Bio-based Textile Innovation from DUPONT™ SORONA® Renewably Sourced Fiber

Joshua Lin | DuPont Industrial Biosciences
Our Purpose

DuPont is a science company.

We work collaboratively to find sustainable, innovative, market-driven solutions to solve some of the world’s biggest challenges, making lives better, safer, and healthier for people everywhere.
We Apply our Science to Solve Some of the World’s Biggest Challenges

FOOD

ENERGY

PROTECTION

WE’RE SOLVING THE WORLD’S GREATEST CHALLENGES TOGETHER
Creating World-Changing Solutions for a Biobased Society

Agricultural Carbon Sources → Conversion → Biobased Products

Bio/chemical transformation

Sugars

Bio/chemical transformation

Biofuels

Bioactives

Biomaterials

Today

Future

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Applying the Power of Biotechnology

We integrate broad scientific fields, biotechnology tools, and process knowledge to create and deliver disruptive technologies that transform markets.

We rapidly create engineered proteins that accomplish the previously impossible and deliver significant value to our most important customers.

We engineer the metabolic pathways of micro-organisms to produce enzymes, proteins, and other bio-molecules at industrial scale and economics.
To Help Solve World Challenges

**FOOD »**
- Micro-ingredients for sustainable animal production
- Omega-3s for advanced aquaculture
- Enzymes for food and beverage

**ENERGY »**
- Products and technology for biofuel production
- Renewably sourced materials and chemicals
- Enzymes that help reduce energy use

**PROTECTION »**
- Process enzymes help to reduce water use
- Feed enzymes that help reduce phosphorus waste
- Probiotics to reduce antibiotic load in livestock production
- Sustainable alternatives to less desirable chemical solutions
Renewably Sourced Polymer

- **DuPont™ Sorona®**
  - Is made, in part, from plant-based materials
  - Uses 30% less energy and lowers greenhouse gas emissions by 63% compared to an equal amount of petro-based nylon
  - Is used in apparel, carpet and automotive textiles

- Provides mills and designers with a versatile and renewable high performance material

*Based on ISO 14040 Life Cycle Analysis*
DuPont™ Sorona® in Apparel

The Story of Sorona®

Harvest feedstock → Ferment sugar into Bio-PDO™ → Add TPA to Bio-PDO™ to produce Sorona® → Fibers and fabrics created with Sorona® → Apparel and carpet made with Sorona®

Sorona® is made, in part, with annually renewable plant-based ingredients.

Two microorganisms convert sugar to PDO stepwise.

Bio-PDO™ process consumes 40% less energy than the chemical PDO process it replaces.
Environmental Benefits of DuPont™ Sorona®

**SORONA® CO₂ EMISSIONS COMPARISON**

<table>
<thead>
<tr>
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<th>SOBORA®</th>
<th>NYLON 6,6</th>
<th>NYLON 6</th>
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<td>kg CO₂ equivalents/kg polymer:</td>
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<tr>
<td>Sorona®</td>
<td>3.38</td>
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<td>Nylon 6,6</td>
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<td>Nylon 6</td>
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**SORONA® ENERGY COMPARISON**

<table>
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<tr>
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<td>Non-renewable energy consumption (MJ/kg polymer):</td>
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<tr>
<td>Sorona®</td>
<td>93.3</td>
<td>138.32</td>
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<tr>
<td>Nylon 6</td>
<td>120.5</td>
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Sources:
- Sorona® data from peer-reviewed LCA of Bio-PDO/ Sorona production (Peer reviewer: Prof Konrad Saur, Five Winds International).
- Nylon 6,6 and Nylon 6 data from Plastics Europe (March 2005) www.lca.plastics europe.org
More third party recognition for Sorona®

- DuPont™ Sorona® fiber/ polymer is a USDA certified bio-based product
  DuPont™ Sorona® renewably sourced fiber is one of the first 11 products approved to use the United States Department of Agriculture (USDA) new product label on certified bio-based products.

- DuPont™ Sorona® fiber/ polymer is Oeko-Tex® certified
  DuPont™ Sorona® received Oeko-Tex® Standard 100 certification, the most stringent Class 1 certification.
Textile Innovation of DUPONT™ SORONA® Fiber
Sorona® offers performance and environmental benefits

- Unique molecular structure and crystalline morphology giving unique properties in fibers, plastics and films. Strain deformation occurs in crystalline regions, allowing full recovery.

