olefin:** Olefin fabrics may have a slightly stiffer structure, yet they are well known for their durability and suitability for outdoor conditions. Their texture is generally coarser compared to acrylic.

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Cost

- **Acrylic:** Acrylic fabrics are generally more expensive than olefin fabrics. This is primarily due to their superior properties such as UV resistance and colorfastness.
- **Olefin:** Olefin fabrics are comparatively more affordable. While offering advantages such as high durability and water resistance, they are typically considered a more economical solution.

Environmental Impact

- **Acrylic:** Acrylic yarns are petroleum-based, and therefore, their production process may be considered less sustainable from an environmental perspective.
- **Olefin:** Olefin yarns are also petroleum-based; however, their production typically requires less energy, and they are regarded as more environmentally friendly. Moreover, due to their recyclability, their overall environmental impact is considered lower than that of acrylic**.**

4. Conclusion

The manufactured outdoor fabric was subjected to the required tests and successfully met the relevant standards.

Table 3.Test results

MENDERES FABRICS OUTDOOR TEST RESULTS		**TE980 HIGH LINE**

TEST	STANDART	700*700 DENIER %100 OLEFIN 150cm 300gr/m² Panama (+-%3)
ABRASSION	BS EN ISO 12947-2	30,000
PILLING	BS EN ISO 12945-2	4/5
SEAM SLIPPAGE	EN ISO 13936-2	2,5/2,3
OIL REPELLENCY	ISO EN 14419	5/6
SPRAY TEST	BS EN ISO 4920	4/5
TENSILE STRENGHT	EN ISO 13934-1	WARP:400 KGS / WEFT:250 KGS
TEAR STRENGHT	EN ISO 13937-1	WARP:12000KGS WEFT:10000 KGS
FLAMMIBILITY	EN ISO 1021-1	PASS
ANTI MILDEW	AATC:2011&30:2004	PASS
ANTI BACTERIAL	JIS L 1902	REDUCTION %95 EFFECTIVE
FINISH		**WATER REPELLENT FINISH**
FASTNESS TO	**STANDART**	
LIGHT	BS-EN ISO 105-B02	7/8
WEATHERING	BS-EN ISO 105-B04	7
UV	ASTMG-154(1200 HOURS)	4/5
WASHING	BS-EN-ISO 105-C06 40C	4/5
SEA WATER	BS-EN ISO 105-E02	4/5
POOL WATER	BS-EN ISO 105-E03	4/5
RUBBING	BS-EN ISO 105-X12	4/5

Material and Structure

- 700*700 denier, 100% olefin, 150 cm width, 300 g/m² weight, Panama weave. Thanks to its high weight and woven structure, the fabric demonstrates superior durability, making it suitable for heavy-duty applications.

Durability

- Abrasion: 30,000 cycles → Very high; ideal for intensive use (e.g., outdoor furniture, public transportation seats).
- Pilling: 4–5 (maximum 5) → Minimal surface fuzzing, maintaining aesthetic appearance for a long time.
- Rubbing: 4–5 → High resistance to friction**.**

Tenacity

- Seam Slippage: 2.5 / 2.3 → Strong performance at seam points.
- Tensile Strength: Warp 400 kg, Weft 250 kg → Very high tensile resistance.

- Tear Strength: Warp 12,000 g, Weft 10,000 g → Higher than TE985, excellent tear resistance.

Water and Oil Repellency

- Oil Repellency: 5–6 (maximum 8) → High resistance to oil.
- Spray Test (Water Repellency): 4–5 (maximum 5) → Excellent water resistance.
- Water Repellent Finish: Water-repellent coating applied.

Hygienic Properties

- Anti-Mildew: Passed → Resistant to mold formation.
- Anti-Bacterial: 95% efficiency → High protection against bacterial growth.

Fire Retardancy

- Flammability: Passed → Flame-retardant performance confirmed.

Color Fastness

- Light Fastness: 7–8 (maximum 8) → Excellent resistance to sunlight.
- Weathering: 7 (maximum 8) → Resistant to long-term outdoor exposure.
- UV Resistance: 4–5 (maximum 5) → High protection against UV radiation.
- Washing, Sea Water, Pool Water: 4–5 (maximum 5) → Maintains color against washing, salt water, and chlorinated water.

General Results

- TE980 High Line is a high-performance fabric specifically designed for outdoor and heavy-duty use.
- Exhibits very high abrasion resistance (30,000 cycles).
- Provides superior tensile and tear strength.
- Demonstrates resistance to water, oil, mildew, and bacteria.
- Ensures excellent light and UV fastness.
- With its flame-retardant property, it achieves the highest level in terms of both durability and safety.

As a result of the study, a patent was obtained for the developed product under the application number 2023/008778. The unique brand name “ ” was designated for the product and officially registered as a trademark. A catalog specific to the product was prepared, and following the completion of promotional and marketing activities, the product was launched on the market. In 2024, a total of 28,180 meters of fabric were sold.

Figure 4.Product catalog image.

ePATS TÜRK PATENT VE MARKA KURUMU
Elektronik Başvuru Sistemi

PATENT BAŞVURUSU

Tahakkuk No	2358589	**Başvuru Numarası**	2023/008778
Evrak Numarası	2023-GE-476470	**Evrak Tarihi**	25.07.2023 16:38:18
Erken Yayın Talebi	Evet, başvurum 18 aylık süre dolmadan yayımlansın.	**Başvuru ile Birlikte Araştırma/ İnceleme Talebi**	Talep Etmiyorum
Tarifname Dili	Türkçe	**Genetik Kaynak**	Hayır
Tarifname Sayfa Sayısı	5	**Kaynağın / Bilginin Coğrafi Kökeni**	-
İstem Sayısı	2	**Kamu Desteği**	Hayır
Resim Sayfa Sayısı	-	**Destek Sağlayan Kamu Kurumu**	-
		Proje Numarası	-
Patent Sınıfı	-		
Referans No	P2023-0686		

BULUŞ BAŞLIĞI / ÖZETİ

Buluş Başlığı	YENİ BİR DIŞ MEKAN KUMAŞ
Buluş Özeti	Buluş, şezlong, bahçe mobilyaları, otel sektörü, şemsiye, oturma grupları vb. kısacası evin dışında olan tüm dış mekanlarda kullanılacak olan yeni bir kumaş türü ve bu kumaşın üretim yöntemi ile ilgilidir.

BAŞVURU SAHİPLERİ

Ad Soyad/Unvan	MENDERES TEKSTİL SANAYİ VE TİCARET ANONİM ŞİRKETİ		
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BULUŞ SAHİPLERİ

Figure 5.Patent application document

Figure 6.Trademark registration certificate

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