Key attributes:

- Super softness
- Comfort stretch with excellent recovery
- Easy dye with good color-fastness
- Chlorine/UV resistant
Range of fiber types with Sorona®
Unique Values of Fabric made with Homo Filament Sorona® Fiber

**ATTRIBUTES:**

- Soft hand feel
- Chlorine resistance
- Superior performance of light fastness
- Renewably resourced ingredients

**Applications:**

- Texturing / Weaving / Circular & Warp Knitting / Seamless
Comparison: Chlorine Resistance & Light Fastness

Test conditions: AATCC 16, exposure at 20, 40, & 100 hours. Fabrics are in turquoise color.

Test conditions: 50ppm active chlorine, run for 1, 2, & 3 hours. Fabrics are in turquoise color.
Color Fastness to Light – Neon Color

**Light Fastness - AATCC 16-2004 (20 hrs)**

- Nylon #1: 2.0
- Sorona® #2: 4.0
- Nylon #3: 3.0
- Sorona® #4: 3.0
- Nylon #5: 3.0
- Sorona® #6: 4.5

**Light Fastness - ISO 105 B02-1994 (20 hrs)**

- Sorona® neon green: 4.5
- Sorona® neon yellow: 5.0

100% Sorona®

Sorona® + Spandex
**Project Information**

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**Fabric Information**

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**Market Approvals**

No Approvals for this Fabric.

**Test Results**

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**Test Method** | **Test Name** | **Unit** | **Results** | **Failed** | **Standard Compliance** |
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**Additional Testing**

- SFH 40 Hours Shade Change: 3
- SFH 20 Hours Shade Change: 4

**Testing Notes**

Received sample on DEC 30, 2010
Report number: TWNT00608439
Summary of test: Pass

*Note: The document contains a DuPont logo in the top right corner.*
Air-Jet Texturing Process

ATTRIBUTES:

- Superior cottony soft hand
- Remain the soft hand feel after repeat washes
- Breathable and quick dry
Comparison: Abrasion Performance

**Abrasion Resistance: ASTM – D3884**

- **Nylon ATY (420 gm / yard):** 1910
- **Sorona® ATY:** 1865
- **Nylon ATY (320 gm / yard):** 1110
- **Sorona® ATY:** 1075

**Abrasion (4000 cycles): ISO 12947.1**

- **Nylon**
- **Sorona®**
- **Nylon**
- **Sorona®**
- **Nylon**
- **Sorona®**

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**Sorona® + spandex (knitting)**

**100% Sorona® (woven)**
Comparison: Pilling Performance

Tumbling Pilling: ASTM – D3512

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<th>4</th>
<th>4</th>
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<tbody>
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<td>Nylon ATY (420 gm / yard)</td>
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<tr>
<td>Sorona® ATY (320 gm / yard)</td>
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Pilling Performance: ISO 12945-1 (5000 cycles)

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<thead>
<tr>
<th>ISO 12945-1</th>
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<tbody>
<tr>
<td>Nylon</td>
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<td>Sorona®</td>
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<td>Nylon</td>
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<td>Nylon</td>
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<td>Sorona®</td>
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</table>

Sorona® + spandex (knitting)  100% Sorona® (woven)
Comparison: UPF & Air Permeability

AS/NZS 4399-1996

Air Permeability (cfm): ASTM D737-75

- Sorona® + spandex (knitting): 50
- Nylon + spandex (knitting): 50

- Sorona® + spandex (knitting): 70
- Nylon + spandex (knitting): 60
Wicking Performance

AATCC 79

Planar Wicking

Vertical wicking test in 30 minutes after 5 washes

Vertical Wicking

Sorona® + spandex (knitting)
Comparison: Tumbling Pilling in Seamless Garment

Tumbling Pilling (Seamless): ASTM – D3512

Sorona® + nylon covered with spandex
Conclusion:

- DUPONT™ Sorona® is a renewably sourced material, that is produced using 30% less energy and 63% less GHG vs. an equal amount of nylon 6.

- Fabric made with Sorona® fiber shows outstanding performance on chlorine resistance & light fastness.

- Fabric made with Sorona® ATY delivers superior cottony soft hand feel and wicking performance, in addition to performs the comparable abrasion and pilling performance by international test method.
THANK YOU